Chapter 1

Artificial Intelligence

1.1 What is Artificial Intelligence

1.2 What is Machine Learning

Machine Learning is the science of programming computers so they can learn from data.
(with the aim to solve a problem without being explicitly programmed.)

For example,
Classification and regression problem.

1.3 Types of Learning

We can think about learning as the way we understand it as a human. We can classify a learning problem based on the degree of feedback. The three main types are:

1. Supervised learning, where we have immidiate feedback.
2. Reinforcement learning, where we have indirect feedback. For example when we are playing the game of chess.
3. Unsupervised learning, where we have non feedback signal. For example, deducing which dog belongs to each owner.

Example 1. Example of a supervised learning task. Recognition of a letter. What we are trying to learn is a probability distribution fuction

$$f : \{0, ..., 255\}^{28\times 28} \longrightarrow \text{probability distribution on } \{0, 1, ..., 9\}$$

1.4 Function Learning

Important principle I: Many supervised learning tasks are about function learning.

Example 2. Example of a classification problem. We want to classify if an image is a dog or not a dog. We would like to produce a value which is correlated with the probability of this image being a dog or not a dog. We can approach the problem in the following way. We want to find a function that takes very high values when dog-image and very low val ues when non dog images and takes the value 0 when its uncertain.

$$d : \mathbb{R}^{\#\text{pixels in image}} \to \mathbb{R}$$

such that $\mathbb{P}(d(\text{image}))$ = probability that the image is a dog.

That is what we mean by many problems can be recast as function learning. Note that there is not a god-given reason why this function should exist. We know that certain points in space, and they have certain values associated to them, but we dont know that there is some big function.

Important principle II: Sometimes function learning can be recast as a classification problem.

Binary classification problem. Rather learning $\mu : \mathbb{R}^{\#\text{bits}} \to \mathbb{R}$. It is better to learn $\mu : \mathbb{R}^{\#\text{bits}} \to$ probability distribution on $\{-1, 0, 1\}$. In number theory the function $\mu(n)$ it is called Möebius function