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functionTales

Belle Romea , '24

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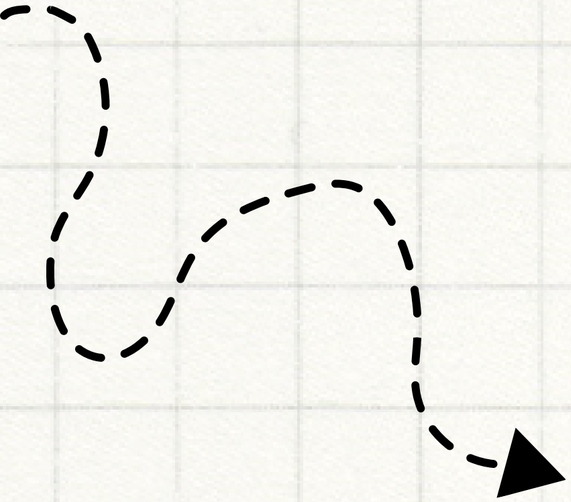
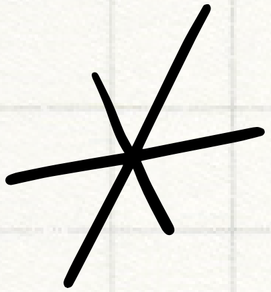
functionTales

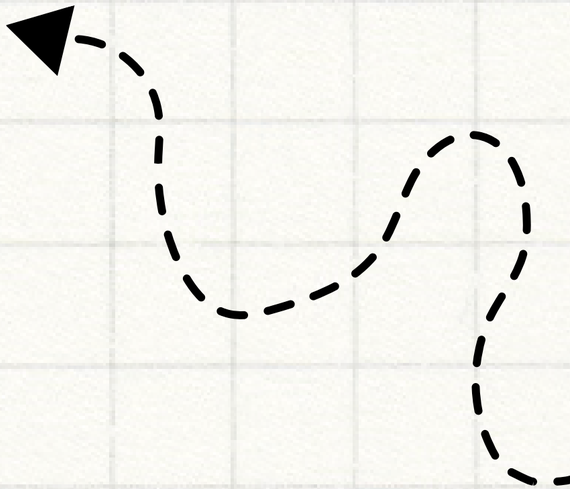
Belle Romea 2023

the problem

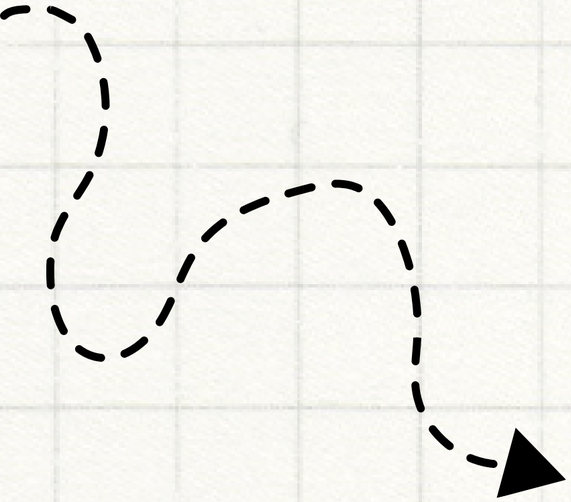


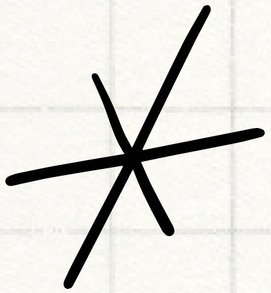
we need more computer scientists





As of 2021, the tech talent shortage amounted to 40 million qualified developers and engineers worldwide, expected to reach 85.2 million by 2030



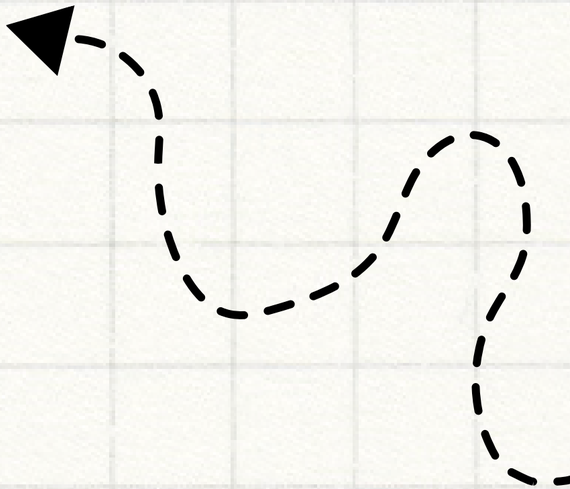


we need more

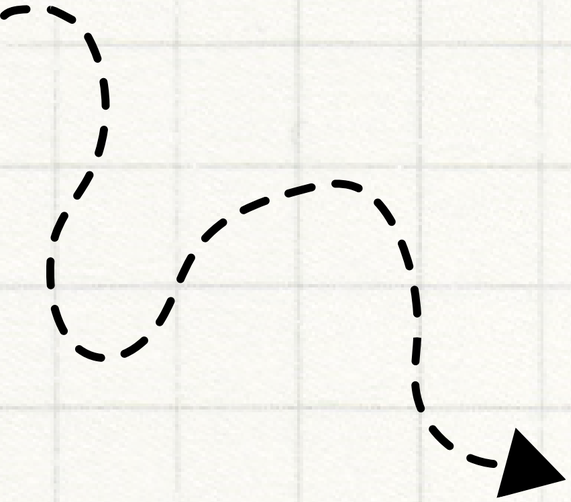
DIVERSE

computer

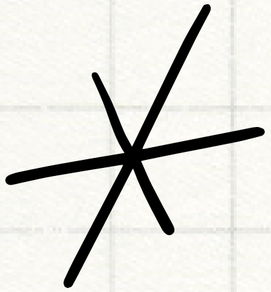
scientists

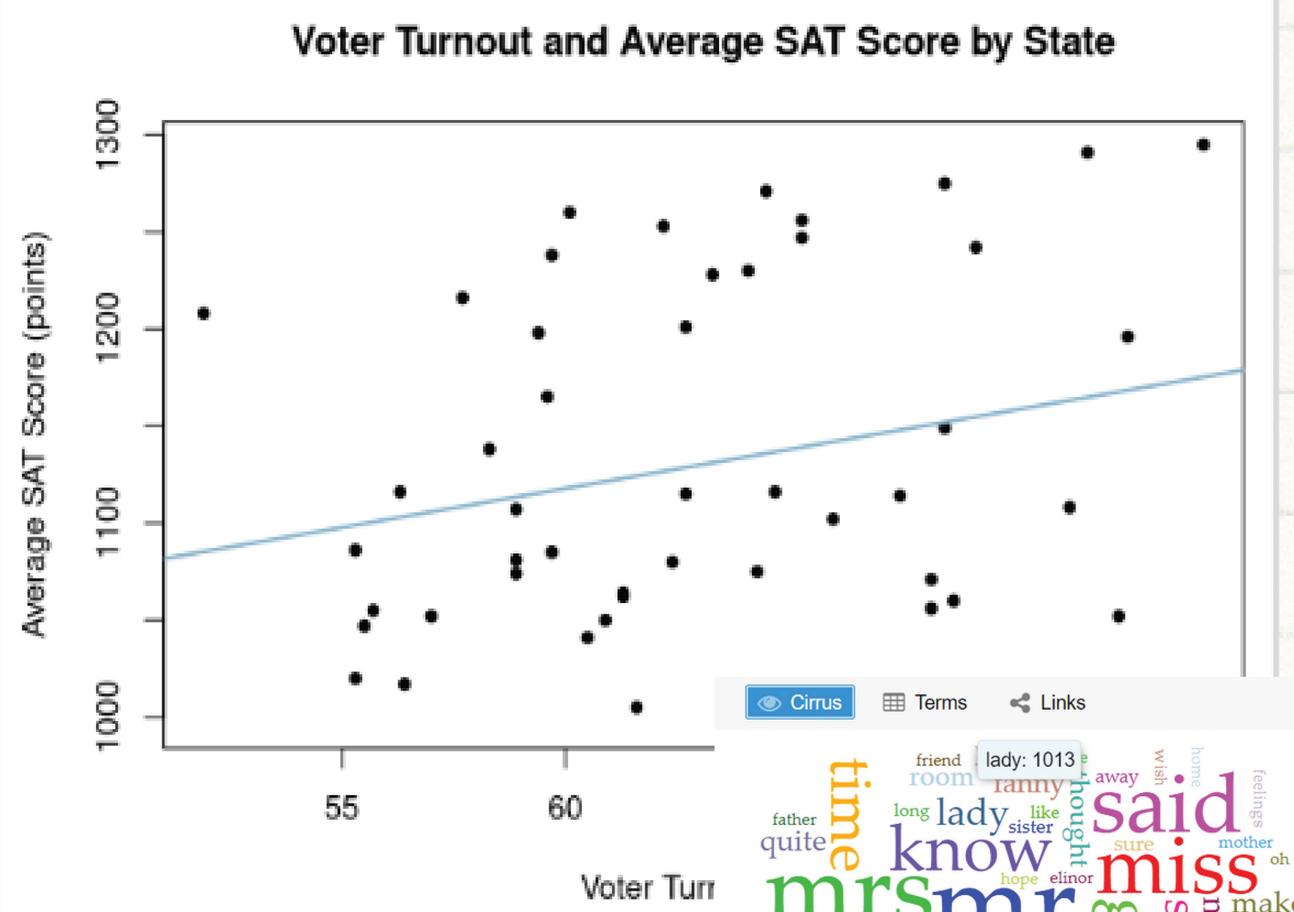


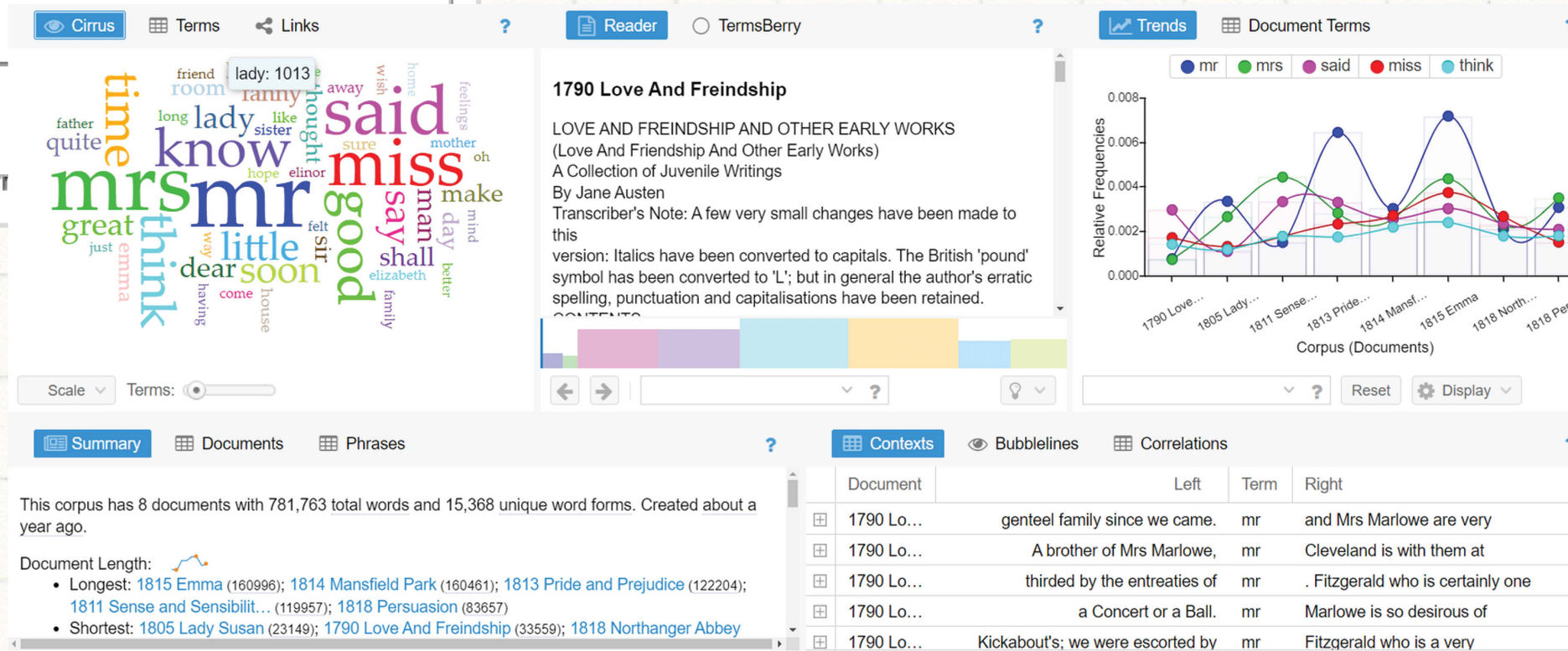
the high tech sector employed a larger share of whites (63.5 percent to 68.5 percent), Asian Americans (5.8 percent to 14 percent) and men (52 percent to 64 percent), and a smaller share of African Americans (14.4 percent to 7.4 percent), Hispanics (13.9 percent to 8 percent), and women (48 percent to 36 percent).

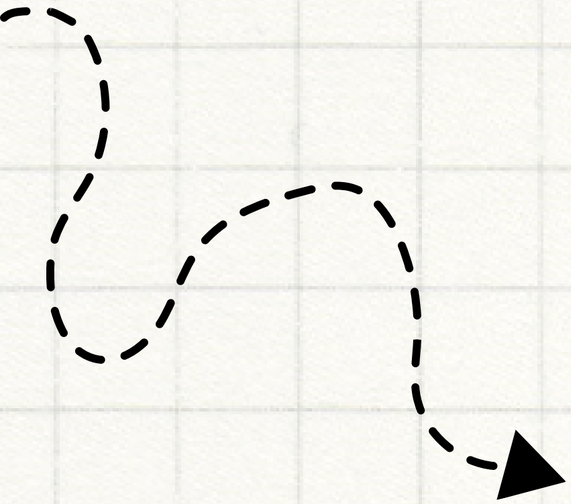


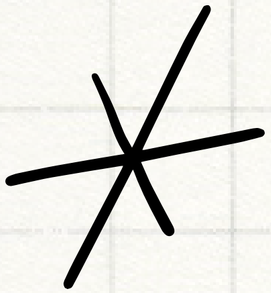
everyone benefits from computational skills




Voter Turnout and Average SAT Score by State
Average SAT Score (points)
1000
1100
1200
1300
55
60
Voter Turn


Cirrus
Terms
Links
lady: 1013
mrs
mr
said
miss
know
time
think
good
great
little
dear
soon
lady
fanny
quite
father
room
friend
long
like
sister
away
sure
mother
hope
elinor
make
man
say
day
shall
elizabeth
felt
sir
just
emma
way
come
having
house
family
better
mind
Scale
Terms:
Reader
TermsBerry
1790 Love And Freindship
LOVE AND FREINDSHIP AND OTHER EARLY WORKS
(Love And Friendship And Other Early Works)
A Collection of Juvenile Writings
By Jane Austen
Transcriber's Note: A few very small changes have been made to this
version: Italics have been converted to capitals. The British 'pound' symbol has been converted to 'L'; but in general the author's erratic spelling, punctuation and capitalisations have been retained.
Trends
Document Terms
mr
mrs
said
miss
think
Relative Frequencies
0.000
0.002
0.004
0.006
0.008
1790 Love...
1805 Lady...
1811 Sense...
1813 Pride...
1814 Mansf...
1815 Emma
1818 North...
Corpus (Documents)
Reset
Display
Summary
Documents
Phrases
This corpus has 8 documents with 781,763 total words and 15,368 unique word forms. Created about a year ago.
Document Length:
Longest: 1815 Emma (160996); 1814 Mansfield Park (160461); 1813 Pride and Prejudice (122204); 1811 Sense and Sensibilit... (119957); 1818 Persuasion (83657)
Shortest: 1805 Lady Susan (23149); 1790 Love And Freindship (33559); 1818 Northanger Abbey
Contexts
Bubblelines
Correlations
Document
Left
Term
Right
1790 Lo... genteel family since we came. mr and Mrs Marlowe are very
1790 Lo... A brother of Mrs Marlowe, mr Cleveland is with them at
1790 Lo... thirded by the entreaties of mr . Fitzgerald who is certainly one
1790 Lo... a Concert or a Ball. mr Marlowe is so desirous of
1790 Lo... Kickabout's; we were escorted by mr Fitzgerald who is a very





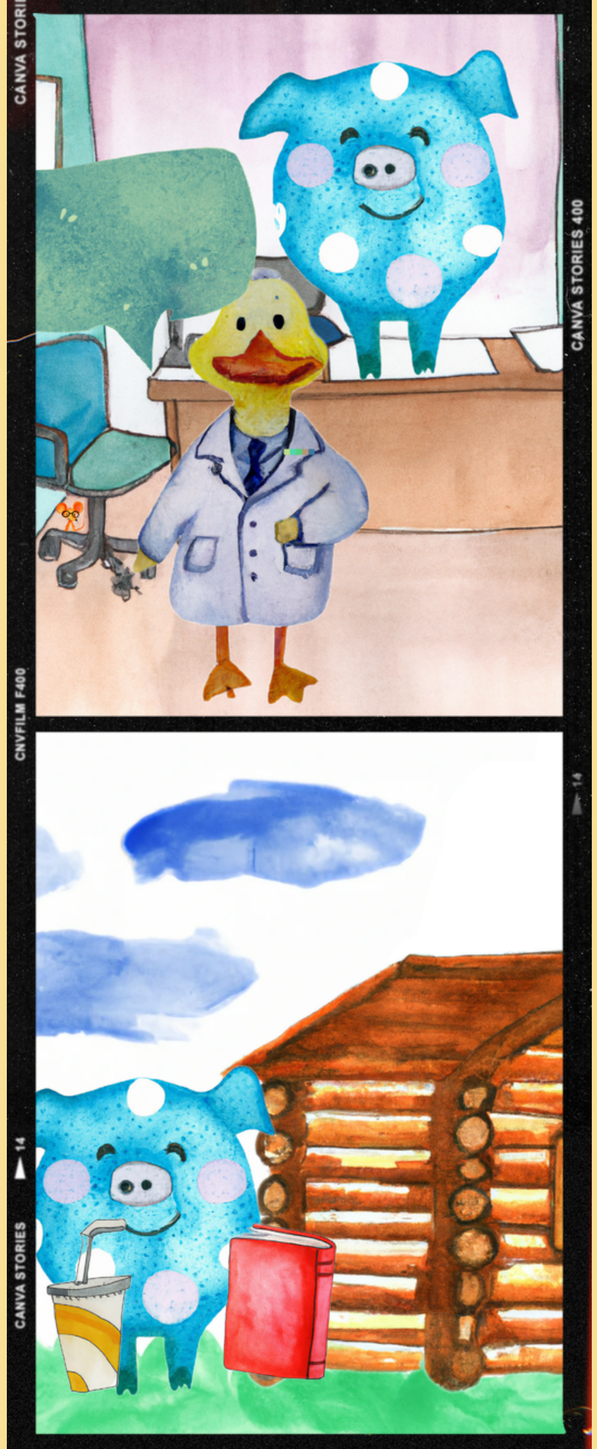
being a computer scientest is a restricted identity... but why?

a solution

FunctionTales

An online choose-your-own-adventure fractured fairy tale that teaches coding concepts to grades k-3 through rebus symbols and gamification

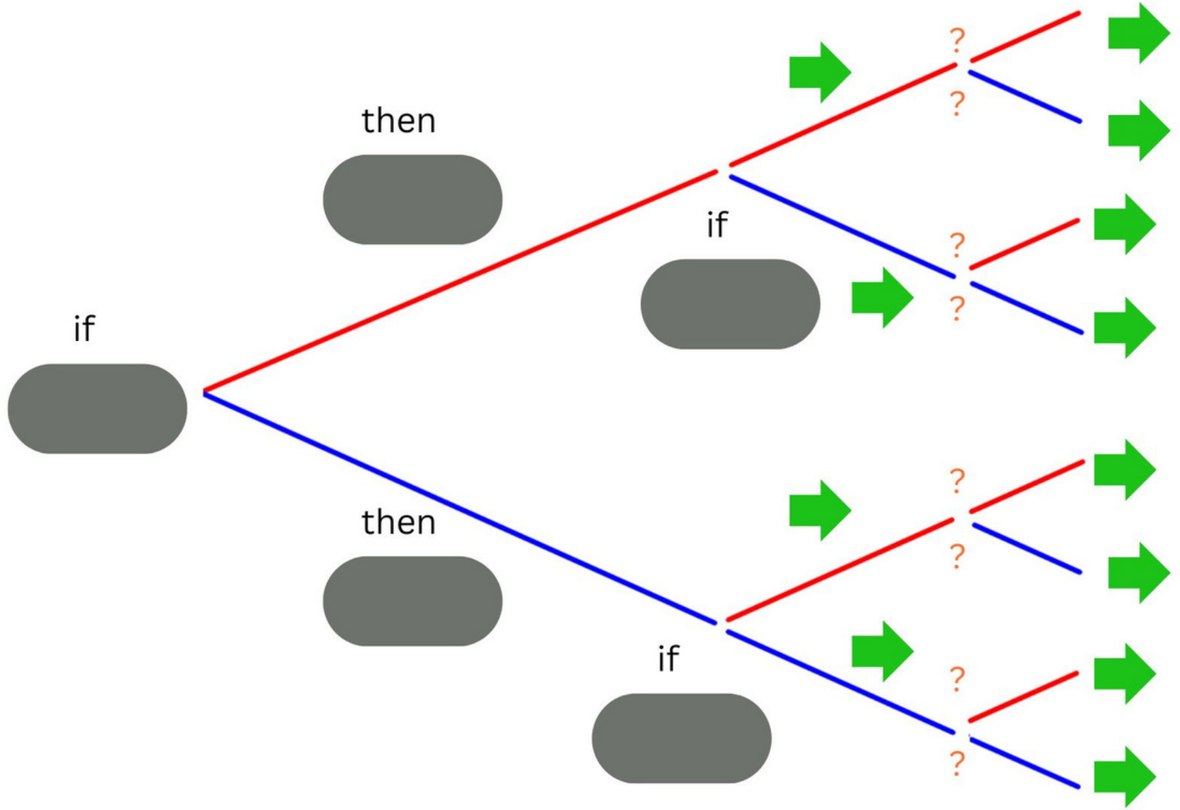
key features



decoding

decoding

coding



Block Design Studio

color

text

the pig finishes his book

the pig blows down the house

the pig eats _____

type your text here...

preview

The fourth little pig drinks lemonade

coding concepts

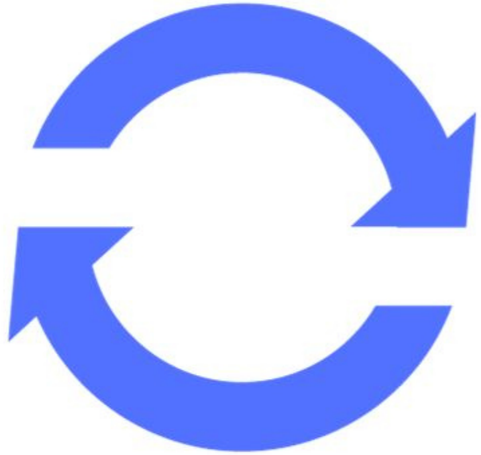
If/Then

Loops

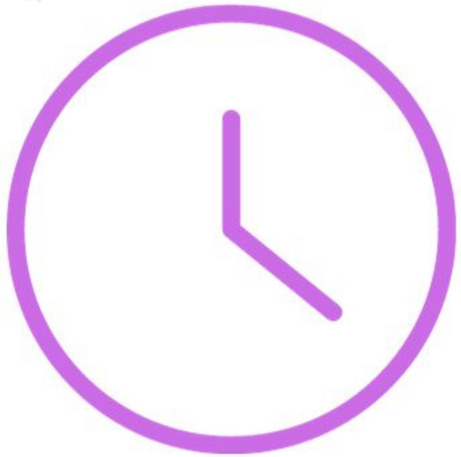
rebus symbols examples

if

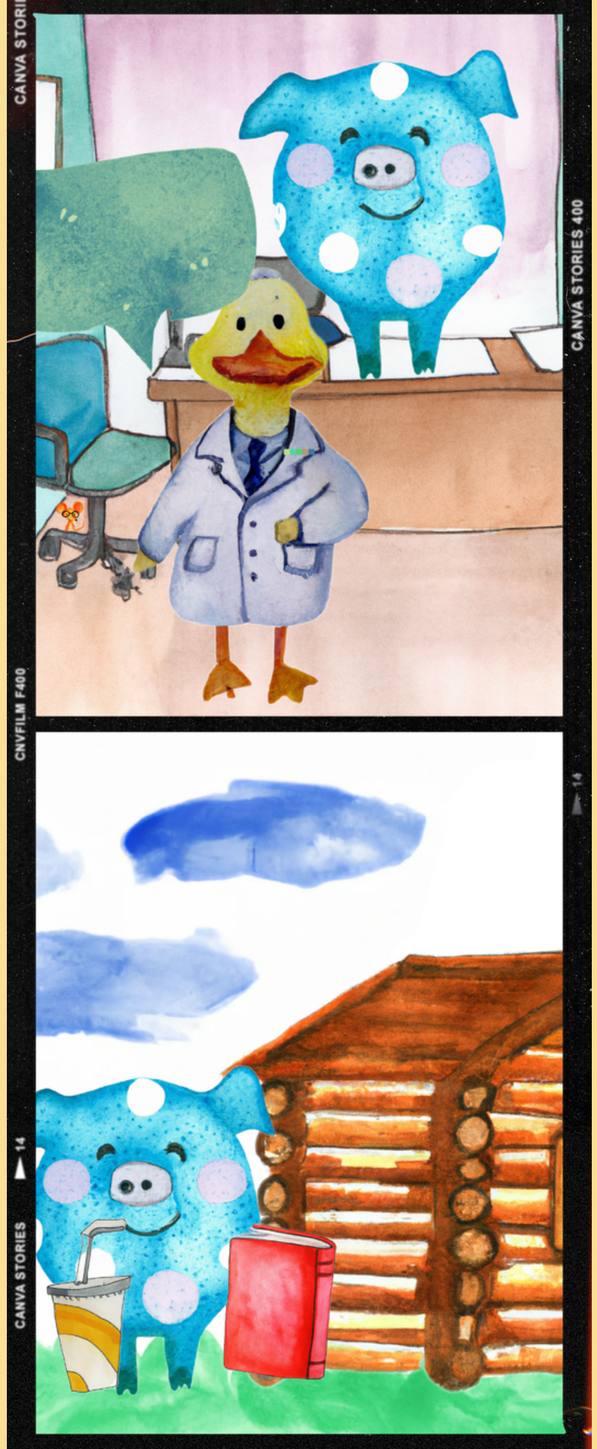
then



for



while

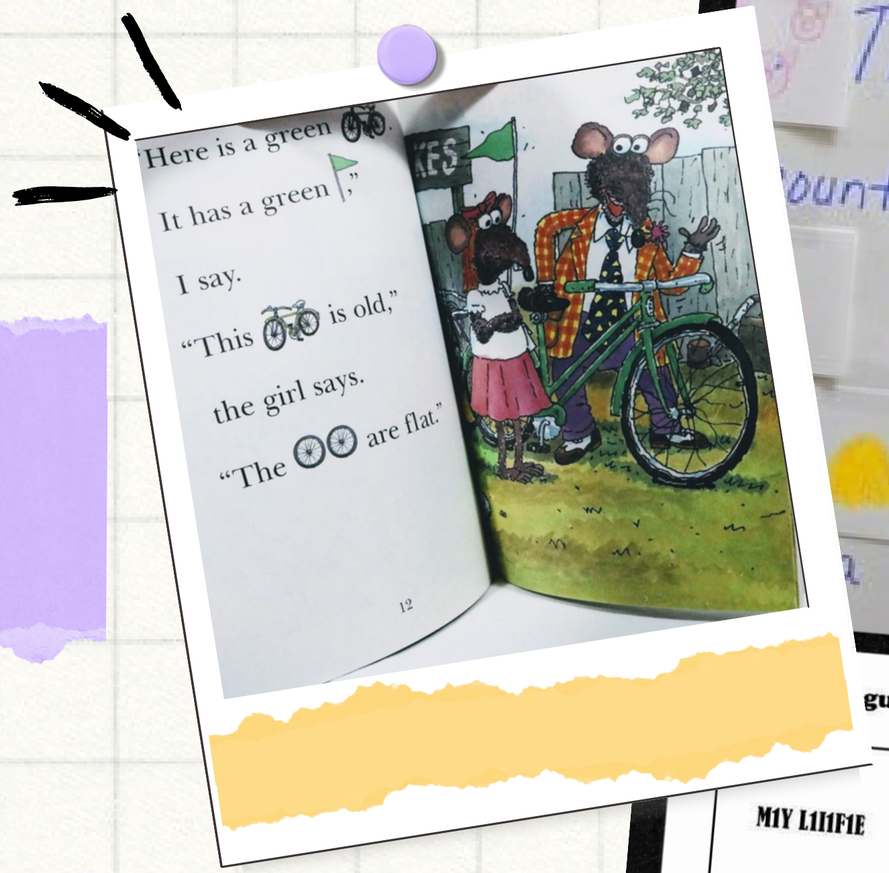


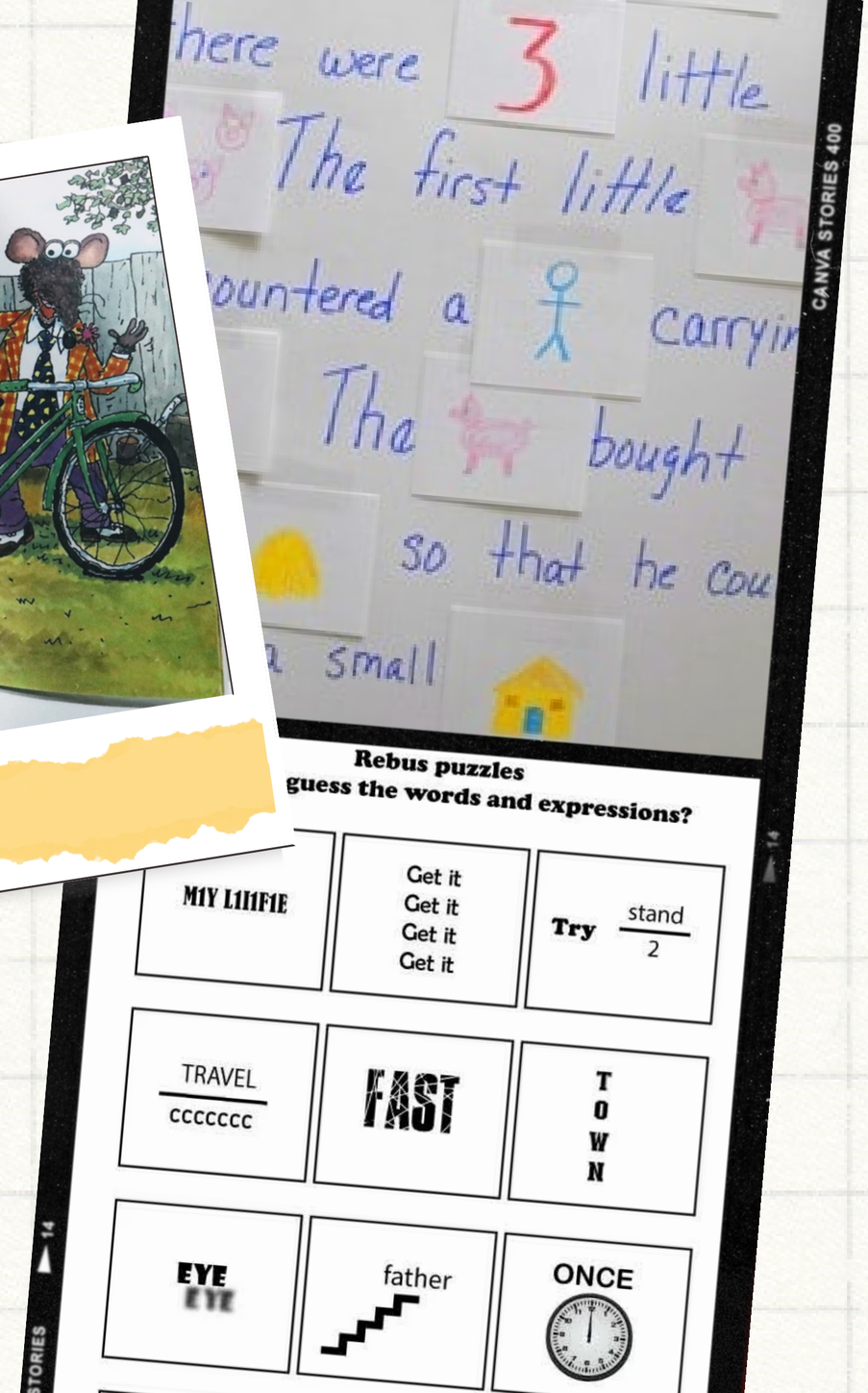
fairy tales

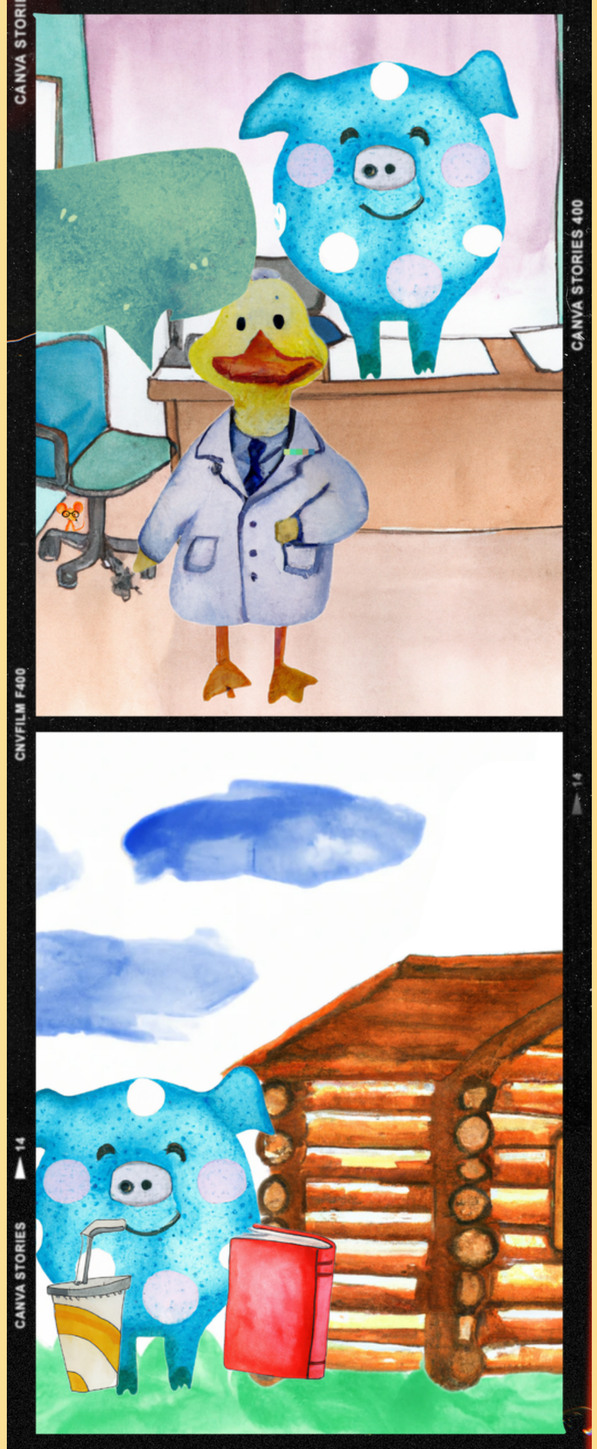
help students form
an IDENTITY

rebus symbols

make concepts
SALIENT





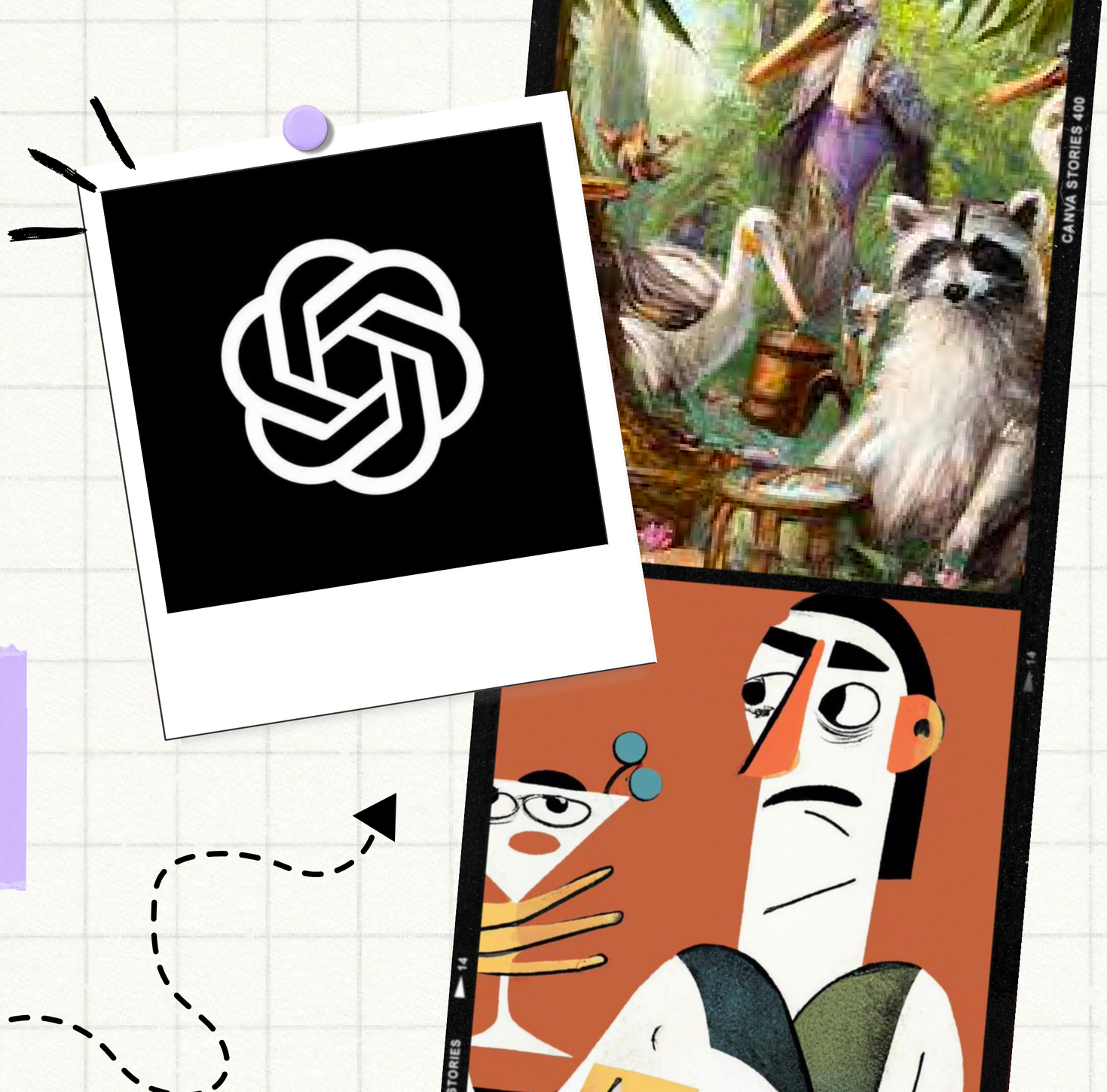


gamification

make learning FUN

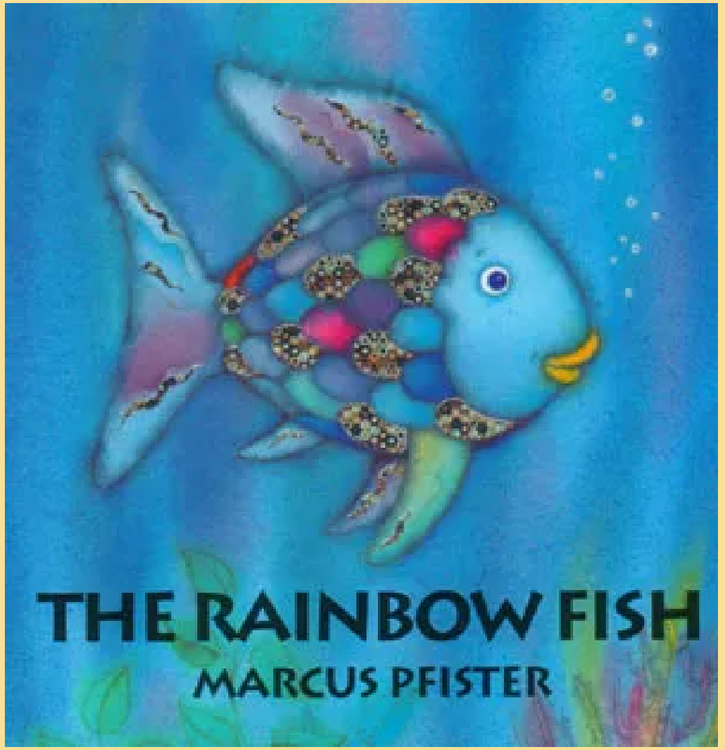
INSPIRE children on how computer science can be used

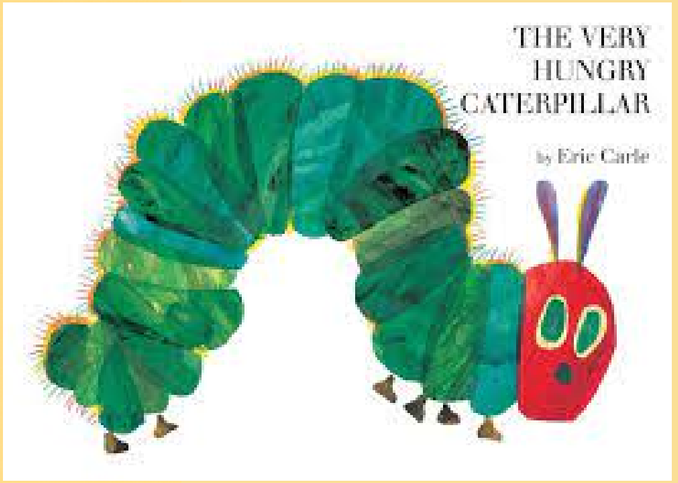
powered by AI



potential setbacks

are physical books better than ebooks?





competition

Kodable

Code.org

Codemoji

future work

the future

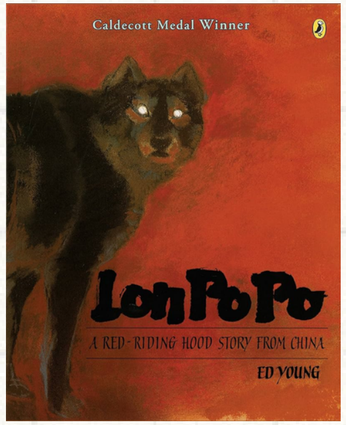
text to speech

increases accessibility and expands age range

Whisper

increased stories

more diverse stories to inspire more diverse readers



research

how well does it work and how can we improve

demo

questions?

additional reading

slide notes

annotated bib

Slide 1: Intro
Hi! I am Belle Romea. I am a senior at Swarthmore studying Computer Science and education. For the last 3 and a half years, I have spent my time working on projects at the intersection of the two fields. I researched the effects computers have on the classroom in comparison to other forms of funding, wrote a POGIL-based AP computer science curriculum, and created an online visualizer to accompany an Intro to Computer Science course. All of this led me here: to create functionTales.

Slide 2: The problem
So let's start at the beginning of my ideation of functionTales. I noticed a few things through both learning computer science and teaching computer science teacher. Through these roles, I have been exposed to many ways to learn and teach coding from building robots with Lego Mindstorms, to visualizing code on Python Tutor, to navigating mazes on Code Monkey, to animating a dance party on Code.org. Somehow these resources helped me have positive experiences coding and inspired me to continue to computer science but the same could not be said for the majority of my peers. These same resources created a fixed mindset in the domain and an inability to form an identity as a computer scientist. This had me thinking there is still a gap between the available resources and the interest this creates for learners.

Slide 3: We need more computer scientists
The essence of the problem is we simply do not have enough computer scientists for the world we live in. Beyond the economic gap this creates, it also creates a lack of brains working on some of today's most important problems. There exists a sociotechnical gap, a gap between what we want our technology to do and what it can do. These gaps create issues in regulating misinformation, creating safe online spaces for marginalized groups, and combating the negative effects on mental health for social media users. These problems affect more people and with graver effects as technology scales without consideration of these issues. The lack of computer scientists encourages companies to neglect these goals due to a lack of engineering power and the cost of engineers.

Slide 4: Stat about computer science shortage
(https://www.forbes.com/sites/forbestechcouncil/2021/06/08/is-there-a-developer-shortage-yes-but-the-problem-is-more-complicated-than-it-looks/?sh=6c7952c93b8e)
It is evident that the current resources are insufficient to attract enough learners to computer scientists. This raises the question, "why?"

Slide 5:
This is probably not surprising to anyone who is aware of the tech scene. I think this is best highlighted by one phenomenon described by a current Google employee "There is never a line for the women's restroom at computer science conferences". A lack of diversity in computer scientists creates systems designed for a white, heterosexual, male user despite being used by everyone. This can have harmful unintended consequences. One example of this is when designing automatic soap dispensers, the technology was only tested on white users. However, when brought to market, users of color realized the soap did not dispense for them as not

enough light bounced off their hands to trigger the dispensing mechanism (https://www.futurelearn.com/info/courses/anti-racist-technologies/0/steps/224822). Therefore, who designs systems affects who the systems we use are designed for.

Slide 6: Stat about tech sector diversity (https://www.eeoc.gov/special-report/diversity-high-tech)
It is very clear the current situation is particularly bad at attracting learners of certain backgrounds such as women and people of color. Again, “why?”

Slide 7:
And if we take a step back we can also see it is not just a problem in one field. Computing affects every field through new innovations in AI and data science.

Slide 8: Graphics from my computing projects
I just looked at my own education experience at Swarthmore.
I used R to analyze presidential results in Intro Statistics.
I used large language models to look at the hit novel of 1778 “Evelina”
We need to navigate a world with these tools.

Slide 9:
One overarching question this brought up for me “Why is being a computer scientist a restricted identity?”. If we ask a classroom “Who is a reader” many kids? Many kids will raise their hands. However, if we ask how many people are writers, even less will raise their rands. Writing is a restricted identity. However, there is no evidence that writers are more talented or dedicated or capable than readers” (Essays Into Literacy, 83). Then we can ask how many of you are computer scientists. This is an even more restricted identity. How can we change the narrative about who is a computer scientist? How can we help learners form an identity?

Slide 10:
This all leads me to think about what is missing. What could attract more budding computer scientists? More diverse computer scientists? What are the gaps in what we see in current learn-to-code programs, and how can we use educational research to fill these?

Slide 11:
This was how functionTales was born. functionTales is a new approach to teaching coding. FunctionTales lies at the intersection of teaching literacy and coding by teaching them in tandem. It is an online platform centered around a chose-your-own-adventure fairytale. Learners have the opportunity to interact with a book interface as they interact with the story. Throughout the story, there are rebus symbols to teach key coding concepts. The target audience is grades k-3.

Slide 11:
In the next few slides I am going to take you through some of the key features and what education theories support them. FunctionTales is not just my vision but is built on research on how people learn to code, learn to read, and learn what they are passionate about.

Slide 13:
There is evidence that people learn to read by learning to decode. Children must learn to distinguish letters and sounds and link letters and letter groups to sounds(The Reading Mind, Chapter 2). Then learners can create a mental dictionary of words(The Reading Mind, Chapter 4). Additionally, learners must learn to decode in a serial order (Becoming Literate 113). These skills are necessary for decoding but also necessary for coding. An understanding of breaking down a larger problem into its parts happens when learners learn to decode. This skill is parallel to problem decomposition needed in computer science. Additionally, decoding in order develops skills necessary for understanding the order of execution needed as a computer scientist. Since decoding skills are necessary for coding, the better you are at decoding, the better you will be coding.

Slide 12:
The first area I delved into was what part of coding should functionTales teach. There are so many aspects of computer science. One could be syntax. Syntax encompasses how to communicate with the computer. Another could be algorithm formation. This involves problem-solving skills. After auditing other learn-to-code programs for a k-3 audience, I realized that control flow is developmentally appropriate. It is also essential to computer coding. The two main way this is implemented is the introduction of the order of execution logic (or if/then) and the introduction of iteration logic (or loops). The goal of the program is to increase learner's literacy and coding skills and increase learner's self-concept as it relates to reading and coding.

Slide 13:
The next area I researched is how I want to teach this. I wanted to create a framework to ultimately build a learner's interest and identity in both coding and reading. A reading format provides learners with a place that engages them fully with new tasks, exert their effort to master something, strengthen their skills, and puts their knowledge to good use to help them learn in a positive environment(Self-theories: Their Role In Motivation, Personality, And Development 4). In order to build an interest and identity in the subject, one must first engage the learner's situational interest. Then one must continue to maintain this interest so the user continues to reengage and has a positive experience(The Power of Interest for Engagement for Motivation and Learning). To engage interest, students must have fun. The choose-your-adventure stories creates an alternative reality where their life is full of adventure and with full agency. This agency comes from control of the story. Learners are additionally motivated to change the narrative of the original story and "break the rules". Research from "Reading Mind" on how children form identities as readers shows that is paramount that they have positive experiences to build a positive attitude toward reading. A positive attitude towards reading makes reading feel easier and makes you read more which increases your reading skills and bolsters your positive attitude toward learning(Reading Mind, Chapter 6). In order to help learners have a positive attitude, functionTales using fairy tales were perfect because they

are familiar. Fairytales allow learners to imagine themselves in the story. The stories feature animals that all readers can imagine themselves as(Fairy Tales and the Art of Subversion).
Slide 14:
I also needed a way to teach the coding concepts specifically. I immediately thought back to my childhood when I spent hours reading the Muppet's *Rizo's Bike Sale* with an icon to represent a rat. This book was built on a learn-to-read philosophy called Rebus. Rebus uses images to represent more complex vocabulary words or concepts. Rebus supports a learn-to-read strategy of natural language acquisition through sight words. Rebus is proven to help learners obtain more vocabulary words more quickly. It is also proven to make the words represented by the rebus symbol more salient. This is exactly what I wanted to do: I wanted to simplify a complex word, have learners learn the word quickly, and have learners remember the word and the concept it represents.

Slide 15:
Although the Rebus symbols make the story more interesting, I wanted to add an element of gamification. There is a lot of evidence that gamification increases engagement and positive experiences for learners. Gamification can increase the positive attitude towards reading and coding(Purposeful Play). Since the stories are choose-your-own-adventure, the story is much more similar to a game. Another aspect of gamification is the mouse appears on every page, encouraging the learners to find the mouse and what to get to the next page to find it again. This also allows learners to make a visual connection with each page. A potential expansion is to create more open-ended play through the ability for learners to practice coding.

Slide 16:
Another key aspect of functionTales is that is powered by AI as a way to introduce learners to AI capabilities. The illustrations are created through a synthesis of images generated by DALLE. These illustrations could inspire learners to use AI in interesting ways.

Slide 17:
It is important to look at some potential setbacks of this platform.

Slide 18:
There are speculations that reading online is not as effective as reading a book. However, studies show the effects are actually neutral(Reading Mind, 162). One suggestion to limit potential negative effects is to keep some of the structural elements of books such as a title page and page filliping capabilities. These are included for the most effective results.
It is important to note the unique features that an online platform can provide in comparison to physical books. These benefits can even tip the neutral effects to positive. One benefit is traditional choose-your-own adventures are constrained to a limited number of branches due to the number of printed pages, however, online there are much greater possibilities. This means that learners can continue to engage with the same story even more times. Additionally, the online platform allows games and exercises to be embedded in the reading. There is also evidence that integrating technology into the classroom can promote learner interest in science

(Promoting learner Interest in Science: The Perspectives of Exemplary 143). To study these exact effects, more research is needed.

Slide 19:
One major competitor is Kodable.
Kodable targets a similar age group with similar. Kodable has many maze-oriented games. An advantage of functionTales is it breaks the stereotype that problem-solving is removed from real-life problems. Additionally, these mazes can reinforce ideas about there being a right or wrong way to problem solve. Another advantage of functionTales is that Kodable is not universally accessible since it requires a subscription.

Another competitor is Code.org. Code.org is free and has hundreds of coding games. One game is built on top of the popular game Minecraft. Another popular game is DanceParty. This is an even more direct competitor due to their pre-reader express and express lessons for young learners. One disadvantage is that learners have very limited freedom in design. The lessons are mostly just puzzle-solving. Again, this just reinforces the stereotype of the purpose of code.

Another potential competitor is Codemoji. Codemoji also uses symbols to represent code. It helps learners build websites without knowledge of syntax. However, it is different from functionTales because Its lack of structure used for scaffolding makes it better suited for older learners.

Slide 20:
There are additional ways to improve functionTales.

Slide 21:
One place for improvement is text-to-speech. Text-to-speech decreases the age range and literacy skills to access the platform. It also makes the website more accessible to learners with different learning disabilities. One potential implementation is Whisper, Open AI's text-to-speech model. This could even increase the potential to inspire learners with the possibilities of AI.

Another place for improvement is including more culturally diverse fairytales. It is evident that the better learners relate to stories, the more likely they are to form a story around them (Investigating the Effects of Culturally Relevant Texts on African American Struggling Readers' Progress). Therefore, it would be helpful to add stories such as Mufaro's Beautiful Daughters, Lon Po Po, The Talking Eggs, and Pattan's Pumpkin.

A final room for future work is conducting comparative research of functionTales versus other major computing sources and its effect on learners