Artificial Intelligence

Lecture 15：Review

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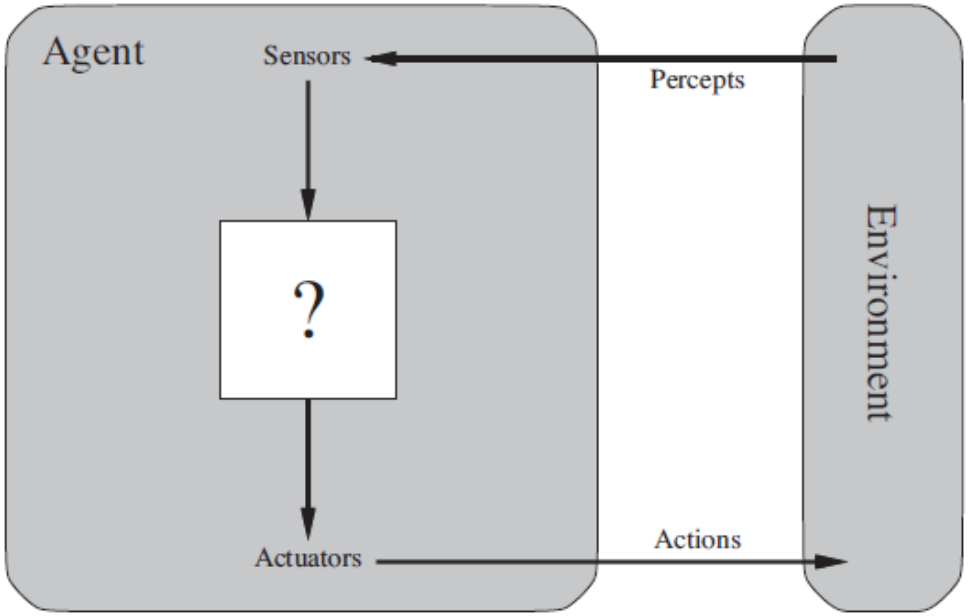
What is AI?

Thinking Humanly	Thinking Rationally
"The exciting new effort to make computers think . . . *machines with minds*, in the full and literal sense." (Haugeland, 1985) "[The automation of] activities that we associate with human thinking, activities such as decision-making, problem solving, learning . . ." (Bellman, 1978)	"The study of mental faculties through the use of computational models." (Charniak and McDermott, 1985) "The study of the computations that make it possible to perceive, reason, and act." (Winston, 1992)
Acting Humanly	**Acting Rationally**
"The art of creating machines that perform functions that require intelligence when performed by people." (Kurzweil, 1990) "The study of how to make computers do things at which, at the moment, people are better." (Rich and Knight, 1991)	"Computational Intelligence is the study of the design of intelligent agents." (Poole *et al.*, 1998) "AI . . . is concerned with intelligent behavior in artifacts." (Nilsson, 1998)

Intelligent Agents

- For each possible percept sequence, a rational agent should select an action that is expected to maximize its performance measure, given the evidence provided by the percept sequence and whatever built-in knowledge the agent has.
  - Reflex agents
  - Planning agents
  - Learning agents



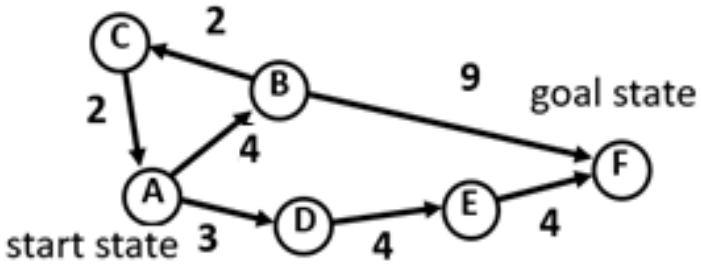
Task environment
- Performance
- Environment
- Actuators
- Sensors

Agent = Architecture + Program

Problem-Solving Agents

- Problem Formulation
  - A search problem consists of:
    - A start sate and a goal test
    - A state space
    - A successor function (with actions, costs)
- Solving Problems by Searching
  - Uninformed Search
    - BFS, DFS
    - Iterative Deepening Search
    - Cost-sensitive Search
  - Informed Search
    - Greedy Search
    - A* Search

- State graph
- Search tree



Adversarial Search

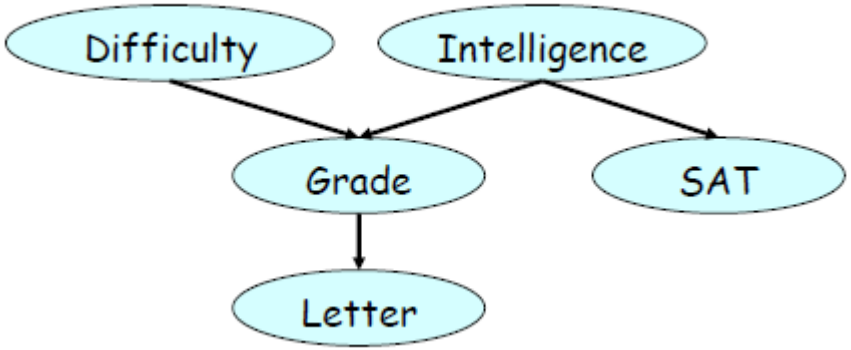
- Problem Formulation
  - A search problem consists of:
    - S_0: the initial state
    - Player(s): defines which player has the move in a state
    - Actions(s): returns the set of legal moves in a state
    - Result(s, a): the transition model
    - Terminal-test(s): is true when the game is over and false otherwise
    - Utility(s, p): a utility / objective function
  - Game tree
- Solving Problems by Adversarial Searching
  - Minimax search
    - Alpha-Beta Pruning
  - Depth-limited search
    - Evaluation function

Constraint Satisfaction Problem

- Problem Formulation
  - A CPS consists of three components:
    - A set of variables $X = \{X_1, \cdots, X_n\}$
    - A set of domains $D = \{D_1, \cdots, D_n\}$
    - A set of constraints C
- Solving Problems by Backtracking Searching
  - Ordering
  - Inference

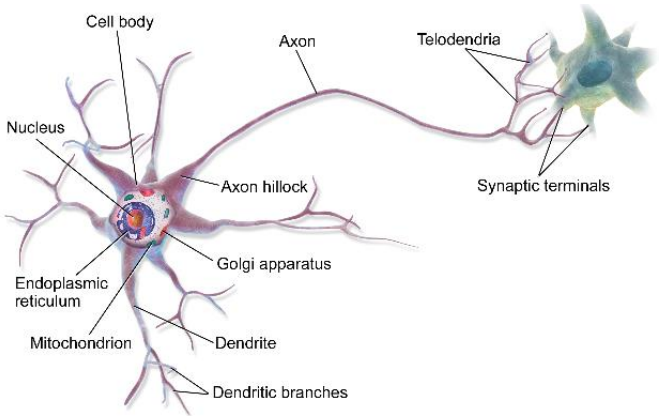
Bayesian Networks

- Representation
  - Joint probability
  - Conditional Independence
- Inference
  - Enumeration
  - Variable elimination
  - Gibbs sampling
- Learning
  - Maximum Likelihood Estimation
  - Bayesian Estimation



Machine Learning

- Classification
  - Naive Bayesian Model
  - Decision Trees
  - Artificial Neural Networks
- Deep Learning
  - CNN
  - Auto-encoder
  - Restrict Boltzmann machine



Markov Decision Process

- Problem Formulation
- Solution
  - Optimal policy
  - Optimal values
- Learning
  - Reinforcement learning
  - Deep reinforcement learning

Final Exam

- Date:
  - 2021年07月01日(14:00-16:00)
- Location:
  - 玉泉教7-102

Good luck!