HARVARD
Advanced Leadership Initiative

Executive Summary

Technology Innovation Deep Dive

April 28-30, 2021

Key Takeaways

- Technology is programmed to do solely what humans tell it to do
- Simple, human-centered technology solutions can often be most effective
- Basic understanding of technology, its potential, and its problems, is essential for everyone in society
- Developing technologies without understanding potential consequences can create new problems that society is unprepared to address
- The market alone cannot control the advance of technology; regulation is needed
- Using technology for social innovation requires flexibility to respond to changing data

The Advanced Leadership Initiative (ALI) is an innovative academic program designed to unleash the potential of experienced leaders to help solve society's most pressing challenges. Participants become part of a vibrant community of changemakers who continue learning, collaborating, and innovating for impact.

ALI Deep Dive sessions highlight one major global or community challenge where ALI Fellows might fill a gap. Deep Dives include specialized readings, notable speakers including industry experts, and faculty from relevant cross-university Harvard programs. These highly interactive sessions focus on problem solving with practical applications of knowledge.

ALI Fellows contribute ideas based on their experience and knowledge to find immediate solutions. Fellows are able to ideate with expert practitioners in the field and consider all affected constituencies.

Technology Deep Dive Chair, Mike Smith, of Harvard John A. Paulson School of Engineering and Applied Sciences

Key Takeaways

- **Technology is programmed to do what humans tell it to do; thus, biased humans will program biased machines**

Computers, mobile devices, and other machines depend on algorithms to run. An algorithm is a set of simple instructions that describe how to perform a specific task. Algorithms can vary in complexity depending on the task. A machine reports or does only what its algorithms computes as the answer based on its inputs. Machines do not have the power to adjust and make rational decisions beyond these answers

Since machines can only perform what algorithms tell them to do, any bias in the programmer designing the algorithm, or the data inputs fed to algorithms, could also appear in the tasks performed by the machine.

An example of how these biases might manifest is in health care technology. In one instance, medical algorithms underestimated the severity of illness for black patients compared to white patients. The system was programmed to monitor hospital use, and the algorithm equated more use with more severe illness. Because black patients in this example had less access to healthcare and did not use the system as much their illnesses were considered less severe.

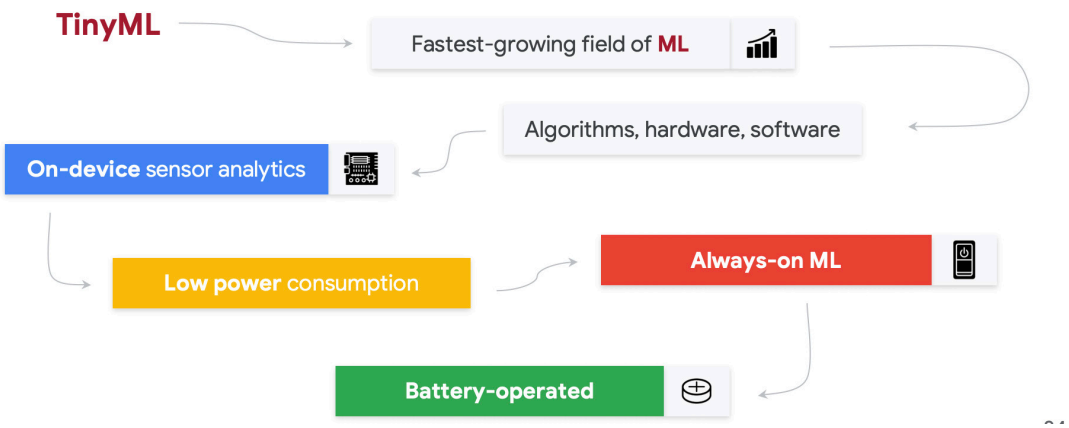


Illustration of what makes up "Tiny Machine Learning" (courtesy of Prof. Vijay Janapa Reddi)

- **More complicated technology is not always the answer; sometimes simple, human-centered solutions are most effective**

Technology is rapidly advancing, but, in many cases, more advanced technology is not needed to solve human centered problems. In order for technology to be useful, it needs to make sense for the humans who are using it. It is important to recognize when artificial intelligence technology can add unnecessary complexity and how this technology can be better directed.

For example, developers designed artificial intelligence to monitor residents with multiple sclerosis in an assisted living home and encourage them to change position to prevent bedsores. In practice, their solution was not always accurate and was difficult to monitor individually. Ultimately, the caretakers' realized that simply ringing a bell at an appointed time would be enough to remind patients and to change position.

Simplicity in technology has also shown to be effective when trying to reach specific members of a community. For example, qualifying families in low-income neighborhoods of San Jose were not using scholarship programs at the same rates as families in higher-income neighborhoods. Policy makers used technology to design a simplified sign-up process that eliminated the complicated mail-in system of the past. In the end, the city saw a 96% increase in overall program participation with this simplified technology.

> "Technology is **value-laden**. Designers of these **systems** can't help but be **influenced** by their own personal beliefs, values, and life experiences."
>
> - Professor Mike Smith

- **Basic understanding of technology, its potential, and its problems, is essential for everyone in our society**

In order for advanced technology to be useful, it requires large, relevant data sets to identify patterns and learn new algorithms. Large data sets allow for machines to make countless observations at a high speed and better understand patterns in the real-world. This reliance on "big data," however, has implications for privacy and everyone, from policy makers to individual citizens, should understand how data collection impacts their lives.

We need to better educate people on data governance in order to develop appropriate regulations and policies. This means that multiple sectors across industries must work together to collect more data, and share data sets, but also respect privacy. Even though data scientists want large data sets to produce better results, individuals must recognize the moral and ethical consequences of data collection.

- **Developing technologies without understanding their potential consequences and risks can create new problems that society is often unprepared to address**

The promise of recent technological advances is great: tiny machine learning (tinyML) and quantum computing can revolutionize our societies with increases in data gathering, analysis, and processing power.

TinyML uses mobile and wearable devices to collect real-world data in real-time, and is the fastest growing field of machine learning to date. It uses much less power than traditional computer servers, and is able to collect data from a broader group of people. Nonetheless, this sort of 'always on' data collection has serious implications for individual privacy.

Quantum computing uses the principles of quantum entanglement—the relationship between individual particles—to store and analyze

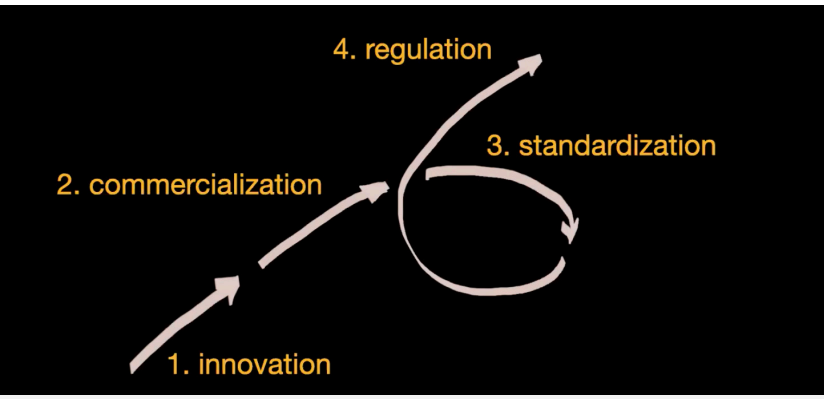


*Diagram shows Spar's "Phases of Technology"

> "AI is like an incredibly smart person who has no common sense. It requires us to **formalize** what we think are successful outcomes."
>
> - Finale Doshi-Velez

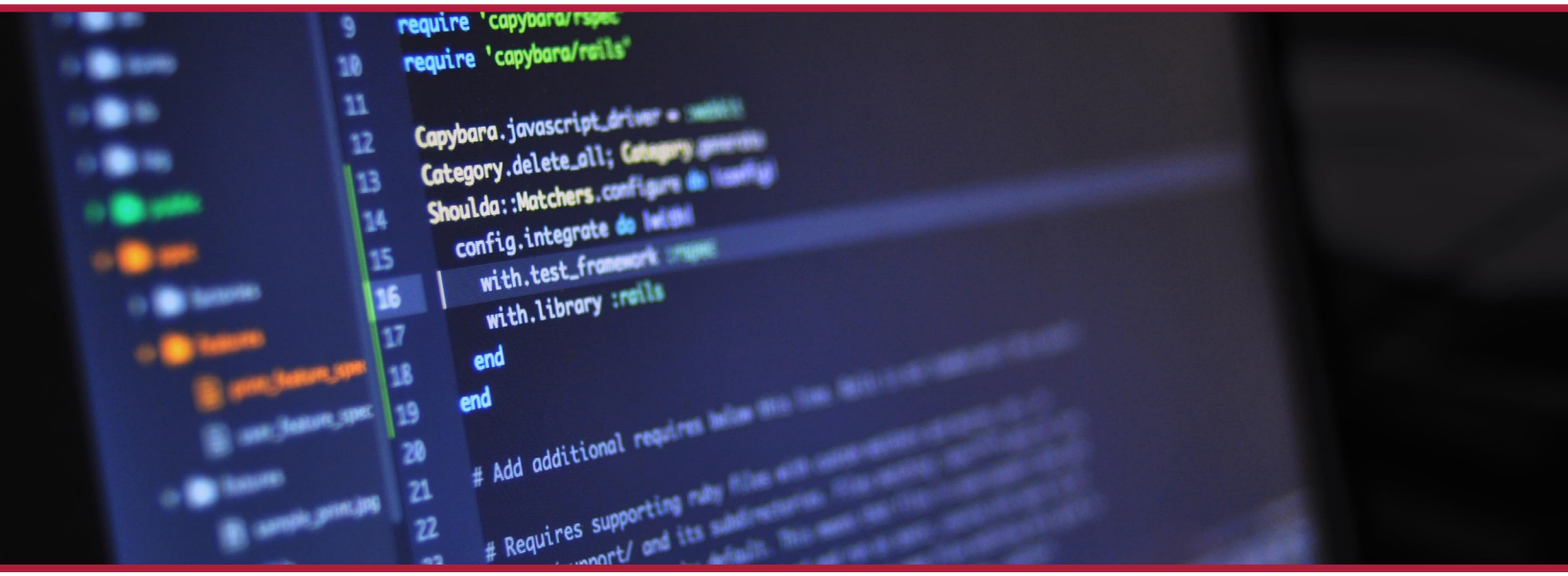
vast quantities of data, far beyond the capabilities of current technology. With that said, there is considerable concern around cyber security with this emerging technology.

- **The market alone cannot control the advance of technology; regulation is needed to keep technology accountable**

Technological advances occur in phases*. Phase one is the innovation stage; phase two is the commercialization stage; phase three is the standardization phase; phase four is the regulation stage.

Many of today's "tech giants" are moving from phase three—commercialization—to stage four—standardization. The growth of these companies has been so rapid, however, that developing regulations is a challenge; regulators need to review and revise their policies as the technology changes. Unfortunately, companies are innovating, commercializing, and growing faster than our regulatory processes.

In a broad sense, though, societies must have regulatory policies to police the ways companies and governments collect data. These policies must also ensure equitable data collection from diverse populations to increase representation and reduce bias in outcomes. In other words, societies need a rights-based framework to hold AI and technology accountable.



One example of a rights-based framework to data collection is the United States' National Institutes of Health program: All of Us, that seeks to collect voluntary health data from individuals to help cure diseases that affect the general population.

- **Social innovation and technology both require flexibility to respond to changing data**

Technology can be a tool to help solve societal issues. To use technology effectively, social innovators need to consider: connections, methods, and questions. "Connections" means communicating across groups that are typically siloed and sharing data across them. "Methods" refers to developing clear means to analyzing data to solve for a particular problem. "Questions" refers to allowing the data to suggest follow up questions and formulate new ways of thinking.

Gary King used this framework in his research to reveal the methods of Chinese censorship. Initially, King and his team set out to analyze social media data using text analysis—a particular "method." After looking at the data, they discovered unusual gaps in their data set that revealed the presence of censorship. They then changed their "question" to understand why the Chinese government censored these social media posts. They were eventually able to reverse engineer the censored terms and discover China's approach to rooting out collective action movements. They later shared these findings with their "connections" in the Chinese academic community.

"Everything is different with **quantum technologies**. It's incredible that something so 'blue sky' science has already given rise to **commercial ideas.**"

- Evelyn Hu

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