

Chapter 5

Machine Learning Basics

Deep learning is a specific kind of machine learning. To understand deep learning well, one must have a solid understanding of the basic principles of machine learning. This chapter provides a brief course in the most important general principles that are applied throughout the rest of the book. Novice readers or those who want a wider perspective are encouraged to consider machine learning textbooks with a more comprehensive coverage of the fundamentals, such as [Murphy \(2012\)](#) or [Bishop \(2006\)](#). If you are already familiar with machine learning basics, feel free to skip ahead to section [5.11](#). That section covers some perspectives on traditional machine learning techniques that have strongly influenced the development of deep learning algorithms.

We begin with a definition of what a learning algorithm is and present an example: the linear regression algorithm. We then proceed to describe how the challenge of fitting the training data differs from the challenge of finding patterns that generalize to new data. Most machine learning algorithms have settings called *hyperparameters*, which must be determined outside the learning algorithm itself; we discuss how to set these using additional data. Machine learning is essentially a form of applied statistics with increased emphasis on the use of computers to statistically estimate complicated functions and a decreased emphasis on proving confidence intervals around these functions; we therefore present the two central approaches to statistics: frequentist estimators and Bayesian inference. Most machine learning algorithms can be divided into the categories of supervised learning and unsupervised learning; we describe these categories and give some examples of simple learning algorithms from each category. Most deep learning algorithms are based on an optimization algorithm called stochastic gradient