Pattern Information Processing (パターン情報処理)

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Contents of This Lecture (1)

- Syllabus (what I will provide in this course):
 - Inferring an underlying input-output dependency from input and output examples is called supervised learning.
 - This course focuses on a statistical approach to supervised learning and introduces its basic concepts as well as state-of-the-art techniques.

Statistical machine learning





Contents of This Lecture (2)

What you are expected to learn in this course:

- How to use supervised learning methods
- Ideas behind the methods
- Novel research topics in supervised learning
- Something useful in your own research/life





Grading



- Small reports
 - Almost every week
 - Deadline: next class
- Mini conference on supervised learning (final day)
 - Apply supervised learning techniques to your own data sets and analyze them!
- Final reports on the above issue

Brief Overview of the Course (1)⁵

- 3 types of learning
 - Supervised learning
 - Unsupervised learning
 - Reinforcement learning







Brief Overview of the Course (2)⁶

Topics in supervised learning

- Active learning
- Model selection
- Learning method

Textbook

Handouts are provided if necessary.
Pointers to related articles will be provided.

I suppose you know elementary statistics and linear algebra. If not, please study them by yourself!

3 Topics in Learning Research







Understanding the brain (Physiology, psychology, neuroscience) Developing learning machines (Computer and electronic engineering)



Mathematically clarifying mechanism of learning (Computer and information science)

Three Types of Learning

Supervised learning (This course!)

Unsupervised learning

Reinforcement learning



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What Is Supervised Learning?

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- The goal of supervised learning is to estimate an unknown input-output rule.
- You are allowed to ask questions to a supervisor ("oracle") who knows the rule.
- The supervisor answers your questions using the rule.



Generalization Capability

- Training examples: pairs of questions and answers.
- If the underlying rule can be successfully estimated, we can answer to the questions that we have never taught.
- Such an ability is called the generalization capability.



Example 1

Hand-written number recognition

We want to recognize the scanned handwritten characters.

Example 1

- Training examples consist of { (hand-written number, its recognition result) }.
- If underlying input-output rule is successfully learned, unlearned hand-written numbers can be recognized.



Example 2: Brain-Computer Interface (BCI)

Control computers by brain signals:

- Input: brain signals (EEG)
- Output: Left or Right

Training

Imagine left/right-hand movement following the letter on the screen

Testing: Playing Games "Brain-Pong"

Other Examples

Other examples are...

- Stock price estimation
- Robot motor control
- Computer vision
- Spam filter
- DNA classification





