FE540 금융공학 인공지능 및 기계학습

Course Introduction

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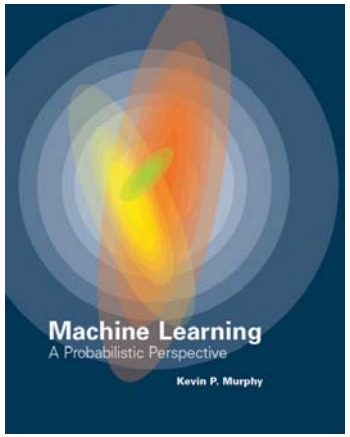
Course Overview

- Primary textbook
  - Murphy, “Machine Learning: A Probabilistic Perspective”



- Grading (tentative)
  - 4 Programming projects: 40%
  - Homework: 20%
  - Midterm exam: 20%
  - Final exam: 20%
- Supplementary textbook
  - Bishop, “Pattern Recognition and Machine Learning”
  - Duda, Hart & Stork, “Pattern Classification”
  - Mitchell, “Machine Learning”
- Related Courses
  - CS470: Introduction to AI and ML

Policies

- ☐ Check KLMS regularly for Q&A and Announcements
- ☐ **No plagiarism**
- ☐ **No late submission**
  - Submit through KLMS by deadline (email submissions automatically discarded)
  - Python for programming projects

Prerequisites

☐ Background mathematical skills such as

- Basic multivariate calculus, e.g.

$$\nabla_{\mathbf{x}} \mathbf{x}^\top \mathbf{a} = \mathbf{a}$$

- Basic linear algebra, e.g.

$$A\mathbf{u}_i = \lambda_i \mathbf{u}_i$$

- Basic probability and statistics, e.g.

$$Cov(X, Y) = E[(X - E[X])(Y - E[Y])] = E[XY] - E[X]E[Y]$$

- You should expect a lot of these…

Machine Learning?

☐ A set of methods that can

- automatically detect patterns in data, and then
- use the uncovered patterns to predict future data, or
- to perform other kinds of decision making under uncertainty (such as planning to collect more data)

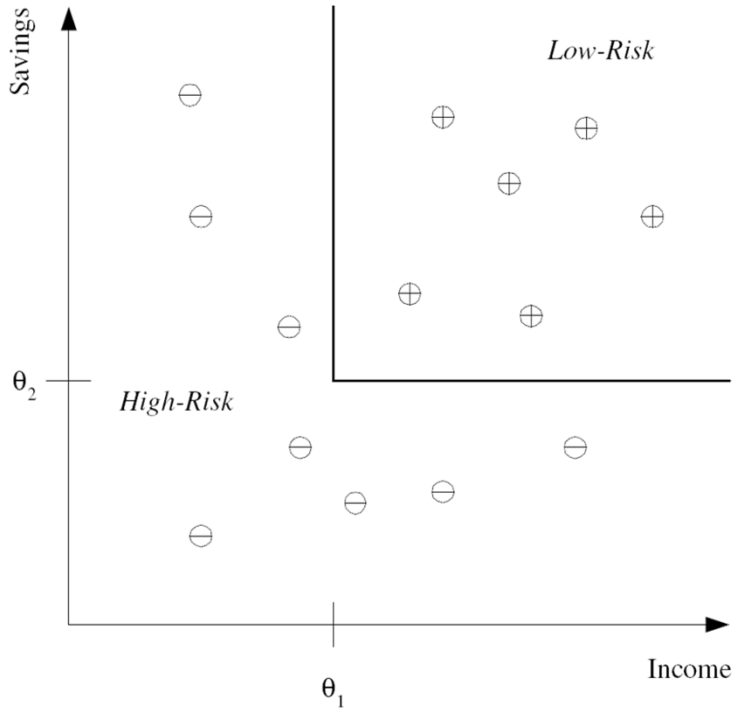
☐ Learning is useful when

- Human expertise doesn't exist (navigating on Mars)
- Humans are unable to explain their expertise (speech recognition, autonomous driving)
- Solution changes in time (routing on a computer network)
- Solution needs to be adapted to particular cases (web search engines that learns user interests)

Supervised Learning: Classification

☐ Credit scoring

- Differentiate between low-risk and high-risk customers from their incomes and savings
- Learned classification rule:
  - IF income > θ_1 AND savings > θ_2 THEN low-risk ELSE high-risk



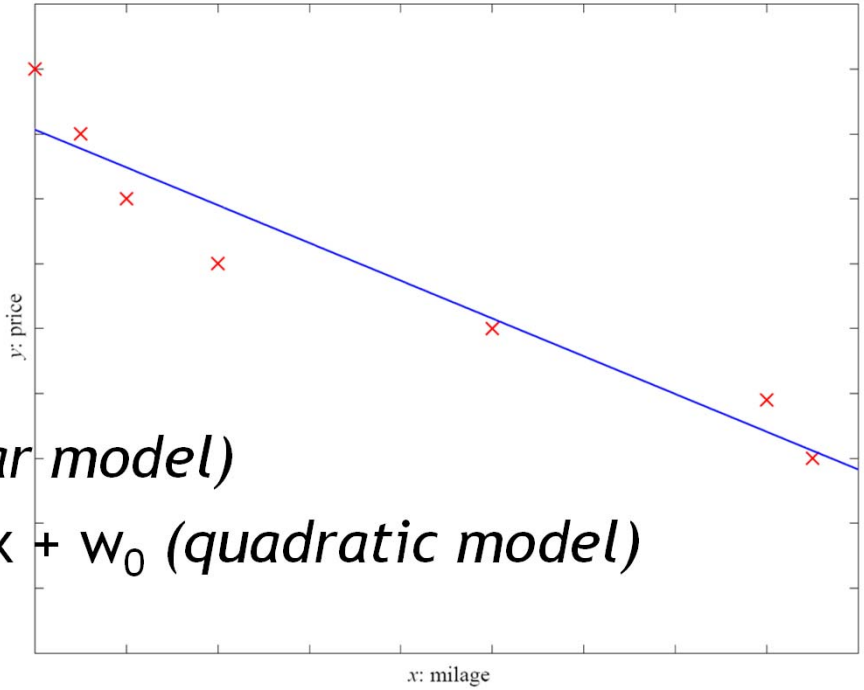
☐ Other application examples

- Face recognition
- Optical character recognition
- Speech recognition
  - Input is temporal
  - Sensor fusion: integration of inputs from different modalities (e.g. acoustic and visual)
- Outlier detection (fraud detection)

Supervised Learning: Regression

☐ Estimate the price of a used car

- x = car *attributes*, y = price
- $y = g(x|\theta)$
  - $g(\cdot)$ is the model
  - θ is the parameter
- Examples of g and θ
  - $g(x|w_0,w_1) = w_1 x + w_0$ *(linear model)*
  - $g(x|w_0,w_1,w_2) = w_2 x^2 + w_1 x + w_0$ *(quadratic model)*
- Output values continuous vs. classification (discrete)



☐ Example applications

- Autonomous car navigation: Learn to steer given input (video image, GPS, …)
- Typically same application areas as classification

Unsupervised learning

- Learning without correct output values (i.e., without supervisor)
  - Classification & regression tasks had target labels…
  - Find regularities in the input
  - “knowledge discovery”, “density estimation”
  - e.g. clustering (group similar instances)
- Example application
  - Customer segmentation in CRM
  - Image compression: Color quantization
  - Bioinformatics: Learning motifs

Reinforcement Learning

- Learning a policy (a sequence of correct actions to reach the goal)
  - No supervisor telling the correct action: Learn from delayed reward (critic)
- Game playing

- Multiple agents, partial observability, …