CHAPTER 1: Introduction to Machine Learning

This chapter introduces the fundamental concepts of machine learning, including supervised and unsupervised learning, as well as common algorithms and their applications. Machine learning is a field of artificial intelligence that focuses on developing systems that can learn from and make decisions based on data. It has applications in various domains including healthcare, finance, and technology.

1.1 What is Machine Learning?

Machine learning is a subset of artificial intelligence that provides systems the ability to automatically learn and improve from experience without being explicitly programmed. The process of learning begins with observations or data, such as examples, direct experience, or instruction, in order to look for patterns in data and make better decisions in the future.

Example 1: Email spam filtering is a classic application of machine learning. The system learns from labeled examples of spam and non-spam emails to classify new, unseen emails.

Example 2: Netflix uses machine learning to recommend movies based on your viewing history and preferences, improving its suggestions over time as it learns more about your tastes.

1.2 Types of Machine Learning

There are three main types of machine learning: supervised learning, unsupervised learning, and reinforcement learning. Each type has different approaches and applications.

For example, in supervised learning, algorithms are trained using labeled data. The model learns to predict outputs based on input features. Common algorithms include linear regression and support vector machines.

CHAPTER 2: Neural Networks

Neural networks are a set of algorithms, modeled loosely after the human brain, that are designed to recognize patterns. They interpret sensory data through a kind of machine perception, labeling or clustering raw input. The patterns they recognize are numerical, contained in vectors, into which all real-world data, be it images, sound, text or time series, must be translated.

2.1 Perceptrons and Activation Functions

The perceptron is the simplest neural network, consisting of a single neuron. It takes several