

CS 2710 Foundations of AI
Lecture 21

Learning

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CS 2710 Foundations of AI

Types of learning

- **Supervised learning**
 - Learning mapping between inputs x and desired outputs y
 - Teacher gives me y 's for the learning purposes
- **Unsupervised learning**
 - Learning relations between data components
 - No specific outputs given by a teacher
- **Reinforcement learning**
 - Learning mapping between inputs x and desired outputs y
 - Critic does not give me y 's but instead a signal (reinforcement) of how good my answer was
- **Other types of learning:**
 - **Concept learning, explanation-based learning, etc.**

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Supervised learning

Data: $D = \{d_1, d_2, \dots, d_n\}$ a set of n examples

$$d_i = \langle \mathbf{x}_i, y_i \rangle$$

\mathbf{x}_i is input vector, and y is desired output (given by a teacher)

Objective: learn the mapping $f : X \rightarrow Y$

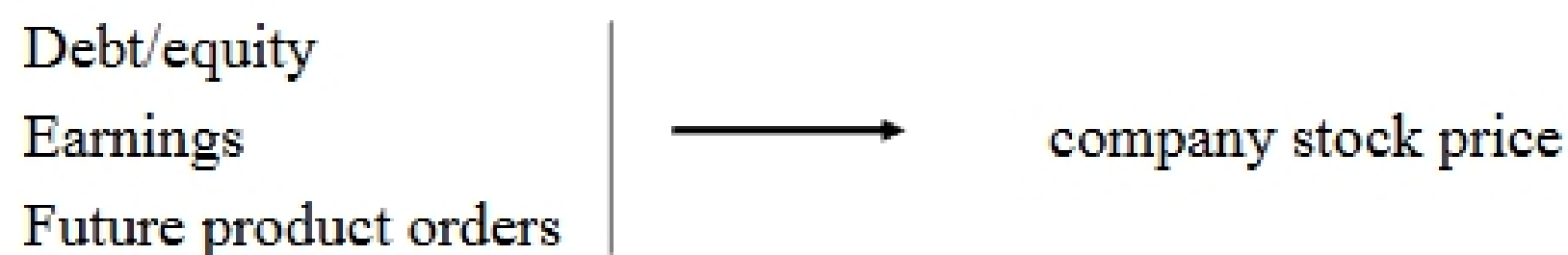
$$\text{s.t. } y_i \approx f(x_i) \quad \text{for all } i = 1, \dots, n$$

Two types of problems:

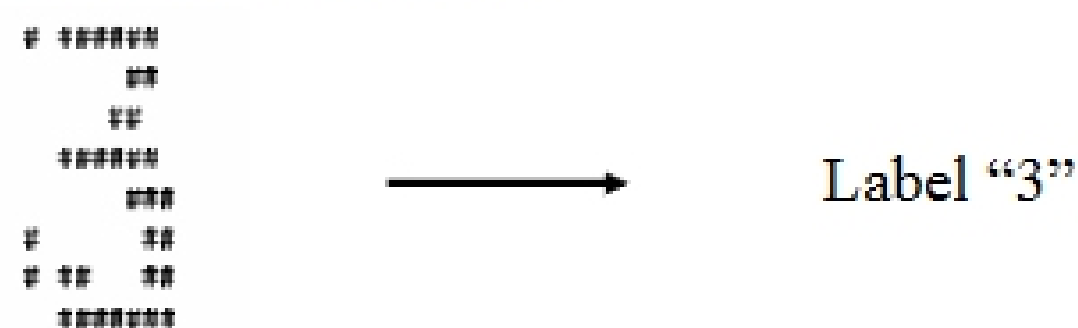
- **Regression:** X discrete or continuous \rightarrow
 Y is **continuous**
- **Classification:** X discrete or continuous \rightarrow
 Y is **discrete**

Supervised learning examples

- **Regression:** Y is **continuous**



- **Classification:** Y is **discrete**



Handwritten digit (array of 0,1s)

Unsupervised learning

- **Data:** $D = \{d_1, d_2, \dots, d_n\}$
 $d_i = \mathbf{x}_i$ vector of values
No target value (output) y
- **Objective:**
 - learn relations between samples, components of samples

Types of problems:

- **Clustering**
 - Group together “similar” examples, e.g. patient cases
- **Density estimation**
 - Model probabilistically the population of samples, e.g. relations between the diseases, symptoms, lab tests etc.

Unsupervised learning example.

- **Density estimation.** We want to build the probability model of a population from which we draw samples $d_i = \mathbf{x}_i$

