Intelligent Learning (IL)

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Outline

1. Introduction
2. Concept Learning
3. Decision Tree Learning
4. Artificial Neural Networks
5. Bayesian Learning
6. Genetic Algorithms
7. Reinforcement Learning

Introduction

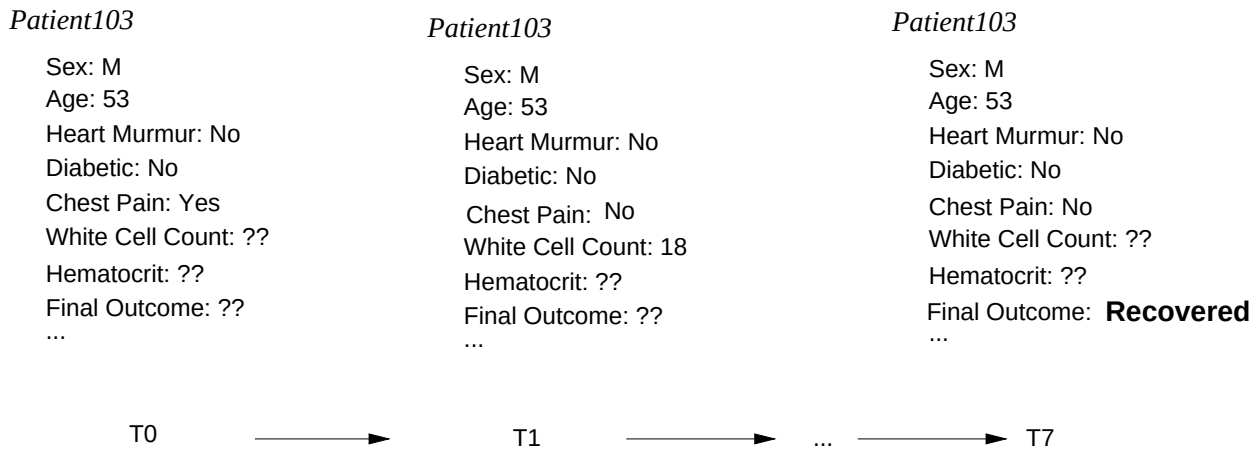
- Why is it necessary and possible to develop intelligent learning algorithms?
- How to define a learning problem?
- How to measure the performance of a learning algorithm?

Objective of Intelligent Learning

- Reflect ourselves
- Explain ourselves
- Help ourselves
- Plan ourselves

The Necessity to Develop IL Systems

- Understand and improve human learning efficiency
  - Medical records $\rightarrow$ medical knowledge



- Some applications where we can’t program by hand
  - Autonomous Driving at 70mph on a highway

- Self Customizing Programs
  - Newsreader that can learn your interests

The Possibility for Machine to Learn

- Recent progress in algorithms and theory
- Growing flood of online data
- Computational power is available
- Budding industry

Learning IL Module?

DISCUSS: On what conditions do you like or dislike learn IL module?

What Does Learning mean?

- Learning = Improving performance P with Experience E at some Tasks T
- The goal of a learning system is prediction on new cases.
- The learning process is to approximate the training examples.
- The learning process is to extract the common characteristics from the training examples.

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- Based on Experience E: from where to learn?

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- T: Play TicTacToe game

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- E: Opportunity to play against itself

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Training experience consists of a pattern of observations (also called features, attributes, constraints, ...) and the corresponding correct classification or prediction.

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- Teacher or not: How to control the sequence of examples to be used for learning?
- Problem: Is the training experience representative of test experience for performance measurement? Lecturing contents and examination questions

What to learn? The Target Function?

Target function represents the relationship between the learning inputs and outputs.

- A set of rules
- Neural networks
- Polynomial function of a number of feature values
- . . .

Look at Learning as Regression

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- Optimise objective function: $\sum_i (\hat{Output_i} - Output_i)^2$.

Performance Measurement

Error Rate=$\frac{Number\ of\ errors}{Number\ of\ Examples}$

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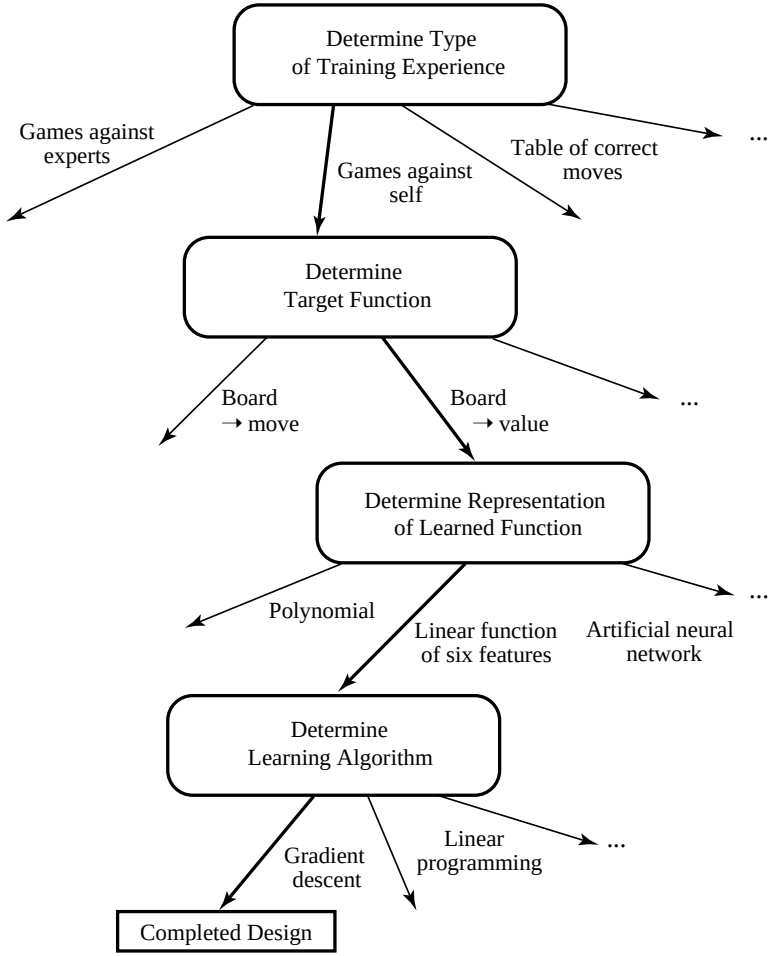
- Test sample error rate: based on test examples
- True error rate: based on new examples

Designing Choice



Relative Disciplines

- Artificial Intelligence
- Bayesian Methods
- Computational complexity theory
- Control theory
- Information theory
- Statistics
- Psychology and neurobiology
- Philosophy

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- What is the best way to reduce a learning task to one or more function approximation problems?
- How can the learning algorithm automatically change its representation to improve its ability to represent and learn the target function?

Questions?

- Use your experience to explain what "learning" means?
- Why is it necessary and possible to develop learning algorithms?
- How to define a learning algorithm?
- List and explain three methods for the performance measurement of learning algorithms.