In the past few years, artificial intelligence (AI) has been a subject of intense media hype. Machine learning, deep learning, and AI come up in countless articles, often outside of technology-minded publications. We're promised a future of intelligent chatbots, self-driving cars, and virtual assistants—a future sometimes painted in a grim light and other times as utopian, where human jobs will be scarce and most economic activity will be handled by robots or AI agents. For a future or current practitioner of machine learning, it's important to be able to recognize the signal in the noise so that you can tell world-changing developments from overhyped press releases. Our future is at stake, and it's a future in which you have an active role to play: after reading this book, you'll be one of those who develop the AI agents. So let's tackle these questions: What has deep learning achieved so far? How significant is it? Where are we headed next? Should you believe the hype?

This chapter provides essential context around artificial intelligence, machine learning, and deep learning.

1.1. Artificial intelligence, machine learning, and deep learning

First, we need to define clearly what we're talking about when we mention AI. What are artificial intelligence, machine learning, and deep learning (see figure 1.1)? How do they relate to each other?

Figure 1.1. Artificial intelligence, machine learning, and deep learning

1.1.1. Artificial intelligence

Artificial intelligence was born in the 1950s, when a handful of pioneers from the nascent field of computer science started asking whether computers could be made to "think"—a question whose ramifications we're still exploring today. A concise definition of the field would be as follows: the effort to automate intellectual tasks normally performed by humans. As such, AI is a general field that encompasses machine learning and deep learning, but that also includes many more approaches that don't involve any learning. Early chess programs, for instance, only involved hardcoded rules crafted by programmers, and didn't qualify as machine learning. For a fairly long time, many experts believed that human-level artificial intelligence could be achieved by having programmers handcraft a sufficiently large set of explicit rules for manipulating knowledge. This approach is known as symbolic AI, and it was the dominant paradigm in AI from the 1950s to the late 1980s. It reached its peak popularity during the expert systems boom of the 1980s.

Although symbolic AI proved suitable to solve well-defined, logical problems, such as playing chess, it turned out to be intractable to figure out explicit rules for solving more complex, fuzzy problems, such as image classification, speech recognition, and language translation. A new approach arose to take symbolic AI's place: machine learning.

1.1.2. Machine learning

In Victorian England, Lady Ada Lovelace was a friend and collaborator of Charles Babbage, the inventor of the Analytical Engine: the first-known general-purpose, mechanical computer. Although visionary and far ahead of its time, the Analytical Engine wasn't meant as a general-purpose computer when it was designed in the 1830s and 1840s, because the concept of general-purpose computation was yet to be invented. It was merely meant as a way to use mechanical operations to automate certain computations from the field of mathematical analysis—hence, the name Analytical Engine. In 1843, Ada Lovelace remarked on the invention, "The Analytical Engine has no pretensions whatever to originate anything. It can do whatever we know how to order it to perform.... Its province is to assist us in making available what we're already acquainted with."

This remark was later quoted by AI pioneer Alan Turing as "Lady Lovelace's objection" in his landmark 1950 paper "Computing Machinery and Intelligence,"[1] which introduced the Turing test as well as key concepts that would come to shape AI. Turing was quoting Ada Lovelace while pondering whether general-purpose computers could be capable of learning and originality, and he came to the conclusion that they could.