Participatory Modeling for Societal Complexity in Healthcare

Background and motivation

By Heider Jeffer

- **Hello and welcome 😃 !**
- We're excited to share our work on participatory modeling for societal complexity in healthcare.

Explore and engage with our resources below:

- **Discover Our Project:** Learn about our approach and research on GitHub.
- **Try It Out:** Experiment with our simulation through this interactive Google Colab notebook.
- **Explore the Code:** Dive into the details of our simulation by reviewing the source code.
- **Here you can find:** How we use Python to answer the Research Questions
- **In the appendix you can find:** Formula, Numerical Example, Simulation Steps that we used in Python to answer the research questions
- **Here you can find** Software Requirements

We'd love for you to explore, experiment, and share your thoughts with us!

Heider Jeffer

Presentation Structure

- **Part 1:** My Background and how it relates to this KTH's PhD position?
- **Part 2:** What motivates me to pursue this position specifically?
- **Part 3:** How would My technical skill contribute to the research goals of this project?
- **Part 4:** Project where I used participatory modeling or similar techniques "KTH PhD project, Developed using Python by Heider Jeffer to answer (Research Questions)"?
- **Part 5:** What do I hope to learn from working within the InSilicoHealth Doctoral Network and at KTH?
- **Part 6:** I have Questions
- **Part 7:** Appendix

Part 1: My Background and how it relates to this KTH's PhD position?

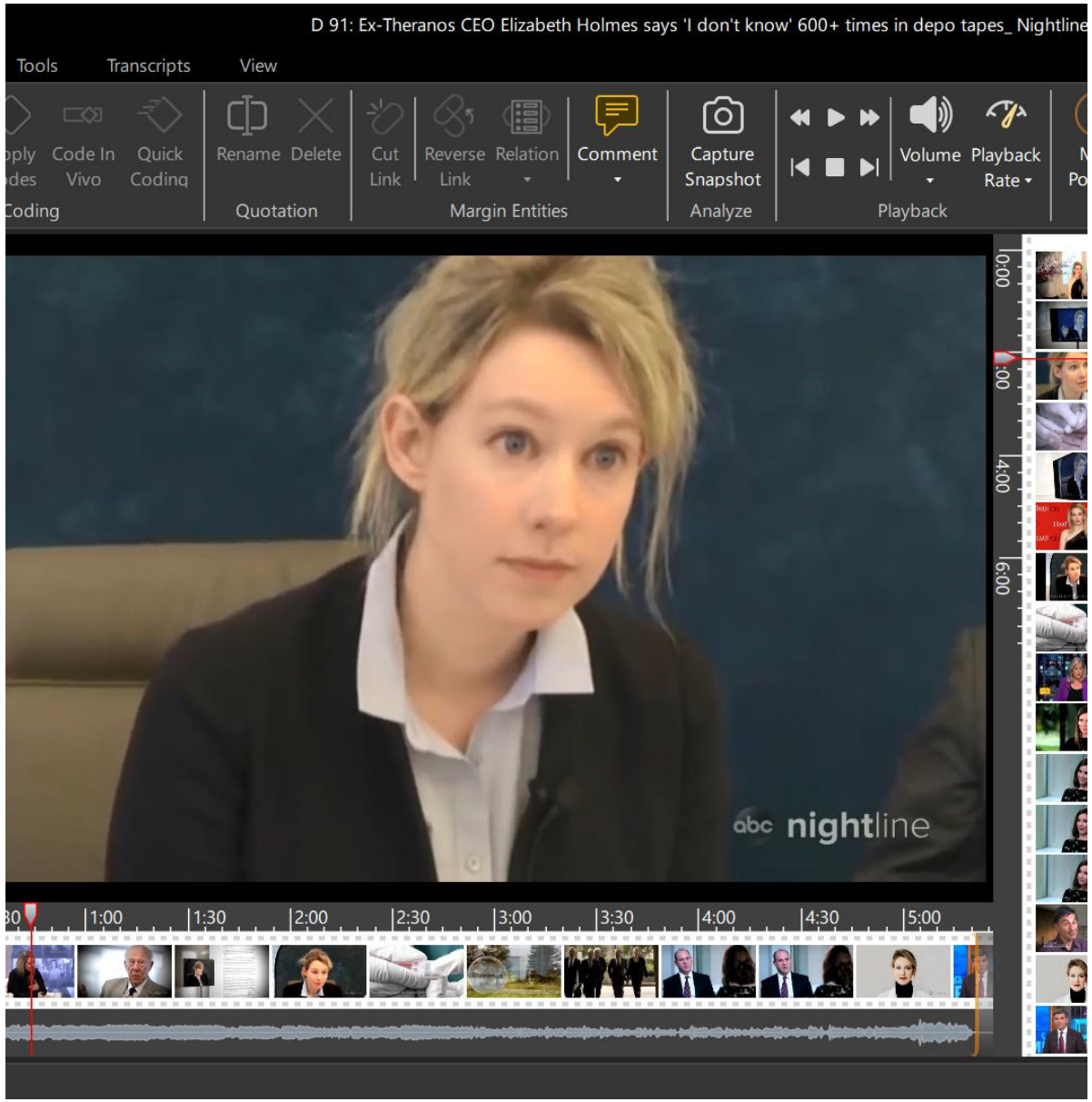
1. Interdisciplinary academic background
2. Master's thesis

1. Interdisciplinary academic background

- Having completed degrees in Physics and Operations Research, followed by advanced studies in Computer Science and Artificial Intelligence.
- My experience at USI, ETH Zürich and the Free University of Bozen-Bolzano (UNIBZ) involved hands-on projects and laboratory focused on participatory Modulation Simulation Optimization, Human Machine Interaction, software reliability and testing, Stochastic process and system dynamics—areas I believe are highly relevant to this position.

2. Master’s thesis

- I explored the failure factors of the “Elizabeth Anne Holmes the American biotechnology entrepreneur the founder of Theranos as an exemplar case study for my research, specifically addressing the regulatory and legal challenges that contributed to its downfall. Using gray literature”.
- I developed a model for both qualitative and quantitative data collection and analysis. This approach allowed me to identify key factors related to the healthcare sector’s challenges. Through this work, I further developed my technical expertise in Python, data analysis, and complex model building—skills I am eager to apply in the PhD role at KTH.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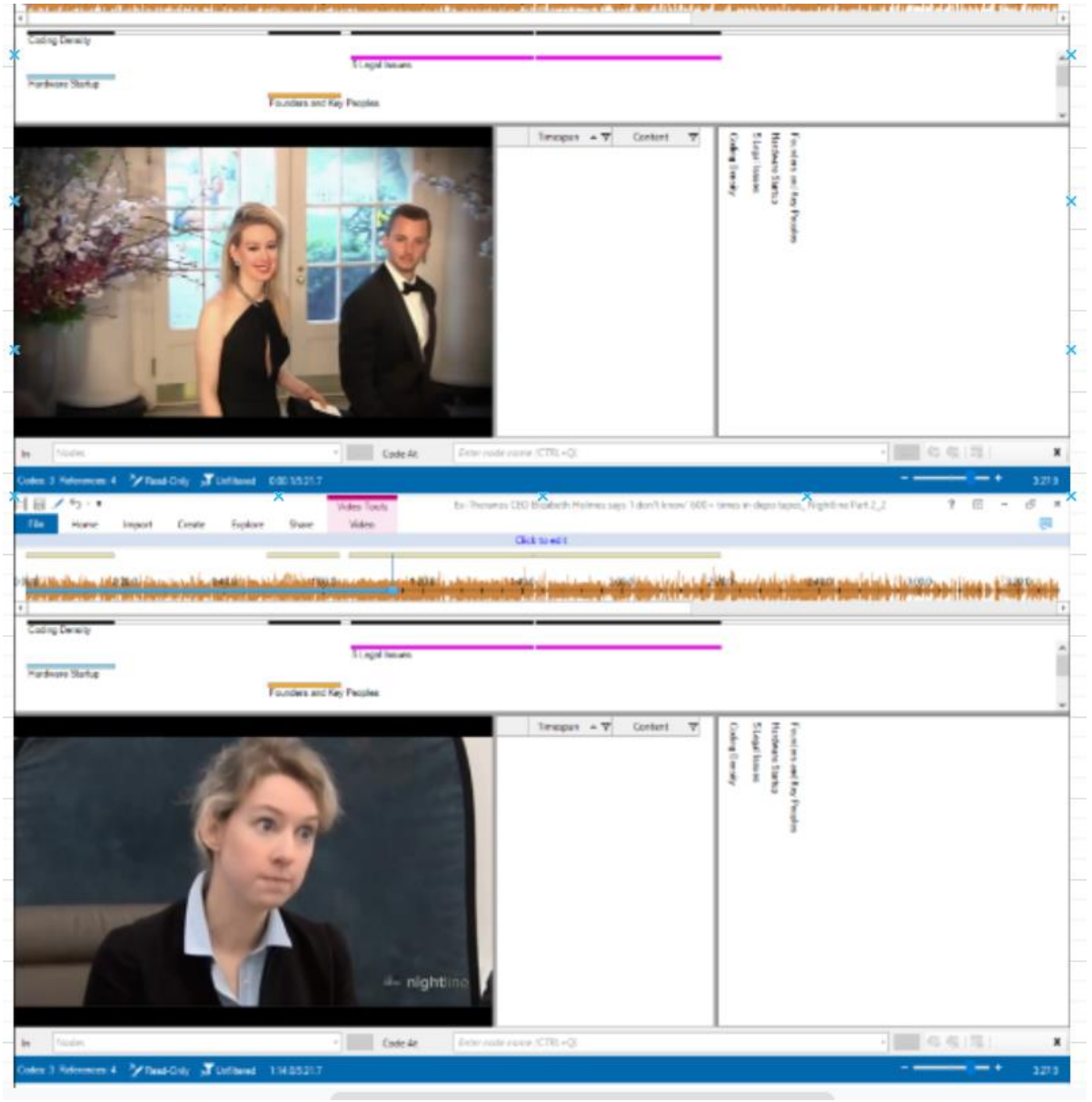
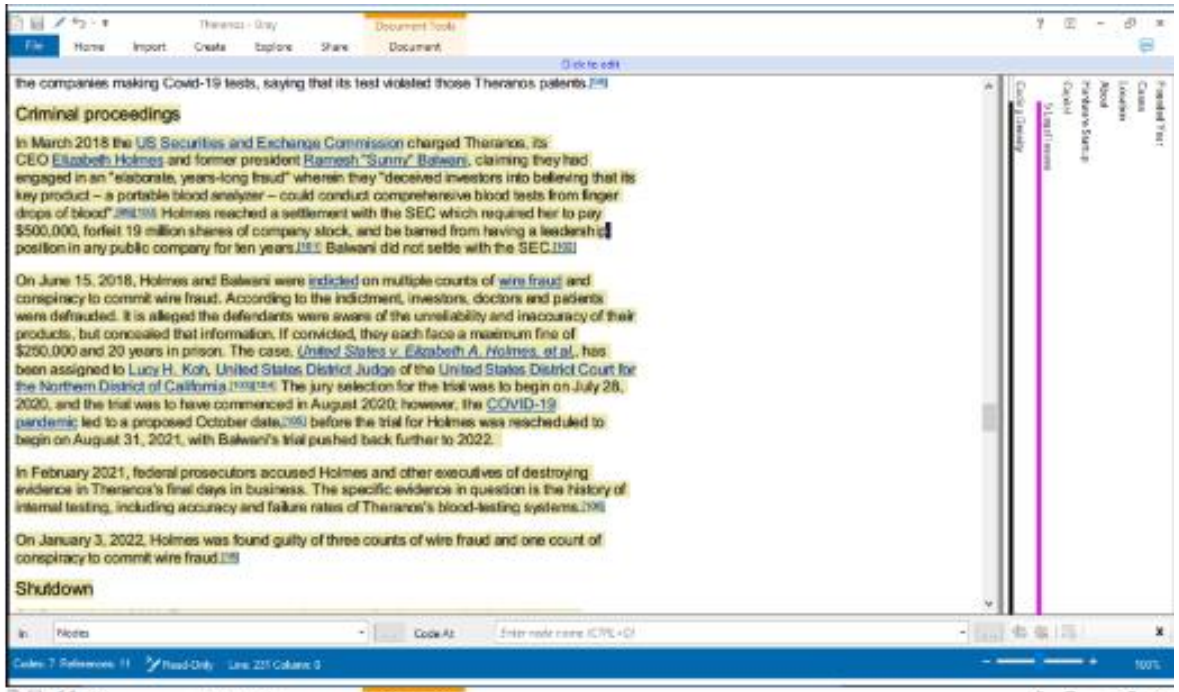




the companies making Covid-19 tests, saying that its test violated those Theranos patents.[98]

Criminal proceedings

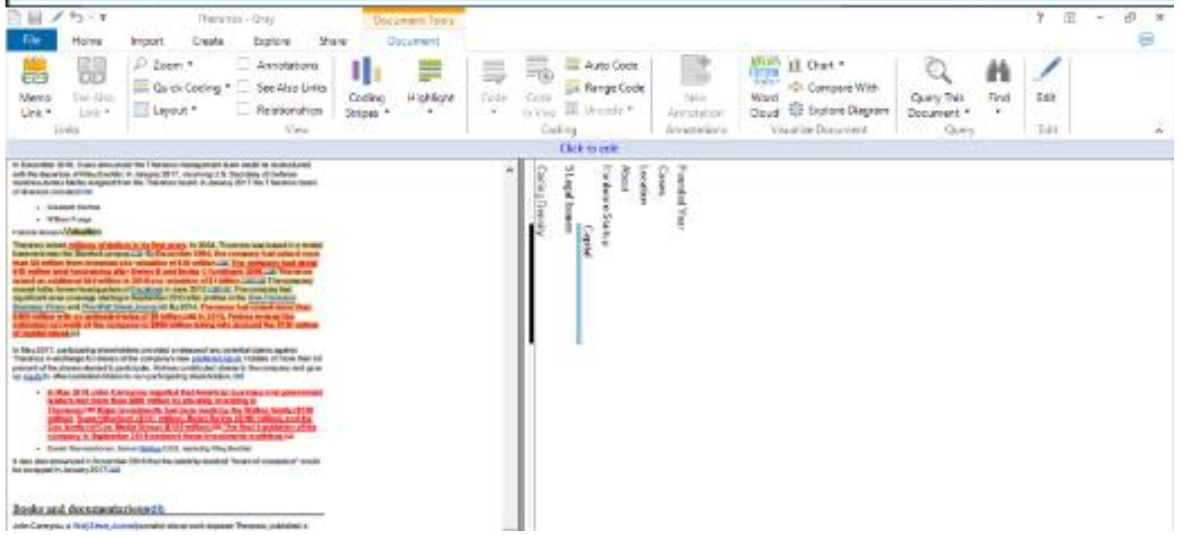
In March 2018 the US Securities and Exchange Commission charged Theranos, its CEO Elizabeth Holmes and former president Ramesh "Sunny" Balwani, claiming they had engaged in an "elaborate, years-long fraud" wherein they "deceived investors into believing that its key product – a portable blood analyzer – could conduct comprehensive blood tests from finger drops of blood".[99][100] Holmes reached a settlement with the SEC which required her to pay $500,000, forfeit 19 million shares of company stock, and be barred from having a leadership position in any public company for ten years.[101] Balwani did not settle with the SEC.[102]

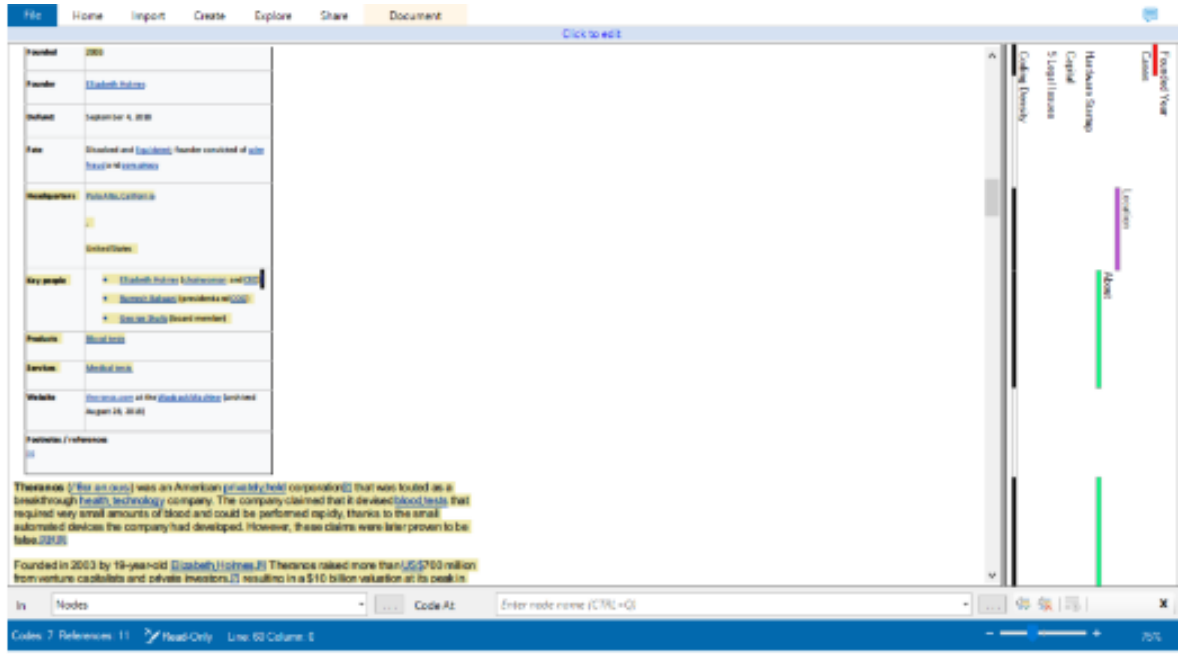
On June 15, 2018, Holmes and Balwani were indicted on multiple counts of wire fraud and conspiracy to commit wire fraud. According to the indictment, investors, doctors and patients were defrauded. It is alleged the defendants were aware of the unreliability and inaccuracy of their products, but concealed that information. If convicted, they each face a maximum fine of $250,000 and 20 years in prison. The case, *United States v. Elizabeth A. Holmes, et al.*, has been assigned to Lucy H. Koh, United States District Judge of the United States District Court for the Northern District of California.[103][104] The jury selection for the trial was to begin on July 28, 2020, and the trial was to have commenced in August 2020; however, the COVID-19 pandemic led to a proposed October date,[105] before the trial for Holmes was rescheduled to begin on August 31, 2021, with Balwani's trial pushed back further to 2022.

In February 2021, federal prosecutors accused Holmes and other executives of destroying evidence in Theranos's final days in business. The specific evidence in question is the history of internal testing, including accuracy and failure rates of Theranos's blood-testing systems.[106]

On January 3, 2022, Holmes was found guilty of three counts of wire fraud and one count of conspiracy to commit wire fraud.[18]

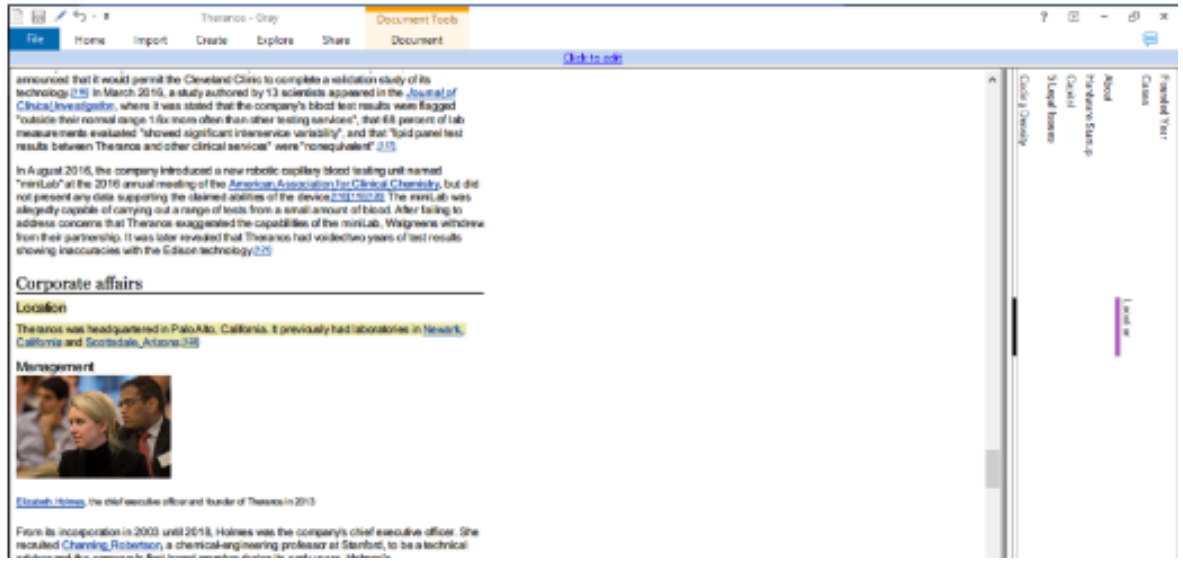
Shutdown





Theranos (/θəˈrɑːnɒs/) was an American privately held corporation[2] that was touted as a breakthrough health technology company. The company claimed that it devised blood tests that required very small amounts of blood and could be performed rapidly, thanks to the small automated devices the company had developed. However, these claims were later proven to be false.[3][4][5]

Founded in 2003 by 19-year-old Elizabeth Holmes,[6] Theranos raised more than US$700 million from venture capitalists and private investors,[7] resulting in a $10 billion valuation at its peak in



announced that it would permit the Cleveland Clinic to complete a validation study of its technology.[16] In March 2015, a study authored by 13 scientists appeared in the Journal of Clinical Investigation, where it was stated that the company's blood test results were flagged "outside their normal range 1.6x more often than other testing services", that 68 percent of lab measurements evaluated "showed significant interservice variability", and that "[p]oint panel test results between Theranos and other clinical services" were "nonequivalent".[17]

In August 2016, the company introduced a new robotic capillary blood testing unit named "miniLab" at the 2016 annual meeting of the American Association for Clinical Chemistry, but did not present any data supporting the claimed abilities of the device.[18][19][20] The miniLab was allegedly capable of carrying out a range of tests from a small amount of blood. After failing to address concerns that Theranos exaggerated the capabilities of the miniLab, Walgreens withdrew from their partnership. It was later revealed that Theranos had voided two years of test results showing inaccuracies with the Edison technology.[21]

Corporate affairs

Location

Theranos was headquartered in Palo Alto, California. It previously had laboratories in Newark, California and Scottsdale, Arizona.[38]

Management

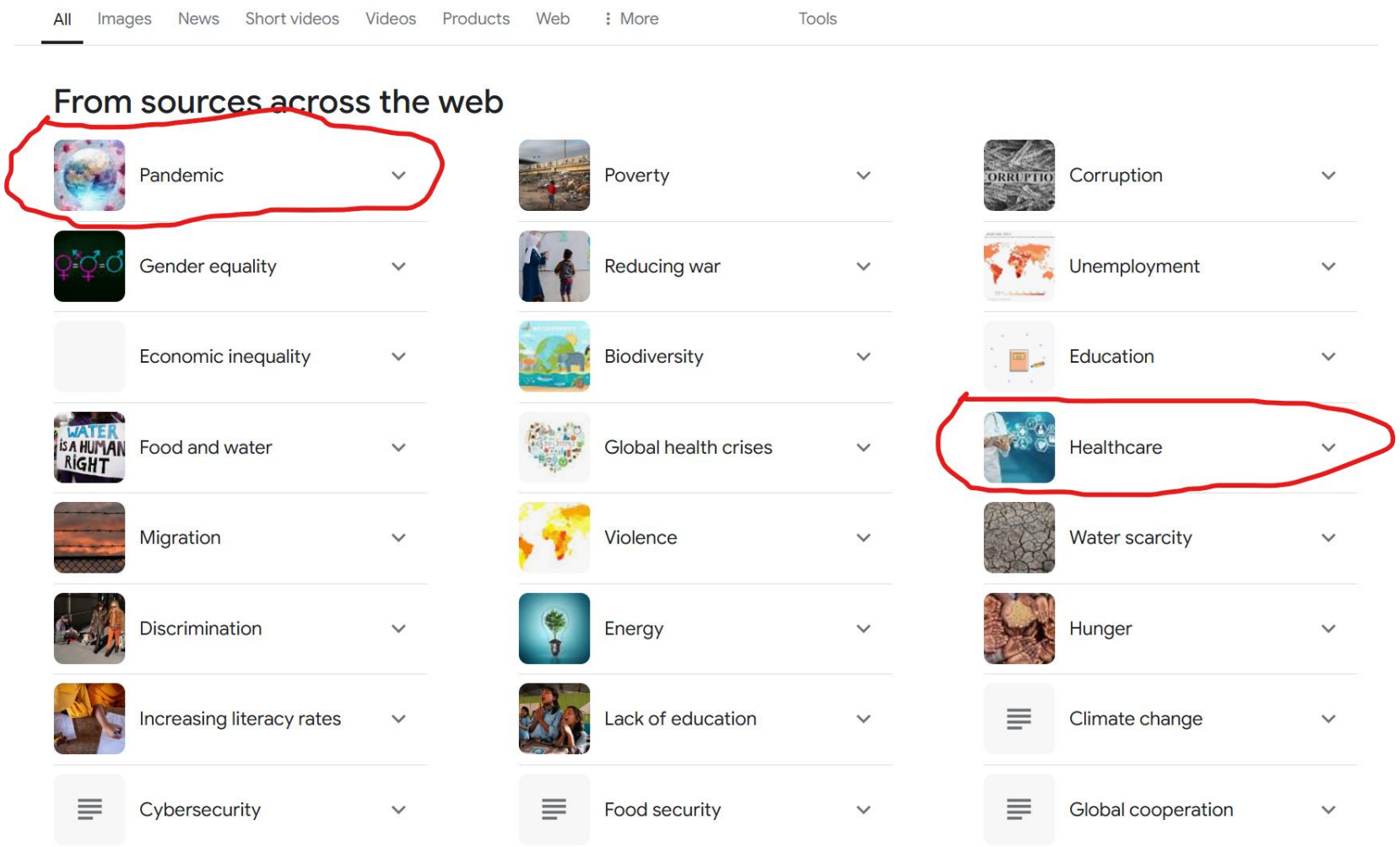
Elizabeth Holmes, the chief executive officer and founder of Theranos in 2013

From its incoporation in 2003 until 2018, Holmes was the company's chief executive officer. She recruited Channing Robertson, a chemical-engineering professor at Stanford, to be a technical

Part 2: What motivates me to pursue this position specifically?

1. The escalating challenges in global healthcare
2. Driving Impact
3. Passion for Real-World Impact

1. The escalating challenges in global healthcare



1. The escalating challenges in global healthcare

- Global healthcare challenges—pandemics like COVID-19, antimicrobial resistance, unequal healthcare access, and rising health issues—are urgent and demand innovative solutions.
- The escalating challenges in global healthcare are hot topics that require immediate action, and we must start as soon as humanly possible.
- I am motivated to address these crises through KTH's platform, leveraging its leadership in research, technology, and collaboration to drive impactful solutions.
- KTH's expertise uniquely positions it to lead efforts in healthcare accessibility, health systems innovation, and health support in local, European and international level.
- Aligning my skills with KTH's mission, I aim to help tackle these pressing issues and build resilience against future global health challenges.

2. Driving Impact

- Advancing In Silico Models to Transform Decision-Making in Healthcare
- What excites me most about this position is the chance to work on the societal complexities surrounding in silico models in healthcare.
- I see enormous potential in developing models that help stakeholders—such as healthcare providers and administrators—make informed decisions that benefit patients.

3. Passion for Real-World Impact

- Leveraging Expertise in Design and Optimization to Contribute to KTH's Vision.
- My past projects on designing, modulation, simulation and optimization has fueled my interest in impactful, real-world applications, which aligns well with KTH’s vision.
- I believe my motivation, combined with a practical approach, would enable me to contribute significantly to this PhD project and make a meaningful impact.

Part 3: How would My technical skill contribute to the research goals of this project?

1. Technical skills
2. Experience

1. Technical skills

- My technical skills span a variety of areas relevant to this project.
- I am proficient in Python, Java, and other languages for modeling and simulation, which aligns well with the participatory modeling and complexity analyses required in this PhD project.

2. Experience

Experience with statistical methods and data visualization will support the rigorous analysis needed to validate and communicate findings effectively.

Part 4: Project where I used participatory modeling or similar techniques

In this KTH PhD project. The Python code I developed for the KTH Project simulates stakeholder interactions and contributions within a participatory modeling framework, providing answers to the **(Research Questions)** explored in this project:

- **Primary Research Question:**

  How can participatory modeling approaches be designed to simulate and address stakeholder interactions, agency complexities, and decision-making processes in the adoption of in silico models for healthcare systems?

- **Secondary Research Questions:**

  How can simulation techniques be used to capture and analyze the interplay of diverse stakeholders in the healthcare ecosystem?

  - *The code models the interactions and contributions of different stakeholders, providing a quantitative and qualitative analysis of their roles in decision-making processes.*

Part 5: What do I hope to learn from working within the InSilicoHealth Doctoral Network and at KTH?

1. Exploring KTH’s Approach
2. Real-World Healthcare Insights
3. Gaining a Holistic Understanding of Healthcare Challenges

1. Exploring KTH’s Approach

To learn about KTH’s approach to integrating participatory modeling within healthcare systems and to understand the nuances of translating model outputs into practical strategies that can be implemented in hospitals

2. Real-World Healthcare Insights

The secondments in Amsterdam and Karolinska University Hospital are also particularly exciting to me, as they offer a chance to experience firsthand how models are applied in real-world healthcare settings.

3. Gaining a Holistic Understanding of Healthcare Challenges

Allowing me to develop solutions that support evidence-based policy and management decisions in healthcare

Part 6: I have Questions

Q1: Could you share more about the specific goals the research group hopes to achieve with this project?

Q2: How does KTH facilitate collaboration between doctoral candidates within the InSilicoHealth network?

Q4: What qualities or skills have you found most beneficial for success in this doctoral program?

Q4: Could you explain more about the participatory model approaches used in this project?

Part 7: Appendix