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PHILOSOPHICAL PERSPECTIVES

> Philosophy is a route of many roads, leading from nowhere to nothing.
> Ambrose Bierce

This chapter explores close relationship between predictive learning and philosophy. The connection is not obvious, because predictive learning is described in precise mathematical terms and well-defined algorithms, whereas philosophical concepts are usually presented using imprecise language. The central question in the philosophy of science and in predictive learning is whether scientific theories (or data-analytic models) explaining known facts (or observations) are just mental constructs, or they describe 'true' Laws of Nature. For example, toy examples of model selection for regression presented in Chapter 2, show comparisons between predictive models (estimated from data) and the true dependency underlying data generation.

Predictive Learning
By Vladimir Cherkassky

This book adopts the position that good data-driven models should have predictive capability. However, understanding and quantifying *randomness* and *uncertainty* is not an easy task. Modern probability theory and statistics had been completely developed only recently (in the 20th century). Yet many philosophers and scientists struggled to grasp these concepts for ages. These philosophical ideas can be helpful for understanding learning algorithms presented later in this book. This chapter focuses on three aspects of philosophy:

- Relationship between facts (observations) and mental constructs.
- Treatment of uncertainty and randomness.
- Philosophical principles for selecting 'correct' or 'true' explanations (or models).

Philosophical treatment of uncertainty and randomness can be also affected by the cultural attitudes prevailing in a human society. As human cultures constantly evolve, our present understanding of uncertainty and risk is different from the past understanding.

A mathematical theory for predictive learning, called Statistical Learning Theory, or Vapnik-Chervonenkis (VC) theory is described in Chapter 4. This theory is used for describing many learning algorithms presented later in this book. VC-theory also provides the conceptual and philosophical framework for estimating predictive models from data. The connection between VC-theoretical concepts and philosophical ideas will be further explored in Chapter 4.

This chapter starts with background material on general philosophical concepts and terminology presented in Section 3.1. Discussion proceeds with an overview of epistemology in Section 3.2. Section 3.3 describes philosophical treatment of inductive inference, and its relation to statistical inference in predictive learning. The following Sections 3.4 – 3.8 discuss general strategies for combining a priori knowledge with available data, known as inductive principles. These descriptions emphasize philosophical interpretations of inductive principles underlying many popular learning algorithms. Section 3.9 describes how the social structure of human society affects its philosophical ideas, and also points out the fundamental challenges in modeling and understanding social systems. This chapter may lack technical rigor, because philosophical ideas can be interpreted and applied in many different ways. In contrast, other chapters of this book present specific and mathematically quantifiable definitions of prediction and risk. However, any meaningful formalization comes with a number of simplifying assumptions. Philosophical ideas can provide useful insights

in understanding assumptions and limitations of various technical approaches for modeling uncertainty and risk.