Spring 2023

Restructuring pedagogical norms in STEM: Towards a socially and ethically conscious approach to Computer Science higher education

Alison Kim , '23

Follow this and additional works at: https://works.swarthmore.edu/theses

Part of the Computer Sciences Commons, and the Education Commons

Restructuring pedagogical norms in STEM:
Towards a socially and ethically conscious approach to Computer Science higher education

By Alison Kim '23

Special Major in Educational Studies and Computer Science

Thesis Advisors: Dr. Edwin Mayorga and Dr. Kevin Webb

Date: 5.12.2023

Table of Contents

Appendix D: Faculty B Interview Transcript																																																																	129

Dedication

I dedicate this thesis to marginalized students in STEM, those who have come before me and will after, in hopes of a future where everyone can recognize the transformative value of our strengths, perspectives, and resilience.

And to those who carry critical introspection, curiosity, anger, perseverance, compassion, and hope in everything that they do – who are more than the sum of their parts, and live within their multitudinous, contradictory selfs, I dedicate this thesis in ardent solidarity.

Acknowledgements

I would like to first and foremost extend my gratitude to my thesis advisors Kevin Webb
(Computer Science) and Edwin Mayorga (Educational Studies) for supporting me through my
thesis.

I met Kevin during my first semester of college when I joined his directed reading, *Computing
for Social Good*, which started my own endeavors of advocating for more socially-critical,
justice-driven work within CS education. While I never had Kevin as my professor in any of the
traditional CS courses I've taken, he has supported me consistently throughout my four years
through several collaborative research projects, the sponsorship of my student-led course, and
now, this thesis. I also met Edwin my first semester of college by being part of his BarrioEd
program. And despite never being a student within his courses, he has also consistently
supported my passions throughout my four years here – from two directed-readings, his
co-sponsorship alongside Kevin for the student-led course, and this thesis. Both Kevin and
Edwin have profoundly shaped and positively influenced my learning, and have supported me
through various endeavors surrounding critical introspection into CS and CS education, of which
were not formally established at the college. I am very profoundly grateful to have met Kevin
and Edwin and I am indebted to the time and energy that they both took to support me.

I would also like to thank the participants whom I've interviewed that deeply informed the
insights gained from my project. I learned so much from their experiences and introspection, all
of which have refined a clearer vision on how the CS department could evolve to support a
diverse and inclusive array of interests and values geared towards transformative orientations and

practices of technology that works alongside greater social movements of equity, justice, and liberation.

I would also like to thank my friends, especially fellow marginalized students in CS, whose perspectives and experiences have informed the necessity of this work. A significant person who has shared my values, endeavors, and hopes surrounding socially and ethically conscious engagement in CS since freshman year has been my friend, collaborator, and fellow advocate, Sidhika Tripathee. Sidhika and I met during Kevin's directed-reading, and I have had the immense pleasure of working with her through Tech for Social Good and collaborating on the creation and facilitation of the student-led course. She was one of the closest friends I had in CS, and I am so thankful to have had her be part of my journey.

And last, but certainly not least, I could not have finished this thesis without the immensely valuable support of my amazing friend and fellow Educational Studies major, Shaadiin Shawnee King. From helping me think through my research question way back in February to accompanying me on many 2AM walks back to our dorm after working on our respective theses, her insights and emotional support were integral to the completion of this project. Thank you Shawnee, our Stone Rice Bowl Day is near!

Positionality Statement

I started my undergraduate at Swarthmore where the very idea of being a computer scientist, or even coding for that matter, was foreign and inaccessible. When I decided to take Introduction to Computer Science on a whim that fall semester, I was surprised by how fun coding was. Learning how to take a particular functionality and distilling into step-by-step instructions of code requires profound introspection into one's thinking and knowledge — including how to articulate them with precision, how to discern gaps in one's knowledge through procedural analysis, and how to problem-solve through creativity. To practice such elements of critical thought through this medium quickly became deeply rewarding; I find that continuous coding practice linearly builds and accumulates knowledge and skills in ways that are remarkably evident.

My subsequent semester was quickly disrupted by the start of the COVID pandemic. Two months later, George Floyd was murdered by the police. The Black Lives Matter movement grew in prominence, and I, in the summer of 2020, partly to connect with other people, communities, and society in general during a period of strict isolation, and partly realizing how little I knew about the horrific atrocities happening in this country, began a consistent dedication to be informed of the social injustices that were happening in the world — how such injustices came to be, how it was written about, and what the conversations around these issues were. And in being informed, to understand my position and role in participating in collective movements for change.

In the Fall semester of 2021, I participated in the No Longer Minding the Light protest, a student movement led by Swarthmore's Black Affinity Coalition that demanded equitable treatment and support to marginalized students on campus, and participated in the subsequent student strike that occurred — refusing to engage in academic work until all demands were met. During the strike, I was a student not by way of academic engagement but as an active thinker and participant in analyzing and shaping the material conditions of my milieu, grounding my positionality as a member of a collective community. Through this experience, I realized how insufficient academic work was in understanding and working against the complexities and nuances of real-life issues. I found the dissonance of the academic milieu, and real life unsettling and deeply frustrating — turning abstract real-life issues to the realm of interpretive discourse while benefiting from them. I sought to reconstruct my education as something not separate from the material reality we live in, to have our understandings be informed of the intricacies of real life problems, and the challenges of turning our understandings into tangible action. I was particularly frustrated that the CS department, and the STEM disciplines in general, did not uphold values of social responsibility and ethical computational practices within their pedagogies, framing knowledge as objective, static and incontestable. I aspired to reposition my understanding (and encourage others) by contextualizing the underlying ideologies, assumptions and values that such knowledge upholds while situating it within its historical, political, cultural, and social context.

Sophomore year, I became an executive member of Swarthmore's Tech for Social Good club and led different projects that would allow CS students to engage in initiatives that integrated their CS knowledge with social justice issues, including a bi-monthly digest highlighting different

dimensions of social equities and oppression and how technology plays a part in upholding and sustaining such injustices. This began a broader goal of propagating such perspectives to the wider CS community at Swarthmore. Spring semester of sophomore year, I participated in a directed reading with Education Studies professor Edwin Mayorga, developing a syllabus for a student-led course that would think through technology from a socially critical lens. The following Junior fall semester, I co-taught a student-led course called CS16: Critical Theory of Technology with fellow Tech for Social Good member Sidhika Tripathee, and sponsored by CS Professor Kevin Webb and Edwin. Taken from the course description, the goal of the course was to explore the following inquires:

> "When we take away the technical, coding aspects of Computer Science, what's left? This course aims to explore this question through a holistic pedagogical approach to the questions that aspiring computer scientists as well as users of technology must confront. What are the detrimental effects of the ways in which exponential production and use of technical products come to reinforce inequalities around the globe? What are the beauties and blooming potentials of the digital age? How can we come to oscillate within that dyadic tension of criticism and hope? How can conversations about tech colonialism, disability theory, critical race theory, etc. come to enhance our understanding about who is propelling the trajectory and direction of where technology is headed?" (Kim and Tripathee, 2021)

My motivation for this course reflects my personal philosophy of how education and learning should always hold space for collective and self introspection, interdisciplinary and relational epistemologies, and mediums for healing, especially for marginalized students. Given the history of Western academia, and the underlying standards of intellectual legitimacy and aptitude foregrounding Whiteness, masculinity, ableism, and heteronormativity, I aspired to create intellectual counterspaces that decenter hegemonic norms, and to push the boundaries of critical scientific thought by forefronting the epistemologies, values, and issues of non-Western, BIPOC, queer, feminist experience. While some may question how reading bell hooks, Audre Lorde, Eve

Tuck, Edward Said, and interdisciplinary scholars of technology advances studies of computer science, I argue that it is the fundamental orientation of values, what truths deem precedence, and what imagined futurities to strive for that become ever so significant to discern within a world increasingly fraught with socioeconomic disparity, racial violence, and imperial exploitation – all of which is ongoing, in part, because of how technological application and advancements are unfolding in the world. To think through scholarship that discusses the intricate mechanisms of oppression across various axioms through the lens of scientific and computational innovation is to understand how technology plays its part in sustaining inequities, but more importantly, how to imbue computer science with a new found meaning that operates with social movements to upend systems of oppression, and to dismantle the legacy of scientific production that has been weaponized to uphold hegemony since its inception.

Moreover, I argue that should learning be embodied as practices of freedom and spaces of radical possibilities, it must originate from deep and intimate acts of care and love. Critical and holistic pedagogy transcend the limitations of academia, often debased by capitalist-driven demands of academic knowledge production and marketable, normative expectations of academic composition – a proper, coherent, and routinized procession of thought that aims to reduce differences in subjectivity (McRuer, 2004). In resisting dominant models of composition, I argue that learning should integrate students as their whole and complex selfs and attend to their intellectual and personal needs, and seek to embrace the inextricable subjectivity and incertitude that defines human thought in ways that inspire collaborative thinking and garners optimism and faith in our difficult reality. These are the philosophies I embody that drive my pursuits in working towards a restructuring of CS that integrates interdisciplinary learning and centers

ethical practices and social responsibility – utilizing CS as a force for good informed by the voices of marginalized communities.

My thesis is also situated within my own perspectives as a complex, flawed being. I am drawn to ideas that complicate the possibilities of human thought, emotion and expression – the struggle through the inexplicable, uncovering the unbounded beauty of learning without seeking futurity in a resolution. The kind that delineates a cathartic vitality, the kind that comforts me, the kind that hurts me. In its pursuit, in the confluence of knowing and becoming, we learn to be loving people and in this pursuit, I begin my thesis.

-

Introduction

<u>Research Premise</u>

With such expansive and ubiquitous applications of computationally-driven technology, it is necessary that Computer Scientists have a critical understanding of the societal implications of their work. Technology and computational thinking imparts an overwhelming and consequential influence within various aspects of the human experience, on both societal and personal dimensions – including how we constitute human progress, how we build values and goals, and how underlying ideologies and assumptions about who we are as human beings drive our orientations and actions. As much as technological innovation has enriched the scope of human civilization's capabilities, from digitally-mediated communication, accessibility of information/education, to innovations within medicine and health, computational applications have also been used as a mechanism to sustain monopolizations of power, and in turn, accelerate social oppression around the world – often in implicit ways, obscured under ostensibly positively intentions to augment the reach and scale of production through automation. However, the epistemological nature and computational processes that construct technological applications have been proven to be imbued with biases along axioms of race and gender, and other categorical identities that branch out of them. Biases in technology, saliently Artificial Intelligence and Machine Learning applications, can produce material harm in significant mass. For example, a healthcare algorithm affecting 200 million people was proven to demonstrate racial bias in the number of healthcare referrals to patients, with significantly less assigned to Black patients who were equally sick than their white counterparts, contributing to the ongoing healthcare disparity in the U.S (Maina, 2018). Other examples of how technology works alongside existing systems of hegemony includes unethical data-mining of user information,

digital surveillance, and proliferation of misinformation. And in part due to the financial interests of technology corporations and the influence they have across economic, political, and social spectrums, unethical applications of technology continue to be widely upheld, and in turn, so do its oppressive ramifications.

CS as a discipline and field is and has been rapidly evolving in the kinds of values, interests, and issues that centers the field, with increasing levels of novelty and specialization. However, what has remained consistent through the general course of its existence is how the field has been centered around whiteness, ableness, masculinity, and heteronormativity within neoliberal capitalism. The implications of its epistemic ontology is one that has been and remains a tool for various dimensions of oppression. I argue that epistemology, values, and motivations within computational knowledge and applications dominate – often in chauvinistic and reductionist ways – how we understand the world, how we identify and solve societal problems, and how we dictate processes within civilization. Such thinking is explicitly and implicitly upheld in CS education: how we understand the tool of computation is reflected in the underlying conceptual structures and teaching practices as well as the people who have access to and are represented in its teachings.

This is to reflect on the sociopolitical dimensions of CS education, inquiring its purpose and what kinds of people it ultimately serves. Thus, to imagine a radical orientation of CS education that aligns with movements of justice and liberation, is to expand the profile of CS education that welcomes a diversity of students (especially Black and brown students and gender minorities) and to include a variety of epistemologies, frameworks, and voices that contribute to the enrichment of how CS can transform its greater meaning. This requires more than learning about

the technical components of CS; it demands critical inquiry and careful implementation

strategies on how to ensure that their product will not reinforce societal inequities. While social

and ethical implications of computer science have been increasing in par with the rapid

applications of technology, and scholarship studying these issues have also been rising as a

legitimized area of study (e.g. Science Technology Studies), the nature of academic institutional

bureaucracy has been evolving much slower to integrate these forms of pedagogy within their

institutions. This is also attributed to the fact that because CS academia continues to be heavily

dominated by white, cis, men, there has been resistance from institutions and faculty to recognize

and act upon the merits of integrating these fields of study.

I argue that higher education should recognize the current harms produced by unethical and

oppressive practices of computer science and teach CS students to think critically about how to

approach their work: how to understand the way in which algorithmic bias could form, the

ramifications of their work across various social lenses, to inquire about the underlying

assumptions and values forefronted in technological applications, and how to apply these kinds

of critical practices when producing code. Currently, there are various initiatives happening to

push for more socially conscious and ethical engagement in CS, but they are relatively small and

are not reaching the general population of CS students, including within Swarthmore's CS

department. While there is no simple and straightforward way to robustly integrate these forms

of conversations and practices across institutions, it is important to keep values of social

responsibility and ethical practices alive, and to spread these values as much as possible.

My research focuses on CS education within Swarthmore College's CS department. Given the necessity of integrating social and ethical oriented teachings of CS, my thesis articulates the ongoing work and the various challenges of justice-driven pedagogical reform within the department. My research aims to explore this inquiry by analyzing the underlying norms, values and purpose of existing curricula, and the institutional and bureaucratic mechanisms that drive the upkeep and evolution of the department, while centering the perspectives of its marginalized constituents. The research question that drives my research is as follows: **how do existing institutional, departmental and curricula conditions affect Swarthmore College's CS department's ability to establish socially and ethically conscious pedagogies within their curricula?** As the next subsection highlights, I take various approaches and considerations to answer this question.

<u>Thesis Road Map</u>

My thesis consists of the following sections in order: Methodology, Literature Review, Data Findings, Data Analysis, Recommendations and Next Steps, and Reflections and Conclusions. The Methodology section highlights two key sources of information that informed the context and findings of my research: my Literature Review and my semi-structured interviews with two student alumni and two Swarthmore CS faculty. The Literature Review section comprises four main topics covering various intersecting considerations that inform my research. The first of which (Section I) explicates a critical orientation of scientific knowledge and the historical, socio-political, and economic contexts that highlight the legitimization of hegemonic epistemologies, motivations, and assumptions within the history of science. Section II discusses the history of scholarship surrounding the liberal arts CS model curriculum since its inception in the 1980s, which deeply informed the evolution and current state of Swarthmore's CS

department's pedagogical missions and curricular structures. Section III discusses the more broader institutional grounding of where this research is situated, and how the distinguishing features of a liberal arts education – bridging frameworks and methods between humanities, social sciences, and STEM disciplines – imparts significant merits when studying STEM within such intellectual environments. Furthermore, it looks at the current curricular missions of the CS department and how it can live into the principles of a liberal arts education in ways that invoke more interdisciplinary engagement. The last section of the literature review is centered around how comprehensive change is effectuated within institutions, where I bring in Tierney's framework of assessing organizational culture and the literature of a case study of a liberal arts college implementing institutionally-wide diversity course reform. I use these two kinds of literature to consider the various constituents, assessment and reform processes, and dynamics of power and representation that shapes how departmental and institutional conversations surrounding DEI initiatives could look like at Swarthmore.

The semi-structured interviews explore and analyze the experience of two recent CS student alumni and two CS faculty members. The motivation for interviewing recent alumni was to understand the connection between the curricular components and general orientation to CS work accrued through their CS education and how it informed the post-grad CS work they do, how they approach it, and general reflections of their experience within the department. I also interviewed two CS professors in hopes of understanding the departmental processes in which they assess efficacy and create goals for the department as well as understanding the current challenges, initiatives and visions on integrating socially conscious understandings of CS and ethical practices within CS applications. The data findings section goes further in depth about the

responses from the interviews. The data analysis discusses the relationship between the students' experiences within the department and the faculty intentions behind their curricular goals and practices; and taken together, the responses from both student and faculty inform how the department can continue uplifting curricular content and pedagogical methods that center social and ethical engagement, and to work towards creating a more inclusive and diverse community within CS that also strengthens faculty-student communication and collaboration. I follow with Next Steps and Recommendations and an overall Reflection and Conclusion of my research. After the data analysis, I outline both short-term and long-term recommendations for the department based on my data findings and analysis. Finally, I conclude with my own reflections of my research, discuss its limitations, and voice my own hope that conversations around diversity, social responsibility, and interdisciplinary thinking, and the voices of marginalized students can continue to be uplifted within the department.

Methodology

This thesis research used two main methods to explore its research question: a literature review and semi-structured interviews with CS student alumni and CS faculty of the college.

Literature Review

The nature of my thesis project necessitated inquiring through various topics that all converge within my research inquiry. Broadly, this included the political implications and importance of teaching a socially and ethically situated curriculum as well as the particular significance and considerations of implementing them at a liberal arts college. In exploring the former, my literature review consists of two subsections: Section I. Political nature of curriculum and the construction of knowledge, and Section III: Computer Science within a Liberal Arts educational model. Section I addresses how what one teaches and how has always been imbued within underlying assumptions of what knowledge is forefronted as legitimate and important, and how knowledge, especially scientific knowledge, historically has been shown to either justify violence and harm and/or reinforce societal oppression or used to upend it. Section III discusses the particular characteristics of a liberal arts education and the attributes of interdisciplinary thinking, especially with regards to science liberal arts education.

In exploring the latter was to highlight the history of a liberal arts computer science curriculum model contextualizing the current curriculum practices of the college (Section II), and to understand how to successfully implement a social-justice based curricula in relation to the institutional and organizational culture of a liberal arts institution (Section IV). Section II "Computer Science within a Liberal Arts educational model" describes the lineage of liberal arts computer science curricula models, from its initial development in 1984 while describing the

conditions to which reforms were made since, and how such curricular revision practices informed the Swarthmore CS department's own shaping of its curricula. Section IV "Institutional and Organizational Culture, implementing curricular changes related to diversity and social justice" utilizes a case study to inform practices of constructing and implementing social-justice curricula on a wide-reaching level and how understanding various dimensions of an institution's organizational culture informs the different components and challenges of its implementation. Section II is used to analyze the current CS department's curricula and its implications, while Section IV is used to understand how to successfully navigate the implementation of socially and ethically conscious pedagogy within Swarthmore's CS department.

Semi-structured Interviews

For the purposes of this thesis, I conducted semi-structured, recorded interviews with two faculty members of Swarthmore's Computer Science department and two recent Swarthmore alumni who received a Bachelor's degree in Computer Science. The interviews lasted approximately one hour and were conducted through Zoom, where through their auto-captioning interface, transcripts were composed (see Appendix). The names of the interviewees and other identifying information will be anonymized by addressing them in my research through a coded title of reference (e.g. Faculty A, Faculty B, Student A, and Student B).

I decided to conduct interviews with two recent student alumni of Swarthmore's Computer Science department. As much as my thesis is centered around social and ethical conscious CS pedagogy, I was not directly looking for participants that have engaged with this kind of work/thinking during their time at Swarthmore. Rather, the underlying purpose of the student

alumni interviews was to understand how institutional and curricular norms of the department affect how students formed their interests, values and pursuits as computer scientists. The interview questions generally covered 1) their experience within the CS department and how it affects what they do currently and their general career pursuits, 2) what, if any, aspects of Computer Science education absent from their computer science experience might have been beneficial to see within the department and 3) how their self-identities and/or values affected their responses. Student A is a 2022 Swarthmore graduate who double majored in Computer Science and Environmental Science. She is a woman of color and currently working as a Web Development Director for a data intelligence company studying and polling the views and behaviors of America's youth. Student B is also a 2022 Swarthmore graduate who double majored in Computer Science and Economics. She is a woman of color and currently works as a Machine learning engineer at a big tech company in the Bay Area.

I also decided to request two faculty members that have had experience integrating socially and ethically conscious pedagogy within [some parts] of their teachings. Professor A was the first women faculty hire in the department's history and specializes in Robotics and Artificial Intelligence (AI). She teaches the AI course offered in the department, and allocates part of her curriculum to include weekly journal prompts that ask students to reflect on particular social implications of the applications of Artificial Intelligence. Professor B is a CS professor of color specializing in machine learning and computational biology and medicine, and co-taught an Ethics and Technology course with a moral philosophy professor from the Philosophy Department. Currently, Professor B is serving a three-year position as Associate Dean of the Faculty for Diversity, Recruitment, and Retention. Generally, the faculty interviews would gauge CS faculty's perspectives on 1) departmental process on evaluating its efficacy in alignment with

the department's goals/missions and introducing change/reform within the department 2) their

personal experiences and perspectives of integrating and teaching socially and ethically

conscious pedagogy in their respective courses, and 3) what the departmental conversations

and/or personal opinions on integrating more robust and long-lasting social and ethical

considerations in CS classes have looked like and currently look like.

Interview Protocols

<u>Student Alumni Interview Questions</u>:

A. How did your experience as a CS major at Swarthmore shape what post-grad work you
    pursued and how you approach your post-grad work?
    a. What values would you say you uphold when approaching your work as a
        computer scientist? Has your Swarthmore education affected your positionality?
        Has the CS department affected this positionality? If so, how?
    b. How would you say the various parts of your identity play a role?
B. Did you (formally and/or informally) study discipline(s) other than CS? Did you
    participate in any salient extracurriculars during your undergrad?
    a. If so, how has this shaped what you do and/or how you chose to engage with CS?
    b. How would you say the various parts of your identity and/or values play a role in
        your academic and/or intellectual interests?
C. Is there pedagogical content that you wish had been part of your CS experience at
    Swarthmore?
    a. Are there teaching methods that would have been beneficial that you wish were a
        part of your CS experience at Swarthmore?
    b. What about the departmental infrastructure (ex: course major requirements, types
        of courses offered)?
    c. How would you think you may have benefited from socially and ethically
        conscious pedagogy within your CS education?
    d. In reflecting on your responses, how if at all, do you think your identity and/or
        values shape those perspectives?

<u>Faculty Interview Questions</u>:

A. What is the department-wide process of assessing/evaluating how the department is
    doing?
    a. What factors into the how the department measures its efficacy regarding:

        i.   its alignment with its missions and values?

        ii.   Student academic success and wellbeing?

  b.   How does the department identify and develop areas of growth and/or improvement?

  c.   What conditions encourage the revisitations to the department's missions and value

  d.   Within departmental decision-making processes:

        i.   If members of faculty have conflicting ideas/values, how are they negotiated and/or resolved?

        ii.   How are students' input factored into decision making processes?

B.   What are faculty's roles and responsibilities aside from teaching their designated courses? What would you say is the bandwidth to which faculty must embody on a semester's basis?

C.   How would you say your own academic interests and values influence:

  a.   your views on the department's mission/values, if at all?

  b.   your ideas on what the department's missions/values should be?

  c.   And within these answers, how does, if at all, your self-identities play a role?

D.   Please tell me about your experiences with the FYS ethics and technology course:

  a.   How did this course come to fruition?

  b.   How did you approach the design and implementations of the course?

  c.   How would you describe the salient outcomes of the course? What were the students' experience and impressions of the course?

  d.   Were there any considerations on what a continuation and/or perhaps a solidification of this pedagogical material would look like within the department? If so, what were they?

E.   Has there been departmental/cross-departmental conversations concerning:

  a.   the integration of a social/ethically-oriented understanding of computation?

  b.   DEI (diversity, equity, and inclusion)?

  c.   If so, what have those conversations been like? Have there been salient changes in how the department approached, discussed, and addressed these issues?

  d.   Have these topics (integration of social/ethical oriented understanding and DEI) been discussed together?

F.   What is the department's current standing on integrations of ethical/socially conscious pedagogies related to computation and technology?

  a.   Particularly, what are your impressions on what the current barriers and struggles are to implementing such an initiative?

Literature Review

<u>Section I: Political nature of curriculum and the construction of knowledge</u>

Knowledge and the construction of knowledge is political. This challenges dominant conceptions of knowledge, especially scientific knowledge, that ostensibly mends the limitations brought by incertitude and subjectivity. However, knowledge as static and incontestable is not a universally accepted idea, nor should it be. Such an orientation is a product of Western civilization and hegemony– whose origins can be traced back to the Enlightenment period, characterized by the insurgence of scientific practice and thought, where knowledge was understood to be based on logic, empiricism, and perhaps most saliently, regarded as singular and objective (Pukshanskii, 2016). However, non-Western modes of knowledge, including various Indigenous ways of thinking for example, construct context-sensitive knowledge derived from perceptive observations, oral and written history and are informed by Indigenous values of intergenerational relationality, community, spirituality and environmental nurtureship and sustainability (Chilisa, 2012). Such formations of knowledge are adaptable and dynamic.

What forms of knowledge are upheld directly influences how one understands the world and its happenings. For example, Enlightenment rationality orients phenomena as a singular, linearized progression of cause and effect. Other epistemologies, like dialectical modes of understanding, situate knowledge through procession characterized by opposing social forces and the contradictory relations produced by such a reality. To adhere to a singular worldview or to take an epistemology whole without considering its flaws or contradictions is a kind of ideological conformity and supremacy veiled under the legitimization of objective and singular conceptions of knowledge.

Then, the conception that knowledge is apolitical can be quickly disputed by the historical

implications of knowledge, particularly science, falsely leveraged to uphold and justify Western

hegemony. For example, constructions of inferiority based on race, gender and disability were

products of what was then seen as scientific evidence and vindicated forms of imperialism,

servitude, and discrimination (Baynton, 2001). Weaponization of knowledge still continues to

serve as a prominent method of social oppression, as evidenced by Florida's House Bill 999 filed

in February 2023, which passed, would ban Critical Race Theory and Gender Studies in Florida's

colleges and universities (Nittle, 2023).

Because the differentiatedness of knowledge is a key driver in unequal distributions of power

and hegemonic sustenance, to understand, critique, and dismantle oppressive structures relies on

critical inquiries of how knowledge is constructed, under what conditions, and who it benefits.

Paulo Freire, in his seminal work *Pedagogy of the Oppressed*, developed the idea of 'critical

consciousness' – to understand the world through its social and political contradictions for the

purpose of changing it for the better (Freire, 1970).

While such critical analysis should predicate every discipline of critical inquiry, Science,

Technology, Engineering and Mathematics (STEM) disciplines, compared to its social science

and humanities counterparts, do not embody critical inquiries into the validity of its knowledge

in their education and teaching practices. More often than not, classrooms and curricula are

structured through one-sided, passive forms of learning, where students are told *what* to think. To

disrupt traditional STEM teachings and learning methods is to argue for a fundamental

restructuring of STEM education that establishes a sociological basis to its curriculum.

Specifically, this is to inhibit more active, collaborative learning that engages students in

understanding underlying ideologies, assumptions and values that scientific knowledge upholds

while situating such knowledge within its historical, political, cultural, and social context.

Moreover, it is to understand the mechanism and behaviors of academic institutions, an

expansive system legitimizing and forefronting specific modes of knowledge and learning, as a

political conduct. Educational theorist Michael Apple argues that the to engage in relational

thinking and action, one must challenge the academic milieu to which one learns under:

> "That is, all of our institutions and sets of social relations—and even our very
> identities—need to be seen as intimately connected to the inequalities that structure our
> society and to the movements that seek to interrupt such inequalities…. It will be hard,
> but we should constantly try to see the world through the eyes of the dispossessed and act
> against the ideological and institutional processes and forms that reproduce oppressive
> conditions. This repositioning concerns both political and cultural practices that embody
> the principles of critical education; but it also has generated a large body of critical
> scholarship and theory that has led to a fundamental restructuring of what the roles of
> research and of the researcher are (see, e.g. Winn & Souto-Manning, 2017; Smith,
> 2012)." (Apple, 2018, p. 688)

It raises the question, what are the current purpose and goals of STEM education, and what

should they be? It is evident that STEM-centered industries are a critical contributor to economic

growth, where such economically-centered orientations of STEM education prioritize STEM

students' abilities to fulfill labor demands of the industry workforce (Labov, 2006). On the other

hand, a more socially-oriented framework of STEM education centers pedagogy and

skill-building that prepares STEM students to utilize their knowledge to contribute meaningfully

to society, to help solve social issues, and cater the goals and missions of their work to social

justice. However, because economically-driven STEM education is the dominant framework

embodied in higher education, forefronting industry demands of technical and scientific aptitudes

rather than endorsing social and moral principles, it has been evidenced that there is less emphasis on socially-conscious learning and career goals for STEM majors than their humanities and social science counterparts (Garibay, 2015). Consequently, students who started as and pursued a STEM major have been shown to have "significantly lower social agency outcomes" often attributed to STEM industry norms and environmental pressures from college and family (Garibay, 2015, pg. 623). However, underrepresented STEM students of color have been shown to value social change more than their non-underrepresented counterparts. As social inequities, oppression, and injustice affect marginalized communities, it explains why underrepresented STEM students of color value rectifying such issues more. Although, because socially-conscious STEM education and practice is not the dominant paradigm embodied in higher education, underrepresented STEM students of color often have to make decisions to "either conform to the dominant disciplinary culture or to find ways to harbor her or his values of making a difference without critical departmental support" (Garibay, 2015, pg. 627). Thus, the dominant economic-centered framework of pedagogy and knowledge can create inequities on who succeeds within STEM. Changing the culture of STEM disciplines to cater towards socially-conscious approaches and support underrepresented students necessitates STEM faculty and departments to understand what knowledge matters to whom and how dominant frameworks can silence or delegitimize the potential for marginalized students to pursue and contribute to the discipline in novel ways. Curricula and organizational standards, missions and goals deeply shape students' attitudes, values and relationships with social responsibility, and it is under the prerogative and responsibility of faculty to instantiate such reforms. (Vreeland & Bidwell, 1966).

However, this is easier said than done. This would be to deconstruct deeply rooted historical structures of STEM education. In tracing the genealogy of dominant forms of science and its

production, STEM's approach to knowledge and knowledge processes can be understood as "a form of rationalism which elevates theory and hence the theoretical disciplines" (Muller, 2015, p. 411) and embodies linear, undynamic approaches to knowledge formation. Otherwise referred to as 'traditionalism', such a pedagogical approach is characterized by minimal changes within the underlying curriculum as it is deemed unchanging in its seemingly objectiveness and rigidity. The main response to the limitations and failings of the traditionalist model, including the inaccessibility of knowledge from underprivileged students, was the 'progressivism' framework. Compounded by the exponential increase in new discoveries and inventions, and in turn, the increasing dissemination of specialized knowledge and labor, 'progressivism' forefronts contextually-salient knowledge and skill-building, predicated by a constructionist approach to knowledge. It centers upon knowledge as a product of human history, and thus, prioritizes a dynamic curriculum that is contemporarily valuable and utilizable. However, the 'progressivism' model shores up concerns of longevity and the sustainability of "differential curriculum requirements of specialized knowledge" (Muller, 2015, p. 412). Furthermore, it undermines the different kinds of pedagogical and discipline-centered knowledgeability that is needed within carefully reasoned and comprehensive teaching. Thus, solutions to circumvent the shortcomings of both 'traditionalist' and 'progressivist' models while integrating their respective strengths is necessary within a social milieu that continuously proliferates new subsets of specialized knowledge. This is to undergird fundamental principles of the discipline while upholding its curriculum to be situated within the social, political, and economic context to which it lies. The first step to this pursuit would then be to explicate and negotiate the "differential internal epistemic and pedagogic architecture" (Muller, 2015, p. 415) that composes a discipline,

informed by a diversity of its constituents and their perspectives. However, as this paper will

articulate, such applications of this practice are intricate, complex, and difficult.

In framing knowledge as a political positioning, this next section highlights the history of

dominant curricula and teaching practices of Computer Science within the liberal arts, exploring

what assumptions such models make about the discipline and the implications of their

implementations.

Section II: History of the liberal arts CS curriculum

The Association for Computing Machinery (ACM), an international coalition for educational and

scientific computing, published its first undergraduate curriculum standard for computer science

in 1968. Since then, there have been numerous iterations that have refined and specialized the

curriculum standards over the past decades, reflecting the rapid evolution and expansion of the

computer science discipline.

When the second ACM curriculum standard was published in 1978 — colloquially referred to as

ACM Curriculum 78 — it was met with criticism for numerous reasons. The ACM Curriculum

78 constructed a discipline standard composed of different programming principles and

applications but failed to discern how to orient such components into rudimentary principles that

underlie the discipline. Thus, critics of the ACM curriculum argued that the model failed to

adequately discern what constituted CS as an educational discipline.

This particular shortcoming of ACM Curriculum 78 made integrations of its frameworks

inapplicable to computer science in a liberal arts setting. As liberal arts institutions are smaller in

size and capacity, it consequently demanded approaches to the computer science curriculum that would tailor to the learning environment particular to the liberal arts. On October 19, 1984, nine computer science professors representing nine liberal arts institutions came together to workshop a model curriculum that aimed to address the shortcomings of ACM Curriculum 78, while discussing how to integrate a robust computer science discipline within liberal arts institutions (Bruce et.al, 2001). In this meeting, they aimed to address the following inquiries:

- What kind of curriculum would be appropriate and realistic in the small liberal arts college environment?
- How could we attract faculty to this kind of environment?
- Could we offer a faculty exchange program? The exchange might facilitate re- search collaboration and perhaps make us more competitive in seeking research grants.
- Could we offer a student exchange program? Given the small number of faculty in each of the schools, such a program could provide a greater opportunity for breadth for our students than any of our small liberals arts colleges could offer alone.
- Could we define a reasonable basic set of laboratory facilities for computer science? How could we justify the need for laboratory facilities to colleagues and administrators who did not think of computer science as a laboratory science?
- Could we collaborate in seeking grants and/or discounts to implement labs in our institutions? (Bruce et.al, 2001, pg. 2)

This gathering led to the formation of the Liberal Arts Computer Science Consortium (LACS), a cohort of computer scientists from liberal arts institutions aiming to advance the practices of teaching computer science within a liberal arts setting. With funding from the Alfred P. Sloan Foundation, the LACS cohort would meet routinely in subsequent years to continue improving and expanding their efforts in creating guidelines for a liberal arts oriented computer science discipline. Such efforts led to LACS's first publication in 1986, "A Model Curriculum for a Liberal Arts Degree in Computer Science", that sought to define the fundamental principles of Computer Science as an academic and scientific discipline and drafted the first iteration of an undergraduate curriculum model derived from such principles.

The publication broadly defined computer science as a "coherent body of scientific principles that will continue to guide the discipline for the next decade or two, rather than allow it to be driven by the needs and priorities of particular technologies" (Gibbs, N. and Tucker, A., 1986, pg. 203). Thus, they argued that computer science is understood as a "systematic study of algorithms and data structures, specifically (1) their formal properties, (2) their mechanical and linguistic realizations, and (3) their applications." (Gibbs, N. and Tucker, A., 1986, pg. 204). In setting precedence to the study of its formal properties, it positioned the discipline as a science.

The paper provided a curriculum framework modeled after this orientation constructed of two introductory courses (CS1 and CS2), four Core courses (CO1, CO2, CO3, and CO4), and three recommended supplemental math courses (Discrete Mathematics, Calculus, and Linear Algebra) (Gibbs, N. and Tucker, A., 1986). CS1 would effectively prepare students for the work required in the subsequent courses by covering foundational topics of program design and problem-solving through the introduction of a high-level programming language (Gibbs, N. and Tucker, A., 1986). It was recommended that CS1 curriculum touch upon particular skills integral to the succeeding courses like "divide- and-conquer algorithms, algorithm complexity, program invariants, and program verification." (Gibbs, N. and Tucker, A., 1986, pg. 205). CS2 would provide an overview of the field by covering different data structures and their representations, searching and sorting data structures, systems software, and introducing concepts of unsolvable problems (Gibbs, N. and Tucker, A., 1986). The Core courses should address the theoretical foundations of the discipline of 1) Principles of Computer Organization, 2) Algorithms, 3)

Theory of Computation and 4) Principles of Programming Languages (Gibbs, N. and Tucker, A., 1986).

By compartmentalizing the discipline into six Computer Science courses and three Mathematics courses, each being a semester-long course (and after their completion, elective courses), students in a 4-year, B.A. degree program would not only have a strong grasp on the theoretical properties of the discipline, but also have room each semester to take courses from other disciplines — upholding a defining characteristic of a liberal arts education.

While there has been revisions and expansions to this model in the subsequent years, much of the foundations explicated in the 1984 model curriculum has maintained its relevance. There are two salient refinements to the 1984 model curriculum that I will cover briefly: one in 1996 and one in 2007. LACS published another paper in 1996 titled "A Revised Model Curriculum for a Liberal Arts Degree in Computer Science", where two key changes were made to the previous iteration of the model curriculum. The first was the integration of laboratory components within the two introductory courses (Walker, H. and Schneider, M., 1996). The second was the integration of multiple problem-solving paradigms (e.g. procedural, object-oriented, and functional paradigms) and multiple programming languages early in the model curriculum (Walker, H. and Schneider, M., 1996). This was to remediate a concern that if students focused on one problem-solving paradigm, they would have a harder time learning and adapting other paradigms needed for the higher level courses. In 2007, LACS published another paper that built upon the 1996 model curriculum titled, "A 2007 Model Curriculum for a Liberal Arts Degree in Computer Science". One of the biggest changes developed in the 2007 model was the addition of a software development course that would formally and adequately support students in designing extensive

projects within elective courses by covering topics like software design, design patterns, unit testing, and APIs (LACS, 2007).

Much of Swarthmore College's Computer Science department's pedagogical objectives and curricular structure stem from the findings of LACS's research. This is unsurprising considering that one of the founding members of the nine member cohort of LACS was Emeritus Professor Charles Keleman, who founded Swarthmore College's Computer Science Program in 1984 and taught in what became the Computer Science department shortly after until retiring in 2011. The CS department follows the LACS framework in its commitment to provide students a strong theoretical foundation in computer science that allows students to pursue various applications of Computer Science after graduation.

The upper-level CS courses of the department are grouped into three main categories. Group 1 courses are courses that explore the theory behind particular mechanics of computational properties, which often rely more heavily on mathematics than the rest of the other courses. Group 2 courses are courses that focus on the systems aspect of computer science, exploring how hardware systems and software systems work together – examples being operating systems and compilers. Group 3 courses are the most broad; these are courses with a strong emphasis on applications of computer science. To complete the major requirement, students must take courses from all three groups and fulfill the two mathematics requirements as well, which is to pass courses of either discrete math, linear algebra, (or any courses above), or statistics. The last requirement is the senior comprehensive, which is a poster presentation outlining a computer

science project a student has completed within their undergraduate, which happens during their

senior year. The full outline of the courses and their groupings look like the following:

Course Level	Course Group Number	Course Number	Course Title
Introductory	N/A	CPSC 021	Introduction to Computer Science
Intermediate	N/A	CPSC 031	Introduction to Computer Systems
	N/A	CPSC 035	Data Structures and Algorithms
Upper level courses	Group 1: Theory	CPSC 041	Algorithms
		CPSC 046	Theory of Computation
		CPSC 049	The Probabilistic Method
		CPSC 09T	Special Topics: Randomized Algorithms
	Group 2: Systems	CPSC 043	Computer Networks
		CPSC 044	Database Systems
		CPSC 045	Operating Systems
		CPSC 075	Compilers
		CPSC 087	Parallel and Distributed Computing
		CPSC 089	Cloud Systems and Data Center Networks
		CPSC 091S	Special Topics: Game Systems
	Group 3: Applications	CPSC 040	Computer Graphics
		CPSC 063	Artificial Intelligence
		CPSC 065	Natural Language Processing
		CPSC 066	Machine Learning
		CPSC 068	Bioinformatics
		CPSC 071	Software Engineering
		CPSC 073	Programming Languages

		CPSC 081	Adaptive Robotics
		CPSC 088	Privacy and Security

The Computer Science major requirements in its fullness are as follows (Course Major, 2023):

1. A total of 8 minimum credits in computer science:
   a. CPSC 021
   b. CPSC 031 and CPSC 035.
   c. One course from each of the following three groups:
      i. Group 1: CPSC 041, CPSC 046 or CPSC 049.
      ii. Group 2: CPSC 043, CPSC 044, CPSC 045, CPSC 075 , CPSC 087, CPSC 088 or CPSC 089 .
      iii. Group 3: CPSC 040, CPSC 056, CPSC 063, CPSC 065, CPSC 066, CPSC 068, CPSC 071, CPSC 073 or CPSC 081.
   d. Two CPSC courses numbered above CPSC 035 that are different than the choices in part (c) above. Excludes CPSC 181 and courses that earn less than 1 credit.
2. The senior comprehensive, CPSC 099.
3. Two credits in MATH at the level of MATH/STAT 027 or above. Discrete Math and Linear Algebra are recommended. Students may satisfy one of these requirements with STAT 021.

From the course groupings to the CS major requirements, there are strong parallels between the model curriculum produced by LACS and the curriculum model of Swarthmore's CS department. Both prioritize having a well-rounded understanding of CS, ensuring that students have experience within three distinct and overarching domains of computer science: the computational theory, the computer's hardware and software systems, and various applications of computer science from robotics to software engineering to privacy and security.

However, what remains to be addressed is how the defining characteristics of studying computer science within a liberal arts context lies beyond strategically structuring the curriculum to account for the flexibility of having students take courses from other disciplines. What is left to be fully explored is how to utilize the nature of a liberal arts education, the ability to pursue

various kinds of disciplines and domains of thought in tandem with each other, that allows for an enriched and contextualized understanding of computer science? The following section explores this inquiry in hopes of highlighting a different dimension of studying computer science within a liberal arts educational model.

Section III: Computer Science within a Liberal Arts educational model

Within the evolution of the LACS Model Curriculum, it consistently focused on refining the principle components (and its chronology) to ensure a comprehensive, theory-based curriculum. Such an approach would ostensibly prepare liberal arts computer science students to apply their knowledge across various subfields and computational applications post-graduation despite the relatively limited amount of computer science courses taken within a student's undergraduate program.

To recapitulate, LACS's work was integral to the development of Computer Science as a *science* with fundamental principles that ground the discipline, where such core principles rooted the myriad of mechanical paradigms and applications within the field. However, aside from the aforementioned identifying traits of a liberal arts computer science curriculum, I want to draw attention to other distinguishing attributes a liberal arts computer science education other than its focus on theoretical principles. Generally speaking, a liberal arts education predicates on the philosophy that a rich, intellectual rigor indicative of a liberal arts education necessitates an interdisciplinary approach to learning. For example, Swarthmore College's mission statement explicitly states their curriculum "[connects] the arts, humanities, natural sciences and engineering, social sciences, and interdisciplinary programs." (Mission, 2023). An advantage of having a well-rounded education ensures the practicality and applicability of their education to

avoid "committing to a knowledge base that might not be relevant tomorrow." (Why liberal arts, 2022) This motive supports the college's "commitment to peace, equity and social responsibility" — to use a liberal arts education to engage with a society with ever-changing values and needs (Mission, 2023). Such institutional goals and missions should be reflected within every academic department's own missions and values.

Keleman was a co-author to the 2010 publication, "Computer Science and the Liberal Arts: A Philosophical Examination" that explicated how the field of computer science benefits from computer science thinkers who received a liberal arts education. In particular, the paper discusses the importance of learning social science epistemologies that explore the benefits and harms of computational applications in society.

> "Like any powerful technology, computer systems can be used for the benefit of all or, in the hands of the selfish, for the benefit of a few at the expense of many. Although relatively few liberal arts graduates may enter a computing profession, many liberal arts graduates will be making policy decisions and taking leadership roles within a democratic society. All of these people need to understand opportunities and issues related to technology; they need insights to understand implications and to ask appropriate questions….People well-educated in the liberal arts with some knowledge of computer science are needed to help decide what computers ought to do." (Walker H. and Keleman C., 2010, pg. 7)

Through a liberal arts education's emphasis in interdisciplinary learning, liberal arts computer science students have the structural flexibility to learn how to code and to understand the societal implications of code. I argue that such a skill is becoming increasingly more important in today's society where widespread applications of computation have been noted to produce racial and gendered algorithmic biases (Beer, 2016). With an increased prevalence in wide-reaching applications of computer science, the 2007 LACS model curriculum had one paragraph that

touched upon social and ethical issues in computer science within a list of curriculum

considerations common to many courses. The paper even recommends that an introductory

course allocate five hours of instruction to "History, social, ethical issues" (LACS, 2007, pg. 7).

> "Social and ethical concerns should be a theme woven through courses at all levels. The 2007 Model Curriculum recommends that specific social/ethical issues be discussed in connection with related technical issues, to show students that the two are not separable. For example, units on testing or proof should discuss the professional's responsibility to produce correct code; topics such as the Internet or cryptography will be presented as applications of course concepts, and those presentations include discussions of the social impact of the applications on areas such as privacy, accuracy, and security. Tables I and II highlight hours spent on social and ethical issues in the introductory sequence and in the core course Principles of Software Development." (LACS, 2007, pg. 7)

However, discussions concerning social issues related to computer science or concrete

pedagogical applications of social issues were not addressed anywhere else within the LACS

scholarships. The recommended practice of having structuralized components to the curriculum

model of weaving social and ethical concerns into the courses are not currently reflected within

Swarthmore College's department.

The current mission statement of the computer science department at Swarthmore is summarized as follows:

- Goal 1: Students should be able to apply problem solving skills to formalize general problem statements into precise algorithmic solutions. These goals are assessed via the lab sequence in every computer science class.
  - Subgoal 1: Students should be able to use abstraction to solve problems.
  - Subgoal 2: Students should be able to use critical and creative thinking skills to solve problems.
- Goal 2: Students should become proficient programmers. These goals are assessed via the lab sequence in every computer science class.
  - Subgoal 1: Students will be exposed to multiple programming paradigms in order to make them more able to learn new programming languages on their own. This skill is invaluable given the rapid changes in the discipline.

- ○ Subgoal 2: Students should assume their programs will contain errors and that their programs will receive invalid input from external sources. Students should learn to write programs that are robust. Students should learn debugging skills, as well as how to adequately test programs.
  - ○ Subgoal 3: Students should have experience using external APIs and libraries.
- Goal 3: Students should demonstrate an understanding of the interplay between theory and practice.
- Goal 4: Students should have a broad exposure to computer systems.
- Goal 5: Students should have experience conducting research and completing large projects. Often such large projects will require a team effort.
  - ○ Subgoal: Students should have the ability to work as part of a team.
- Goal 6: Students should demonstrate adequate competency in theory, systems, and applications, the three main areas of the computer science curriculum.
- Goal 7: Students should be able to apply the computational and algorithmic problem solving skills learned in computer science across many disciplines.

In looking at the mission statement, there are several goals identified as demonstrating sufficiency in application-based practices and problem solving. In the broadest sense, Goal 6 mentions adequacies in applications of computer science; Goal 3 highlights "an understanding of the interplay between theory and practice." Here, I argue that proficiency and critical introspection of computational applications is greatly incomplete without a robust, societally-contextualized understanding of its applications. Social components of computer science applications is an element that also aligns saliently with Goal 7, applications of computer science problem solving skills across different disciplines, of which can and should include how computational thinking and problem-solving approaches enhance or conflict with social epistemologies of knowledge and understanding.

It is currently unclear how each of the goals are reflected within the course curricula – some of the goals and its implementations are more concrete and visible to like Goal 4: exposure to computer systems, which is interrelated to the course major requirements of the department, or

Goal 5: whether students have the opportunities within their education to conduct research and complete team projects. However, other goals like Goal 3 and Goal 7 are more difficult to assess – in part due to the difficulty identifying the curricular component these goals are being met with and its efficacy in achieving such goals. Thus, through my student alumni interviews, I hope to have a clearer understanding of how the more interpretive goals are/are not being met and whether socially and ethically conscious curricula could address these goals in beneficial and novel ways.

The lack of robust integrations of social and ethics based curricula does not mean that the department does not find such issues important to teach, rather, it reflects the struggles within institutional bureaucracy and faculty bandwidth to robustly and effectively implement these standards into the department. Such struggles stem from various factors – to understand them is to understand the institutional context to which these changes are being implemented. Thus, the fourth and last section explores how institutional and organizational culture informs processes of change by identifying its different constituents, strategies in minimizing resistance, optimizing the time to instantiate changes, and how to measure the effectiveness of these reforms.

Section IV: Institutional and Organizational Culture, implementing curricular changes related to diversity and social justice

The study "Debating Diversity and Social Justice Curricular Requirements: How Organizational Culture at a Liberal Arts College Informed the Change Process" described the challenges and outcomes of an institutional-wide diversity course reform at a southern Liberal Arts College. The study had defined a diversity course as a course that addresses the history of different dimensions of social oppression, explores contemporary issues of social oppression, invokes critical

introspection into students' own history and experiences, and engages in methodologies and practices in working towards social justice (Miller, R. A., & Holliday-Millard, P., 2021). The study had articulated 1) the particular components of an effective diversity course, 2) measuring the efficacy of the diversity courses, and 3) the institutional challenges in introducing a wide course reform and its relationship with the organizational culture of the institution (Miller, R. A., & Holliday-Millard, P., 2021).

While in this study, the diversity course reforms were only happening within the humanities and social science departments, there is a case to be made on why STEM departments also necessitate similar pedagogies within their own teachings. The first of which is to understand how science carries its own textured and interwoven lineage with social injustices (see section I), and how the inability to account for unethical applications of science has resulted and is resulting in scientific knowledge and practices that harm marginalized communities (see section I). The second is the assertion that the general education of an institution should imbue the college's mission and goals within each course, including STEM courses, while developing course-specific criterias, review processes, and outcome assessments to discern how adequately the courses reflect the broader goals and values of the institution (Jeske, 2002). Thus, if the mission and goals of Swarthmore College, as Section III articulates, includes interdisciplinary thinking and values of social responsibility, STEM departments, including the CS department, demands its own educational spaces that address various dimensions of social oppression that scientific knowledge perpetuates and how science should be understood and utilized to ameliorate oppression. Thus, this study provides the groundwork for what to consider when introducing socially and ethically conscious curricula within Swarthmore's CS department.

Foundational components and measuring efficacy within social justice courses

In the study, an institution-wide diversity course reform was catalyzed by the ineffectiveness and

performative nature of the preexisting diversity course requirement of the college (Miller, R. A.,

& Holliday-Millard, P., 2021). Thus, the faculty committee in charge of this new initiative

designated specific requirements that would ensure a more productive diversity curriculum,

which in summary, were the following:

- Examine students' own identities
- Examine underrepresented social and cultural groups
- Explore and understand systems of inequality, discrimination and prejudice amongst marginalized populations
    - Emphasis on the structural components of inequality
    - Emphasis on viewing through a variety of lenses, perspectives, ideologies than one-dimensionally
- Examine how social contexts influence knowledge construction and whose knowledge is seen as legitimate
- Experimental and dialogue-based teaching
- Methods to identity or resolve those inequalities

The study also constructed a framework on how to measure the efficacy of these courses, of

which included cognitive development of students's understanding of societal issues and

increased civic engagement (Miller, R. A., & Holliday-Millard, P., 2021). The study also stressed

the importance of evaluating course efficacy for specific groups, most saliently, white and/or

privileged students versus students of color and/or marginalized students (Miller, R. A., &

Holliday-Millard, P., 2021). Ideally, the course would benefit both types of constituents –

white/privileged students would be able to directly benefit from the course by evaluating their

own positionality and to understand how to be co-conspirators in working towards social justice.

Students of color/marginalized students should also positively benefitting from the course –

understanding their positionalities situated within different logic of their own privileges and

marginalities, the intricacies of social oppression and intersectional consolidation —that goes beyond students of color/marginalized students' understandings of power and injustice from their own experience and doesn't rely on students of color/marginalized students educating non-marginalized students in the classroom.

The components of the study's diversity courses can greatly inform the components of what integrations of socially and ethically conscious CS curriculum could look like. For instance, examining computational knowledge through social and historical contexts, exploring and understanding systems of inequality driven by computation, thinking through and implementing methods/strategies to apply CS in ways that do not reinforce structural inequities, and embodying discussion-based, experiential, collaborative-based learning methods, can be effective curricular practices for this initiative. To assess outcomes and feedback of social and ethical CS curricula should, drawing from the study, pay particular consideration to the marginalized constituents – as such reforms addressing sensitive and potentially personally-salient topics, if wrongfully applied, can cause more harm than good for marginalized students.

Understanding reform processes through Tierney's framework of Institutional Organizational Cultures

In order to understand how change is implemented within an institution, it is important to discern the culture of the institution. Institutional culture and institutional change embodies a cyclical relationship where one informs and affects the other. Institutional culture can be understood through several paradigms developed by organizational development scholars, but for the purposes of this thesis, I will focus on one coined by higher education governance expert William G. Tierney. Tierney's framework discerns institutional culture by evaluating six

components (environment, mission, socialization information, strategy and leadership) of each individual institution (Kezar and Eckel, 2002). This necessities inquiries of institutional values, beliefs and assumptions like "how is the mission defined and articulated? Is it used as a basis for decisions? What constitutes information and who has it? Or how are decisions arrived at and who makes them?" (Kezar and Eckel, 2002, p. 440). Understanding institutional culture becomes important when deciphering what kinds of change and through what strategies become successful in institutions. It has been proven that change that goes against institutional cultures and their values experience more difficulty and resistance. (Kezar and Eckel, 2002)

The study utilized Tierney's organizational framework in understanding how institutional culture informs how curricular reform is implemented within an institution. In understanding how to navigate introducing curricular reform, the faculty committee of the diversity course reform utilized Tierney's framework to construct application strategies and to address areas of resistance. More specifically, this was to understand the "existing *environment* and *mission* of the organization to "work" the structure and introduce change, and with this *information* and *strategy*, … provide informal *leadership* and navigate politics in the organization." (Miller, R. A., & Holliday-Millard, P., 2021, p. 1102). Questions were then formed through Tierney's framework on how to develop a reform process successfully (Miller, R. A., & Holliday-Millard, P., 2021). Such questions informed this thesis's faculty interview protocols, in understanding the process of measuring department efficacy and introducing reform operates within Swarthmore College CS department, and how broader institutional infrastructures and culture informed such processes.

Table 1. Examining diversity curricular change through the lens of organizational culture

Component of organizational culture (Tierney, 1988)	Questions about Elite College's curricular change process
Environment	• What is the history of the college and prior diversity efforts? • What do public communications suggest about the college? • How does the college compare itself to similarly situated institutions?
Mission	• What are the mission and goals of the college? • What are the purposes of the diversity and social justice course requirements?
Socialization	• What does a faculty member need to know to create change at Elite College? • To what degree will the college culture permit change and deviation from tradition? • What sub-cultures exist (e.g., faculty cultures, disciplinary cultures, identity-based groups)? Are they in conflict?
Information	• How is information controlled and shared? • Who educates faculty during the change process? • What stories are told about diversity at Elite College and the curricular change process?
Strategy	• What strategies are used in the change process? • How are decisions made? • What tensions exist between idealism and pragmatism? • What resource and financial constraints exist?
Leadership	• Who has power at the college and in the curricular change process? • What are the defined roles for faculty and administrators in the curricular change process? • Who are the formal and informal leaders of the curricular change process?

Relatedly, another aspect that the study had considered was potential areas of challenges when introducing wide, diversity curricula reform, which were articulated by previous studies and included the following (Dee, 2016; Goodstein, 1994a, 1994b; Humphreys, 1997):

- shared leadership and ownership,
- coalition building,
- integration with institutional mission and local context,
- specificity of goals,
- budgetary considerations,
- engagement with critics and resistors

I drew from the questions arising from Tierney's organizational framework aimed to explore similar inquiries from my faculty interviews on how change is instituted and the organizational

cultures that may create tension/resistance/negotiations between the different constituencies

involved within the context of Swarthmore College and its CS department.

Data Findings

<u>Student Alumni Interviews</u>

One striking commonality between Student A and Student B's experiences were the scant

retention and relevance of their CS coursework within their post-graduate CS jobs. Both

students, having participated in tech internships during their undergraduate studies, claimed that

those experiences most shaped what kind of work they pursued, where they garnered the relevant

skills that informed their full-time work. For student B, this included having workplace

experience, which they denoted as lots of self-learning and researching for a project, learning

ways to think through optimizing solutions and approaching problems from different angles, and

collaborating with a mentor or project manager. Because courses at Swarthmore mostly cover

various foundational components of CS, it naturally cannot ensure direct applicability to a

particular CS job/work – given it operates under specific technical and working environments

based on the nature of the team/company's project that may be very different from the

environments they were used to during their undergrad. However, both students felt that the lab

work within their CS classes were in most part, situated within isolated, abstract contexts, and

given that most labs were done in a two week period, they were not able to see the greater

purpose of their lab work or the necessary contextualization needed to understand the cohesion

of all their labs long-term. Student B's impression of most labs were as follows:

> "…[the labs were] heavily focused on getting an assignment done…getting the lab done,
> just trying to make my way through the course through the semester, and that was sort of
> my heavy focus as a student"

Student A had similar impressions: "everyone has to do these labs, and there's …if the lab

works, it works if it doesn't, it doesn't." Both students preferred project-based labs, where

students had the agency to utilize their CS knowledge to pursue something that aligned with their passions, and having the experience to work with groups of three and more. Student B brought up ideas of having more project-based labs that collaborated with local businesses or companies, engaging in CS outside of the "Swat and education bubble", where their work would hold greater value than just within academia. Student B particularly appreciated her Machine Learning (ML) course where they were to engage only with the concepts of ML, but also focused on the ethical implications of ML and CS in general. Her project was on recidivism for prisoners and exploring how using ML to predict recidivism was unethical to use in these situations. To student B, this was a way to apply knowledge from class and understand how ML engineers in industry or research would use and apply these concepts. This also meant that she needed to do research understanding the social context of her project and understand general uses of ML within societal environments.

Both students appreciated particular aspects of their experience within the CS department — most saliently, collaborative work. They found that collaborative work experiences within their CS work motivated them to seek that out within their workplaces. Student B even went on to say that if she did not have thorough experiences with collaborative work, she may have been hesitant to seek out the guidance and opinions of her team members or manager.

As women of color in CS, both students shared their experience of being discriminated against and disrespected by their male counterparts within CS work environments. This in turn, fostered values of respectful workplace dynamics and collaboration and the personal importance of seeking out workplaces with more women. Student A shared their experience working lab

partnerships with male students, and how she aspired to strongly uphold her values when when managing employees within her current job:

> "I was with male students who disrespected me, did not listen to me, did not value my input as valued work for the labs or assignments, and I think that definitely in a weird way, made me more passionate about collaboration, because I think it is important to have respectful and proper collaboration, because if you do, it's great, and I think it is so much better than just trying to work alone or fight against someone you're trying to work with."

Student B shared an experience where a male lab partner took the keyboard away from her unannounced while she was typing on the computer. She remembers calling out the action specifically, but did not invoke concerns about gender discrimination to the lab partner or her professor, and just waited until a new lab partnership was put into rotation. Both students described how when they would face discrimination within lab partnerships, they did not go to the course instructor about these issues. Student B also mentioned that when her CS friends, who were also women, approached the faculty when they were being very explicitly discriminated against, the instructor's response was in her words, something along the lines of "I'm a professor, not a counselor so I can't do anything about this."

While faculty members mostly being white, cis, men rightfully attributes to marginalized students's uncomfortability or distrust in safely and adequately having such experiences of discrimination addressed, Student A believes that if more of the faculty openly address issues related to marginality, she believes she would have been more comfortable having these conversations with her professors.

> "I think if my other professors talked about race or class, or gender or ability, or anything in class, I would have probably felt more comfortable talking to them about it. But because none of my professors would ever talk about it in any context, because they weren't… because it wasn't in the curriculum and so and why would they talk about it? I think it just would have led to a better experience as a student in that department."

After those experiences, Student A gravitated towards working more with women to avoid facing similar situations of discrimination and disrespect. Student A had also shared her experience being discriminated against in her tech internships as well. She recalled one particular summer internship where she was "clearly discriminated against" that discouraged her from working within that company again. While Student B has said that she is currently content with her work and workplace, noting that her manager is a woman, Student A attributed her harmful experiences with the general values that are often cultivated within the CS community and wants to move away from tech work in general.

Values upholding careful consideration towards marginalized groups within CS was something Student A believed was hard to materially see within the department and the workplace. Rather, what was forefronted was values of efficiency, productivity, and novelty, instead of situating their work across various axioms of oppression or social justice causes. Thus, she had a difficult time finding friends or community with the other CS students in the department.

> "It didn't feel like [the CS department] cultivated people with similar values as me, so I like couldn't really seek out friends within the department because they were not necessarily minded people, because the CS Department has very different values that I think that I do. And so it cultivated people with [what] the CS department values rather than what I can relate to. Yeah, I had a hard time finding friends in the CS department, honestly."

These kinds of values were not just exclusive to the department, but in her impression, the CS industry as a whole. Within her tech internships, she was disillusioned by what her work was

advertised as doing meaningful, agentic work within the company. However, her experience as an intern was "doing a lot of busy work, just work that needed to be done, that someone just told you to do and not really work that the interns wanted to do, [and] it was really disappointing." She first thought that it was her particular team or manager, or the company in general, but having had multiple different workplace experiences, she believes that it is attributed to "an integrated web of hierarchy" that exists at many tech workplaces. Her general impressions of tech culture "cultivates and [prioritizes] certain voices and [pushes] certain voices away". She also found her work individualistic and isolating, finding it "disheartening", where voicing her own ideas of approaching a task or her opinions of the project was shut down by her manager. While she is not facing these issues within her current job, she does not find her work exciting, and coupled with the discrepancies of her own values with the industries, she is thinking of leaving tech work behind and pursuing urban environmental, farm and education work. It must be noted that Student B has a different and more positive experience in her current job, as she notes how her manager encourages questions and honest communication, including if Student B has an issue with the task assigned, and says she has a lot of agency within her work and is even welcome to propose new initiatives or projects, which was a very different experience from her former internships which aligned more with Student A's experience. This can be attributed to wide variations between work expectations and environment across different companies and projects that highly affects the kinds of experience students can have.

Additionally, Student A spoke about her identity as a queer and disabled person and believes that those aspects of her identities were not as welcomed to share. In the interview, she provided an anecdote about how one of her co-workers within one of the internships she did at a big tech

company was afraid to mention that he recently married his husband or talk about queerness in general, even though he had been working in that company for several years. Student A discussed her own hesitation of discussing her disability within the workplace, fearing it would negatively attribute her worth as an employee. She said the following:

> "I honestly don't talk to my work colleagues or employers about disability, because I'm scared of the consequences of it. Because I think disability has to do with a direct link to production, or what is valued in the workplace. I've been lucky that I work part time, so I can just get away with taking rest when I need to, and not having to declare that. But I feel if I start working full time, I think it would change the way that my employers perceive me and my value to the team, and therefore I don't know."

Both students interviewees believed in the importance of socially and ethically conscious work for personal as well as professional reasons and wished more of those discussions were part of their CS experience at Swarthmore. For Student B, such conversations were important for work in industry, and wished that the CS faculty who had experience working in industry would leverage their insights into their curriculum, and wished for more community and research based projects of more than two people that built upon each other, instead of having distinct, individual labs.

> "If you want to go into AI, or you're going into a company that's going to be dealing with spreading information, or social media there's a lot of people you have to think about, and how your work is going to affect… not just your team, but your company, and also the general community that's going to be using them. And so I think that's sort of harder to learn. You have to learn that on your own when you go into the workplace, and that's something that we don't get at all as well, the only brief experience that I had with that was in my ML Class…"

Student B noted that if one wished to foster a social and ethical lens to their work, they had to seek those kinds of experiences by themselves, and wanted the faculty to include that into their course content more. She attributes her desire for more of those conversations with her experiences as a woman in tech.

"...being a woman in tech is just different from the experience, I think it's very different, and maybe say, some of your other peers or coworkers. And I think it just pushes you to think more about your workplace environment and I just feel I'm more conscious of everything I do in the workplace, and how I interact with people and how I respond to people's questions, or how I talk to people. And so I think, just having that conscious mindset of always being aware of how I'm positioning myself in the workplace also has led me to be sort of more also focused on, say, what are the further implications of my own work, the skill based work that I'm doing. And so I think, just having already that mindset in place, also pushes me to think about other issues."

For Student A, she wished that the faculty would have more conversations about structures of power within workplaces, as that was something that deeply affected her experience in tech work, and provide more general support navigating real-world work dynamics more. She also believed that if there were more socially and ethically oriented conversations, then she wouldn't have stayed in those internships that she did "for that many years". Her identities as a disabled, queer, women of color, her academic experience as an Environmental Science major, and her extracurriculars cultivated values of diversity, equity, inclusivity and social justice. She noted how for her Environmental Science major, she took more humanities and social sciences courses, where the courses explored the *relationality* between various aspects of society. She mentioned how her ecofeminism class explored the relationship between environmental studies and feminist studies, and how one informs the other.

" …one thing I really do like about the Environmental Studies Department was how we integrated conversations about race, class, gender, ability in almost every class I took within it, and I think, this are all identities that inform who I am, how I live in this world, and I think are so important to talk about all time, because they affect everyone, everything…. At least now in the society that we live in."

Within her CS courses however, there was no discussion of relations of power and oppression, despite such topics being prevalent within the CS discipline. This allowed her to utilize her

knowledge from her environmental science major to "[fill] in other parts that I could then apply to CS". Her extracurricular work within the Tech for Social Good also provided opportunities to understand CS in different ways "specifically trying to expand what CS was within Swarthmore to something else". Drawing from Student A's response, I argue that in expanding understandings of CS through the integration of various social frameworks, it is important for the CS department to be informed by and act upon the evolving issues, values, and trajectory of CS applications affected by various contemporary contexts.

CS faculty interviews

Processes of measuring efficacy and assessing the department

Faculty A and B identified several components and processes of how the department evaluates its efficacy and goals. The interviewees identified several mediums to which the the department assesses its standing from formal mediums like the yearly, self-conducted departmental review mandated by the college and external reviews from the Middle States Commission on Higher Education, to more informal assessments like student surveys, conversations within departmental meetings, or internal discussions amongst various department chairs of the college. Faculty B also mentioned how they utilize external resources, like literature from ACM, to discern other aspects they should consider when evaluating the department. The more comprehensive and robust departmental assessment happens every 10 years, where the department must conduct an extensive self-study report of the whole department, and give it to three to five external examiners who visit the college and relay different solutions of improving the department.

At the beginning of each academic year, the department collectively decides one goal to tackle for the school year and at the end of the academic term, the department concludes the assessment

and writes a report on it. Goals can range in their specificity; Faculty A mentioned how one year the department assessed the efficacy of the course groupings for upper-level courses and whether students successfully retained key concepts from all group categories. Other years, the department picked more specific goals – focusing on unit testing, assessing for example, whether unit testing practices were being taught in ways that increased students' ability to understand coding and debugging processes better. Both faculty acknowledged the importance of student feedback as well, although aside from informal conversations with students, it has been some time since a department-wide student survey was performed or the last time the department conducted an exit survey for graduating seniors of the department. The faculty also make critical observations in the classroom to discern student receptions of departmental and/or curricular practices. When creating department goals, Faculty B noted that the institutional missions of the college also inform this process, one of which stems from the college's emphasis on interdisciplinary learning. Faculty B stated that the CS department focuses on understanding how students can identify and integrate various forms of knowledge within their education, and tries to embody the institutional values as much as possible.

> "We think about students in terms of computational thinking, and how that fits in with the way they approach learning in other subjects. We try to find integration across departments as much as possible. We try to think about what the classroom environment is, and the pontiatrical expectations and the interactions that students are expecting when they come to Swarthmore. So I think, when you look at our mission and our values that are stated, a lot of that's in there, so we expect students to be able to write in our discipline. We expect students to be able to communicate within the discipline. We expect students to be able to take ideas of filling in different subjects and bring them into the classroom, but also take the ideas of computer science and extend them outside the classroom. So I think those are a lot of things that are from the college mission." – Faculty B

When asked how the department identifies their goals and areas of improvement, the impression

from both responses indicated that finding areas of improvement weren't the issue, but finding

the time and bandwidth to adequately address them. Faculty A particularly noted that "one of our

overarching goals that's constantly on the top of our minds is diversity, equity, and inclusion" and

mentioned the Advisory Council to the CS Department (ACCS) program that started after the

rise of the BLM, where the results of a department-wide student survey showed that

marginalized students in CS felt less sense of belonging and ability to succeed in the department.

Faculty A also relayed that the Ninja program, paid CS tutors that help students in the

introductory and intermediate courses were also designed with DEI in mind. Relatedly, Faculty B

expressed sentiments about how critical curriculum assessment is something that the department

must continue working towards, specifically mentioning his own interests in focusing on

ethics/social justice components of CS.

> "I think the one that in my mind that I would like to see uplifted is the consideration of where ethics and social good fits within our curriculum. And I think there is a widespread feeling of that in the department. But it's not something that we've solidified. It's still a work in progress, so I think it's not so much that I don't think our mission or our values don't include that, but I think we need to work more on that still." – Faculty B

However, more often than not, areas of struggle stem from greater challenges facing the

department as well as balancing with other duties as faculty. The faculty described other

obligations they must fulfill each semester aside from teaching their designated classes, which

included institutional service (being part of institutional committees, especially for tenured

faculty), and student advising. Faculty also have more scholarship-driven responsibilities like

attending conferences, reviewing papers, and giving talks about their area of expertise. Within

the CS department, each faculty is also assigned specific departmental roles like running course

lotteries, being in charge of the assessment for the year, hosting department panel events…etc.

Senior CS faculty also advise junior CS faculty as well.

Within the faculty's departmental duties, the most notable task that both faculty explicitly

mentioned was undertaking the arduous process of hiring more CS faculty to account for the

rising number of students who become CS majors or minors at the college. Faculty A described

the hiring process as something that consumes so much of the department, and doesn't make way

to attend to other areas of the department.

> "So much of our department meetings are taken up with hiring because we're constantly … we're constantly understaffed, and we're constantly trying to hire visitors and there's very few qualified visitors available, so pretty much from the end of the fall through the whole spring semester, we're still doing it now. We're still working on hiring. And so it really is unfortunate in that it limits what we can talk about anything else, and we would much rather be talking about assessment and thinking about curriculum…But there's not there's not as much conversation about what we're doing as all of us would like, to really think more deeply about what's going well, what could we improve on, what things do we want to add that we don't have. So honestly, we just don't have enough time to have those really deep conversations about the curriculum." – Faculty A

Because I had conducted the student interviews before the faculty interviews, I had an

opportunity to inquire about their impressions of one salient aspect of the student responses,

where both alumni wished there were more socially-contextualized, project-based experiences,

which would have been a very beneficial experience and relevant to the post-graduate tech job

they have. When I brought this up during the faculty interviews, they both acknowledged why

such experiences were important, and how, in Faculty B's words, "we haven't been able to

necessarily provide as many of those opportunities as … that we want." While Faculty B

believes that students should have multiple of those experiences, not all Group 3 application

courses guarantee opportunities for such levels of engagement. Faculty B also discussed

particular tradeoffs and other factors to consider when teaching socially-conscious projects, including sustaining a balance with "mak[ing] sure that we get the full spectrum of understanding the theoretical foundations and the applied side." There are also challenges of having to adequately support and supervise different projects in a large class, like his ML class. He stated: "supervising projects is labor intensive, much more so than a typical project or assignment that you can offer that's repeatable. And so I think that's another thing, where, if our class size were 20 instead of 40, I think we would have a lot more." Faculty B discusses how one way he circumvented this problem was that he had to limit the types of projects he approved for the course to manage all of them successfully. Creating opportunities for students to engage with CS that reflects the kinds of post-grad work of research or industry has become a particular challenge after the CS major requirement revision in 2019, when amongst other things, the department had to eliminate the Senior Capstone course: a semester-long, collaborative, research and application based project situated within a particular real-world issue. Faculty B expressed that trying to have other courses fill in the gaps of the Senior Capstone has been difficult. That said, other faculty members have been implementing their own alternative solutions: Faculty A had mentioned that another CS faculty member who is currently teaching the ML course teaches social and ethics components of the ML in the beginning of each lab section course, circumventing the challenges of facilitating these components within a large class, which Faculty A expressed interest in implementing within her own courses.

However, not all CS faculty feel strongly about the importance of socially and ethically conscious CS curriculum. Faculty A highlighted sources of disagreements amongst faculty on what components of CS pedagogy they felt were important to prioritize. In particular, there were

some faculty members who wanted avenues to engage in CS more interdisciplinarily, especially on a societally critical level, creating relationships and sources of collaboration outside the department, whereas other faculty valued ensuring all the core components of CS were adequately addressed before stepping in that direction. She also mentioned how certain faculty, particularly older faculty, are less welcoming to course reform, which could seem like their expertise on how their course should be taught can be undermined. In navigating contentions or disagreements regarding identifying and approaching departmental reforms, both faculty stated how the department upholds the quaker values of the institution, and tries to reach a consensus as much as possible, and at least provide opportunities for everyone to voice their opinions.

Faculty experiences teaching social and ethics CS

In the methodology section, I had mentioned that both faculty interviewees had some form of experience teaching socially and ethically conscious CS within their courses. For Faculty A, this was through her AI course. When asked how the idea of implementing a social component came about, she stated that Computer Scientist Melanie Mitchell, whom she went to graduate school with, had started sending her drafts of what became a published and well-known book titled, *Artificial Intelligence: A Guide for Thinking Humans*. Faculty A stated that the book "aligned with part of my world view of AI" and started having it be a required book for her AI course, upon her dissatisfaction with the more traditional AI textbooks that were circulated. While *Artificial Intelligence: A Guide for Thinking Humans* is not a traditional textbook, it describes a more high-level, societally-focus analysis of the functionalities, myths, capabilities, and limitations of AI, and thus Faculty A had to explain the more technical aspects of the AI algorithms articulated in the book. She explained why she found exploring these issues

important, exploring societal applications and implications, she argues, imbues AI a more

nuanced, complex meaning:

> "And I just think it's so important to think about the …what AI could be doing, how it could be changing our society. What choices are we making without really even realizing that we're making them, and how they might affect us down the road. And so I think the book does a really nice job of kind of starting you throughout the whole thing thinking in a new way about AI instead of just as, 'it's a computer science subject, and here are the algorithms we're going to learn.'"

Faculty A valued discussion-based learning for these kinds of topics, and in hopes of encourage

students to read and engage with the textbook, started implementing a reading response

component to her course, and based on the responses, Faculty A believed "[the students] were

really reading it, and they really connected to it and got something out of it and enjoyed it."

Because her AI course averages around 40 students, Faculty A also talked about challenges in

navigating discussion-based components of the course, as students may not feel comfortable

sharing in front of a high volume of students. Thus, Faculty A relegated to having students

discuss in smaller groups with their neighbors and share with the rest of the class. As a strong

proponent of collaborative learning, Faculty A also expressed her preference for project-based

learning, where students are able to decide what topic/issue to pursue, as then, students obtain

more personal ambitions in engaging with the discipline. She said,

> "I think that whenever you try to apply what you're learning in class to a problem that's interesting to you, and connects to things that you care about, that's when you're going to learn the most, and really push yourself the most, because you're now really excited to accomplish this thing because it's something that's relevant to you rather than me deciding in advance, you're going to do this lab about X, Y, or Z. So I think project-based courses are really beneficial for students."

In reflecting on these implementations, she noted that "...for the most part, it really seemed students embraced it and enjoyed it and got value out of it."

For Faculty B, he had co-taught an Ethics and Technology course with a Swarthmore's moral philosophy professor (whom I will reference as Professor Z) in the semester of Spring 2019. He and Professor Z came to Swarthmore in the same year, and so already knew each other since the beginning. Faculty B started conversing with Professor Z, expressing his frustrations regarding national conversations around AI, and upon further discussion, they had decided to try co-teaching a course about it.

Faculty B was interested in Faculty Z's work, but did not know much about philosophy, and visa versa. They believed that the experience of co-teaching a course that converges their respective expertise would also allow them to learn from another. Faculty B attributes the possibility of this cross-departmental collaboration to the culture of the college, which "encourages faculty from different disciplines to interact quite often, because if it was just a one time meeting it wouldn't have happened". Once the idea spawned, they continued to meet to hash out the course details like course prerequisites, teaching methods, and finding an apt balance between computer science and philosophy material. They decided that the course would be a Freshman Year Seminar and have roughly six CS-oriented students and six philosophy-oriented students. Both faculty wanted the curriculum to not just explore case studies, which is the traditional approach within engineering-ethics courses, but to create more dynamic conversations with one another. The curriculum material drew from their former conversations about individual issues concerning ethics and technology and they were able to bring in their own perspectives and

interests into the curriculum. Some of the topics that the course covered were Machine Learning and Algorithm Bias, AI, and Surveillance and Privacy.

Upon his reflection of the course, Faculty B stated the difficulty in catering to each students' interest, and believed the CS students needed more background knowledge on fundamental philosophical concepts. Given the opportunity, Faculty B stated he would not want to reteach this course as a FYS to have the course be accessible to a broader body of students. After the completion of the course, Faculty B and Z took various components of the curriculum and implemented them within their individual courses. Other faculty, who were aware of this co-taught course, expressed high interest in the course, and implementing concepts of teaching structure similar.

Co-teaching a course is expensive, and requires each faculty to relinquish the courses they usually teach in the semester, and thus is hard to implement regularly. He also believes there may be hesitation from other faculty members to engage in a similar co-teaching, interdisciplinary course, which he would like to understand why:

> "It's hard to get to, but I would like to see is, while a lot of people have been very open, have been very positive receiving this at the college, [Professor Z] is really the only one that's been eager to like, actually do it. Like actually partner with us, and doing these things. And so she's actually going to co-teach a class with Professor A next year. And so I'm trying to figure out why is there a hesitance from other faculty at the college that are positive about this" – Faculty B

Faculty B, however, wanted to utilize the success and outcomes of teaching the course and inquire, "how can we manage to keep these ideas going given all the other expectations that we have?" One idea Faculty B particularly discussed was the embedded ethics model, which as the

name suggests, embeds conversations of ethics into the preexisting curriculum. Benefits of an embedded ethics model is that the department does not need faculty to teach a new, separate course. Furthermore, studies on teaching ethics recommend that ethics be integrated into an existing curriculum to reinforce the idea that issues of ethics touch various aspects of a discipline, and must be understood in relation to each other. Faculty B implemented the embedded ethics model for each of his lab assignments the last time he taught Machine Learning, and believes there are ongoing initiatives where this model is being applied to other courses in the department, and ultimately hopes "to see it come into the introductory courses, and so on." Both faculty interviews mentioned several CS professors implementing these models within their own courses, but there is still much more that needs to be done. Faculty B expressed his own personal "dream" of reinstantiating the ninth course credit requirement for the CS major but have it within another course outside of the CS department that "requires students to apply their computational knowledge to one of these more ethical or social issues", mentioning the intersection of art and computer science as an example. Faculty A had also mentioned that this idea was going around the department, and while she agrees with the sentiments of having CS students receive a well-rounded, interdisciplinary, education, she expressed challenges in the details of this idea, stating:

> "...then the problem is, how would we decide which courses would count? And how would we make sure that there's really a connection there? And so, there's a lot of questions about how you could implement such a thing, but I still think it's kind of a good idea."

Other considerations and next steps

Faculty A recently received a grant from the National Humanities Center to co-teach an AI and Ethics course with Professor Z. She emphasized that external resources outside the institution was a resource that allowed her to evade institutional challenges of co-teaching a course, and

said "we're getting paid a good chunk of money to have … to incentivize us to make this course

that is about creating responsible AI." Another beneficial aspect of receiving this grant was that

Faculty A is part of a cohort of professors across institutions who also received grants to create

new courses, and they meet once a month to share ideas, and to support each other trying new

projects and initiatives.

Not only are socially and ethically conscious curriculum significant for a more holistic, nuanced

understanding of CS and its applications, addressing issues of social oppression and imbuing

values of social responsibility are also deeply tied to diversity, equity and inclusion within the

department. Both faculty interviewees acknowledge this, and found importance then, of bringing

these issues into the forefront starting from the introductory course, as Faculty B says:

> "there is definitely a good amount of evidence, showing that … it's students are
> interested in this topic, particularly, students from underrepresented backgrounds are
> disproportionately interested in these topics… addressing these issues in the introductory
> levels is another way to engage students that we traditionally overlook and traditionally
> don't consider being a computer scientist or don't see themselves in the conversations. So,
> I think from that perspective, we have had conversations about how their view …they
> would- if we're interested in talking about attracting students from underrepresented
> backgrounds and making sure they feel represented, that these conversations can help
> with that."

As most of these conversations were happening informally amongst different faculty, Faculty B

expressed a desire to have these conversations more robustly as a department to be transparent

about these ongoing initiatives to the students, as he states:

> "But I would say, where we fall short is that I wish it was a departmental conversation, so
> that there was a … so there was more follow-through, and that we also were on the same
> page about… what is our end goal?... I'm hoping that we can make it much more

cohesive, much more explicit. So it's a … So students see it and know it's happening rather than just in this patchwork piecemeal way."

Data Analysis

Exploring Relationality between CS Curricula and CS Norms

The student interviews showcase the myriad of benefits and importances of socially and ethically

centered CS pedagogy, mainly: 1) the importance and obligation as computer scientists to

understand how technology can reinforce societal inequities, 2) the pragmatic benefits of having

CS experience through socially-contextualized projects due to its relevance to post-graduate CS

work, and 3) the benefits of having a more nuanced, layered understanding of CS through

interdisciplinary (especially the convergence of STEM and social science/humanities disciplines)

pedagogies.

The aforementioned significance of social and ethical components of CS curricula indicates its

inseparable necessity within the CS curriculum models, especially within application-based

components of the curriculum. This is to redefine and renegotiate what LACS asserted as their

definition of CS, which served as the basis of their model curriculum: "a coherent body of

scientific principles that will continue to guide the discipline for the next decade or two, rather

than allow it to be driven by the needs and priorities of particular technologies" (Gibbs, N. and

Tucker, A., 1986, pg. 203). It is their failure to consider how "needs and priorities of particular

technologies", of which social and ethical CS pedagogy falls under, is interdependent with how

"scientific principles" of CS is defined. The reluctance to integrate the social impact of

computation within its pedagogy is to question what its curriculum ultimately seeks to serve. I

argue that especially within the past several decades, there has been a crucial need and moral

responsibility to consider and act upon the wider ramifications of its dissemination. This is

incomplete without constructing principles, procedures, and strategies that a) account for ethical

and unbiased construction of code, b) discern underlying assumptions of epistemologies, values, and motivations of computational applications, and to c) prognosticate the usages and the wider ramifications of its applications on a epistemic and social level, including whether it does or does not align with hegemonic ideologies, functionalities, and apparatuses. Moreover, one of the questions that the LACS seeked to answer was "What kind of curriculum would be appropriate and realistic in the small liberal arts college environment?" (Bruce et.al, 2001, pg. 2). As I argue in Section III of the literature review, what is indicative of a liberal arts college does not merely concern its infrastructure, but the values of a liberal art education, which includes interdisciplinary learning and social responsibility, at least in Swarthmore College.

There are other normative values within CS as an industry and as an pedagogical discipline that are affected by broader historical and social contexts, which can hinder socially and ethically conscious engagement. CS is a highly skills-based discipline whose pragmatic benefits are much more lucrative; these particular aspects of CS are often the reason why students decide to pursue it in their higher education. In a 2022 salary survey by the National Association of Colleges and Employers, CS majors averaged the highest salary post-graduate out of any undergraduate degrees, which was followed by Engineering and Math & Sciences. Given the current social and economic environment, at least within the U.S., where coding or tech-based jobs are in high demand and pay more generously than other disciplines, it would be unsurprising if students' motivations and values in CS cater towards ensuring that they can reap the benefits of studying CS. Thus, if many students' post-grad motivations are to have a high paying job and secure long-term employment, their motivations during undergraduate can include getting "good" grades, attaining tech internship/work experience to boost their resume, and generally excelling

within the conditions of how the field stands currently – which places strong emphasis on

acquiring technical skills (e.g. fluency in various programming languages, building integrative

projects, data modeling…etc.) – instead of critically inquiring and reflecting about what the

nature of CS is ultimately serving and harming.

It must be said that the CS department within its pedagogical practices uphold the dominant

disciplinary values and practices of CS without no direct intention of undervaluing the interests

and voices of underrepresented students, but with the intention of preparing CS students to

succeed post-graduate by forefronting the knowledge and practice required for skills-based work

that are most in demand. As Section III of the literature review notes, the CS department's

missions never explicitly state having social considerations and ethical practices as a pedagogical

goal, and are geared towards ensuring proficiency of CS as a concrete, scientific practice

forefronting fundamental principles of theoretical, systems, and applications and their

interrelatedness, problem-solving, and teamwork. While the student interviewees had noted

differences between their coursework and their industry work, it must be noted that both lab

assignments within the classroom and work in industry often follow the model of a

manager/teacher assigning an objective which workers/students must accomplish through code,

often not making way for other aspects of critically engaging in CS – something that Student A

had experienced in both the classroom and in the workplace. In short, CS application and

teaching often follows the paradigm of "how can we write code to accomplish X?" rather than

"What are the implications of accomplishing X – who is this benefiting or harming?" As the

Garibay reading in Section I of the literature review articulates, marginalized students who

demonstrate a greater interest in socially-conscious engagements in STEM, must often choose

between conforming to the dominant values and expectations of the discipline or to pursue their personal motivations with less institutional support.

The normative motivations, values, and goals of CS as a discipline and practice serves those who align with and *benefit* from it. Can CS, without robust integration of social and ethical practices, serve the needs of marginalized CS students, given the harm computation enacts to communities of color, gender minorities, disabled mind-bodies, and impoverished people of which the students are part of? What does inclusive CS education look like, then? The following section explores what inclusive and equitable CS education is and is not.

Rethinking Diversity, Equity, and Inclusion in CS education and exploring its limitations

What does it mean to embody the values of DEI? I argue that it goes beyond equal treatment amongst all groups of people, but to have the values, interests, and needs of marginalized people be thoroughly integrated into the milieu of its constituents. And as Section I of my literature review articulates, marginalized students demonstrate a higher interest in understanding a discipline through a societally conscious framework, as well as engaging with a discipline through social justice forward work, and this claim is also supported in my student interviews. Then, in the context of Swarthmore's CS department, generative and conducive DEI practices that support its marginalized students should include societal and ethical considerations and practices of CS – as the lack of such considerations means that there is less pedagogical support towards the needs and interests of marginalized students. This, in turn, also necessitates a revaluation of what and how to assess students' aptitude in CS.

Both faculty interviewees expressed support for more social and ethical considerations and stated that they integrate these elements within their upper-level, application courses. Both faculty also collaborated across departments to construct cross-departmental, interdisciplinary courses related to ethics and CS. However, to understand to what extent and how they cover these components requires a different discussion, of which I was not able to inquire during the interview process, which I regret. I hope to discuss how to adequately construct and measure the efficacy of socially and ethically conscious CS curricula in the following section, Next Steps and Recommendations.

Values of DEI, of course, extend beyond the curricular aspects. Both student interviewees, being women of color, faced discrimination and marginalization within their lab partnerships. These acts of discrimination, which I would attribute as forms of microaggression, reflect the male-centeredness of the discipline, and how women's contributions and knowledge of CS are still held to levels of skepticism much different from their male counterparts. Furthermore women's (and other gender minorities) marginality within CS is corroborated by the fact that both students expressed hesitation going to their faculty to discuss their experiences because of how the faculty would respond to their concerns as eleven out of the fifteen CS faculty are men, and nine out of fifteen of the CS faculty are white men (Faculty & Staff, 2022). Even for non-white or non-male CS faculty, there still can be limitations to their understanding perhaps because of the norms, values, and beliefs that the department – in this context, as a faculty and student community – fosters implicitly, which can stem from the general norms, values, and beliefs of the CS field as a whole, which I addressed in the previous section. Despite positive intentions of many CS faculty, their positionality then, can hinder a nuanced understanding of the experiences and perspectives of marginalized students, which was a concern Student A

expressed. And while the faculty earnestly values DEI and dissents any acts of discrimination or marginalization, Student A went on to state that the values cultivated in the department and the kinds of students that it attracted made it difficult for her to find friends and a sense of belonging in the department, which can attribute to the dominant priorities and values that CS students have, which is more concerned with technical aptitude, accumulating skills, and work experience rather than orienting the focus on how CS socially impacts various communities, and emphasizing ethical practices.

Within the student and faculty interview responses, there are salient differences between the students' experience within the department and faculty's departmental and curricular intentions as summarized in Table 1. While there could be other undetermined factors that contribute to the inconsistency between the student and faculty responses regarding the department, it is still important to think through some reasons why this may be the case. The first of which may be how the faculty members, like Faculty A and B who push these values within the department, may be an underrepresented group within the department, where the students have not had many interactions with these kinds of faculty. Second, the general implementation of social and ethically conscious curricula may not have been adequately and robustly implemented, leaving a scant impression to the students who may not be able to recall these experiences. Third, these dissonances can be attributed to a need for more candid, transparent communication between students and faculty, especially from the voices of marginalized students. These are all considerations which I hope to expand on in the following section.

Table 1: Student interviewee vs Faculty perceptions concerning topics/issues related to the department

Topic/Issue	Students interviewee's Perception/Experience	Faculty Perception
Coursework relevance to post-graduate CS work	Not very relevant	Part of the departments goals, however balancing with theoretical foundations
Teaching methods	Most courses are several weeks lab assignments situated within an abstract environment/scenario. Not enough socially-contextualized projects	Faculty interviewees claim their courses focus on project-based socially-conscious teaching practices, but cannot say about all faculty
Prominence of socially and ethically conscious curricula	Not very prominent	Faculty interviewees stated that they implemented them into their application courses
Efficacy of DEI support	Student A: never felt belonging because of the culture of the department Both students faced discrimination in lab partnerships	Both faculty interviewees mentioned how DEI is a goal and value that is highly prioritized in the department

This leads to other limitations of DEI initiatives within a discipline, in both academic and industry environments, that operates under structures of power primarily composed of white, cis men who also occupy the highest levels of power. Due to the dominant demographic of the CS faculty being white men, there are concerns on how departmental action and pedagogical conversations surrounding societal inequities occur. Furthermore, in Swarthmore College's 2021 alumnus Miryam Ramirez Velazquez's Computer Science and Educational Studies thesis, "Not Just Teaching How: Supporting a Culture Shift in STEM Education", her research highlighted the lack of faculty preparation in critically reflecting on the purpose and efficacy of their pedagogical content and teaching methods.

> "In all of my interviews the professors mentioned that there was little to no explicit conversation about what it means to teach and how teaching goes beyond just transmitting content to students… the faculty pointed towards feeling underprepared in the social aspects that came with teaching such as adjusting their classes for the different

backgrounds of all students and social justice issues pertaining to STEM. These are issues that they have had to learn to deal with through their experiences as professors." (Velazquez, 2021, p. 22-23).

Another DEI issue that Student A highlighted was how navigating structures of power within post-grad CS work was something that she had to learn herself, and wished that her CS education could have prepared her for. These are considerations that may have been difficult for the department to realize themselves, and it may not be erroneous to assume that many of the faculty did not have to navigate hierarchies of power in similar ways that Student A had to. There are also considerations of mental wellness, especially for underrepresented students who bear other sources of stress, burnout, and even sometimes trauma, of sustaining themselves within an environment where they face the implications of their marginality. These concerns that aren't necessarily suited to be addressed in classes, they nevertheless should be discussed by way of departmental events like panel discussions or other events, which was something that Student A mentioned.

Finally, there exists a troubling paradigm of how DEI initiatives often require marginalized constituents, in this context marginalized CS faculty and students, to bear the majority of the responsibility of bringing DEI issues and initiatives into the limelight and also in implementing them. While DEI initiatives should always be informed of the experiences of its marginalized constituents, another issue arises when they are brought to higher levels of responsibility and labor to spearhead them, often which is never directly compensated for. Both faculty interviewees are part of an underrepresented group within CS and also are some of the faculty who directly are working on DEI related issues. And it has also been stated within their interviews that some faculty, particularly the older faculty members, are more reluctant to change

their courses for the needs of DEI initiatives. This draws attention to how the members of the

department as a whole are equally responsible in upholding the tenets of its departmental and

institutional goals, and how the distribution of labor must be consciously considered within

conversations and developments of DEI-centered work.

Recommendations and Next Steps

<u>Short Term Recommendations</u>

While individual faculty have been developing their own methods of bringing social issues and ethics into their curriculum, it is important to discern the short-term and long-term strategies and goals of integrating socially and ethically conscious pedagogy into the department. The short-term recommendations following the information obtained from the literature review and the interviews are outlined as follows:

1. Developing ways to streamline different ongoing initiatives and while bringing in the entire department faculty in the discussion concerning its efficacy and goals
    a. how to allocate time and bandwidth for this conversation
    b. How to discern and come to consensus on approaches and goals
    c. How to ensure conversations are productive
2. Discerning objectives and measuring efficacy within social/ethic curricula
    a. Explicitly discern criterias of socially and ethically conscious pedagogies
    b. Implement review processes and outcome assessments to gauge efficacy
3. Making sure of transparent communication across faculty members and the student population of ongoing initiatives and future expectations related to DEI and social and ethics conscious curricula

The systemization of the DEI work

The first recommendation stems from the responses of the faculty interviews, where there currently exists various social and ethical curricular initiatives from some of the individual faculty, but there haven't been thorough departmental conversations that bring in all of the faculty members into the discussion, which is something that Faculty B noted as wanting more of. As shown above, there are three aspects to the systemization of this work to account for: 1) finding appropriate time and bandwidth to have routinely conversations, and within the conversations 2) making sure to come to a consensus of the current approaches and goals of these initiatives that include all faculty input and engagement and 3) ensuring that these

conversations yield tangible outcomes. I argue that this would address some of the challenges that the professor interviews highlighted. In having all department members be aware of the importance of social and ethic based curricula and be informed of the attributes and shortcomings of current initiatives, all faculty could contribute to thinking through provisions and implementation strategies, leveling the distribution of work so it does not fall upon a few faculty. For instance, this could look like allocating some of the weekly departmental meetings to highlight current initiatives, identify objectives, future goals, and strategies in assessing effectiveness, and talk through each of the faculty's roles and responsibilities.

Discerning objectives and measuring efficacy

To discern what and how much socially and ethically conscious pedagogy to include requires several steps: 1) distinguish what current aspects of the curriculum are important to maintain, and 2) create a guideline/protocol for developing course-specific criterias, review processes, and outcome assessments for socially and ethically conscious pedagogy. A fully, robust implementation to the aforementioned objectives are long-term goals, but conversations around what that could concretely look like and strategies on how it can be achieved is something that could be done starting now. The following outlines recommendations on what to consider for the aforementioned components of the guidelines:

Recommendations on how to allocate space for social and ethically conscious components into a existing curriculum:

1. A student end-of-course survey inquiring:
    a. What concepts/practices students retained the most (low retention rates can also indicate whether there are too many concepts covered in the course that could be overwhelming)
    b. Relatedly, what concepts/practices students found importance in
    c. What concepts were less significance/did not retain as much

2. Reevaluation of course objectives and goals (and utilizing input of other faculty members), informed by broader/future impact and importance, and its ties to departmental and institutional goals:
   a. Thinking through what concepts/goals could be less emphasized or condensed
   b. Restructuring the course (e.g. concept chronology, concept grouping, methods/lab assignments) to suit the new objectives of the course
   c. Rethinking course assessment standards and criteria

Recommendations on course-specific criteria (recommended that it be explicitly stated on the course syllabus):

1. Integration of experimental, dialogue-based teaching/learning practices:
   a. Examine students' own identities in relation to underrepresented social and cultural groups
   b. Examine how social contexts influence knowledge construction and whose knowledge is seen as legitimate
   c. Explore and understand systems of inequality, discrimination and prejudice amongst marginalized populations that are perpetuated by computational technology:
      - Emphasis on the *structures* of inequality in discerning how they are reinforced
      - Emphasis on viewing through multiple lenses, perspectives, ideologies
2. Integration of computation and project-based learning and constructing principles, procedures, and strategies for:
   a. Practices of ethical and unbiased construction of code (e.g. how to work with societal data in ethical ways, in project-based work: methods identifying a societal inequality and strategies on how a project address a certain societal issue)
   b. discern underlying assumptions of epistemologies, values, and motivations of computational applications
   c. prognosticate the usages and the wider ramifications of its applications on a epistemic and social level, including whether it does or does not align with hegemonic ideologies, functionalities, and apparatuses

Recommendations on review processes and outcome assessments:

Review processes and outcome assessments are methods on how to gauge the efficacy of these implementations, of which would optimally discern what solutions and practices are best suited for the department.

Outcome assessments:
1. Student survey form to be conducted at the midpoint and end of the course inquiring:

      a. Identifying salient components of socially and ethically conscious CS curricula that students found importance

      b. Asking how well the overall curriculum links social and ethics oriented engagement to the technical components

2. How well the discourses, considerations and insights developed by current critical scholars of technology are being conveyed within the curriculum

3. Contextualizing efficacy by comparing it with assessments of other CS application courses

4. In embodying DEI values, have particular consideration to the feedback of marginalized students and faculty

Review processes:

1. Have routinely department-wide conversations where faculty share experiences teaching the course throughout the semester comparing student reception, challenges and successes

2. At the end of the academic term, assembling all results from outcome assessments, and having a department wide conversion outlining goals for the next term and what to continue with and change from this year implementation for the following   year.

Importance of transparency and direct communication across department constituents

Within the interviews, both Student A and Faculty B expressed the need for more transparency and communication across the entire department – including communication across different faculty and to the students – about DEI goals of the department, what initiatives are ongoing, and future plans. This includes being transparent about hiring more CS faculty (especially BIPOC faculty), short-term and long-term goals and implementations regarding socially and ethically conscious curricula. For example, in light of lab partnership discriminatory experiences, outlining in the syllabus and talking to the class at the beginning of the course on the importance of respectful and equitable lab partnerships, and how the faculty will approach a situation where a student is affected by discrimination.

<u>Long-term Recommendations</u>

The long-term recommendations are difficult to discern specifically, but are informative to how the department can evolve to be more diverse and inclusive – in both the demographics of the department and its curricula:

- More project-based (of groups of 3+) computational application that situates itself in a social context. Examples:
  - Partnering with a community organization and providing a resource/service by way of a project
  - Students addressing and exploring a social issue and constructing a project that tackles this issue
- Within weekly/bi-monthly lab assignments, emphasis in exploring implementation strategies/practices that does not perpetuate algorithmic bias and is based on a social issue
- More CS work industry events/talks concerning real-life applications of computations and more events/talks that bring in critical scholars of technology
- More cross-disciplinary courses that collaborates with faculty from other departments that thinks through an intersecting aspect of technology
- More BIPOC faculty in the department
- Having a critical technologist scholar in the institution (this does not necessarily need to be housed in the CS department… other potential departments include sociology/anthropology, philosophy, history, gender/sexualities department)
- Reinstating the senior exit survey
- Collaborating with other peer-institutions (e.g. tri-co institutions) to leverage their resources and input within the greater movement of having STEM be more inclusive and interdisciplinary.

Reflections and Conclusions

I conclude this thesis with general reflections on my research experience and a shared optimism that the culture and curricula norms within the CS department, and STEM disciplines in general, can embrace the transformative attributes of centering a diversity of frameworks, voices and constituents within its learning. On a personal level, this thesis was the culmination of engaging with these kinds of inquiries and challenges across various mediums throughout my four years within the CS department. Upon the conclusion of my research, I hold various emotions together. I am deeply saddened by the students' experience of discrimination and marginalization within CS classrooms and workplaces, indicating that the general culture of CS still has long ways to go in ensuring an equitable and inclusive space for marginalized Computer Scientists. I also hold deep gratitude for the faculty members who share my values of socially and ethically conscious CS pedagogy, continue to work towards ensuring those curricula remain upheld within CS learning spaces, and strive to create welcoming environments for BIPOC and gender minority students, despite the challenges and pushback they can face all while managing all other faculty obligations and duties. I end with a grounded optimism that the CS department, and the field of CS education in general, can evolve in ways that contribute to the empowerment of marginalized students and uplift the validity of their experiences and insights.

I hope that my thesis can be utilized to inform CS faculty of different considerations and strategies in ensuring a diversity of frameworks, constituents, and student demographics within the field of CS – all of which can imbue the discipline with a more nuanced and profound meaning. With the recent passing of one of the most influential contemporary philosopher and

historian of science, Ian Hacking, I would like to end with a quote from him about the

transformative orientation of the power of knowledge:

> "What are the relationships between power and knowledge? There are two bad, short answers: 1. Knowledge provides an instrument that those in power can wield for their own ends. 2. A new body of knowledge brings into being a new class of people or institutions that can exercise a new kind of power." (Hacking, 1981)

References

Apple, Michael. (2018). Critical curriculum studies and the concrete problems of curriculum

      policy and practice. *Journal of Curriculum Studies.* 50. 1-6.

      10.1080/00220272.2018.1537373.

Baynton, D. (2001). Disability and the justification of inequality in American history. In P.K.

      Longmore & L. Umansky (eds.), *The new disability history*. New York, NY: New York

      University Press. Retrieved May 1, 2023 from

https://socialwelfare.library.vcu.edu/woman-suffrage/disability-justification-inequality-american-

history

Beer, D. (2016). The social power of algorithms. In Information, *Communication & Society* (Vol.

      20, Issue 1, pp. 1–13). Informa UK Limited.

      https://doi.org/10.1080/1369118x.2016.1216147

Bruce, K. B., Cupper, R. D., & Drysdale, R. L. (2001). A history of the Liberal Arts Computer

      Science Consortium and its model curricula. *ACM Transactions on Computing*

      Education, 2(3), 1–11. https://doi.org/10.1145/1731041.1731044

Chilisa, B. (2012). *Indigenous research methodologies*. SAGE Publications.

Course Major .Program: Computer Science - Swarthmore College - Acalog ACMS™. (n.d.).

Retrieved May 1, 2023, from

https://catalog.swarthmore.edu/preview_program.php?catoid=7&poid=259#CourseMajor

Dee, J. R. (2016). Universities, teaching, and learning. In L. Leišytė & U. Wilkesmann (Eds.),

Organizing academic work in higher education: Teaching, learning and identities (pp.

13–32). Routledge.

Faculty & Staff. Computer Science :: Swarthmore College. (2022, October 13). Retrieved May 4,

2023, from https://www.swarthmore.edu/computer-science/faculty-staff

Freire, P. (1970). Pedagogy of the Oppressed. New York: Seabury Press.

Garibay, Juan. (2015). STEM Students' Social Agency and Views on Working for Social Change:

Are STEM Disciplines Developing Socially and Civically Responsible Students?.

Journal of Research in Science Teaching. 52. 10.1002/tea.21203.

Gibbs, N. and Tucker, A., "A Model Curriculum for a Liberal Arts Degree in Computer

Science," *Communications of the ACM* (29, 3) March, 1986, pp 202-210

http://dl.acm.org/citation.cfm?id=5667.

Goodstein, L. (1994a). Achieving a multicultural curriculum: Conceptual, pedagogical, and

    structural issues. *The Journal of General Education*, 43(2), 102–116.

    https://www.jstor.org/ stable/27797217

Goodstein, L. (1994b). The failure of curriculum transformation at a major public university:

    When "diversity" equals "variety." *NWSA Journal*, 6(1), 82–102. https://www.jstor.org/

    stable/4316310

Hacking, I. (1981, May 14). *The archaeology of Foucault*. The New York Review .

    https://www.nybooks.com/articles/1981/05/14/the-archaeology-of-foucault/

Humphreys, D. (1997). *General education and American commitment: A national report on

    diversity courses and requirements*. Association of American Colleges and Universities.

Jeske, J. (2002). Nurturing rich general education courses. *The Journal of General Education*, 51

    (2), 103–114. https://doi.org/10.1353/jge.2002.0010

Kezar, A., & Eckel, P. D. (2002). The Effect of Institutional Culture on Change Strategies in

    Higher Education: Universal Principles or Culturally Responsive Concepts? *The Journal

    of Higher Education*, 73(4), 435–460. http://www.jstor.org/stable/1558422

Kim, A., & Tripathee, S. (2021, May 21). *Course Description and Goals*. CS 16: Critical Theory

of Technology — Fall 2021. Retrieved May 3, 2023, from

https://www.cs.swarthmore.edu/courses/CS16/F21/

Labov, J. B. (2006). National and state standards in science and their potential influence on

undergraduate science education. *CBE Life Sciences Education*, 5(3), 204–209.

LACS, "A 2007 Model Curriculum for a Liberal Arts Degree in Computer Science," *ACM*

Journal of Educational Resources in Computing (7, 2) June 2007

http://dl.acm.org/citation.cfm?id=1240202

Nittle, N. (2023, April 3). *Florida bill would bring bans on gender studies and Critical Race*

Theory to colleges and Universities. The 19th. Retrieved May 1, 2023, from

https://19thnews.org/2023/04/florida-house-bill-999-higher-education-race-gender/

McRuer, R. (2004). Composing Bodies; or, De-Composition: Queer Theory, Disability Studies,

and Alternative Corporealities. JAC, 24(1), 47–78. http://www.jstor.org/stable/20866612

Miller, R. A., & Holliday-Millard, P. (2021). Debating Diversity and Social Justice Curricular

Requirements: How Organizational Culture at a Liberal Arts College Informed the

Change Process. In *The Journal of Higher Education* (Vol. 92, Issue 7, pp. 1085–1108).

Informa UK Limited. https://doi.org/10.1080/00221546.2021.1912553

Mission. Meet Swarthmore :: Swarthmore College. (2023, March 16). Retrieved April 30, 2023, from https://www.swarthmore.edu/meet-swarthmore/mission

Muller, J. (2015). The future of knowledge and skills in science and technology higher education. *Higher Education*, 70(3), 409–416. http://www.jstor.org/stable/43648878

Pukshanskii , B. Y. (2016). On the role of enlightenment in the modern education. *Journal of Mining Institute*, 221, 766. https://doi.org/10.18454/pmi.2016.5.766

Velazquez, M. R. (2021). *Not Just Teaching How: Supporting a Culture Shift in STEM Education* [Undergraduate thesis, Swarthmore College] Institutional Scholarship http://hdl.handle.net/10066/23046

Vreeland, R., & Bidwell, C. E. (1966). Classifying university departments: An approach to the analysis of their effects upon undergraduates' values and attitudes. *Sociology of Education*, 39, 237–254.

Walker, H. and Schneider, M., "A Revised Model Curriculum for a Liberal Arts Degree in Computer Science," *Communications of the ACM* (39, 12) December, 1996, pp 85-95 http://dl.acm.org/citation.cfm?id=240502.

Why liberal arts? Meet Swarthmore :: Swarthmore College. (2022, February 28). Retrieved April 30, 2023, from https://www.swarthmore.edu/meet-swarthmore/why-liberal-arts

Appendix: Interview Transcripts

Appendix A: Student A Interview Transcript

AK: My first question is how did your experience as a computer science major at Swarthmore shaped your post-graduate work you pursued, and how you approached your post-graduate work.

Student A: Yeah, I think I have a unique circumstance where the postgrad work I'm doing right now was something I started doing while I was at Swarthmore. So it wasn't at the end of my Swarthmore CS major that I pursued this. But I think in terms of how I approach my post-grad work, and why I chose it and the CS major influence on it, I think honestly, Swarthmore in particular, did not have that much of a big influence on me choosing the work I did, even though technically it is a technical position. I think it was more due to experience I had outside of Swarthmore, different internships, different, other experiences that I came to figure out what I wanted or what I didn't want. And so, and I think what I prioritized most in my post-work experience was the people I worked with rather than what I did, at least for now. And that was all due to previous work experience. I will say that I think in terms of how I approach my work, I do think that Swarthmore, or the CS department had a little bit of a….. so i'm having… it's hard for me to differentiate this CS Department and its impact on me versus my experience as a CS student in Swarthmore, because I think I got a lot out of other stuff I did with it's Swarthmore as a CS major, which includes tech for social good, and the course that we co-taught, and conversations and stuff we had outside of the department, rather than specifically classes I took, for example. Yeah, I think if I were to specify what classes in the CS department taught me would be maybe to prioritize collaboration and to seek that out. But in terms of other stuff that I looked for in postgrad work, which was viewing tech through a critical lens, or having, a lens of inclusivity, and that was, I would say, not necessarily just because of the CS Department.

AK: Gotcha. Yeah, thank you so much for your answer. And I think you're hitting on points that I'm actually gonna ask more explicitly about extracurricular work, because you bring up a really good point about how it's hard to discern your know your experience as a CS in general, and trying to discern, what the particular influence of the department had and it's staff, faculty, and courses, etc. But if you don't mind describing just very generally, what work that you do just, or maybe just yeah, a very general description again, no identifying information will be addressed in the thesis, but I think it would be nice to help contextualize.

Student A: So currently, I'm working for [company name redacted]. But it's a company that polls youth, young people specifically, and the work I'm doing within it is that I am the Web Development Director. So I direct the technical team in all of its projects and different rules and responsibilities. So a lot of it is honestly just managing people and helping people with other technical stuff with their roles and responsibilities as well as, leading bigger objects as well. Yeah. But I honestly, I will say it as well, currently, I am thinking about leaving my work and leaving tech work as well as a whole. I've been applying for jobs in urban, environmental, farm work and education work and I think some of that is because I'm obviously excited by it. But I think there's also been a push away from the tech sphere just based off of the environment that technical industry cultivates and prioritizing certain voices and pushing

certain voices away, and just the ways that thinking is cultivated is very differently than what I would want to be involved in, if that makes sense.

AK: Yeah, no, thank you so much for sharing. I mean, you bring up a really interesting point about people's experiences when they come to realize that the environment, the workplace environment, that a lot of times, technical or CS industries oftentimes cultivates something that, what I am hearing from you, doesn't necessarily align with your prioritizations or your values. Can you maybe, not specify it directly in the context of your job, but the general impressions that you think that those kinds of workplaces cultivates. And why it doesn't really align with the kinds of values or the work that you want to engage in?

Student A: Yeah, I mean honestly, I will say this isn't as it's not so specific to the work I'm doing right now. Because I think I'm pretty happy with what's happening here. It's just not that exciting, because I feel alone. I guess maybe this is connected. I think so, I did say I seeked out collaboration, and that was something I got CS at Swat. But I think the way that I've experienced CS work is that it isn't really conducive to collaborative work, or I hasn't been structured in that way. And so I feel a lot of different rules are very siloed out, and so that one person is responsible for something, and then, if they're not able to do it, then I don't know. It's very independent or individualistic and that's something that I have found across all the CS work I've done, which is just really disheartening. But I think other things that haven't aligned with my values is especially in the bigger companies I've worked for. I think it's a lot of the work that I was assigned to do, I had no agency over it. It was, I was told to do something, and I did it, and if I didn't do it, I did a bad job. So if I had any ideas of changing it, or different ways of trying to work towards this goal, I was rejected because that was not what my manager thought of, or that was just , I don't know, there's very little agency and it was very hierarchical. So those are things that I think was really discouraging. There's also , I had a really bad summer internship experience where I was very clearly discriminated against, and so that definitely didn't encourage me to stay there. Yeah. I think those are some examples if that makes sense.

AK: Yeah. Yeah, Thank you so much for sharing – a lot of very, very valid points. I feel I definitely resonate and definitely do value the sharing of your experiences, I think that's something that a lot of times, a lot of marginalized people within this industry, experience. And that is something that I really do want to highlight within, yeah, within my thesis work. Yeah. So I'm just gonna move on to the next question, which is very related, which is, what values would you say you uphold when approaching your work as a computer scientist? How has Swarthmore's education affected this positionality? And how has the CS Department in particular affected this positionality?

Student A: Yeah. I think especially right now, because I'm working, because I have a position of power in my work that I have, I feel a lot of responsibility to make sure that I'm strong in my values, and also I practice my values. So, I think some of which are… so all the things I said I didn't I try to move away from. So I think I try to encourage collaboration, I think I try to encourage agency and creativity. So these are all things that honestly, I will say Swarthmore helped to cultivate in some way or another. And specifically, I think the CS Department, I think it's really helpful that all of our labs were partner based labs, and I mean, I didn't take CS21 at Swat, so I don't know I and I know that maybe didn't include partners. So in my experience, all the classes I have ever taken at Swarthmore I worked with a partner and

I think that's something that not all other schools have done. And so I think its something I really valued because it moved away from the idea that CS can only be individualistic work. So I really appreciated that. I think in terms of having agency in the work that I did, I'm not too sure how much the CS Department encouraged or helped with. Just because I don't know, they're like everyone has to do these labs, and there's…if the lab works, it works if it doesn't, it doesn't. Yeah, I'm not too sure about that. And then in terms of creativity, I think some classes that did good with that, because I think there are certain classes where you can choose your final project, and you could do something that aligned more with your passions or what you want to do. So I think that was really nice, too. Yeah.

AK: Yeah, that's really really great. I mean, I think that a lot of your responses seem to point out, I guess maybe the dissonance between the impressions that you have of what it means to work as a computer scientist through, you, your bachelor's education within the CS Department versus maybe the more, the realities of getting a job in the tech field after post-grad, and maybe not seeing as much experiences of collaboration or agency or creativity, that you experienced within your education at the CS Department here. I would want to ask how you grappled with that dissonance, and whether that was something that was shocking to you when you went into those kinds of real world tech jobs.

Student A: No, I think honestly going into these….because in my internships I didn't experience this. I was surprised. Because I think I , especially when I first started it, my first internship was after freshman year. And so it was as early as I could have done it within a college setting. And I felt there was a dissonance between what I heard from other, I don't know which is what I just heard out there from, I guess mainly from these companies, who are just advertised interns having such a big impact on their company, and having such a big role. And therefore I would think that they would have agency… it indicates that they would have all these values. So when I realized that the impact the interns just made was doing a lot of busy work, or just work that needed to be done, that someone just told you to do and not really work that the interns wanted to do, it was really disappointing. And I think this is similar to Swat in that both these institutions, a lot of…so I worked for [company name redacted]. And so, while I was at [company name redacted], there was a lot of clubs that were founded and those so there was, interns for accessibility, interns of whatever whatever, all these different … I mean, there's a cooking club, it's a big range of stuff, and there were interns that hosted events, hosted speaker panels, and really cool, important work and discussions, but they were all outside of the work experience, and I think it's similar to what Swat that I think there's a lot of cool impact-driven work done that's Swarthmore by the students also, but it's all outside the classroom setting. So I don't know, I thought it was really interesting that…and then [company name redacted] would then advertise as :look at our interns in all these cool things", was not because they helped these interns do these cool things. It's just they, the interns, did them despite of also having to work, and on their own hours, and without compensation, or encouragement. And so, I don't know, I think that was interesting. But after I realized that there's a big disconnect of what I expected my experience to be versus what actually happened, I think that I just was like, "Okay I can't do that anymore or I think I realized I just can't". For a while, I thought maybe, that I would be able to change… if I had a different team, if I had a different manager, maybe I would be able to convince them, but it's just such an integrated web of hierarchy. It's just very, very hard to make any sort of change unless you've worked there for decades. And after that I just realized that that's not space I can uphold these values that I treasure because they don't respect these values, and therefore they don't respect me.

AK: No, that's awful. But I appreciate you sharing all this, just especially because I haven't had any experience with a lot of more technical or CS industry jobs. And so this insight is something that I actually really didn't know too much about. And yeah it is something that I feel…it seems to me, it's, it's definitely a bad thing to basically have the CS department…maybe curate particular kinds of values and expectations of what good CS work looks within the department, and I'm not saying that those values or expectations are bad, I think that it's good to encourage creativity and collaboration and agency. But I feel like there also seems to be an issue where perhaps the students that graduate from the department and enter into I maybe these well sought after big tech job roles oftentimes, then have to maybe confront a different reality of what their work is going to look like. And I guess to me, I'm wondering how the CS Department can grapple with some of those kinds of issues. I think these are issues because it's not the CS Department needs to particularly change the way they do things. I think the way that maybe the way they allow students to engage with computer science is something that is done in a productive and collaborative, and inclusive way. But I feel there also needs to be said that, maybe not a lot of real life tech jobs aren't really this. Just especially when, I don't know, in the CS Department missions a lot of times prioritizes… that they want students to be prepared for any work that they encounter after they graduate from the department here, and perhaps things like social environment and navigating structures of power within, industry or big work settings is something that maybe should warrant more conversation about, and especially, I think this is important for a lot of minority students within CS who, I feel often get the brunt of a lot of these kinds of shocks. Right? Yeah, I'm sorry. I'm just spitballing. But that's what I'm thinking right now.

Student A: I think that's a great thought. And I think that honestly, would be a great start of making students at least be aware of what they might be entering….because it was a big shock, and I think it's pretty, we actually talk about structures of power a lot. Actually, we don't in the CS Department. We don't talk about structures of power in the CS Department. We do in other classes at Swat, but I think that's something that would be really important to talk about in the CS department, because I think it's so apparent when you enter a technical job. It's so structured that it's really hard to not even see it and not face the consequences of it. And I think talking about it would be a great first step of being aware of it, and then trying to realize, how can we grapple with it? How can we, whatever, do whatever we need to with it? The students.

AK: Yeah, I definitely agree. And yeah, maybe just a quick follow up question… Just maybe talking about you articulating a lot of your experiences within and outside of Swarthmore, your dissonance between your experience working with CS work at Swarthmore versus the more real life jobs that you enter and the values that uphold as a computer scientist….How would you say that your self identities played a role into the way that you experience things and the values that you uphold, or the insights that you have now?

Student A: Yeah, I mean, I think, honestly, I will say, even within the CS department, because of my identity as a woman and definitely a woman of color. I had some pretty bad CS partnerships because of it where I was with male students who disrespected me, did not listen to me, did not value my input as valued work for the labs or assignments, and I think that definitely in a weird way, made me more passionate about collaboration, because I think it is important to have respectful and proper collaboration, because if you do, it's great, and I think it is so much better than just trying to work alone or fight against

someone you're trying to work with. So I think those identities definitely within Swarthmore CS department made me, yeah, more passionate about collaboration. And I think with outside of the CS Department, it became all too clear, just because I think in honestly, in all of my work experiences, including now, I only work with men, which is.which is fine, but, *laughs*

AK: I didn't want to say anything but dang, that is horrifying.

Student A: Actually, actually, it's if I actually think about it it's absolutely terrifying to think about.Yeah, and I think it's just, pretty disheartening to feel very different all the time and I don't know I think especially within my internships I've had, I have felt a big power imbalance because of the ways that people act because of their identities, and the way that I'm expected to act because of my identities. And so I think that's made it harder for me to exist in these spaces, and harder for me to uphold my values because everything's just harder.

AK: Yeah. Thank you again for sharing.Yeah, it's one of those things I feel it's unsurprising, but I feel the very fact that it's unsurprising shouldn't take away from the fact that this is such a serious issue. Right, that is truly I just feel… we have, it's such a and maybe I should I should carefully use my words here, but it feels such a hot topic, or trend to really push diversity and equity in CS, for STEM in general right? But I feel a lot of times the real life experiences that marginalize people face a lot of times comes from the actual fundamental structures of the systems that are in place within the industry right? and it's one of those things that can't be quickly ameliorated or solved through a nice little DEI program to welcome in people right? And I feel your experience reminded me of those kinds of more pertinent issues that really can't just be completely, just… "okay, we're done with that" just through…those kinds of superficial gestures without actually, radically changing the structure of the system and the nature of it. Right?

Student A: I guess I haven't talked about queerness and disability, And how that impacts because I think, I mean lets see, let's talk about queerness first. So I guess, two summers ago, when I still at [company name redacted], it was during pride I had the bisexual flag on my background, virtual background, and I remember a worker, a teammate on my team was "oh, I like your background". I was like, "oh, that's great!" I later was talking to him and he told me, and he's someone who's been in the team for a couple of years now. And he told me that he was gay, and that he just got married to his husband and I was like, that's great. And then, but he also was like, "I haven't told any of the team that I just got married, because I feel I wouldn't be accepted". And it's just… I don't know it's such a big part of your life that you feel you can't share with the people you see every single day for hours and hours. And it's just, I don't know. It just creates an environment of hostility, of lack of acceptance. And I think, I don't know, isn't fun to be in that kind of workplace environment. But I think, because I was thinking about disability, and I think, I honestly don't talk to my work colleagues or employers about disability, because I'm scared of the consequences of it. Because I think disability has to do with a direct link to production, or what is valued in the workplace. I've been lucky that I work part time, so I can just get away with taking rest when I need to, and not having to declare that. But I feel if I start working full time, I think it would change the way that my employers perceive me and my value to the team, and therefore I don't know. Yeah. But also I will say that I think being disabled, I think I encourage a much healthier work relationship to my employees, which is really nice and I hope that they appreciate it. But I try to put less value on production as a metric of value or anything, which has been nice.

AK: Yeah, thank you so much for sharing and and for covering those kinds of two aspects of their identity, which I feel are so important, and I feel people who share those identities can also feel a very similar marginalization or stigmatization, even if there are maybe, legal grounds to be protected from discrimination, those kinds of jurisprudence only really goes so far, and that, there's still is of many different levels of stigmatization, sense of belonging sense of agency, to be able to, to have a healthy relationship with the work that you do. And it reminds me, particularly with the context of disability, and you make a really great point, and I agree with that, oftentimes ideas of ability, is so much predicated on productivity, and that I feel like because the nature of most tech industries are basically based off of inventing novel things where you always push new things, you always have to make new things right. I feel those kinds of metrics of productivity and efficiency, because their objective is to push more new things, and create more things within the context of neoliberal capitalism, etc, it seems the very nature of the work that the CS industry pushes can a lot of times be incredibly ableist right, or at least upholds, ableist standards of productivity and efficiency. Right? And I don't know. I'm not really sure if that's an inherent nature of what the industry is, and what it demands. I don't know, just because I think that because I wouldn't even say that all the things that are pushing in novel ways and creating new stuff aren't really inherently good by default, just because it's new and novel, right? I don't know, I think maybe it's just because it's so intricately related to capitalism that this is just the way that things are, but it definitely feels these are kinds of workplaces where values really don't necessarily align and I guess, prioritize the needs, and also the values that disabled members of computer science just brings the table in general. Right? Yeah. Well, that's said, I'm going to move on to the next questions. And this is actually something that you touched upon earlier, when you're talking about the extracurriculars that you did, but I wanted to ask you, have you formally and/or informally studied disciplines other than computer science. And did you participate in any salient extracurriculars during your undergraduate?

Student A: Yeah, I guess so formally, I also majored in Environmental Studies. So that took up technically as much time as computer science did in my life. I think extracurricularly, I did tech for socially good from freshman year to basically Junior year. And then through that I met you out, Alison, and then we both [were part of] Critical Theory of Technology together which is another big I guess I wouldn't really say it was an extracurricular, but I guess, technically yeah, which was honestly a highlight of Swarthmore for me.

AK: Me, too, I feel it was just such a good opportunity to be able to share that experience with you, and it's one of those things where I feel e both had very strong want to to be able to do something this, because we believe in the the importance of bringing these conversations to the table. Yeah, that's really great and yeah, I would say that your other discipline as an Environmental Science major and your work through tech for social good or the initiative of the student-led course, has that shaped how you choose to engage with computer science and the values that you uphold? Tying your Swarthmore experience together, how does that help you reorient who you are as a computer scientist?

Student A: Yeah, I mean honestly it very drastically changed or informed who I was as a computer scientist. I think, through tech for social good and the student-led course, I definitely started viewing CS through many, many more lenses, and specifically a critical one, and then became aware of its impacts and uses outside of what we were taught in the curriculum in CS. Because I think I mean, we really

weren't taught about any impacts of CS on anyone really in my classes that I took. So I think this was a great way of both having really important discussions about technology as well as also, I think, through Tech for Social Good, I was able to meet other people who are also interested in using computer science in different ways and specifically trying to expand what CS was within Swarthmore to something else. And I think for environmental studies, I had to take so many more classes, more humanities-based courses that I think then filled in other parts that I could then apply to CS. So I don't know, I took so many classes that I enjoyed. I took eco-feminisms, where I learned how ecology and feminism is related, and therefore how that could be extrapolated to almost anything as well. I took Plants and People which focused on connection to the earth as a way of connection to self, and how that is important in seeing how technology and other parts of your life, is connected to self and others and stuff that. So I don't know. I think it played a pretty big role in the way that I view computer science and who I am, in that regards.

AK: Yeah, and it also just seems your academic interest or disciplines reach across NSE and social science and humanities spectrums, and I have an impression that also allowed you to find the importance of interdisciplinary thinking, or to be able to grapple with two different kinds of fields of thought and seeing the relationship between those and and why that is so important in this world. Yeah that's really wonderful. And yeah, and this follow up question is going to be a question that I asked for all 3 kinds of key questions, which is: how would you say that, your identity and/or values, played a role within your academic pursuits as an environmental science major, or the things that you found resonant within your courses that you took or your general what extracurricular and intellectual interests, if at all?

Student A: Yeah, I mean, honestly, I would say one thing I really do like about the Environmental Studies Department was how we integrated conversations about race, class, gender, ability in almost every class I took within it, and I think, those are all identities that inform who I am, how I live in this world, and I think are so important to talk about all the time, because they affect everyone, everything…at least now in the society that we live in. And I yeah, I think I was drawn to environmental classes because of that. And then, I think having Tech for social good and the student-led course was having other avenues to explore those conversations as well within this other massive interest of mine, CS, that I was not really having within the classes that I was taking.

AK: Yeah, that's really wonderful. Okay, so now it's the final set of questions. And this is more about reflecting on your experience within the computer science department at Swarthmore, but also reflecting, particularly in ways in which if you would have liked to see something, that is not present within the department that you'd have liked seen that would have maybe benefited your general experiences there, and your preparation for post-grad work. And so I'm just gonna go through each subsection that talks about various aspects of the department. And so the first one is the pedagogical content. So yeah, I want to ask, Is there pedagogical content that you wish had been part of your CS experience at Swarthmore?

Student A: Yeah, I mean, I think I mean broadly, as I said earlier about not having any race, class, gender based plus more based conversations and integrations within CS was the lack of interdisciplinary anything within CS was something that I missed a lot, and I think that content would be really really beneficial within all classes. Because I think…Yeah, because I don't think it'd be worth it to have one class that focuses on how tech intersects with everything else and have that as a requirement because then I think it's pretty easy for students to be "Ok I'll take this one class, and this is all that matters, and then

everything else I do in CS Doesn't apply." So I think, if it was to be integrated within every single class, that's what would be great. And honestly. I don't think it'd be too hard. I mean, obviously it's hard, it's easy for me to say that not as a professor, not knowing the bureaucratic processes behind it, changing curriculum, and adding more things to it. But I mean that's something that definitely would be helpful. I think encouraging… it would have been helpful to have cross-disciplinary classes, so if there is some cross-listed classes between CS and any other department…I don't know. I think that would be really interesting and it would have been really cool, but we really had none of it — they even took away the engineering cross-listed classes with CS. I think Yeah. I think those are the couple of things that come to mind.

AK: Yeah, yeah, that's really wonderful. Yeah. And then I wanted to follow that up with more in terms of the teaching methods that maybe you thought would have been beneficial that is different from the straight up, curriculum, or the knowledge that they were encouraging on to the students, but do you think that they're could have been teaching methods that you would have liked to see integrated if that were beneficial to you as a student while you were there and or beneficial after graduating.

Student A: I think one thing that could have been nice was to integrate outside speakers or guests to come in, and that could be just people who have more specific expertise on a certain subsection of a class or cool organizations that are doing cool tech work locally or.. that could be so variable right. But just having real life people come in with experiences would be really cool. I think that was something that was lacking. Yeah, I mean, this might be hard to integrate, but having more student based discussions or just conversations… I know that was kind of attempted in some classes I think, with varying success levels depending on students, or depending on the class or the way it was structured, but yeah, more student-based discussions would also been cool.

AK: Yeah, Thank you. Thank you for sharing. And then I'm just going to lead into the next aspect which is just more about departmental infrastructure. So maybe reflecting on the major requirements that you had to partake in as a CS Major which are the CS 21, 35, 31, and then group 1 2 and 3 classes, and then 2 mathematics classes….like those kinds of aspects, or just reflecting on the kinds of courses that are offered in the department, and maybe things potentially – if you have anything in mind – that you wanted to see about different kinds of courses being offered that might have been beneficial for you as a computer scientist or maybe reflections on the ways in which the course major requirements were structured and stuff like that, if you had any opinions.

Student A: I mean, I'm sure this is a very cold take, but having more classes just be available for students, and not being lotteried out of classes. Because I think there are a couple of classes I took because I was forced to, because there were no other classes that were available that weren't full, so just being able to choose what classes I want to take would have been helpful. And I think that just means more faculty members, probably – which would be good for everyone. I think more faculty members would also mean more class variety, because I think that would be really cool, because I think it's pretty hard to come across a class that's not a standard CS course, because they're just not that many class available, so you can't take specialized courses towards anything. In terms of how you have to take 21, and then 31, 35, yeah, I'm not sure how they're other ways to structure this. I wonder if it would…I don't know. I think there definitely was an issue with the way that you made the higher level courses available

to only upperclassmen that students who are first interested in computer science can't get to it unless they take 2 years of CS basically. I think it discourages learning about computer science if you do it that way. Yeah. I think that's mostly it.

AK: Yeah. I actually wanted to come back to something that you said towards the very beginning of this interview, when I was talking about how Swarthmore's CS department could prepared you for the work that you're doing in postgrad, I think you remember you saying – and correct me if I am wrong – that you were saying that it was mostly through the internships that you had during your undergrad experience that was part of the work that you do now that was most helpful, which I think is something really interesting and salient to point out just because the mission and goals of the department is so that because so much of the education that you received through the CS Department is very theoretical and foundational, really honing in computer science an actual science, their rationale is that once you have a theoretical foundation for just a lot of different components of computer science, you should be equipped to be able to apply those kinds of knowledge to a field that is rapidly changing, and also is exponentially increasing in the kinds of specializations and subfields that they have and I'm seeing a dissonance between their ostensible goal and the experience that you, and other people might have in terms of how much the education in the CS Department has really prepared students for the actual work that they're going to be doing. Do you mind speaking a little bit on that?

Student A: Yeah, I think that is a great point. I think that having, or including, some sort of structured, I'm not sure if class is the right thing, or what avenue or form would best work for this, but having some sort of …because I was thinking specifically about having a bunch of martialized identities, and how that affected what I had to harshly learn from the real world, and was very unprepared for from because of Swarthmore… I think, having some way of having conversations about what it looks like. Well, I think talking about power structures, just talking about real world issues within the CS context and outside of the CS context would be very beneficial to integrate into the department. Because I think that's something regardless of what work you're doing within the CS field, whether it be research or tech industry, or anything else, I think these issues will definitely show up. And I think having a mentorship program, I'm not sure if that would be the best way of doing it. But just some way of having some sort of support both going out into the real world and facing these things, but also support beforehand to prepare would be really beneficial.

AK: Yeah, thank you so much for sharing. And I really do agree. I think maybe generally, the kinds of things that the department should implement… but I think the actual application is difficult because of the paradoxical nature of who is in these positions to be having, and, constructing and, moderating these conversations right? If we think of the Computer Science Department as mostly made up of cis, white men, I just feel those particular kinds of demographics just by nature, and they're great people.. just by nature aren't people that I feel should be leading these kinds of conversations. And I feel,maybe because you mentioned the idea of bringing in external kinds of guest speakers, or people that are very much involved in this work, I think, is something that I feel could definitely be something that I feel they should consider. Right, these conversations shouldn't be being directed by the hegemonic demographic, right? But I think that it also makes me think about, maybe, bandwidth of students' time and ability. I think that just because, the nature of Swarthmore, and the STEM Departments and CS departments in general are quite demanding, especially for marginalized students for a variety of reasons. A lot of times, we've been

talking a lot about changes and reforms we've been constructing as something additional to what is currently the status quo. And it's so hard… I don't know, there might be challenges actually having positive acceptances and a lot of robust in nature from the students about these conversations, if it is built on top of the current work that they're doing, and it makes me think that if we really want to forefront a lot of these issues, and we want to have values that really address these issues and support marginalized students, it seems there there has to be a more broader or wider scale reevaluation of the kinds of things that they want to forefront or the values that they push, just because I do think that those stuff is, is really hard to find a lot of engagement, and just because everybody so busy with the work that has more material consequences aka their grades and things like that. Yeah, what are your thoughts on that?

Student A: No I think one hundred present, it would not work if it was an additional thing you have to do, or an extracurricular, or anything for extra credit whatever. I think none of that would work because of all the things that you decide because it would just be increasing the burden. And I think that the point is to lessen the burden, if possible. Right, I think what's actually important is to shift these values to move away from right now it's prioritized, which is, I think…. I think the Swarthmore CS Department, really, and I'm not sure if I'm just making this up, or but I have a sense that what they value a lot is to make sure that students within the CS Department at Swat, at a liberal arts college, can be competitive with students at bigger schools that just have CS schools. And so I think there's a lot of CS department values geared towards making students competitive enough with these other students, which I think is just so silly. And I think that's all based off of grades and hard skills of what content you know, what classes you know about, rather than focusing on different values which are as important, if not more important, of software skills of, just being interdisciplinary or having different ways of thinking about technology, and all these other things that are also as important. So I think honestly what Swarthmore actually needs to do is change their mission and their values and their goals to shift away from being competitive in these very rigid ways of grades and certain weird metrics of how many CS students at Swarthmore get jobs at these companies, or whatever. I don't know how they're measuring this. But, instead, to be more about valuing different skills, and also valuing inclusion and prioritizing that, and making students feel proud of being CS students with more rather than being overworked and competitive.

AK: Yeah, I mean, I feel you brought in something that I did think about very directly, but I can very much see that…maybe because A) because a lot of these faculties have gotten undergraduate and graduate education from a lot of these kinds of big, R1, CS focused kinds of institutions. It really does mean, we are losing the identity of a liberal arts computer science department, right? Which, honestly, if honed in, can be such a huge attribute where this department can be really making an impact that you don't really see other R1 institutions doing or that because they're not equipped to do so because of the nature of how the institutions are structured. But yeah, it really does seem like they're really trying to mirror the kinds of institutions that are at the competing edge of CS education, right? But I feel that in turn, it undermines the very aspect that we are a liberal arts institution, and that there are different, but just as real attributes of receiving those kinds of education as well. And I feel that's what I was reminded of when you were talking about those things… And if you have a lot of times, it can be influenced with the fact that a lot of these professors didn't go to liberal arts schools, or they got their graduate school, at CMU or UCSD, institutions like that. And it also seems, graduate work that they do to obtain their PhD and to have the necessary credentials of a professor also doesn't allow them the opportunities to think about these kinds of conversations. And, if they're going to be going into a liberal arts college and teaching, what does that

really imply? How is that different from other research-based universities and the thing is is that, [student name redacted], for example, for her thesis, a huge part of it was talking about how a lot of times faculty just aren't equipped to have these kinds of conversations of integrating, social and ethically conscious curriculum that really uphold those liberal arts values. And so it's also just a matter of faculty preparation and their abilities to be able to successfully lead these kinds of conversations as well, just because it isn't something that is required to obtain a PhD. And so I feel there's also just a lot more nuances in terms of that as well, that I was just thinking of.

Student A: Yeah, I think that makes sense. And I think so then maybe it's like, what the CS Department needs to do? I'm sure they have faculty training, I'm sure they have that for those every so often. And I'm sure it's hard to quantify, and to train, and to prioritize certain values, but it's kind of not. There's certain things you can do to be like hey, these are our values, which are the values of the liberal arts college. How can we incorporate this in a CS department where things that we can make sure we do routinely to keep sure we're on track with this … or conversations we need to have with students or conversations we need to have with each other all the time, and so I think, incorporating that … I'm sure they can create a training or little checklist or things that they can make sure that they do every so often to remind themselves or to encourage what to make easier to facilitate these values if they wanted to.

AK: Yeah, yeah. I agree. Okay, just a couple of more questions. And this one is, I think it just very much explicitly touches on, how would you think you may have benefited from socially and ethically conscious pedagogy within CS education? So I think this is definitely not just within the confines of implications of biased algorithms and stuff, but also like you were mentioning about conversations about power and hierarchy within workplaces and industry, how to navigate those and how to navigate a lot of times the power imbalances that naturally exists within an environment that exist within a racist, misogynistic and ablelist society.

Student A: Yeah yeah, I'm trying to think about how… is it bad if I say there that there isn't anything within the CS Department that has, that I felt like…well, actually, let me think, can you ask me this question one more time, and then I'm going to try….

AK: Yeah, I am so sorry. Also, my questions start with the question and turn to more of a statement, so I apologize. It makes a lot of sense that it's hard to keep track of the question. But the question that I have on the paper is. as follows: how would you think you may have benefited from socially and ethically conscious pedagogy within your CS education?

Student A: So I'm obviously trying to think of in what ways has CS education at Swat used ethically, socially conscious pedagogical teachings or forms. Which honestly… the thing is… Yeah, I'm sure not remembering. I just feel there hasn't been a lot of that conversation honestly within the CS Department in the classes that I've taken and I think if there have, because I know that some classes that I took that maybe we would for a lab, there'd be one little snippet of "oh, AI can be used for these things, and can also be used for these things". That's it. I don't know, I just feel a lot of what I got out of ethically socially conscious lenses of CS was not within the curriculum within the department.

AK: Gotcha, and in the case where you experience a CS department that really did robustly integrate a lot of these conversations and in generative and productive ways, how do you think you might have benefited from that education?

Student A: Oh, I mean I'm sure honestly I think that it would have really, especially if I, if it was integrated from the very beginning of me entering the CS department, which I think it should be… right, I think every class should have that. So I think I wouldn't have gone or at least stayed at the internships that I did for that many years. I think I would have seeked out different avenues of computer science that I felt more aligned to, because I would have realized that they're out there, because we would have talked about it, and I think so I think pretty broad, real life consequences. And I think I probably would have engaged with computer science in a very different way, and I think I would have probably taken different classes and or different community engagement work and stuff like that.

AK: Yeah. Yeah, thank you so much. Yeah, that's really great. And then the last question is, the follow up question that I've been asking which is, yeah, kind of reflecting on the things that you wish have been implemented at the CS Department, how do you think that your identities or values shape those kinds of perspectives?

Student A: Yeah, I mean, I think my identity shapes all these perspectives very   clearly and strongly. I think that a lot of my needs that weren't met in the CS department was felt by me pretty strongly… I felt very strongly because of identities and because I… either I didn't feel included enough, or I just felt we weren't having important conversations that I was being impacted by and I saw other people being impacted by. Yeah, I mean, I don't know, I'm trying to think about specifically, if I can point to something. But yeah, I think, for example, I think trying to find an advisor, for example, in the CS Department, I specifically chose. I think. Yeah, my freshman adviser… I mean, I think there are so many visiting professor, so I think my freshman year advisor was a visiting professor who left after my freshman year, so that I had to find a new one, and it was [faculty name redacted], and she also then left for 2 years, for sabbatical, and then pregnancy. But I had a really good time with [faculty name redacted] because I felt I could…she's also a woman of color, and we could talk about certain things, we could also relate to certain things, we could also have conversations about identity in a way that felt more in depth than I could with [faculty name redacted], for example not to shame [faculty name redacted] but as an example, or just I feel more comfortable bringing up with [faculty name redacted]. But then she was gone, and then I couldn't find another advisor that I felt comfortable enough to have these conversations with. So I think that's just one example of how who is consisted of the CS Department or also, I think if my other professors talked about race or class, or gender or ability, or anything in class, I would have probably felt more comfortable talking to them about it. But because none of my professors would ever talk about it in any context, because they weren't… because it wasn't in the curriculum and so and why would they talk about it? I think it just would have led to a better experience as a student in that department.

AK: Yeah, I think that last point that you brought up is so incredibly important because I felt a lot of dissatisfaction about the fact that in more informal conversations I had with professors and in them knowing that… I was one of the students that was really passionate about social and ethically orientations and conversations to computer science and technology, I remember that they would be saying that they believe in the of the value and importance of that, but I feel it doesn't really say much if there really isn't

things that they are doing to really push those things to the forefront right? Because then how else are you going to know if these professors really have aligned with a lot of the values of equity and socially justice and conscious computer science, advocacy and justice kind of values, right? And so I think you bring up a really good point is that there seems to be a need that even if the faculty of the computer science department really do find those values important, it is another thing to just believe in them, but not being able to use those kinds of values and push them within their teaching methods or their curriculums. Because, yeah, it also makes marginalized students, like you were articulating, a lot more difficult to be able to comfortably share their experiences, and for the faculty to act as good mentors and good instructors to help kind of, grow and shape people to be good computer science that feel supported right? And yeah, it really shouldn't have to fall onto the one woman of color in the STEM department. Yeah, to be able to do the leg-work as well, also, especially that Vasanta is non- tenure she's on the tenure track too, which means that she also has probably a 1 million things going on within her own work, and also just her own values and needs to be able to to to fulfill all the obligations for her to ideally get tenure, for example, thing, too. Yeah, I think that's really powerful and insightful. And those are the last questions that I had to ask. Thank you so much.

[A follow up from Student A before the end of the meeting]

Student A: I would be honest. I mean, I guess this is something that I should have mentioned in the interview, so you can add this in if you want to. But I think the one thing about CS department was also, it didn't feel like it cultivated people with similar values as me, so I like couldn't really seek out friends within the department because they were not necessarily minded people, because the CS Department has very different values that I think that I do. And so it cultivated people with the CS department values rather than what I can relate to. Yeah, I had a hard time finding friends in the CS department, honestly.

Appendix B: Student B Interview Transcript

AK: Okay, yeah. So can you just tell me just a little bit about yourself?

Student B: So as I mentioned earlier, I'm originally from Palo Alto, which is in the Bay Area in California. I graduated last year in 2022. And so while I was at Swat I was a double major in computer science and economics. I also spent a lot of time on the Varsity Track and Field team, and I was also on a couple of other clubs like the Phoenix, and I was also a tour guide for while I was there. Right now I am back home in the Bay area in California. I am working as a machine learning engineer at [Company name redacted]. Yeah, and that's a remote job. So I sometimes work at home, sometimes work in the office.

AK: Yeah, that was really helpful. Thank you so much. Some of these questions are going to ask what you do in your postgrad work so I apologize if you have to say it again, but this does really help contextualize things. And yeah, it's really cool that you're from the bay area. I'm not from the bay area, I'm actually from Southern California. Yeah, and so it's always nice to see Californians here. Can I actually just ask what the weather is like in California right now?

Student B: It's pretty good. It recently just started getting warmer, probably like last week. I think it's in the high sixties this week, which is really nice, I know NorCal and SoCal weather is slightly different. I'm sure it's definitely warmer down in Socal right now. But yeah, I mean, I really like warmer weather, so I think it's nice to be finally heading into spring.

AK: Yeah, All right. Wonderful. So yeah, I'm gonna just jump into the first question, which is, and if you see me looking down, I have [the list of questions] printed out right here. But yeah, so my first question is, how did your experience as a CS major at Swarthmore shape what postgrad work you pursued, and how you approach your post-grad work.

Student B: Yeah, so I think for me the biggest way it shaped what I pursue was probably the classes that I took, because I think that directly informs my skills and maybe what I would be interested in doing postgrad. And so with the courses at Swat, I feel a lot of it is really focused on getting the material and content to you, and practicing that through labs and stuff, and then kind of learning some of the real world applications, but it is very focused in a classroom setting, and so I think from that little bit of, sort of limited exposure to the CS Skills, that informed what I wanted to do after Swat. But I think with the courses at Swat in terms of someone who wanted to go into, say, industry versus academia, I think there's definitely less help than what would then what I would have wanted to see within the courses. So I guess at Swat it was specifically just learning the content and skills.

AK: Right, okay, I see. So I remember you mentioning that your position within [Company name redacted] is a Machine Learning engineer, and I don't know if you've taken the ML class at Swat, but would you say that particular course was helpful having taken that course when you decided to take on this position at [Company name redacted]?

Student B: Yeah, I think so. I think for sure, I took machine learning because I felt it's something that a lot of people are talking about, and it's a very hot topic, and there's a lot of implications and use cases.

And so I thought that was a really interesting course. I hadn't thought about pursuing machine learning afterwards, but I think it did help with getting me as an applicant to different companies and stuff, so I think taking that machine learning course definitely helped give me that sort of base of what it means to do machine learning in industry and the foundation of machine learning.

AK: Yeah, okay, that's really great. And I remember part of your response was also talking just about your identity and role as a computer scientist within the context of Swarthmore, and then transitioning postgrad into being a computer scientist in real life, or more CS industry stuff. What would you say are some of the similarities, or differences that you witnessed about how you approach your work when you were a student here at Swarthmore versus how you approach your work now.

Student B: Hmm. I think at Swat a lot of the work that I… how I approached the work was… I was trying to learn and trying to understand the broader implications of what the professors were teaching, but it was also very heavily focused on getting an assignment done…getting the lab done, just trying to make my way through the course through the semester, and that was sort of my heavy focus as a student, whereas I think, as full time employee, it's more focused on self-learning and a lot of reading, doing research. There's a lot more, I guess, weight to what you're doing, because it affects your team, your company, the customers, and so there's a lot more to think about with what you're doing, and it has more real world implications. What you're doing has real effects, and so I think you have to be… it's just a different mindset in terms of … at Swat, I was like, okay, I'm learning, and then just turning out this assignment, whereas now I'm more, okay, what's the best way to approach this with a lot more angles to go about a lot more people to think about.

AK: Yeah, thank you so much for your response, and before I move on to the sub-question to this question, I just want to quickly ask, do you find your work enjoyable right now?

Student B: Yeah, I think so. For the most I definitely enjoy what I'm doing. Because, should I go into detail what specifically or?

AK: Yeah, sure.

Student B: Yeah, so my work is on the Fraud Team at [Company name redacted], and so it's the different products with [Company name redacted] Phone or meetings or whatever, and so it's basically using machine learning to try and detect what may be fraud or not fraud. And so for me, I think that's pretty cool, just because you can look at a lot of data and find different patterns. Yeah, so I think it's pretty enjoyable, it's definitely different from what I learned at school, but I think it's more interesting. Yeah.

AK: Yeah, that's wonderful. And then, yeah, my next question was, what value would you say you uphold when approaching your work as a computer scientist, and has your Swarthmore education affected your positionality, and I guess more specifically, has the CS Department affected this positionality. And if so, how?

Student B: When it comes to values when I'm working, hmm, I feel maybe more of it comes from work ethic… I'm trying to think about specifically values when I'm working. I feel it might be a little bit

tougher, because I feel the work that I'm doing is so focused on data. I guess a lot of it has to come with maybe privacy, in terms of customer privacy and just being very careful when it comes to handling customer information or customer, personal, identifiable information. And so that's probably something I didn't have to think about while I was at Swat and so I feel it's… I think it's a little tough to say that maybe there were a lot of values from the courses at Swat that directly reflect into full time work. I think it's just very different.

AK: Yeah, yeah, that's great, Thank you so much. And when I also talk about values, it's also definitely things like do you value collaboration with other people or do you, or do you feel like you prioritize having your agency to approach this particular task or problem in the way that you want to, that stuff also is right… I say values, and maybe I couldn't find a better word to describe it, but just the things that you think about as your role with the things that you do in terms of coding, but also just the general workplace environment and the people that you work with… that kind of stuff I would say is also something that I also wanted to mention, just in case the wording was just a little bit confusing.

Student B: Yeah, so I think for work style, I definitely really value collaboration and balance with individual work. I think that is directly reflected with Swat sort of CS workstyle, because a lot of the time you are sort of learning on your own, in lecture and whatnot, but also for the labs, or maybe projects that you might do, that's very collaborative, you work with a lot of different people in the classroom, and I think if we didn't have that collaborative sort of weekly lab experience, I might have felt a little less likely to want to collaborate in, say, my workplace now. I think that set the norm for , you know, in tech, "yes, it's okay to ask questions, collaborate, get different opinions on, say, a project that you're working on", and I think that helps me now to approach another employee, or my mentor, or my manager, and sort of, set up meetings to get their opinions, or, ask help from other people, so I think that's a value that I think reflects between Swat and the workplace now. And then I think another thing was that while I was taking courses at Swat as a woman in tech, I tended to prefer working with other women in the classroom just because the dynamic is better, and there's been cases at Swat where the men in classes tend to take up more space, or when you're working [with them] on a lab, it's not exactly comfortable with [them] downplay[ing] what you want to say. And so I think now in the workplace, it helps a lot that my manager is a woman, and there are also other women on the team, and it's definitely more comfortable working in that environment. And so I think maybe when I was looking for a postgrad opportunity, I definitely gravitated more towards managers who were women.

AK: Yeah, no, thank you so much for sharing, and I think that your experience is something that I've also heard just a lot of other people experiencing really similar things, especially if you are a gender minority doing lab partnerships at Swarthmore. So yeah, I really appreciate you sharing, and I know that within your response you were talking a lot about your experience, as a CS major at Swarthmore. Was there any other salient information that you wanted to maybe highlight about reflecting on your 4 years through the CS Department, whether… whether you enjoyed it, whether you found… what are some things that you really appreciated that you haven't covered already, or what are some things that you wish that could have been there that might have been helpful for the things that you're doing right now.

Student B: Hmm. Yeah. I think this has to do more with the content and maybe less with how stuff is taught. But I feel… so with my machine learning class, that was actually one of the only classes where we

did a project that was focused more on, say the ethical implications of machine learning or of computer science in general. And so a lot of the other projects that we did for other classes was pretty focused on just the content. Oh, can you make a game for Software Engineering, or something, or CS21? Whereas with Machine Learning, that was only course where they pushed us to do research and apply the machine learning content on something that was more in the real world, and so the project that we did in machine learning was on recidivism for prisoners, and whether or not it's ethical to use machine learning in a case like this, and I thought that was a really really cool way to use machine learning and also sort of apply everything we learned in class and understand how maybe machine learning engineers in industry actually uses, or even how machine learning engineers in academia might use machine learning. And so I know it's probably hard to do that for a lot of other courses at Swat, but I think that could have been reflected in some of the other courses I might have taken. I think, another really cool thing they could have done with , for example, Software Engineering at the end of this semester, they have us do a project that's basically… you're coding up I don't know, a website or an app or something. I think it would have been a really great way for us to go outside of the Swat and Education bubble, maybe to sort of team up with local, small businesses or companies and sort of create a website for them, or better enhance their online presence, something that I think that would have also been a more community focused way for us to do a project. So I think what I really would have liked to see was more projects that we're focused on real world and community applications rather than just a classroom application.

AK: Yeah, I 100% agree. And I really appreciate you sharing that just because I think that part of the research for my thesis is grappling with the dissonance between the the computer department's purpose and and that goals for the way that they structure the curriculum, and what they teach, and the dissonance between that and the kinds of information that students who go into either industry or research that are producing some sort of product, or engaging in some sort of computational thinking in anyway that are basically being contextualized in the real world. Just because, and I'm not sure if you know this, but basically, the reason why… kind of what you said earlier before, that so much of the courses and the department is very focused on the theoretical and fundamental basis of it.. That is how our lab assignments are as well.. It's because their rationale is that within a liberal arts college, just because we aren't able to offer as much courses, or take as much CS courses, than R1 institutions, for example, and just because of the fact that computer science as a field in general is rapidly increasing in the kinds of subfields and specializations that you can go into, and the demand or the needs, or values of the industry is rapidly changing, their rationale for having a very strong theory focused pedagogy was because then you're able to apply your foundational thinking in computer science to whatever social context that you're pursuing after post-grad. Which is their rationale, but I'm seeing not only from your experiences, but from what I've heard from others as well, is that they're all there needs to be some sort of pedagogical content where students are able to have hands on experience on either, yeah building projects that are very much embedded within a particular social context, or just having more of the curriculum focus more on about those kinds of conversations, just because those are skills and things that you also need to build up within your work, so I really appreciated that. And I wanted to just contextualize the reason why I ask that question is because, part of my thesis trying to figure out, where is the gap within the understandings of what the department thinks that it's doing versus what the students they believe that they would actually benefit from when they actually pursue work postgraduate, if that makes sense.

Student B: Yeah, yeah, I yeah, I agree with that. Yeah, I think the way they maybe teach the course or how they present the material is very much focus on one lens… maybe it is how they research in academia, or how they do their work, but I think you need to understand that a lot of students, maybe want it to have it seen in a social context, or outside of the classroom. Basically yeah, completely agree.

AK: Yeah. And then my last sub-question is just about identity. And so, I want to ask whether you feel any aspect of identity played a role in how you experience the Computer Science department, how you transitioned from graduating from the department to into your job now. Would you say that there are any salient aspects of your identity that has contributed to the way that you experience the department and what you do now?

Student B: I mentioned earlier about being a woman in Tech. I think that definitely was a huge role, maybe not necessarily having the best experience as a woman in CS at Swat, versus now, I try harder to gravitate more towards women in Tech. I think that's as I mentioned earlier, that's one… I'm trying to think…I think another part of my journey would be especially as an Asian person in Tech. There's a lot of Asian people in tech, especially in the industry and I think that sure, that creates maybe a work environment that you might be comfortable in because it's different people that you are… who you have grown up with and are comfortable interacting with, but I think it would be nice to be inclusive of more minorities in tech, especially specifically at the engineering level. I think that's something that maybe was reflected a little bit more at Swat in sort of the CS majors, but I think in industry it's definitely a lot harder. I don't know if I really identify as an athlete, I know that's what I mentioned as something that I did at Swat, but I don't think that played a huge role per se, and I also don't think that plays a huge role right now either, in terms of post-grad work. Yeah, I don't know. I can't… I don't think I can think of anything else at the moment.

AK: Yeah, no worries, and I think that was a great response. I remember in your previous responses you mentioned how being a woman within the CS department at Swarthmore has definitely shaped your experiences, and not all the time in the most positive way. And I've also just… guess I'm a senior too, and talking to a lot of other gender minorities within the CS Department. I hear very similar stories about different lab partnership dynamics, especially if your lab partner is a cis man, for example. I was wondering, if you had ever had experiences within lab collaborations, or anywhere else within the CS Department where you felt you were being disrespected, or your opinions weren't as valued or upholded as much, and you believe that it was due to the fact that you're a woman, did you do anything? Was it something that you were comfortable talking to the faculty about, or something that you wanted to address.. maybe directly to the person perpetrating a lot of those kinds of harms … yeah, I wanted to ask your experiences on how you navigated that.

Student B: Yeah. So I think for me, definitely came from lab partnerships. I think that was probably the most time I spent, for example, with cis men during the lab assignment, a lot of one-on-one time. I think a lot of it just came from maybe not taking into account, say you have an opinion or an idea you think "Oh, maybe we should try this for the lab assignment", and then sort of brushing it off and being like, "No, I think we should do it my way or just"… I had an experience where I was typing on the lab computer, and they took the keyboard away from me so that they could type. And so it was just I guess it was sort of shocking in the moment, and I think I said something "Hey, I was typing can I?" and he gave me back the

keyboard. I think I might have addressed the action directly, but I don't think I ever addressed the fact that, hey, why are you disrespecting me in this way? And so I don't think I ever talked to faculty, or maybe confronted the students straight on in that sense. And so yeah, I don't. I think it's just something that I didn't feel… it wasn't that I wasn't comfortable bringing it up, but I just felt… unfortunately, this happens a lot, and I just felt… I finished working with his lab partner and I moved on to a better lab partner. And so yeah for me, it was just I don't know, what's a good way to approach faculty or approach the student about this. Yeah.

AK: Yeah, and I don't know. I sometimes feel, perhaps if we had a lot more a diverse faculty demographic, it might be something where minority students might feel more encouraged to speak out about their experiences. There is something… when you were talking about the things that you experienced, a lot of it does seem like those micro aggressive kinds of gestures where they are not flat out, being super discriminatory or misogynistic, for example, but you're still able to indicate levels of disrespect where you probably feel… no, if I were a cis man, I feel this would have not been happening to me, or if they were a cis male and had to endure this, they probably would have had a lot different reaction than I do. And you also talk about the fact that like, it was one of those things where you just have to move on to the new partnership, and it is something where it's tricky to find some sort of "resolution" to a lot of these things. Yet, I feel it still doesn't take away the fact that a lot of these kinds of actions or behaviors from cis men lab partners definitely comes from perhaps internalized kinds of misogyny or gender standards, etc. And you're definitely not the only one who experienced things to that degree. And I yeah, I just feel… And the reason I asked this question was because I wish that there were a better way of addressing this, and I think a lot of it has to do in part with, I think, maybe the fact that most of the faculty are white, cis men, and it isn't something that is fully just easy to bring this up and talk about, especially just because as computer scientists, there's so many other things going on in our lives, right? And it just feels you're gonna have to… the person that feels affected has to do more of the brunt work of voicing their concerns, trying to figure out a way to ameliorate this situation or whatever. And yeah, I don't know, that's what came to mind when I was listening to your experiences, and I feel like that should change, the culture should really change so that things like that don't happen anymore.

Student B: Yeah, I agree. I think it a lot definitely has to do with the faculty that we have at Swat. I had a couple of other friends in the CS Department who actually did approach faculty and say, this student is really being disrespectful and being misogynistic, and I believe the faculty response was "I'm a professor. I'm not a counselor, I can't do anything about this." And it was… it was bad. Yeah. So yeah, I have to agree, the faculty is just not.. it's not conducive for helping students approach them about this situation.

AK: Yeah, yeah, Thank you so much for sharing. And yeah, that is, that is quite awful. And it's so funny because it is your job actually to be able to mend a lot of these kinds of things, just because I don't know, they always like to stick in that DEI statement towards the beginning of their syllabus, or the CS department mission statement or whatever. But it seems like there is a distance between what they purport to value, or advocate for versus when a minority person actually experiences some level of discrimination or harm within the context of their classroom, it definitely seems like those aren't being addressed… I wouldn't even say very well, I think they really aren't being addressed at all. I feel that kind of culture definitely should change if they are really advocates for DEI initiatives… etc. Yeah, so thank you so much for sharing. And I'm gonna go into the next set of questions which is more about the experience and

disciplines that you study outside of the CS Department. And so yeah, I remember when you were introducing yourself, I remember you're talking about the fact that you were also an Econ major alongside with CS, and you are also an athlete, and part of the Phoenix and so I wanted to just ask, is there any other salient disciplines that you formally or informally studied or were interested in? Or did you participate in any other salient extracurriculars that you haven't covered before? And has any of those kinds of different factors in your life shaped what you do or how you choose to engage in computer science?

Student B: Yeah, I think the ones I listed were the most common ones, like double Major in Econ and CS, and then, being an athlete and being on the Phoenix. Yeah, I would say because originally I wanted to do Econ and Finance, and CS was sort of a major added on later, and I just wanted to be able to use, say, coding skills or analytic skills within finance. But I think the one thing that was maybe different about Econ and CS is that the way Econ is taught at Swat is also, I think, very super theoretical. It's just the way that it taught, I was like " I have no way of how… I don't know how I'm gonna ever going to apply this into a real world situation, like none of this stuff that I'm learning right now, I just… I was like "how am I ever going to use this with a community, a future community, or a future company, or anything that?" It just seems so theoretical and foundation like you mentioned before. And so I think the only difference with CS was that it seemed a little bit more, say, skill based and maybe I could apply, for example, this specific coding knowledge into a future job and whatnot. So I guess the link between my two majors is that I think Econ being an Econ major made me want to pursue being a CS major. And I think with sort of having the Econ background when I do CS work now, I don't really think there is much of a connection unfortunately, my econ major is sort of just gone… I don't use it at all anymore, but I think it just makes me appreciate more of when I try to do self learning now that I'm able to contextualize it more into the work that I'm doing, like the company that I'm working for or say, the specific customer, base or group that I'm working with and so yeah, I think Econ is just was not super helpful for me. Yeah. yeah.

AK: Yeah, thank you so much for sharing, and I don't know… I feel like… honestly, I blame the structures of academia and just the economic situation that we're in right now where post-graduate students are trying to find work, but … It seems… yeah, there's just been a growing number of experiences where … if there was a particular thing that you studied in college, and it doesn't really perfectly align with the thing that you're doing now. But I feel that doesn't necessarily mean that the thing that you studied is going to completely go to waste. There's a lot of that dissonance happening, but I feel it is honestly because of the greater structures of … workplace, demand, and stuff that, but also just the nature of academia that a lot of times warrants a lot of those dissonances. … I wanted to ask, I think it should be touched upon why you decided to pursue CS? It was more because, and I'm assuming that you started pursuing economics first, and then wanted to be able to have more skill-based orientations to working with Econ, where you … decided to become a CS major after? If I'm getting that right. Yeah. And so I just wanted to ask, if applicable, would you say any parts of your identity or value played in your role in your academic or intellectual pursuits or interests?

Student B: I think another thing, maybe that was different between Econ and CS that I often notice was, I think there's that stereotype that Econ is a lot of athletes are Econ majors, or a lot of white, cis male athletes are Econ majors, specifically, and I think that was also very– That was pretty, very true, especially when you're just sitting in an Econ course, and you look around. I think that created sometimes a pretty uncomfortable environment in terms of speaking out in class, or having to collaborate … and also

that was sometimes reflected in maybe it's a certain way some of the professors might speak– some of the Econ professors might speak to you. I think in that sense, maybe the CS department was a little bit better in terms of [the] educational way the professors taught the content, and maybe some of the other students in the course. It definitely felt the CS courses were maybe a little bit more … diverse compared to Econ courses, but I wouldn't say by much … Sorry, I forgot where I was going with this. But what was the question? I'm so sorry.

AK: Oh, no, it's okay. Just what various parts of your identity, your values, played a role in your academic and intellectual pursuits and interests, and you were talking about how it seemed within your Econ classes there was an overwhelming demographic of white, cis men and how that played a role in your experience.

Student B: Yeah. So I think … that also pushed me to want to do a CS major more than having Econ major as my sole focus, but only marginally. Just because I think even within the CS realm, it wasn't the best experience for women … either. ... Yeah, I think that's probably pretty much it.

AK: Yeah, and just a quick follow up question. I don't know if this is applicable, but I know that there are some computer science students who pursue internships that give them a taste of what an industry-level work would look like, a lot of times within the summer. I was wondering if, during your undergrad experience, if you ever had that experience of working for a company, or doing a technical role, and whether that affected how your postgraduate pursuits, or preparations?

Student B: Yeah, yes. So I guess I would say for me, I first did an econ finance internship. And then I also did a CS … data-based internship. I'll be honest, I'm gonna say … maybe having the courses, and some of the foundation listed on my resume. Say, oh, I took Intro, or I took Databases, and I know Python, or whatever. That was probably very helpful for gaining an interview or getting the internship. But I think the internship experience itself, and having workplace experience and understanding what it means to be collaborative with a manager or a mentor, or just being thrown into a workplace environment, where not everything is someone's lecturing at you, but you have to go and sort of learn…, you're given a context, and you just have to go and explore on your own. I think that definitely was more helpful in terms of understanding what it is I would be pursuing postgrad, and maybe also, during [the] application process for someone who wants to go into industry. I feel for academia, it might be a little bit different. Maybe it's more research-focused. But I think the internships and having that work, exposure, and experience was definitely and sometimes … much more helpful than courses at Swat themselves.

AK: Yeah … Thank you for your response, and I feel your response is definitely something that I think a lot of other students also believe as well. I think that it seems to me the courses with the technical skills that you gain through taking courses at Swarthmore, a lot of times help leverage your qualifications and your ability to participate in internships and to be hired through that manner. But then, the skills and the real life experiences that you gain through your internship a lot of times can maybe be more informative of what your work can look full-time after you graduate Swarthmore, or even the preparations. Yeah, to be able to do that post-grad work. Am I getting that correctly?

Student B: Yeah, that's exactly the point. The classroom setting and the workplace setting … it's just so different. And maybe it's specifically how the courses and stuff are taught at Swat. But … There's a slight

disconnect between, perhaps, the way you work and a CS course versus how you have to work in a company. etc.

AK: Yeah, yeah. And I think that's a really great segway to the final question, which is more about reflecting on your CS experience at Swarthmore, and comparing that to what you do now. I'm gonna ask a series of questions about the Department that gauges if there could have been something within the CS department that would have been beneficial to your life and your role right now within your postgrad work that isn't there at the moment, if that makes sense? What are some things that you wish have been part of your CS experience at Swarthmore through the Department? And so the first aspect of that is the pedagogical content, and I know that you did touch upon saying how you wish that there were more pedagogical content on social implications or applications … of the discipline or the subfield of Computer Science. If you wanted to expand on that, you definitely can, or if there were any other things in terms of the actual things that they teach in the courses at Swarthmore that you feel may have better prepared you to do the work that you do now, or may have been more relevant or more interesting.

Student B: Yeah. yeah. So what I touched upon earlier, I think having … Because I think a lot of the professors at Swat, they started in academia, and are in academia, and then some of them have industry experience, but not all of them. I think if they could leverage that somehow, and give that knowledge to us, it would have been really beneficial, because I think a lot of students at Swat are interested in going into industry. But then there's also some who are also interested in doing academia but … I don't think the way you approach CS is different, but I think it's just the work you do might be different. So I think, professors … needed a way to present the issues and problems and solutions that they themselves have come across, and whether it's academia or industry, and if they had presented that or given that knowledge to us through the courses, or … lecture series, or something that would have been really helpful. I think because I know that they do have some lecture series every once in a while. But I think it's also very focused on content, like a specific algorithm, … and while that is interesting, I think a lot of students would also like to hear … the experiences that the professors themselves might have had in academia or industry. Yeah, I think that's something I really wish we had while we were at Swat. I just feel that was a big gap from the CS department. … As I mentioned, I really wish there were a lot more projects in the CS courses, whether it was community-based or research ethical-applications-based, or even just having a style of project where it's sort of the stuff you learn throughout the semester builds upon itself rather than having a bunch of separate individual labs. I think just that structure would make it sort of easier to understand what you're learning in the course, and how it might build up, and how someone in the real world might also be doing … might use what you're learning in the classroom.

AK: Yeah, I really appreciate those responses. I think specifically when you were touching upon your wish to have had in-speaker series that talk about faculty's experiences working with research, working within the research community or the industry community. … There are skills that are very necessary to computer scientists that exist outside the realm of the actual, theoretical research content. Right? I think a lot of that is navigating work experiences within a particular industry, whether that be the more research industry or more like the … company-based industry. I feel that's really important, just because I don't know the exact data on this. But I'm assuming there's a lot of people who are pursuing some sort of CS relevant work that gradually outside of the CS major. And I feel what your response reminds me of is that there has to be a recognition … [in] the ways in which you prepare a student to be a good computer

scientist in the real world does include things other than the actual theoretical knowledge that they teach within the classrooms, right? I really … appreciated you voicing that opinion. … So this past question talked more about the actual content, or the things that they teach. Would you say that you wish that there are particular kinds of teaching methods, the ways in which particular courses taught or expanded upon a particular subdiscipline in CS, that would have been beneficial that you wish were a part of your CS experience at Swarthmore?

Student B: Hmm. Okay. Because I know, I feel the [lecture-based] courses focused on the professor, and what they want to present in terms of the material and the content. I feel for me, personally, that is … The easiest way to learn. It's just giving me the material, and then I just have to go and understand it myself. … I feel there was also enough of … collaboration … teaching method, … a lot of group work.. I think that is a pretty big part of the CS work at Swat, so I did also appreciate that they included that. In terms of teaching methods … I think the way they taught it was probably the easiest way for me to understand, which was lecture-based and then having labs throughout, and maybe a project at the end, to apply what you've learned. But specifically, [the] teaching method for me, lecture is just what's easiest for me to understand.

AK: Yeah, I really appreciate you showing that. And I actually have a follow up question just about when you're working with partnerships, right? Can you name experiences where you weren't working with one other person, as in your CS partnership wasn't just a group of two working on a lab assignment? And I say this just because my impression of the CS industry is that you have a particular role, as a part of a bigger group, but I feel a lot of times your role is situated in a particular team or a cohort that focuses on a specific aspect of the company's goals and missions, right? And so to me, what I remember is that … software engineering was the only time in my CS experience where I had worked with a group of three other people. So we were a group of four working on a project. And I was wondering if you remember any experiences where you were working with more than one other person, and how those experiences differed when you were working with one other person?

Student B: Hmm. Yeah. … I definitely agree that the labs that we had are just you and one other lab partner. Yes, [I] also agree that software engineering, that was one of the times I worked, and I think it was a group of three. I want to say [that in] my machine learning class, the project that we worked on, which was recidivism for prisoners, that one [was] … also a group of three. … One other example that I can think of was for my algorithms class. I think the labs that we had, instead of a group of two, we did groups of three or four. So I think those three… are the only three examples I can think of where we worked beyond just a duo. I think for me, I definitely appreciated working in a bigger group more than just a lab partner. You mentioned when it's … just you and your lab partner… I feel there's a lot more to be learned when you're in a bigger group of people. There's a lot more, not just sort of scale focus bring in more opinions and bring more ideas, but also understanding how to work with groups, larger groups, and a lot of figuring out logistics, or solving conflicts between different opinions and things like that. I think it's beyond just skill-based, but also work ethic-based. You can learn a lot from that as well, and so I definitely would have also enjoyed it more if we had more group experience rather than just two lab partner-focused projects or labs. Yeah.

AK: Yeah, I really appreciate you sharing that. I also honestly really wish that more of my Swarthmore experience had groups of three or more kinds of partnerships, just because I think that the skills … like you said work ethics, and being able to collaborate with more than one person is something that really does have to be formulated like a scale, I would say, and something that is really important, I think, for a lot of different kinds of post-grad opportunities, including, academian research and CS industry things. I also feel oftentimes in partnerships of two, it's a lot harder to have conflicts being remediated or resolved. And I've often found that, if there is another person or two other people within the group that you're working with, a lot of times it allows for more of a democratic process and resolving a potentially harmful conflict or something like that. So yeah, I really appreciate you sharing those sentiments. I'm graduating this semester, and … Software is the only class that I've ever taken that I've worked with more than one person, which honestly, … I think that's wild to me. I wish I had more experiences.

Student B: Agreed. Yeah, ... I don't know why they decided to do that, partners in groups of two. Maybe they felt it was the easiest way for you to … be collaborative, but also for you to be able to do exactly 50% of the work, or whatever the way they wanted it to be? But … I think there is a lot to be gained from working in bigger groups for sure.

AK: Yeah, All right. Wonderful. And this is the final question, actually. … How would you think you may have benefited from a socially and ethically-conscious pedagogy within your CS education? And, if at all, do you think that your identity or values play a role in shaping those perspectives?

Student B: I would say yes, it definitely would have been nice to have a more ethically, socially-conscious based CS education. I feel the stuff we learn in the CS course, it can be really easy to get into the nitty gritty like, "Oh, how exactly does this algorithm work, or how does this database work?" Yes, that's important, but also at the same time, when you get into industry it's not just you working on your project. There's a lot of other people that you're working with … for certain … industries. If you want to go into AI, or you're going into a company that's going to be dealing with spreading information, or social media, there's a lot of people you have to think about, and how your work is going to affect not just your team, but your company, and also the general community that's going to be using them. … I think that's harder to learn. You have to learn that on your own when you go into the workplace, and that's something that we don't get at all at Swat. The only brief experience that I had with that was in my ML Class, where we spent… It was like two weeks where we talked about what are some ethical implications of using machine learning and everyday issues. … I think that was a really cool learning point and understanding "Oh, so for CS there are definitely things outside of just learning the models that you can apply machine learning to." And so I think it's tough because I feel at Swat you have to … if you want to have that ethical, socially-conscious lens on your learning, you have to do it yourself. You have to force yourself to do a project that's going to be focused on that, or maybe write a paper or a thesis that is going to be focused on that. You have to go and seek it yourself. I think it would have been nice if Swat professors, or the Swat CS Department, was proactively including that in their courses or their content. … I would have really liked to include that, and I think it'd definitely be pretty beneficial to a lot of other students who may not have been exposed, or thought of CS through that lens, specifically.

AK: Yeah, that's a really wonderful answer. And I do want to kind of respond because I think you've set some really important things. But just to a follow up question to that response, [do] you think that either

the values of you uphold or your identities play a role in why you believe that kind of integration is important?

Student B: I would probably say yes, I'm trying to really self-reflect and think what specifically. I would probably say, as I mentioned before, being a woman in tech is just different from the experience … [of] some of your other peers or coworkers. And I think it just pushes you to think more about your workplace environment, and I just feel I'm more conscious of everything I do in the workplace, and how I interact with people and how I respond to people's questions, or how I talk to people. And so I think, just having that conscious mindset of always being aware of how I'm positioning myself in the workplace also has led me to be more … focused on, say, what are the further implications of my own work, the skill-based work that I'm doing? And so I think, just having that mindset in place also pushes me to think about other issues. Yeah.

AK: Yeah, it's a really wonderful response. And I think that when you're talking about your opinions and your experiences, it reminded me that I feel so much of the content of the CS courses at Swarthmore, a lot of times is "Here is a problem, of a lab assignment, and I need you to do X, Y, and Z things to make it work, for example, right? It's in a very, very general way. But I feel a lot of times, the thinking that is required to reflect on the implications of the work, allow you to reorient a problem or an objective, and say, "Is this something that truly should be implemented in this way," and "How is this beneficial, or how might this create harm?," when this is actually being applied. And I feel we don't really get that criticality. We're just learned to be like, "Okay, here's the lab assignment. I need you to go implement X, Y, and Z things." Kind of like a checklist. And I think that, what your responses remind me of is that I feel … There really should be more critical reflections on the functionalities and the implications that it has, because it also then ties into the fact that different ways of coding a particular functionality, or even the nature of a particular functionality. It has implications, right, even if they aren't incredibly explicit. And I just feel those kinds of thinking could have been more encouraged or implemented within the curriculum at Swarthmore because I don't know it just seems so much of my experiences, right? The lab assignments are just, "Here's the assignment. All right. Now go [do] these problems." And I think another thing that you were mentioning is that a lot of times, if students wanted those kinds of experiences of being critically conscious about the implications of their work, it's something that they have to seek out on their own, right? And I feel that is something … a lot of times marginalized people, really forefront those values more. And … we're so busy already because of the demands and pressures of this college that it is just really hard, and it shouldn't be an obligation to be doing that work on your own supplementally to the CS work that you're doing within your courses, right? And so it makes me think about the sustainability of having students engage with them on their own, instead of having it, or robustly integrated to the Department, if they do believe that these kinds of conversations are really important for every single Computer Scientist to have, just because, if they are pursuing anything related to computer science and the outside world, it might be beneficial to to understand the context of what you're doing the work under, and how you're doing it, if that makes sense?

Student B: Agree. I don't know. I feel the professors maybe don't think it's a valuable thing to expose students to, but I feel it should definitely be included in their curriculum, not because there are students who are looking for it, but they're probably are students who have never thought about it in that way, and

it's important for them to also focus their education and CS education in the way and think about it from different perspectives from different students. Yeah.

AK : … But yeah, thank you so much for sharing those kinds of insights. And I really also do agree that students that may have not considered what implications of their work might look like can really benefit from … I just feel so [many] of the things that they teach ... A lot of [the] times reflect what they think should be the important aspects of being a computer scientist. And I feel to reorient what it actually means to be a computer scientist is to then reorient the values or the knowledge that they forefront, right? It seems to me just because technology is so ubiquitously applied in so many different aspects of different industries, life in general, right? … There should be values that forefront– understand the implications of this. Just because a lot of times it does contribute to wider dimensions of oppression that are predicated on race and class, and gender and etc. So I really do appreciate you sharing those kinds of responses with me. Is there anything else that you'd like to mention before we end this interview?

Student B: I don't think so. Yeah.

AK: Yeah, that's totally fine. Thank you so much for having this interview with me. Your responses were incredibly insightful and super helpful, and I appreciated you taking the time to do this. And yeah, that's honestly it for me.

Appendix C: Faculty A Interview Transcript

AK: Maybe to start off, I'd love it if you can introduce yourself in terms of how long have you been working at the college? What do you mostly teach in terms of courses? And if you have particular specialties within the subfield of computer science that you specialize in?

Faculty A: My name is [Faculty A]. I'm in the Computer Science Department. I came in 1994. So I was the second ever computer scientist on campus, and in the beginning I taught everything because there was only 2 of us, so we had to teach everything. But now I specialize in teaching Artificial Intelligence and Robotics, although I haven't taught Robotics for a while because it's hard to teach it in a big class, because we don't have a lot of robots. … I am going to teach a new AI and Ethics course for the first time in the spring which I'm really excited about with [Professor Z] in Philosophy. And I also teach the Intro course and Data Structures and Algorithms.

AK: Yeah, that's really wonderful. Thank you so much. So I think I'm going to move on to the questions that are more particularly relevant to my thesis. And the first kind of subset of questions talked about the Department kind of process of assessing and evaluating how the Department is doing in general. And so the first question that I wanted to ask is, what factors into how the Department measures this efficacy, regarding it's alignment with the mission and the values of the department, as well as student academic success and well being?

Faculty A: So, I don't remember exactly when it became more official. I believe it was after a Middle States review of the college. But the Middle States [Commission on Higher Education] review had a concern that the college as a whole, was not doing enough direct assessment of their goals, and I believe that [Faculty name redacted] was Associate Provost at the time, and he was the person who was kind of tasked with starting to get us more in line with what Middle States wanted. So prior to that time, the Department had always been interested in assessing how we were doing, and we kind of did it more on a sort of relaxed basis, because we weren't expected to do it every year. But after that Middle States review, every department was supposed to every year submit a report, and … about what assessment you tried that year, and how it went, and the outcome, and so on. So that was probably about 10 to 15 years ago. So each year what we do now is that we pick one of our goals, one of our curricular goals, and we focus some kind of study on that goal. And then we write up, report about it, and send it to the associate Provost and Robin Shores, who's in institutional research.

AK : Gotcha. And when you talk about particularly curriculum goals, are they more general in the sense of particular… find a way to teach a particular concept? Or is it more focused on a particular class? Let's say that, for this year you guys are tackling curricular reform in Intro to Computer Science, for example.

Faculty A: So, it could be really broad. So one of the things we looked at was the way our curriculum is structured … is into group one, group two, and group three courses, and we wanted to know what students retained when they were seniors about what is some key concept from group one? What is a key concept from group two? What is a key concept for group 3? So we actually did an exit survey of all graduating seniors, and we asked them … We came up with questions that we thought would kind of assess kind of really basic things about level- group one, group two, group three we expected students to retain, and we

looked at how well they actually remembered some of those things. So that was a very broad thing. One year we looked at testing, like unit testing. Like how valuable is doing unit testing in CS 35? Does that help students understand coding better? Does inventing their own tests lead to better understanding, rather than us, just giving them tests? So we can look at super specific things or super general things that we've kind of done the gamut.

AK: Yeah, that's really great. Thank you for your response. And then, yeah, the next kind of part of that question is just talking about what has been the departmental conversation that looked like when you guys were talking, perhaps talking through student academic success and well being?

Faculty A: So, one of the things that we struggle with is that so much of our department meetings are taken up with hiring because we're constantly …We're constantly understaffed, and we're constantly trying to hire visitors and there's very few qualified visitors available, so pretty much from the end of the fall through the whole spring semester, we're still doing it now. We're still working on hiring. And so it really is unfortunate in that it limits what we can talk about anything else, and we would much rather be talking about assessment and thinking about curriculum. But we just really don't have time. And so the things that we end up talking about … we plan what our assessment is going to be in the fall early and then we make sure that the assessment is making progress throughout the year. And then, at the very end of the spring semester, we wrap up the assessment and write about it. But there's not there's not as much conversation about what we're doing as all of us would like, to really think more deeply about what's going well, what could we improve on, what things do we want to add that we don't have. So honestly, we just don't have enough time to have those really deep conversations about the curriculum.

AK : Yeah, I really appreciate the transparency, but I know that this is something that other faculty members, informally and formally, have kind of talked about as well … that there is just a very much labor-intensive kind of process right now within trying to hire faculty members in the CS Department, which is totally valid. So I really appreciate you saying that. The next kind of question that I wanted to ask related to this conversation is, where … within conversation, where you guys are able to come talk about the efficacy of the department, how does the department identify and develop areas and growth for improvement?

Faculty A: So I don't remember … Did I eventually share with you our goals?

AK: Yes! Thank you for that.

Faculty A: So I don't remember what year we- I think we actually- so what often happens is we have a retreat. And so the retreat will be after the school year's over early in the summer, and that's the only time that we can find time to actually talk to each other about these big things. And so typically, the retreat would last 2 full days and, we sometimes will go off campus, somewhere nearby, but just to be somewhere different, so that we're not just in the same old place talking about the same old things. So we've gone to Pendle Hill, for example, and hung out there for a couple of days, and we also went to a bed and breakfast nearby, where they make food for you, so we could hang out there. So I think the last time, when we came up with those goals, we started that at a retreat, and then we were able to kind of fine tune them after that. And so typically because our goals … there's a lot of goals there, and there's a lot to

talk about, that's each year as we think about our assessment project, we go back to our goals and think about, "Well, what have we not considered lately? What's something that we need to look into more deeply?" But, I mean one of our overarching goals that's constantly on the top of our minds is diversity, equity, and inclusion. How do we make our curriculum accessible to the widest range of people, make them feel welcome, make them feel a part of our community? And so that's something that's kind of always in the back of our minds whenever we do anything. So, we recently started the ACCS program. We recently started the mentoring program, where people who are in [CS] 31, [CS] 35 can get a mentor who's a little bit older. We have the Ninja program, which was started in …with all of that in mind. So that sort of big idea of diversity, equity, and inclusion is always there, overarching even the much more specific concrete goals that we're working on.

AK: Yeah, thank you so much for your response. And then, within these conversations about assessing efficacy, revisiting particular missions or goals, or thinking through things that haven't been as considered … Now I'm assuming that these a lot of times lead to different … a conversation with faculty as a whole, just about what these kinds of potential changes would look like. And so within those kinds of processes, if members of the faculty have had conflicting ideas or values, how are they negotiated or resolved? And were students' input also factors into decision-making processes about the direction of the department and things like that?

Faculty A: So in the past we used to do, and some, I think, some departments still do this … We used to do an exit survey of all seniors, and I talked about how we did it that one time, when we were evaluating the breadth of our curriculum. But we've just have gotten out of the habit of it. So we haven't gotten as much student input as we have in the past, with respect to some of these things. We are scheduled to do a department review next year, I believe. And so a department review is supposed to be done every 10 years. We were slated to do it right before the pandemic. and we had picked our reviewers, and one of our reviewers actually died, which was really unexpected. And so it got delayed. And then it was the pandemic, and so nobody did any reviews during the pandemic, so we're pretty far behind. You're supposed to do them every 10 years, so I think it's been maybe 14 or 15 years since we've done one. So it's a really good opportunity for people who are outside of your department, people from around the country, you bring 3 to 5 people to campus. You write a self study. You do surveys of your students, alums and current students. You kind of look at the whole department, and you kind of offer it up to the external examiners to get them to think about ways that you might improve the Department. So that's coming up soon. So we'll definitely be getting a lot of student input in preparation for that, but most of the times when we're thinking about things, lately, it's been more just us kind of … somebody will say, "I really think we should do x, y, or z," and then we discuss it as a group. I mean as a Quaker institution, our goal is always to try to find some kind of consensus, but we don't always get there, and there's sometimes differences of opinion. It's more about how to go about it than the goals itself. I mean, we're kind of on the same page about … there's not anyone who's, "No, we don't want diversity, equity, inclusion in CS." It's not that. It's more about, "Well, how do we go about it? What's the best way to achieve it?" And so we occasionally have disagreements, and then we usually figure out a way to compromise, if that's the case.

AK: Yeah, that's really great. Thank you so much for your response. And I'm just gonna go into the next type of question which is just about faculty rules and responsibilities. And so what are the faculty, roles,

and responsibilities, aside from teaching their designated courses? What would you say, is the bandwidth, to which faculty must embody on a semester basis?

Faculty A: So we- I got this idea when I was chair from talking to math … and because math is a big department like we are, and there's just so many things that have to be done to make a department run smoothly. And so one of the things that they did was they had what they called departmental jobs, which were divvied up amongst all the faculty, and so we decided to do that, too. And so it just helps because the chair can't do everything, it's just too overwhelming. So somebody's in charge of off-campus study. Somebody's in charge of the assessment project that year. Somebody's in charge of running all the panels for what's it like to go to grad school, What's it like to get an internship, What's it like to get a job? Things like that. So, we basically created a structure so that everybody can contribute and that everybody's doing some departmental service towards making things run more smoothly, and we also have a lot of staff that help run the department, but on the faculty. So we have Lori, who runs the Ninja program. We have Jeff Knerr, who runs the system, and we have our administrative assistant, and we have lab instructors. So it's a big department with a lot of moving pieces, and everybody contributes. So, all right, my dog's whining. I'm gonna let him out here … So… did I answer the question? Was there more to it?

AK: Oh, yeah, I mean, I was just talking just about what are the things that faculty have to be responsible for? And I think that… right… Not only do they have to make sure that they're doing their role in teaching and making sure, and grading and things like that, that are more course specific. You're also talking about how there are departmental obligations that are designated to each faculty.

Faculty A: A couple of more things I thought of. So there's advising, always. And I think in CS … I mean, we– I have 30 advisees. That's a big number compared to what some people and other departments might have, so that's a big thing that we do as well. And then we also have our senior comprehensive. And so that's something we all do on top of what we normally do, because it's not a class that anyone gets credit for teaching. It's a poster that students do. We all come in multiple nights to review the posters. We all talk about the posters, and so on. So there's all kinds of things like that that are kind of built on top of just going in and teaching your class.

AK: Yeah, thank you so much for your response. And this is honestly just to gauge the faculty bandwidth, right? Of just things that they have to partake in on a semester-long basis. And yeah, and I think I also remember, kind of informally, what… one of the CS professors is talking about how they're in some institutional committees, for example. Committees that aren't directly related to the department, but more … I think one of them was about the construction in Singer Hall, I think, was one of them, for example.

Faculty A: Yeah, so full professors tend to get more difficult committees, not always. But untenured professors tend to have only one committee, and it usually is relatively less work, whereas tenured professors would … might be put on two committees, might be put on one really heavy committee and one lighter committee. So, for example, I'm on the committee. Some committees are elected. So I'm on one of the elected committees called Committee on Faculty Procedures. And we meet every week for an hour and talk about what is going to be covered in the faculty meeting that week. Anything to do with faculty governance. That's … if there's issues about that. And so another elected committee is called the

Committee on Educational Policy, CEP, and that's the committee that tries to decide which departments should get a new position when someone retires, or resigns, or leaves the college for some reason. So there's some committees that are super super amount of work.

AK: Yeah, and that's really helpful because when you're bringing about particular changes to the department, it's hard to be able to balance that with the current ongoing responsibility that you have as a member of the department. And so I think your question really…very adequately and hopefully answers that. Yeah. And so I wanted to move on to the third kind of question, which is, more particularly talking about the Department's missions and goals. And so the first subset of questions I wanted to ask was, how does the broader institutional missions and goals of Swarthmore College affect the Department's missions and goals?

Faculty A: I think when we sat down and wrote our goals, we had Swarthmore's goals up and looking at them at the same time. So we were thinking about, "What are these big, overarching goals, and what are our goals? And how do they relate to those?" I think that this is one point where we do have some tension sometimes in the department. So for some of us, we would like to have the department be more …making connections and reaching outward and doing more interdisciplinary stuff. And other people are more protective and want to make sure that we do all of the core computer science well before we reach out and try to do more. So I think that's a tension that we struggle with because I think it's …some of us feel how computer science contributes to society is really important, … and that's something that seems that fits Swarthmore's overarching goals. And whereas other people are like, "Well, we have to do computer science well, and that's the most important thing." And so I do think that's something we go back and forth on a lot.

AK: Yeah, that's really interesting how you talk about those tensions of focusing on making sure that the more core fundamental principles of computer science are being relegated to the forefront, while there may be other kind of faculty whose perspective is more aligned with reaching …cross-departmental work, and that kind of interdisciplinary thinking that is very indicative of a liberal arts institution, right? And it's actually interesting that you say that because … and maybe you'll find this interesting, but when I was interviewing recent student alumni of the CS Department. So these are just who have graduated, that are currently working at CS industry jobs and… For example, one of the students I interviewed does machine learning. She's a machine learning developer at a tech company. But when I was asking her about reflecting on her experiences, she said that the most kind of, salient and long lasting pedagogical impact that really benefited her, the way that she takes on her role in this job, was the kind of pedagogical application where you basically are able to partake in a particular kind of sub discipline of computer science. Machine learning, for example, is the example that she gave. You know, do a project, but that project is contextualized in a real life kind of social context just because I do find that there are particular skills that are needed to be able to kind of think through what questions are important when designing or implementing code within a particular social context. What are the things that you consider and what are ways to kind of go about it, so that you're getting perspective and ideas from different kinds of people and things like that? … Which I would say is a core part of what makes – what is a computer scientist, regardless if you go into industry or not. And this is kind of a response that this … More than one student has said before, just because they thought that there … was a distance between just a lot of the more centralized kinds of thinking in the the computer science courses that were, more on lab assignments and

stuff, and the dissonance that they felt when they actually decided to partake in a job in the industry, where maybe now they have to do coding or computer science under a lot more different kind of factors? And so yeah, I was wondering, … if that was something that you … were aware of or thought of when … you were thinking through student alumni kind of responses, or know where students end up after postgraduate work, if they do continue to kind of pursue a computer science field?

Faculty A: Yeah. So I think when I first started at Swarthmore, a larger percentage of our majors went to grad school right away, and I think it… People are still going to grad school, but they're delaying it, and they're going to work in industry for a while. So I think that our graduates are doing a lot more varied things right now than they did in the beginning. I'm a huge believer in projects. I think projects are great, and almost every upper-level class I've ever taught has a project in it. It's hard in AI to make it a big project, because there's so much I want to cover in terms of just introducing what's going on in AI. But in my robotics class, I reserved about 4 or 5 weeks of the class for the project, and I think it was run more like a seminar. And so it really was about connecting it to other things out there in the world, and seeing– doing what– I mean I was really open-ended on what people could pursue, and some people pursued things that I wouldn't even really say ended up being robotics at all, but more machine learning. But I think that whenever you try to apply what you're learning in class to a problem that's interesting to you, and connects to things that you care about, that's when you're going to learn the most, and really push yourself the most, because you're now really excited to accomplish this thing because it's something that's relevant to you rather than me deciding in advance, you're going to do this lab about X, Y, or Z. So I think project-based courses are really beneficial for students. I think it's– some students hate them, though. I've been told, "Well, I don't have an idea. I don't know what I want to work on." So I always give a list of possible project ideas as a starting point and say, "This is just to get you thinking you don't have to do any of these. You can do something of your own choice, but you just have to run it by me first."

AK: Yeah, that's really great, and I very much appreciate it when you were talking just about a lot of the attributes that come with project-based ways of teaching or application. Just because I think that that is something that is perhaps more transferable in the knowledge that you gain from the project into when you work at a team that an industry company, and you have a particular role, and it's something where you're also … , if this is a multi-person project, you also learn things about collaboration and working with potential conflicts and working as a team together to successfully complete a particular objective. And so I do appreciate you pulling that out, and you mentioned your AI course, and one of the reasons why I was very interested in having you as a faculty interviewee was because … you teach the AI course at the Department. But I'm also aware that you have particular curriculum content that you integrate that perhaps gives a more interdisciplinary, well-rounded perspective of AI, which also would include thinking about the usages of AI in the social contexts and the implications that they have. And I also remember that you mentioned, earlier on, that you're planning on teaching an AI Ethics course with [Professor Z] in the Philosophy Department. And so I wanted to talk to you perhaps about those experiences that you have leading those curriculum as a professor. … The first thing that I wanted to ask was about your AI course, just because I don't know how much information that you can relay to me about this course that you're teaching … in a year or so. … With regards to implementing those social and ethical considerations of AI within your class, how did that idea come into fruition?

Faculty A: Sure. So there's a really popular textbook, that if you were to look at most AI classes around the country, they use, and it's written by 2 professors named Russell and Norvig. And it's called *Artificial Intelligence: A Modern Approach*. I mean it's not that modern anymore, because it's kind of an old book, but it's very stodgy. It's one of these 500-page reference books that tries to cover everything in AI. But the things in AI that I care about the most are the shortest number of pages. Hardly anything in there, and so I used to use Russell and Norvig because it was the standard textbook. But I just grew tired of it. And so I went to grad school with someone named Melanie Mitchell, and she wrote a book. It's not a textbook. It's more a science book for people who aren't necessarily scientists, and it's called *AI: A Guide For Thinking Humans*, I think is the title. But you could find it on my website if I have that wrong. And she had started sending me drafts of the book while she was writing it, and I got really excited about it because she went to grad school the same place I did, and so she thinks about AI in a similar way to me, and all of– a lot of books when I pick them up, I'm, "Oh, I don't want to talk about that. I don't want to talk about that." But everything in her book was, "Oh, I want to talk about that. Oh, that's really exciting, too." So it was really fun to have a book that aligned with part of my world view of AI, and she allowed me to actually use the draft for free in my class the first year that it was available, and then once it became published, … it was a required textbook for the course. And so because it's not really a textbook, I had to do more of the work of explaining the algorithms myself in lecture. It gives you a high-level view of what the algorithms are doing and what they're about, and why they're important. But it's not a hardcore computer science textbook. But I felt that was easy for me to sort of fill in that content. And I just think it's so important to think about the …what AI could be doing, how it could be changing our society. What choices are we making without really even realizing that we're making them, and how they might affect us down the road. And so I think the book does a really nice job of kind of starting you throughout the whole thing thinking in a new way about AI instead of just as, "it's a computer science subject. And here are the algorithms we're going to learn."

AK: Yeah, that's really wonderful. I appreciate that. It's because… I don't know, and it's also really nice that you were able to find a … literature that really spoke to a lot of the interest that you wanted to push to the forefront about AI within your classes. With regards to you implementing this particular aspect to your AI course, how would you describe your experiences teaching or implementing that into your instructions, or if you want to just note any salient outcomes of these implementations, including if you were able to gauge the students' reception and impressions of this kind of discussion?

Faculty A: So I do have a course evaluation, but it's not… it's more instead of direct assessment, it's more asking students, "How did you feel about this," right? So it's not … if I were going to try to publish a paper about it in educational research, it wouldn't be the right kind of metric to ask. But I mean in the past, when I would ask students, "did you read the textbook?," I would get a very low response rate. Another thing that I did was … I have a reading response that students have to do every week … and it's graded. It's basically, "You did it. You did it poorly, or you did it really well." So you– it's a 1, 2, 3, or 0 if you didn't do it at all. So it's a very low stakes reading response, but I really wanted them to do the reading. It's a great book, and I wanted them to read it, and so, I think, based on reading their responses, they were really reading it, and they really connected to it and got something out of it and enjoyed it. And the reading is relatively short, so it's not a huge burden to do the reading every week. What I would really love is if I could teach AI to 20 people at a time, and we could have discussions, but I usually have 40 people, and so that makes discussion a little bit challenging. A lot of people are not that comfortable

speaking up when there's 40 people in the room, so, ideally, I would want it to be a lot less me lecturing and a lot more us discussing ideas, and I try my best to get that to happen. But depending on the class, it doesn't always work. Sometimes what I do is I'll give them a question to work on and have them talk to their neighbors, and then come back together and share. And that works a little bit better, because then they're not talking in front of the whole group. They're kind of talking to one another. But for the most part, it really seemed students embraced it and enjoyed it and got value out of it.

AK: Yeah, that's really great, and I was then … may perhaps ask, just because of a positive reception of this integration to the curriculum, as well as you finding value and having conversations as well, were there any considerations on continuing these kinds of implementations within, if you teach AI in a future iteration or even fine-tuning or refining particular approaches of having these kinds of conversations, that might be more effective or just kind of better, in general, for all kind of people involved?

Faculty A: So [Professor name redacted], who's a visitor now, but when he was a student at Swarthmore, he took AI with me, and we didn't do it this way back then. And when he taught AI– he's taught AI and machine learning, both, and when he taught AI, he kind of just took my structure and did it in his own way, but used the structure for the most part, used the same textbook, and he's a person who really is interested in AI ethics as well. And so he's teaching machine learning right now, and he decided to try something new that he had never done before. He uses some of the lab time to talk about ethics, so he'll have them read something, and then, in lab, they'll spend 20 minutes or 30 minutes talking about that reading before they start working on the lab. And they don't do it every single week, maybe every other week. And by talking about it in the lab, you have a much smaller set of people. You have 20 people instead of 40 people, so people maybe, are more interested or able to talk. So, that's a new idea I hadn't thought of. Maybe I'll try that. [Professor name redacted] teaches Parallel and Distributed Computing, and she restricts it to 20 people, and then she has them meet in groups of ten. And so then, they can have a lot more discussion. So I think a lot of us are interested in trying to have less lecture and more discussion, but because of the number of majors we have and the limited number of faculty, our courses just tend to be big, and it's harder to integrate those kinds of discussion things in when you have such a big class.

AK: Yeah, I really appreciate you highlighting just a lot of the more … factors that an external factor a lot of times aren't able to be controlled by one single person, which obviously includes, the in balance between the number of faculty that are in teaching at the department, and the number of students, which a lot of times then creates bigger course prices, which a lot of times can be tricky to navigate in how to have fruitful discussions around. And I also think that when you're integrating these new pedagogical contents into the curriculum, I feel there also has to be a way of balancing. Okay, I'm introducing this particular component of discussion into the curriculum … then there might lead to considerations of what things to take out. … so that there is a balance, so that you aren't overloading the curriculum. And so I was wondering if you had any experience having to work around these issues and what that process for you has been like?

Faculty A: So there are certain topics that are kind of my favorite topics that if I'm going to teach AI, I want to teach this, because, first of all, if anyone's going to do research with me, ultimately, it would be nice for them to know some of these things. So, for example, I always talk about neural networks and deep learning, because that's something that's near and dear to my heart. And I've been doing it for a long

time. I always talk about genetic algorithms or some kind of evolutionary computation, which isn't typical in an AI class. But it's something that I think is really cool, and students can understand it and do some really cool projects with it. And so there's a lot of topics in AI that could come and go. I mean AI is broad, and you cannot cover everything in AI in one semester. So you always have to throw stuff out. There's always going to be choices you have to make. And so I have just decided that I'm going to pick the things I enjoy talking about the most, because I think when I'm talking about things I'm excited about, it makes it more fun for the students too. But I also try to show a balance, a little bit of a balance, because we also have a machine learning class. So I try to make sure that there are things they're seeing in AI that they're not going to see in machine learning, so that there's a little bit of overlap, but it's not a huge amount of overlap. So that is, kind of, always a choice I have to make every time I teach AI. I have to decide what I'm including. And so I just removed a topic that– it's okay to remove a topic. It's … people– I think of the class as teaching you of how to think about AI, and once you kind of have the idea of how to do it, you can apply it to another topic later. But I'm going to show you four or five or six really big ideas. And then, when you try to learn about a new topic, those big ideas, some will apply. Some won't. But you'll have the kind of structure you need to to understand that new concept.

AK: Yeah, very nice. Thank you so much for that response, and I think that … helped kind of clarify, just because, as you mentioned, AI, is something where there are an increasing specializations across time, right, there are just particular specialized applications of AI that might be more valued or pushed to the limelight more. And … that is something that is dynamic and changing because that is the nature of the industry. And so it makes a lot of sense that you do have to make those kinds of decisions on a semi-routinely basis just to assess but to also recognize … that if there are more fundamental concepts of AI that can be honed in and articulated through these 5 different major topics. Then hope … that will be adequate to equip students to be able to take those concepts and apply them into other fields that they might be interested in, after graduation, etc. So yeah, that was really helpful. Yeah, the next sort of questions is gonna go more, not within the context of a course but more departmental-wise, and so has there been departmental conversations, or even cross-departmental conversations, even particularly within the NSE Department, for example, concerning the integration of socially and ethnically-oriented understandings of the computer science discipline, for example. as well, as conversations around diversity, equity, and inclusion?

Faculty A: So there is a group … There's a committee. I'm trying to remember what it's called. It's basically about excellence in science. It's a committee that every science department has a member on. And you know about the teaching and learning center which has recently been started, right? That Elaine is … from the Education Department is running the Teaching and Learning Center.

AK: Nothing much about it, actually.

Faculty A: It just started this year. But the idea of a teaching learning center is that it's a place where faculty all across the college could go and think about teaching in a meta way, right? How could I become a better teacher? How could I grade in a different way? How could I motivate students? How could I– come film me teaching and give me some feedback about how I'm doing. It's all those kinds of things wrapped up into one place. And so for many years this group, this committee, this Science Excellence Committee, was involved in pushing this, "We want a teaching and learning center. We think it would be

beneficial to the college to have a teaching learning center." And also was thinking a lot about things like … we have a writing requirement. Should we, as an institution, have a quantitative requirement? Maybe a Q would be attached to some classes, like there's a W attached to some classes? Are there certain quantitative reasoning things that every student graduated from Swarthmore should know? For example, how to interpret a graph. What's happening … how to interpret statistics to know that something is a real fact versus something that's just a spurious thing . So we've had lots of discussions about that. I was on that committee for several years running, but it's been 3 or 4 years, so I don't know what their focus is these days, but those are some of the things that we talked about. And another example is… so data science is an interdisciplinary concept, and at a lot of institutions, you would have a data science program, an interdisciplinary program, and it would probably have statistics and computer science and some social sciences in it. And it's something that we have talked about off and on, members of CS have met with members of statistics and members of other departments, like Econ, but partly what happens whenever we sit down to talk about it is, we're … three of the most over-enrolled departments already: Econ, Math and Stat, and CS. And how are we gonna start this new program? How is it even gonna work? We don't have the staffing to do it. And if we start offering these data science classes, even more students are going to want to take these classes. So partly, we kind of end up being overwhelmed with thinking through how to do it. But I think there's a lot of people who think that we should have data science here, but right now it's just kind of spread out in a lot of different courses, as one example of ways that we talk to each other. So Ben Geller– do you know Ben Geller? So he is right now in charge of the S3P, the Summer Scholars Program. But he also is kind of a person who oversees all of the student mentors across all the different science departments. So he runs some training. So Lori runs training just for our ninjas. But Ben runs training for all of the wizards and the pirates and the ninjas and everybody. So that's a way that we all are trying to think about how best to support students, to make science at Swarthmore welcoming and accessible to the broadest range of students possible. So there's all kinds of different things happening at the science level, thinking about excellence in science teaching, and how to be the best kind of science programs that we can have.

AK: Yeah, but that makes a lot of sense. And I appreciate you highlighting just a lot of the more cross-departmental conversations that happen, and a lot of times the navigation on … how to go about some of the initiatives and desires of integrating more interdisciplinary curriculum, like data science, into the college. Which is something that, I feel, as students it's very difficult for us to know about this, because it happens on more of a faculty departmental-basis. So I really appreciate this insight. Yeah. And so I wanted to ask about the other aspect of my question, which was about whether departments within CS or maybe STEM in general have had conversations concerning integrations of a more robust social and ethically-oriented pedagogy within their departments?

Faculty A: So one of the things we've been talking about, and this is one of the things where we have some disagreement within the department. But so we, the CS major used to be nine courses, and then two math courses. So a total of 11 courses. When the number of majors started to grow so much that we couldn't actually fit bodies into courses and have them graduate in time, we removed one course from the major. So the major is now eight courses in CS and two math courses. One thing we talked about was, "What if we made the ninth course something they have to take somewhere else in the college? They can't take it in CS. And preferably they can't take it in science. They have to take it in social science or humanities, and it would be a course that has some relationship to computer science somehow, like digital

humanities or maybe it has some data science in it, or something?" We thought … Some of us thought that would be a really nice way to try to– one of the things people get upset with CS is that we're– we don't Swarthmore to become the college of computer science, right? We don't want everyone to major in computer science, and we don't want that either. We want… we're here because we love a liberal arts philosophy, and we want our students to be well-rounded, and so could we bring more departments? Could us having all these students actually send some enrollment to other departments to sort of help them with their under enrollments. But then the problem is, how would we decide which courses would count? And how would we make sure that there's really a connection there? And so, there's a lot of questions about how you could implement such a thing, but I still think it's kind of a good idea. And it's something we've talked about. We're going to have a retreat this summer. So maybe that's the topic we'll talk about again.

AK: Yeah, thank you so much for that. And I feel that is something that I feel goes with the kind of limitations that… you know about faculty bandwidth and over enrollment and things, but also trying to figure out creative solutions to encourage interdisciplinary engagement, just because we are within a liberal arts college, and that is something that we are able to leverage would be compared to other more research institutions where their students have less mobility in terms of what classes they can take if they decide to commit to a specific major. And I think that … one kind of creative solution to this eight credit limit would be to have in a requirement that does encourage computer science students to to engage with either social science or humanities-oriented classes that does bring in their computational knowledge to be able to contextualize their engagement with that particular course would be something that's really interesting, but would also encourage a lot of inter… their cross-departmental collaboration and engagement, which I think is really really interesting.

Faculty A: There's one other idea. So, I'm not a fan of this idea. But one thing people have floated out there is that, "What if we had people from other departments teach CS 21?" So what if someone from English taught CS 21, just like in the … lots of courses can be writing courses, right? You don't have to be in the English department to be a writing course. You can be in any department and be a writing course. Could we somehow gain faculty by farming out 21 to more faculty and other departments? It's kind of a radical idea. And I'm not a fan of it. And the reason I'm not a fan of it is because I think to really teach 21 well you actually have to really know computer science well. And I don't think someone just kind of picking it up is going to have the depth of knowledge to teach it well. And so people have been saying, "Well, you could mentor them." And then I'm like, "Well, if I have to mentor them, then it's not really saving me the work." Farming it out is not really gaining me any time, so I do think co-teaching it with someone could be super interesting, but that also is very costly in terms of faculty resources. I've co-taught courses. This will be my third time with [Professor Z], and every time it's been amazing. I loved it. I co-taught, of course, with a psychologist who's not here anymore on sort of computational models of psychology, and I co-taught, of course, with an engineer who's not here anymore on robotics. And now I'm going to get to co-teach with [Professor Z], and I think co-teaching across disciplines and across divisions is super useful for the faculty and for the students, because they get to see totally different perspectives applied to the same problem. But it is very resource intensive.

AK: Yeah, thank you so much for sharing that and for inter … And I didn't realize that I was actually pretty surprised by one of those ideas that was run around was to have another professor from another

department teach the Intro to Computer Science class. I thought some concerns that I would have, just alongside the ones that you mentioned, was just about, a lot of times how that maybe can undermine … the qualifications that you need to effectively teach CS 21 that doesn't just involve knowing … knowing Python, for example, but also that I feel a strong foundational experience within CS 21 a lot of times can affect how well students do, and the … other intermediate network of courses, or even whether they decide to pursue other intermediate and upper-level courses within CS 21. And so I feel there is also a lot of conversation around that, I think. But I appreciate you kind of sharing those other ideas that have been…

Faculty A: To me, what the big goal for 21 is that when you're done, you've been exposed to how to think like a computer scientist, how a computer scientist would approach a problem. And I don't think if you are not a computer scientist, you would necessarily be able to express the ideas in a way that a computer scientist would, so…

AK: Yeah, I definitely agree and that it isn't just about relaying the more static kind of content of the material, right? There is a particular art to the way in which you want to relay those materials and what things you want to push to the forefront, and I think a lot of it has to do also, with not only learning how Python works, it's also … like you said, it's more of a kind of combination that you have to build, especially when you are starting with CS 21, where you might not have any experience and you have to build those skills. And it's something that I feel I really appreciate within CS 21, and it's something that I've been writing about in my positionality statement, my thesis … just because I think that one of the truly important aspects about learning computer sciences was that … the cognitive orientation that you have to embody when you're solving things, in terms of coding and things like that, because I don't know… To me, it makes me reflect a lot about what exactly I know. When how do I identify particular gaps in my knowledge, just because the whole time– or a huge access to computer science is that you have this idea of a particular functionality that you want to implement, and you want to sort it into line by line, instruction code, right where you have to be super meticulous, and so to … be sometimes a little bit pedantic, right? And identify particular things that might be missing where the computer might not be able to translate what you thought you meant into executables, right? That is something that is so important within the idea of thinking like a computer scientist and something that I feel is … definitely does not go away, right? But you take intermediate upper-level courses, something that you actually enhance over time. So I think that you're absolutely right. .... I feel, hopefully, they'll be able to consider those aspects as well when they think about that particular kind of solution or approach.

Faculty A: Yeah, I don't think it gains as much. So, hopefully, we've squashed that idea. We'll see.

AK: Yeah, All right. Yeah, that's really great. And then the other last subset of those questions was just, have the topics of social and ethically-oriented curriculum and the DEI initiative …Have they been discussed in tandem with each other?

Faculty A: So there's an institution called ACM, which stands for American Computing Machinery or something like that, right? So they put out a sort of model curriculum, and I think I talked a little bit about this the last time, and so that model curriculum is kind of for all CS departments across the whole country. But a smaller liberal arts college can't possibly teach that curriculum, because it's expecting that you have

25 faculty or something. And so there's this group called LACS, Liberal Arts Computer Science and they introduce their own model curriculum for liberal arts schools. And one of the things that's interesting is that the ACM model is now starting to have more and more social aspects in the curriculum. So the curriculum is starting to say, "You need to be spending some time talking about social implications of computing. You need to be spending some time talking about bias in data," and so on. And so I think the last time we looked at the curriculum …that model curriculum, and we looked at our curriculum and we tried to look at what we were missing and what we did well, that was one of the things that a lot of us identified that we wanted to try to integrate that more into more courses. So I think it's something like the way that I've done it in AI, and the way that [Professor name redacted] has done it in machine learning. I think there are some courses where it lends itself really well. I think other courses it's harder to see how you would get social implications in them. And maybe some of the systems courses are that way. Maybe some of the theory courses are that way. I think the group 3 courses, it's easier to see how to get those topics more embedded in the course but I think it's worth thinking about for every course and thinking, "Is there some way I can connect to society and how this might affect society?"

AK: Yeah, and have those kinds of conversations been talked about with regards to the initiative that the department also pulls? Just because if we're talking about social and ethically-conscious curriculums, right? It's one of the things that A. Not only affects marginalized populations on a societal level, but it's one of those things where … There has been studies shown that marginalized students within CS or in STEM are more inclined to be interested in having those conversations with the department, and that might perhaps encourage more retention to marginalized students if those conversations are also addressed, because those are things that they themselves find valuable and important to talk about.

Faculty A: I mean, we've definitely looked at those studies that show that. And especially even women, female students seem to be more engaged in computer science when you use socially relevant examples rather than a physics example or something else. And so that's definitely something we've talked about for a long time. I think we haven't systematically sat down and looked at every single course and thought about "how could we?" It's more if the particular instructor is excited about doing that, it happens. But I think going forward, it is something that we're gonna think about more, because I just think it's … you have to. … We're at a liberal arts place that it just makes sense… should be part of the curriculum.

AK: Yeah, that makes a lot of sense, and I think that's a nice segue to the final question that I wanted to ask was that… You've mentioned that there are faculty, including yourself and [Professor name redacted] and [Professor name redacted], for example, that do find these pedagogies important, and that there has been initiatives from each professor teaching their own designated course this semester to creatively integrate a lot of these conversations into the material for the course they're teaching. … I wanted to ask, what are the current barriers or struggles to implementing a more robust integration of these kinds of pedagogies within the department that you maybe haven't articulated before or something that you want to share.

Faculty B: I think it would just be what you mentioned earlier. If you're adding something into a course, it almost always means you have to subtract something out because you can't just keep adding and adding, because it's going to be too much. So to make the time and the space to add some of these things, it means you're gonna have to get rid of something. And for some people that's more of a struggle than others. I

remember how we have a 14-week semester in the spring and we have a 13-week semester in the fall. There was some … There was a time when the faculty were trying to convince… were trying to decide, "Should we just have two 13-week semesters?" It's kind of weird that we have one semester that's longer. So if I teach AI in the spring, I have an extra week. But if I teach AI in the fall, I have one less week. And there were certain faculty who were like, "I could not possibly teach my class." This is like the general faculty, not just CS. "I could not possibly teach my class in 13 weeks. I must have 14 weeks. There's no way. And so if you got rid of that week, it would just decimate my course," or whatever. And so I think that some people are very rigid and thinking about, "I have to cover X, Y, and Z. If I drop X, it won't be a course anymore. It's not a good course anymore." Whereas, I'm much more like … as I was talking about AI, I move things in and out all the time, and I'm much less wedded to particular topics than to sort of the big ideas that I'm trying to get across. So, I think, for some people it's just hard for them to imagine removing certain things, which means it's hard for them to imagine injecting new things because "how am I going to fit that in?"

AK: Yeah. And I feel with those considerations, right, about, "I need the X, Y and Z components to be integrated into my curriculum. This is something that is non-negotiable," or "How can I have one less week of the semester?" And I feel those kinds of considerations should go hand in hand with evaluating the retention of what these students get out of these courses, right? If the purpose of making sure to implement all of these aspects of the curriculum into the courses, I'm wondering how they would also be able to gauge whether all of these components are things the students are really responding well with. That they're engaging with them. That have a lot of more pragmatic or value after they beat the course, right? I was wondering if you have had those kinds of considerations when you were teaching your own course and shifting the curriculum and things like that.

Faculty A: So I mean one of the sort of philosophies of how we do things in our department, anyway, is that if you're teaching 21, 31, or 35, we have a curriculum, and you are following that curriculum. That's just how it is. We have a structure, and we want these topics covered, and you have to follow that. Because we've had in the past, visitors who come in and then make CS 35 way more about C++, which you have to learn a language, and it happens to be C++, but that's not what the course is about. The course is about data structures. And so we've made it very rigid because we want to make sure that the things we care about are being focused on, and the things that we don't care about are not being focused on. But when you teach an upper-level course in our department, we figure that you are the expert in that course, and you have free reign to run that course in– as long as it's a reasonable way of running it. I mean, there's lots of typical ways you could run it. You could have a project at the end. You could have a couple projects throughout. You could have labs every week. You could have a very much more discussion-based class with lots of readings. But as long as you're running a reasonable course, we kind of let you run it the way you want to, and I think that if we … I think it's hard at Swarthmore to say to everyone you need to do things a certain way in your upper-level course, which you're the expert in, because they feel very protective of that "this is what my expertise is. I know what's best. I know what the students need to learn," so on. But I totally agree with you that that one extra week that they spent on topic Z, who knows if the students a year from now we even remember topic Z. And had you thrown that out and covered implications to society more, maybe that would have been retained so much better and would have been much more useful to the students. But I think it's a hard sell to certain faculty. I definitely think it is a little bit, I mean, even though I'm the oldest one, I would say there is a little bit of age … the longer you've

been doing it a certain way you can't imagine doing it another way. I mean. I've always been someone who's very willing to adapt and try things. So I don't think … But I just think if you have been doing things a very particular way for a long time, it's hard to change.

AK: Yeah, I mean, that makes sense, right? And there's always these kinds tensions of you're respecting a lot of the agency, and valuing the expertise of a particular faculty in terms of how they want to teach their particular class, versus being able to be more reciprocal of other input or changes right within the curriculum to things that the department in general or the college in general deems important. And it does make sense that the intro and intermediate classes are pretty static and rigid in terms of its curriculum, just because I feel it does pave a lot of the way for students' aptitude and capabilities and confidence when they reach other… more of the upper-level classes. And so I feel there is, I think, a lot of times the lineage between the connection between CS 21, to 35, and 31, and then I feel then back to upper-level courses. But I feel within the upper-level courses, I don't see as much of a good connection between each one, maybe, for AI and ML. Maybe, for example, that might be something very related. For me, PL and Compilers, I don't know, because they're both taught by [Professor name redacted], and because they use OCaml in both. But I honestly would say that, I feel … [Professor name redacted] and I have talked about this, but I'm in Compilers right now, and a lot of the students within Compilers took CS 21 and CS 31 during the pandemic. And a lot of times I feel it might be something that is acknowledged by other students as well, and including the faculty that, doing it within that pandemic and remote learning was definitely not ideal, right? And that there were a lot of shortcomings and limitations that– not by their own design, but because of the access to remote learning, but also my CS 31 class is a class of 72 people, which also has a lot of difficulty in that. But that is definitely … I feel has influence, people's comfortability with assembly language, for example, because compilers is very much based on that. And so, I do understand a lot of times the fact that there are particular things that need to be addressed in this particular adequacy in 35 or 31, for example, that a lot of times is very helpful and meaningful when you get to some of the upper-level courses that take those particular concepts, and really kind of build upon them. So I really do understand what you're saying, within those kinds of methods.

Faculty A: But one of the cool things, at least 21, is we pretty much invent a new lab for every lab in 21, every semester. And partly we do it because there's a lot of cheating and we want to avoid that. So there, there. If you're doing something totally new, there's no way you can at least cheat off previous years, but we also do it just because we can then make it be about something that's happening right that minute in the world. So if it's an election year, we often will do sorting and searching on election data, some kind of election data. If there's been some kind of shooting that's happened, maybe we do it on data about people who've been … gunshot deaths around the country. We do all kinds of different things, and so we try to make 21 be as to-the-minute as we can for certain things, and I think they are trying something new this year in 21. I just heard [Professor name redacted] and [Professor name redacted] talk about it really briefly, but they did some kind of data and searching and sorting, and then they had a discussion about the data as part of class, which I had never done in 21 before, so I don't know the details of it. I just heard them mention it really briefly, but I'm going to find out more.

AK: Yeah, yeah, that sounds all really great. Thank you so much for these responses. They are really really helpful. And I feel would be really valuable insight to what my thesis is trying to kind of research upon. And yeah, those are all the questions that I have. If there's anything else that you wanted to mention

before, we end this interview related to the questions that we ask. Yeah, feel free to kind of mention them. But it's not that's it for me, and thank you so much.

Faculty A: So do you have a thesis to your thesis, like what is your main question you're asking, or what is your main thing you're going to be focusing on?

AK: Yeah. And so the general research question that I'm asking, and I don't have it pulled up line by line, but it's basically kind of talking about the institutional processes of implementing socially and ethically-conscious pedagogy within the department, basically. And so I think a lot of that is a reconfiguration of values in CS and STEM in general, I think. Just because now I feel we're starting to shift from teaching and understanding STEM as something that is static and objective, into something that is a lot more dynamic. It needs to be kind of contextualized within the social environment that it exists in. To me, it's studying … the shift. and how that is happening. What is important to the students in terms of their preparation for when they go into industry or research, if they pursue computer science work after graduating? And also a lot of times, the institutional, and the more bureaucratic barriers with making a lot of these changes happen, right? Which is why I wanted to ask a lot more questions related to that is just because it's something that it is very difficult for me to look up or research about, right? But again, it's still, I would say, such a huge aspect into the challenges of integrating a lot of these kinds of initiatives are things that no one really is able to really change on their own, right? And I think that also plays a factor into broader issues, just about trying to hire faculty and to be able to balance the number of faculty with the number of students, the department, and things like that too.

Faculty A: So yeah, one thing that just what you said made me think of … The college has at times had money available to do curricular development. So, for example, if you were gonna introduce a new course that you wanted to like, go to Chester and do something with Chester as part of the course you could apply to the Lang Center and get money to help you plan that course out or have the time– Give yourself some summer time to be paid to focus on that curriculum. And so the course that I'm teaching with [Professor Z], I may have mentioned this to you before, but we got a grant from the National Humanity Center to make that course. And so we're getting paid a good chunk of money to have … to incentivize us to make this course that is about creating responsible AI. So I think that a lot of faculty have trouble finding the time to do these initiatives where they're trying to push beyond what they've been doing into some of these new areas and funds like that can be a really good way to help faculty make those changes.

AK: Yeah, thank you so much for that accent. It's actually something that I really haven't considered before. But I do think that it is something…a huge factor in, so I guess, navigating the more institutional limitations, right of etc., and perhaps getting more support or funding from these third party institutions, to be able to receive grants.

Faculty A: so that you feel more kind of supporting. And this ever I feel is, something that I want definitely take into consideration when thinking through the research question that I have for this thesis, and that was really helpful. But yeah, is there anything else that you wanted to kind of mention before we end. This would be the last thing I promise. So in this grant the national they made the institution agree that we could co-teach this course so they said, we're not giving you the money unless you agree that they can Co. Teach this course. And the other cool thing about it is there's 15 other institutions who are

also inventing new courses, and we all meet once a month and talk to each other over zoom and share ideas. So none of them are computer scientists except for a few. And so I'm going to share some Python notebooks with them that they can use in their courses to show people what deep learning is, and things that, and they're sharing with me readings that I would never have thought about or known about that I could cover in my course. So I think that these big initiatives can really be important to moving people out of their comfort zones and trying new things, because you have all this support.

AK: Yeah, and I really like the idea of the cross-institutional kinds of collaboration as well as cross discipline, kind of collaboration. And I feel these kinds of initiatives also address maybe some of the concerns about faculty's own qualifications on teaching about more interdisciplinary aspects of Computer Science, when for example, a particular faculty, major in Operating Systems, within their Phd and stuff. And I feel initiatives can also just allow faculty to even evolve within themselves as kind of instructors, or even learners of their own. I feel like that's something that I feel is really valuable, especially just because it also is really hones into interdisciplinary collaboration.

Faculty A: Yeah, really cool. The more the college could do that itself would be really beneficial too. Well, good luck with your thesis and you gotta finish soon right?

AK: Oh, yeah, this month is going to be incredibly busy for me. But yeah, I really appreciate you taking the time to do this interview. And yeah, I'll follow up if I have any kind of information or things that I want to relay.

Faculty A: Bye, bye, thank you.

Appendix D: Faculty B Interview Transcript

AK: Alrighty, yeah. So would you mind introducing yourself a little bit? How long have you been working at Swarthmore? What did you mostly teach when you were a faculty member here? If you had, like an academic specialty within, like a subfield of computer science, feel free to also include that as well. And what work do you do now as a dean?

Faculty B: Great. So My name is [faculty name redacted]. I've been here since 2011, so 12 years now. I arrived as a visiting Professor, and then I came out of tenure track in 2012. My area of specialty is Machine Learning, and in particular, applying machine learning algorithms to problems in biology and medicine. So I look at some interdisciplinary projects working in … there. My courses have been related to that. So initially, the courses I offered were bioinformatics. Then I offered machine learning as well. And I've also taught at the introductory level, primarily the CS 21 course, and CS 35. So I will return back to the faculty. I'm in a 3 year position now, where I'm on a leave. So I'm Associate Dean of Faculty for Diversity, Recruitment and Retention. A lot of words there. What it comes out to is I work a lot on early career faculty development, so mentoring and development workshops with the new faculty that we hire. And I work a lot with departments on shepherding along our tenure and review processes, so making sure that everybody is following standards. And as well as with hiring and searching, so I do anti-bias training with the search process. I interview all of our tenure track finalists–things like that. So a lot of things related to those conversations, and diversity and recruitment and retention are there because those are underlying themes to all of those activities. So I think about, and I study with faculty on the committee that I serve on, various retention policies and recruitment issues, particularly those that impact faculty from backgrounds that are underrepresented in the academy.

AK: Yeah, that's perfect. Thank you so much. So, now I'm going to move on to the first general subset of questions, which talk about the process in which the Computer Science Department assesses and evaluates how the Department is doing, basically. And so the first subset question that I wanted to ask is: what factors into how the department measures this efficacy regarding its alignment with its missions and values and student academic success and well-being?

Faculty B: Yeah, I would say there's a variety of approaches here. So there …the constant one is that there is a requirement from the College that every department, every year evaluate or assess one of their departmental goals. And so we do have a process every year where we decide which goal we are going to assess, and we come up with a process to do it. It's direct assessment. So it's not surveys, it's actually looking at the curriculum. And so it could be that we look at exam questions that evaluate a certain concept that we expect all of our courses to teach, and we go through at the end of the year and evaluate how students did on those questions and their courses… I think we like to…we like to touch as many of our goals as possible. Some of them are more global goals and missions in our curriculum. And so it's not easy to say like, "Let's look at our exams, or let's look at writing assignments." And so, we have other mechanisms for doing our evaluation. It could be a student survey, it could be ... We have a retreat roughly every year or so, where we focus in on some topics that we've identified of interest. It could be because faculty have identified it. It could be because students have identified it. So, there's a myriad of ways at which we address those, and we reevaluate our mission and our values every year. We check to see the ones that we have and go from there. The other aspect is, I think, there are internal and external

metrics as well. So, we have …The ACM is the main organization for computing. They occasionally output documents about curriculum or about trends in the field or etc.. And, we will often use that to inform … check to see our ... is our curriculum in alignment with that. And, then there are internal discussions about what's going on at Swarthmore. So, particularly amongst the NSE faculty, the chairs will meet very regularly, and there's a lot of initiatives that come out of there.

AK: Yeah. And then the other kind of aspect was that do you guys have any departmental conversations about how you gauge students' academic success and well-being within the department?

Faculty B: Yeah. So, as part of the direct assessment we do, we do look at student success in terms of our ability to get across the key skills that we think that the Department requires. I think there's other ways to do that as well, right? So, we do look at how our students are doing post-graduation. We often get the college to run alumni surveys and give us feedback there. We have conversations with our students that have graduated. We have conversations with our students informally through advising. I mean, we occasionally have departmental-wide surveys, as well. So, I think the last one we did was during the pandemic in response to the Black Lives Matter movement. We had a survey of students there. I think we rely on the college to help us a little bit, too, in terms of identifying trends, just because, anecdotally, we'll talk to students, and we'll see things in our courses. But I think there's some trends that we have as conversations as a college, as a faculty about what's going on in a wider basis?

AK: Yeah, that's great. And I remember that you mentioned that we do have, or the part of the department process, is to evaluate its kind of missions and goals on… an annual basis. And so I want to ask more specifically about how does the department identify and develop areas of growth for improvement? What is that process generally like?

Faculty B: So we have a meeting at the beginning … We have at least one or two meetings at the beginning of the year to talk about…What are the things that are of interest. And so each faculty member has input. It is very much driven based on our expertise. Like what are we seeing in the classroom? What are we seeing in the field? What are we identifying? And we come to a consensus on what we should focus on. And it's not necessarily one thing, but we try to at least find one topic to focus on. I would say we have a pretty good sense of what our troubles are, what are some blocks… So, for example, the idea of abstraction is a core concept in our field. And so, I think we try to weigh things towards what are the core concepts that we teach across a lot of our courses. But other things are … What are some building blocks we expect in our introductory course? And are we sensing issues when we have students coming later in the curriculum that we're having to re-teach those things or they're not remembering them? And so then we want to go back and evaluate. Where is that being lost or are we not teaching it properly the first time? So I think that's how we come across…We do that every single year, and I think there's a lot of institutional memory from year to year. So we say, "Okay, there are two things this year. We only have time to do one." The following year we often will choose the second item or decide to continue evaluating the first item because we're trying to institute some changes.

AK: Yeah, that's really great. And yeah, within these kinds of processes where you guys are assessing efficacy and being in conversation with other faculty members of the Department, when you guys ultimately do have to make a decision on changing a part of the objective or mission, or changing part of

like the departmental infrastructure, let's say, if members of faculty have like conflicting ideas or values, what is the cost of how they're negotiated or resolved? And are students' input also factors into these kinds of decision-making processes?

Faculty B: Oh, definitely, yeah. I mean, I would say, we don't have like students voting or anything like that, but we do gather feedback from students that informs all of our discussions, particularly ones that are significant changes. We're often wrestling with things because we know they're not going to be popular changes, or they're not necessarily the … They're not obvious changes to everybody, or even in agreement. I think we try to live into the Quaker idea of consensus as much as possible—that doesn't mean that we fully agree on the resolution, but that we've all had an opportunity to voice our concerns or different opinions. And there are not … We try… We don't take straight votes. We often say, "Okay, well, maybe I don't agree with this, but I'm willing to step aside, since I sense that the other faculty feel much more strongly about this than I do," or something along those lines. So again, I think it varies by topic and issue. I think core changes the curriculum more often than the most contentious, or hiring decisions – those tend to be the ones where we have much lengthier conversations, and have to navigate differences. But, as much as possible, we try to develop a consensus in the department.

AK: Yeah, that's great. So I'm just gonna move on to the next question, which is about faculty roles and responsibilities. And so, the question is, what are faculty goals and responsibilities, aside from teaching their designated courses? So what would you say is the bandwidth to which faculty must embody on a semester basis?

Faculty B: Let me know if I'm going off base here, but my understanding is that you're interested in what we are doing outside of the classroom? What are the other responsibilities, right? So, we divide things up into teaching, scholarship and service. And services come to this big bucket that varies depending on your point in your career. So, early on that tends to be a smaller bucket. And then, as you advance in your career, you're expected to take on more of an institutional service responsibility just because you've built up the institutional knowledge, and you have more of the bandwidth since you're not worried about getting tenure, and all those things. So I would say scholarship is a huge thing, right? So that takes up a lot of our responsibility. So supervising students, attending conferences, doing service within our fields, like reviewing papers, things like that, giving talks on campus about our areas of expertise. Service can include advising students. Serving on committees of the college is a huge part of it, and then service within the department is a huge aspect to it as well. So we try to divide up roles in the department. So an example would be, I was a faculty mentor, which didn't mean that I was responsible for mentoring all the faculty, but I had to make sure that all the faculty that were junior faculty were getting mentoring from at least one senior faculty member. So we'd sit in each other's classes, and I would come up with the schedules for that. It's somebody else who takes on the responsibility, for example, of organizing seminars and talks. We have one person that does the assessment job that we talked about earlier, whose job is to attend the college-wide meetings and communicate what we're doing as a department. So, we take on a variety of service roles that take up a large portion of our time, and it really is all encompassing anything from student-facing to college-wide-facing to our scholarly field-facing.

AK : Yeah, that's really wonderful. Thank you. And I'm just going to move on to the next set of questions again, which talk about the construction of the department to the mission goals. And so maybe the first

sub-question I wanted to ask is, how does the broader institutional missions and goals of Swarthmore College affect the Department's mission and goals?

Faculty B: Yeah, I think it has a huge influence. We're at a liberal arts college, a small liberal arts college. We're not… You know when I talk about looking at the ACM Guidebook, there's no way we're going to meet all of the requirements they have in there because they're assuming that students are taking 16 courses and so on. So we live into the goals of the college as much as possible within our discipline. There are sometimes gonna be trade offs. So, for example, I don't think it's controversial to say that we haven't lived into the honors side of the curriculum as much, just because we have so many students we've had to cut some of our seminars and things like that. But we try to think about how students can integrate their way of thinking. We think about students in terms of computational thinking, and how that fits in with the way they approach learning in other subjects. We try to find integration across departments as much as possible. We try to think about what the classroom environment is, and the expectations and the interactions that students are expecting when they come to Swarthmore. So I think, when you look at our mission and our values that are stated, a lot of that's in there, so we expect students to be able to write in our discipline. We expect students to be able to communicate within the discipline. We expect students to be able to take ideas of filling in different subjects and bring them into the classroom, but also take the ideas of computer science and extend them outside the classroom. So I think those are a lot of things that are from the college mission.

AK: Yeah, that's really great. And I'm not really sure just because I know that you haven't directly been working as a faculty member of the department. But I was actually just wanting to ask if you know what the current missions and values of what the department looks like now. And … I don't know… your opinions on what that looks like. If there are any areas of improvement. But also feel free to… yeah, like, say that I don't know if you haven't…

Faculty B: I've been in the day to day business for the last year and a half, but I think I've been abreast of any major shifts. I would say there hasn't been a major shift in the last year and a half, so I think … I still have a good amount of understanding there, so you… Sorry, can you repeat the question? That it's about what my views are on the current mission?

AK : Yeah.

Faculty B: Yeah… I like our mission and our values, and I think we've … It's been iterated on over many years, and I think the core of it is pretty timeless in the sense of the things that we get across. I think we've been successful working at the edges of trying to adapt to the trends in the field as well as trends in the college. And so we definitely have adapted some in small places there. I think the one that in my mind that I would like to see uplifted is the consideration of where ethics and social good fits within our curriculum. And I think there is a widespread feeling of that in the department. But it's not something that we've solidified. It's still a work in progress, so I think it's not so much that I don't think our mission or our values don't include that, but I think we need to work more on that still.

AK: Yeah, thank you so much for that response. And I actually wanted to circle back to when you were talking about ideas of … having missions and values that encourage taking the things that you learn in

computer science and applying it into other disciplines or taking other disciplines so and applying it to the context of … computational thinking etc. And I wanted to … relay that I had interviews from… recent student alumni from the CS department, who are currently working in the CS industry. For example, one of the students that I've interviewed is now an ML Engineer at a tech company. And they were basically talking about how , just because a lot of the courses are oftentimes very rooted in its theoretical components … They express that they particularly enjoy the aspect of their experience at, and being a CS Major, where they were able to take a particular concept and apply it to a project within a social context. Just because that level of thinking also requires particular skills and considerations on how to approach those kinds of things, which is what they found to be very important just because once they're working in the real life industry, they're working … designing or developing something that is going to be contextualized in some sort of real life level, right? And I remember this particular student interview that they really liked their machine learning class, and how they made a project at the end that would be able to apply their knowledge into a project but situated within a real life context. And I was wondering if you think that those kinds of values should be more integrated into the departments, or… Yeah, I was just wondering what your thoughts were on that.

Faculty B: Yeah, I think it's one of our missions and values is to give students the ability to … we expect students to have done a project, and applied some concept to a much larger idea. And it is one of the things that we struggle with, because we haven't been able to guarantee every student that ability, and we haven't been able to necessarily provide as many of those opportunities as … that we want. And so we have a … we do have like a … We have a trade off there, where we have … we don't have the staffing that we wish that we had, and we have a lot of students, but we also have to make sure that we get them the full spectrum of understanding the theoretical foundations and the applied side. Our Group 3 courses are supposed to provide that. The theme behind their group 3 courses are that they're more applied in nature, or they try to take some of the theoretical foundations we build**,** and like CS too, and apply them in real world scenarios. But again, it's hit or miss, in terms of which courses actually have a project, or how much they move into that applied lens. And so I would definitely say it's a goal of the department that every student should have at least one. And actually multiple of those experiences. And our capstone course used to be that. We used to have a capstone course that students had to take. That was a project course, and I think we really struggled when we had to drop that course because we've tried to have our other courses lift up what was in that one culminating course, but it's patchwork. It's not complete. And so I would say that's one of those ongoing conversations that we've had. I think the other difficulty is that supervising projects is labor intensive, much more so than a typical project or assignment that you can offer that's repeatable. And so I think that's another thing, where, if our class size were 20 instead of 40, I think we would have a lot more. We would have a lot more flexibility there. Even when you bring up machine learning, I've had to restrict the types of projects, sometimes, that students can consider just because I can't. If it's completely wild wild west, I can't supervise all of them effectively. And so, just trying to come up with a strategy. So I think there's a lot of tensions there, but I agree that we do think about … one of our core missions is that students should get the opportunity to apply in a much larger project the theoretical ideas to a real world scenario. We'd like to build more of them directly.

AK: Yeah, that's really great. And I really appreciate something that you mentioned is the aspect where supervising projects that students have designated by their own design. It is something that is a lot more labor intensive to manage, than, for example, like a prepared assignment that, like all students currently

follow. And while there is definitely a lot of benefits in having students' agencies to really hone in their creative or problem-solving skills, it is definitely something that has a lot of limitations in terms of practicality and bandwidth. And that's something that I really appreciate you mentioning. Yeah. And so I'm just gonna move on to like the next set of questions which actually is talking specifically about your experiences teaching the first year seminar of Ethics and Technology with [Professor Z] And so yeah, I think that my first question is, how did this course come to fruition?

Faculty B: Yeah. So [Professor Z] and I …we came in at the same time at the college, and so we were often … we're in the same cohorts, so we often interacted quite a bit, and I never taken a philosophy class, but I was really interested in hearing about her research, and so on. And so we would just … we started having a conversation, and I expressed to her that I was frustrated with the national conversation about AI in particular, and how it went straight to like the super intelligent, enslaving robot, and not really dealing with what was going on in the ground. And so we just started having more and more conversations, and she pointed me to an article that was written by a philosopher, and we just at one point said like, "Why don't we teach a course? Like this sounds like a course, like this sounds like something that we could do." And so it seemed like dreaming at first, but we kept working on it, and we thought it was robust enough to offer. So I think it was very much an iterative process. It helps that Swarthmore College allows faculty or encourages faculty from different disciplines to interact quite often, because if it was just a one time meeting it wouldn't have happened.

AK: Yeah, that's really great. And so, after you guys had decided that, like, "Hey, I think we have the bandwidth, and we want to implement this course," how do you guys both collaboratively approach the design and implementation of the course curriculum… and the teaching methods?

Faculty B: Yeah. So we have a lot of decisions to make in terms of the content, in terms of prerequisites, in terms of where it would fit in the curriculum. And so for each one of those we had a conversation, and some of them were more for me to say like, "Would this count as an upper level CS course? Am I quick… pretty easily recommended that we didn't pursue that path. It made much more sense to make it more accessible. And so, we … every one of those conversations we would just hash out together. Some of them required us to go back to our departments to have a conversation about, so, in particular, could the Department release me from my re- ... the introductory course they need me to teach in order to teach this course, and so I had to negotiate that there. In terms of the actual content, I think we really quickly, early on decided we didn't want it just to be case studies. We didn't want it to be like what a typical engineering ethics course would be, which is you read a book about case studies and then talk about them. Often, there's not like a framework that you build out of it. It's more about creating conversations, and with [Professor Z] being a philosophy professor, and wanting it to count as a philosophy course, I was very amenable to the idea that it was going to be grounded in some … in understanding philosophy first. So we decided early on we were going to give a survey of philosophical frameworks and a little bit of background on them. We knew it wasn't going to be a full fledged intro-to-philosophy-type course, but that was going to be where we started. We decided that we wanted it to be a discussion-based course. So we …that was, I think, one that early on we decided to make it a first-year seminar. Part of that was that I never taught one before, so I was really intrigued by the idea. We thought it would be good to bring in students if they didn't have a lot of background to kind of .... so we basically just had a lot of conversations about each of these individual issues, and we brought our own perspectives and interests

into that conversation. In terms of the topics, we marched through and looked at the literature that was out there and tried to group them together, and some things were an interesting topic, but they didn't really have a lot of themes that coalesced together. So we decided that wasn't gonna make the course. Other ones we thought we were gonna … it didn't really fit in with the frameworks that we were going to be providing. So we dropped those as well. And so we came up with some themes that were philosophical to begin with, and then more algorithmic later on. So we had a topic around algorithms. We had a topic around AI. We had a topic around bias and discrimination. And so we were able to fit in those themes together. And so I think that was very much just a collaborative process.

AK: Yeah, that's really great and maybe reflecting back on your experience teaching the course, but also reflecting on how this course ended after the semester, how would you describe your experience teaching the course? If there is any salient outcomes of the course that you were considering your reflection, and if you had an impression of what the students' experiences was like in the course?

Faculty B: Yeah, those are great questions. In terms of the student perception, I think it was generally very positive. It's only 12 students. So right yeah, small sample sizes here. I think overall, the students were happy that they took the course. There were some disagreements with … some students didn't… were not really… didn't have an aptitude for it… were not really interested in some of the computational things that we talked about because they were more interested in the humanity side, and vice versa. We tried to pick about 6 humanities-focused students and 6 CS or STEM-oriented students. And some of the STEM students didn't really pick up the philosophical approaches, and it would have appreciated more background there, and some… So I think we were-it just hard to fit every student's interest in that way, but I think in general, students were very happy that they took the course and the things that they picked up from there. I would say the positive outcomes were many. So one issue that I think comes up in one of your later questions is one of the issues as a department that we're dealing with is that we want to teach these things, but we don't have the skills and the capacity to do so. And so personally, this gave me the tools to be able to engage in those conversations much more fruitfully and effectively. So I was able to… I was a student for a large part of the course. I was able to learn from [Professor Z], and I think she would say the same. I think as much as you can read an article about something that's going on in tech, having a computer scientist explain to you what's actually going on underneath the hood is very helpful to understand what the … how the underlying issues play out. I think it was a proof of concept that we would not do it … I think we would do things differently. I don't think I would do a first-year seminar again. I think I would be- I'd want it to be much more widely available to students. But it gave us the ability to do a lot of these- to pilot a lot of these ideas. And so a lot of these topics that came up are now showing up in some of our individual courses. So I use a lot of them in my machine learning course. I know [Professor Z] has used them in and formed them in some of her bio and ethics courses. And I think there was an institutional framework there as well, where a lot of faculty outside that were not involved, were very interested in learning more about how it worked out, and replicating some of the ideas there. So I didn't cover everything, but I would say the main things were just like on a personal level there was a huge benefit, and then from a departmental perspective we built up a lot of … I think it was a proof of concept that was a positive outcome. And I think the students that I've talked to after the fact … were all universally saying that these are – it was an interesting conversation. They want to see it in other parts of the curriculum, and were glad that they were a part of it.

AK: Yeah, that's really great. And it really does seem like such… like a really salient (25:45) and insightful opportunity to have no person who is an expert in computer science and machine learning, in particular, with a professor whose expertise within, moral philosophy which I believe is [Professor Z's] specialization within philosophy. So, I honestly bet that there were a lot of really cool discussions and interactions. Note, from both faculty, but also the students that are coming in from different kinds of disciplinary backgrounds and perspectives. It is really nice to see that there was such a huge positive reception to the course, and to see that the students were able to have a positive response to it. And so I wanted to ask if there were any considerations of what a continuation or solidification of this pedagogical material would look like within the department. And if there were any conversations, what did that look like?

Faculty B: Yeah, there, so those are ongoing, and that is … the crux of the issue. I don't think there's a lack of will. There's a lack of … or in terms of how the implementation would work. I should add that also there were- I was able to reflect on this within my scholarly committee, so I give a talk at the mainAI conference about the experience. And what the common thing that came up there that's coming up here is just the limited resources, and I don't mean that in terms of like Swarthmore is poor or anything, but it's more like in terms of it's expensive to have 2 faculty teaching a course with 12 students, right? Especially when both the departments are heavily enrolled, and having dedicated courses for this. And so, really the question is, how can we manage to keep these ideas going given all the other expectations that we have? I don't want to have to give up my machine – the courses I teach. [Professor Z] has other courses that philosophy expects her to teach. We'll be on sabbatical every so often and so just a lot of logistical issues. So I think those are ongoing. I would say there are a few models nationally that I think we're using here. So one is teaching in a held aside course at the upper-level computer science levels, so teaching an ethics course for computer scientists. That's something that we're not close to. Yes, that would be nice to have, but I think it's just difficult for us to fit in, but it's something that we're considering. One is to have these types of courses outside of the department, and I think we- that's more likely to happen. Particularly, there's been a huge surge with ChatGPT and interest from other departments, and trying to understand how they can include some of these ideas in there. So I think we're more likely to see some of these topics spread throughout the curriculum. From computer science perspective, I think the model that works best, and that we've been able to do in medium turn, is this idea of embedded ethics. So the idea of incorporating ethical conversations within our existing courses. I think there's a few advantages to this. For one, it doesn't require us to teach a new course. It doesn't require us to hire somebody to teach a new course. It doesn't require us to make a trade off there with dropping some course of handing in …In putting this course in place there. The other advantage is having talked to [Professor Z] and read the literature on effective ways to teach ethics, it can actually be protected to have a separate course, because students often think it's a- they've checked off that box. And the idea of embedding it within our courses means that you're seeing it multiple times throughout your career, and it's not- it's something that we think is- it should inform your thinking throughout the process of being a computer scientist. And so I've been able to do that. We did that the first- the last time I taught machine learning, we incorporated in each of the lab assignments, and then had a held-aside week for it. I know AI has done that, so I think that's an ongoing project to incorporate more of our courses. I'd like to see it come into the introductory courses. and so on. We also have a new hire that… who thinks about this quite a bit as well. That's starting next year, and one of their ideas is to teach a course on it, so that's a possibility as well. I think the bigger goal of mine that is … been frustrating that … It's hard to get to, but I would like to see is, while a lot of

people have been very open, have been very positive receiving this at the college, [Professor Z] is really the only one that's been eager to like, actually do it. Like actually partner with us, and doing these things. And so she's actually going to co-teach a class with [Professor A] next year. And so I'm trying to figure out why is there a hesitance from other faculty at the college that are positive about this, But Haven't really jumped in, and is there a model for maybe having a single course that you swap in? You swap out the philosopher and bring in somebody from black studies to … there's more of a focus on.. the implications on marginalized groups, or we swap out the computer scientist and bring an engineer to talk about… something related there. So I think that's an ongoing conversation. So lots of implementation issues, but we've made that- we've had successes stepping stone successes along the way that I'm hoping to keep building up on. My dream is that we would have- I'm not saying that this is shared by the Department. My dream would be that we would have- We would bring back our ninth course that's required, that what used to be required for computer science, but it's not necessarily taught in the Department. It's some kind of course that requires students to apply their computational knowledge to one of these more ethical or social issues. So it doesn't have to be ethics. It could be … it could be something more in the political science realm or the social science realm or the humanities realm. It could be a myriad of options. If students are interested in art and computer science, maybe there's something there that could come into play. But there would be a course that's taught outside of the department that plays on some of the ideas that we're trying to get students to incorporate in their curriculum.

AK: Yeah, that's a really great response. I actually really do appreciate highlighting there's a lot of different kinds of pathways to… You kind of articulated on how you would approach implementing or integrating these kinds of curriculums and conversations within Swarthmore's CS experience of students. And the thing is that I definitely feel like I don't want to undermine the fact that these are conversations that are happening. It's probably not explicitly being said, mentioned to students, because these are all processes that are… in the process of developing, trying to fix, discern, just for an outline of how exactly it's going to go, and it seems like those kinds of initiatives when you had mentioned the ninth course or something… could have been something that like … if the senior capstone was something that was implemented again. That's something that students can pursue in that direction. I remember.. I remember talking to [Professor Z] and she was telling me about how because of … they have to cap the credits, I think like at 8 credits back in 2019, they have to get rid of the senior capstone. And I remember her talking about the fact that she really thought of that as a loss because she had really good experience with leading the capstone, and … she was also seeing some really cool work from students as a result of the capstone. And so yeah, I think that's a lot of conversation about faculty bandwidth. There's also conversations about the fact that there's just a lot of students in the Computer Science Department right now. And I don't think that is something that's gonna change soon, just because it is something that is of a wide interest to a lot of people, and those also aspects of departmental hire and things like that as well. So I really appreciate you highlighting those things, and I remember you mentioned the idea of embedded ethics, right? The idea that ethics, and socially conscious considerations, isn't something that should be supplemental. It should inform your everyday practice as computer scientists. And I was wondering if there were any conversations about trade offs between taking a current existing curriculum that doesn't have these integrations, and seeing what parts of the curriculum they can talk less about or pull away from, so that they're able to make the room to input a lot of these kinds of social and ethically conscious considerations, just because there is a gain and a loss aspect to that.

Faculty B: Yeah, I think there's been pockets of conversations, I would say that a lot of the momentum was lost with the pandemic in terms of the issues that we had, and we haven't had a departmental- So our department meetings during the academic year are so fixated on hiring and searching, and all that stuff that we in these conversations, but they're very brief, and so we require these departmental retreats to really focus in on topic, and we just haven't had… we haven't had one in a couple of years. And so I've been- I think we're gonna have… I'm positive we're gonna have one this summer, and so I think I'm hopeful that that would be one of the topics for half a day about a full day. So yes, I would say that I've had individual conversations with people in the departments that are talking about incorporating in their areas of expertise. And I know [professor name redacted] was trying to pilot some ideas for CS 21 this year, not sure where that ended up landing. But I would say, where we fall short is that I wish it was a departmental conversation, so that there was a … so there was more follow-through, and that we also were on the same page about… what is our end goal? … What are we trying for here? So [Professor name redacted] been working on things and his areas of expertise. I've been working on things, [Professor name redacted] , [Professor name redacted], and so on. I'm hoping that we can make it much more cohesive, much more explicit. So it's a … So students see it and know it's happening rather than just in this patchwork piecemeal way.

AK: Yeah. So I think I was going to follow- I was going to introduce like my next sort of questions, but it seems like a lot of the questions that I was actually going to ask is something that you have actually like mentioned, like talked about pretty explicitly including the idea that of a … more departmental, so like bringing all the faculty together and sitting down and taking input or impression on what these kinds of integrations … would look like. And I really do understand that I think so much of the things that have happened in the college has definitely been changed or lost with momentum because of the pandemic and just a lot of the challenges, the new challenges that came from that, but also working around how do we continue doing the work that we did, despite a lot of these limitations? So I think it's totally valid and fair. … I wanted to ask when the department has had conversations regarding diversity, equity, inclusion, which is something that each department should be able to consider, have … those kinds of conversations surrounding DEI initiatives been talked and discussed, together with the social and ethical integrations within the CS curriculum?

Faculty B: I think, in our departmental conversations they haven't been as tied together and definitely individual conversations they have. I mean … When [Professor name redacted] and I talked about what we wanted to do, for example, in our machine learning course, … it was a very heavily tied together because the examples that we use … often bring into account how these issues … disproportionately impact marginalized groups. I definitely have pointed out that one of the aspects to incorporating … So I think I'll back up and say the one thing that has come up in our conversations is the idea that there is definitely a good amount of evidence, showing that … it's students are interested in this topic, particularly, students from underrepresented backgrounds are disproportionately interested in these topics, and that it's … like when I was thinking about doing bioinformatics at the introductory level. This is also a way to get students interested… addressing these issues in the introductory levels is another way to engage students that we traditionally overlook and traditionally don't consider being a computer scientist or don't see themselves in the conversations. So, I think from that perspective, we have had conversations about how their view …they would- if we're interested in talking about attracting students from underrepresented backgrounds and making sure they feel represented, that these conversations can help

with that. But I would say, for the most part, usually they've been separate conversations, and I think it's … because it depends on the type of conversation we're having. So a lot of the DEI things that we've thought about, there's 2 aspects. Their one is the … recent inclusion of faculty in our search process. So that's in terms of recruiting faculty. And the second aspect, that's probably more relevant to what you're asking here is student perceptions. And there we think about a myriad of issues. One is support. One is what interested them about being a computer science student, and then making them feel like they're seeing and a member of the community. And so I think the … ethics can help with a couple of those some parts there. I think so. A lot of our conversation is a bit about support. And that's why … the mentioned program that [Professor name redacted] created in CS31 that pairs up students with upper-level students, that came out of that conversation. So that's less tied to the Ethics conversations, but I think there's more more conversations to be had at the intersection.

AK: Yeah, that's really great. And so the last question that I have written down is like, what are the department's current standings on integrations of ethical and social conscious pedagogies related to computation and technology? But it really does seem like you have pretty much adequately addressed that question. If you had anything else that you wanted to note just around those kinds of … conversations or barriers and challenges. Yeah, let me know. But-

Faculty B: Yeah, I would say that it's an all-the-above strategy for me…. But when I gave the talk at Triple AI, they asked, "what's the one best way to do it?" And each of the panelists was coming from a different perspective, and I was like, " whatever works, whatever you can do like it's there's not a one size fits all solution". And so yeah, I think that's what we're trying to do here is try to comment from any different perspectives because we might have dreams and aspirations, but getting there is messy. And so I'd rather not lose momentum. And so, even if it's not necessarily what I would envision the end product being, I would like to at least make sure that we're trying different avenues and seeing what sticks. I should also mention that the college is going through strategic planning right now, and while ethics in CS is not the specific topic, but integration … Digital fluency and integration between STEM and humanities has been a huge topic, and this has been a useful …This has been a threat of conversation within there. So yeah, so that would be the only other thing I would have mentioned, I think, might come out of that strategic plan as well.

AK: Yeah, that's really great, and I appreciate you telling me about like the kind of conversations that the institution is having about integrating more STEM and humanities disciplines together, just because I think that it's one of those aspects of being at a liberal arts college that I feel like can be really honed in, and can be an identifiable…trait that is like incredibly unique, but also very meaningful and positive compared to R1 institutions where students may have less academic mobility to be able to to take a lot of courses that are into just interdisciplinary or outside of their major discipline of choice. And so I really do appreciate that, because … I think particularly for CS, because it is so deeply contextualized in particular social contexts when you're applying a lot of the things that someone is creating or designing. I feel like … it is also just very helpful for what students do post-grad, what do they go into research? For industry? To be able to have those kinds of skills, and to know what questions to ask and how to navigate that … within the new cat chapter of their life. So I really do appreciate that a lot of these conversations are happening. And yeah, those are the end of my questions. If you had anything else that you wanted to say just regards to what we talked about in general, let me know. But this has honestly been a really big

pleasure, and I really appreciate you relaying your experiences and for telling me very insightful things, just because I think that this would really help contextualize my thesis a lot. And it was something that I'm also just really curious, more personally, just as a person who has been interested in these things for a while.

Faculty B: Well, I appreciate you studying this topic and asking really great questions. And if you're willing to share your work thesis with me when you're done with it, I'd be-

AK: Yeah, absolutely. And I might also just be in touch just to make sure that the transcript that is going to be put an appendix to the basis, as well as when I talk about it in my discussion and analogies section…. Just so I'm making sure that you're okay with the things that you've relayed, … and so that I'm able to make sure that I'm properly expressing what you said to me within the thesis. I might … touch up on that as well. But yeah, I can definitely share my thesis. It's going to be … digitally published, when it's due I believe. I think it is the requirement. That's why I'd love to relay to you the insights that you provided me as … and couple that with the responses that student alumni shared to me, and the other fault that I'm interviewing as well. But yeah, I really appreciated it, [Faculty B]. It's really good to see you. And yeah, thank you so much again.

Faculty B: Yeah, thank you. Good luck with the rest of the semester.

AK : Bye, take care.