Leslie Valiant, *Probably Approximately Correct*, Basic Books, 2013

Summary

Algorithms are the step-by-step instructions used in computing for achieving desired results, much like recipes in cooking. In both cases the recipe designer has a certain controlled environment in mind for realizing the recipe, and foresees how the desired outcome will be achieved. The algorithms I discuss in this book are special. Unlike most algorithms, they can be run in environments unknown to the designer, and they learn by interacting with the environment how to act effectively in it. After sufficient interaction they will have expertise not provided by the designer, but extracted from the environment. I call these algorithms ecorithms. The model of learning they follow, known as the probably approximately correct model, provides a quantitative framework in which designers can evaluate the expertise achieved and the cost of achieving it.

These ecorithms are not merely a feature of computers. I argue in this book that such learning mechanisms impose and determine the character of life on Earth. The course of evolution is shaped entirely by organisms interacting with and adapting to their environments. This biological inheritance, as well as further learning from the environment after conception and birth, have a determining influence on the course of an individual's life. The focus here will be the unified study of the mechanisms of evolution, learning, and intelligence using the methods of computer science.

The book has the following simple structure. Chapters 1, 2, and 4 set the scene for the natural phenomena to which the quantitative computational approach is to be applied. Chapter 3 is an introduction to computer science, particularly the quantitative study of algorithms and their complexity, and describes the background for the methodology used. Chapters 5, 6, and 7 contain the resulting theory for learning, evolution, and intelligence, respectively. The final chapters make some informal and more speculative suggestions with regard to some consequences for humans and machines.