

## **Machines That Teach Themselves**

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The human race has been using tools for over 2.5 million years, and has been building machines for just over 2000 years. Over the past 200 years, we have developed refined machines to do physical work through the industrial age, and in the past 50 years, innovations in broad technology areas including electronics and computer science have spawned the digital age. Until now, machines were hand designed to perform specialized functions in a highly efficient way using engineering principles. In the information age, data volume is increasing by 40% annually and streaming at faster rates each year. Moreover, this exponential growth is dominated by an acceleration in unstructured data, due to the variety of sources including documents, video, audio, and embedded sensors. Finally, high dimensionality and uncertainty in data require new computational methods to extract latent patterns and semantics. Taken together, these challenges necessitate a new way to build machines to make information-age data useful.

In this session, we explore machines that process information into useful output in a variety of applications, but are optimized in a very different way: by learning their own models. Our first speaker, Dr. Emma Brunskill (Stanford University) will discuss how interactive machine learning can be applied to self-optimizing tutoring systems in classrooms. Her work advances the paradigm of reinforcement learning, which is an important pillar in building machines that teach themselves. Dr. Suchi Saria (Johns Hopkins University) will focus on machine systems that utilize highly heterogeneous data, ranging from sensor streams and genomic data to unstructured data, such as text, to perform inference. We will hear how she applies a variety of machine learning methods and computational statistics to improve healthcare through predictive models and individualized treatment. Dr. Jordan Boyd-Graber (University of Maryland) will discuss qualities that ubiquitous machine learning should have to allow for a future filled with natural interactions with humans. This will include question-answering AI as a way of evaluating how well AI systems can communicate what they're thinking to humans.