DM828 (5 ECTS - 2nd Quarter) Introduction to Artificial Intelligence

Introduktion til kunstig intelligens

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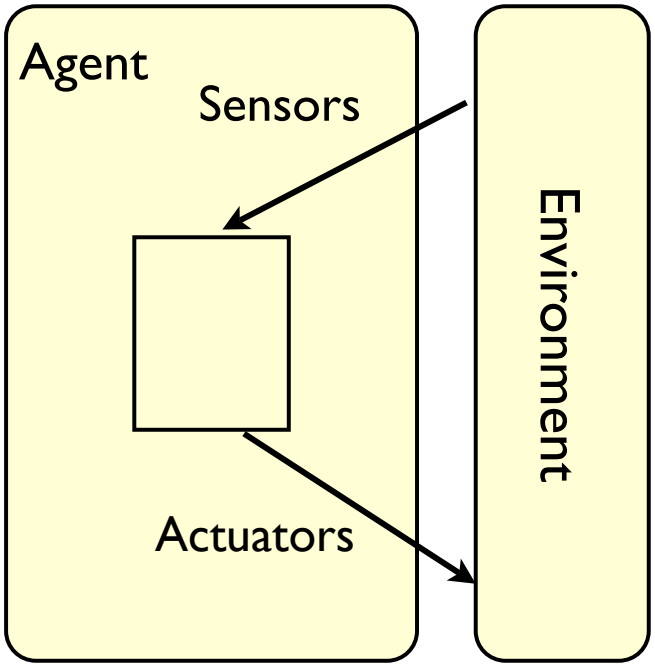
What is AI?

Artificial Intelligence is concerned with the general principles of rational agents and on the components for constructing them

Agents: something that acts, a computer program, a robot

Rationality: acting so as to achieve the best outcome, or, under uncertainty, the best expected outcome



➡ In complicated environments, perfect rationality is often not feasible

History

Alan Turing. “Computational Machinery and Intelligence.” Mind (1950) [Reference to machine learning, genetic algorithms, reinforcement learning]

Workshop at Dartmouth College in 1956 by John McCarthy, Marvin Minsky, Claude Shannon, Allen Newell, Herbert Simon [The field receives the name Artificial Intelligence]

...

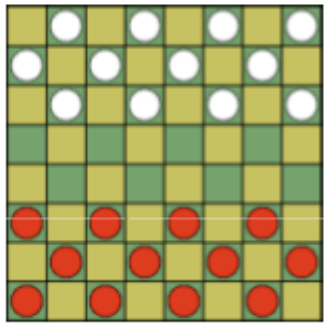
Today: AI is a branch of computer science with strong intersection with operations research, decision theory, logic, mathematics and statistics

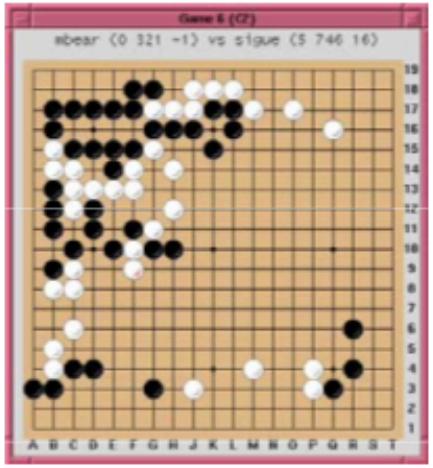
Contents

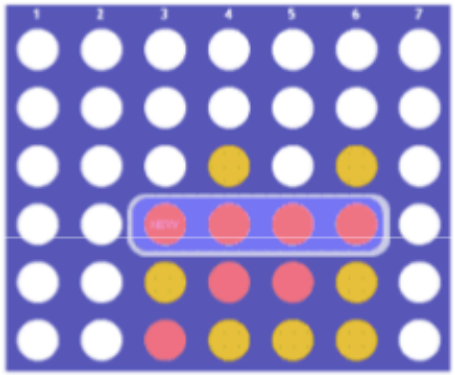
1. Introduction, Philosophical aspects (1 lecture)
2. Problem Solving by Searching (3 lectures)
   - Uninformed and Informed Search
   - Adversarial Search: Minimax algorithm, alpha-beta pruning
3. Knowledge, Reasoning and Planning (4 lectures)
   - Propositional Logic, First Order Logic, Inference
   - Automated Planning
4. Uncertain Knowledge and Reasoning (5 lectures)
   - Decision Theory
   - Probabilistic Graphical Models
   - Sequential Decisions
   - Multiagent Environments, Game Theory
5. Learning (2 lectures)
   - Reinforcement Learning

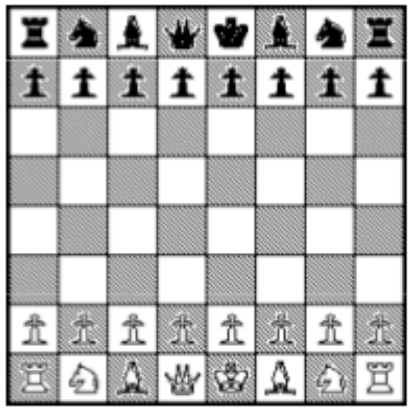
2. Problem Solving by Searching

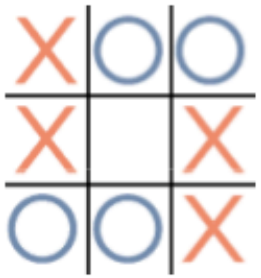
- Uninformed and Informed Search
- Adversarial Search: Minimax algorithm, alpha-beta pruning

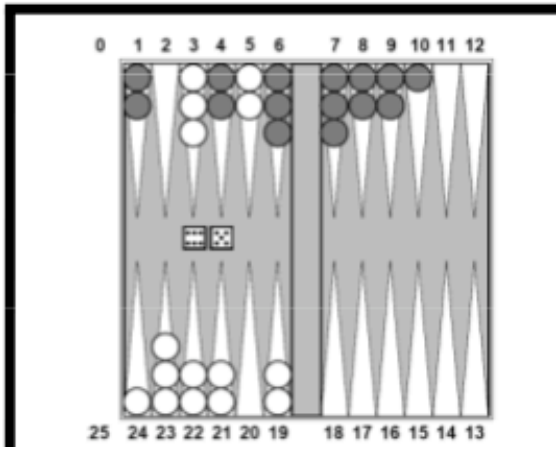






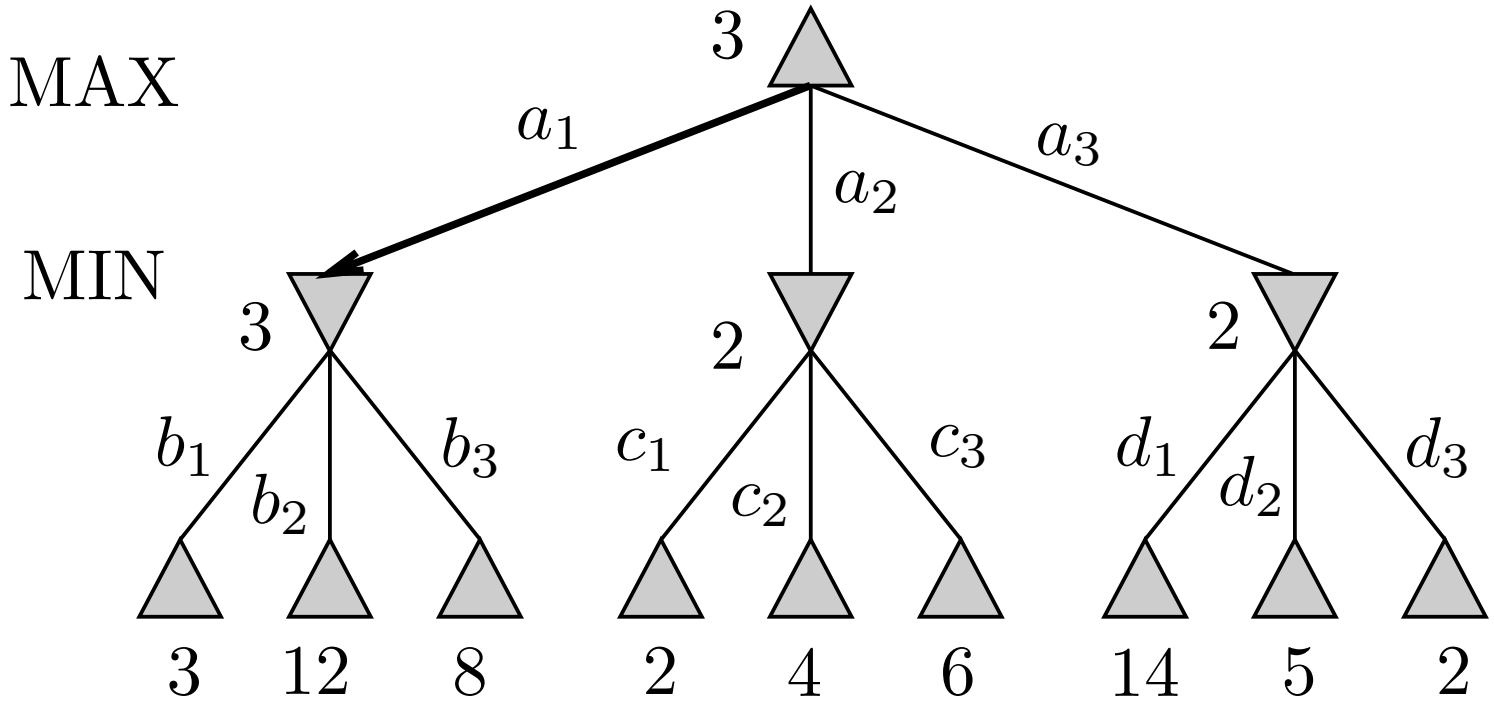






2. Problem Solving by Searching

- Uninformed and Informed Search
- Adversarial Search: Minimax algorithm, alpha-beta pruning



3. Knowledge Representation

- Propositional logic, First Order Logic, Inference
- Automated Planning

Generate sequences of actions to achieve objectives where actions are abstractions of real activity

Init = $At(C1, SFO) \wedge At(C2,JFK) \wedge At(P1,SFO) \wedge At(P2,JFK) \wedge Cargo(C1) \wedge Cargo(C2) \wedge Plane(P1) \wedge Plane(P2) \wedge Airport(JFK) \wedge Airport(SFO)$

Goal = $At(C1,JFK) \wedge At(C2,SFO)$

Action $Load(c,p,a)$

PRECOND: $At(c,a) \wedge At(p,a) \wedge Cargo(c) \wedge Plane(p) \wedge Airport(a)$

EFFECT: $\neg At(c,a) \wedge In(c,p)$

Action $Unload(c,p,a)$

PRECOND: $In(c,p) \wedge At(p,a) \wedge Cargo(c) \wedge Plane(p) \wedge Airport(a)$

EFFECT: $At(c,a) \wedge \neg In(c,p)$

Action $Fly(p,from,to)$

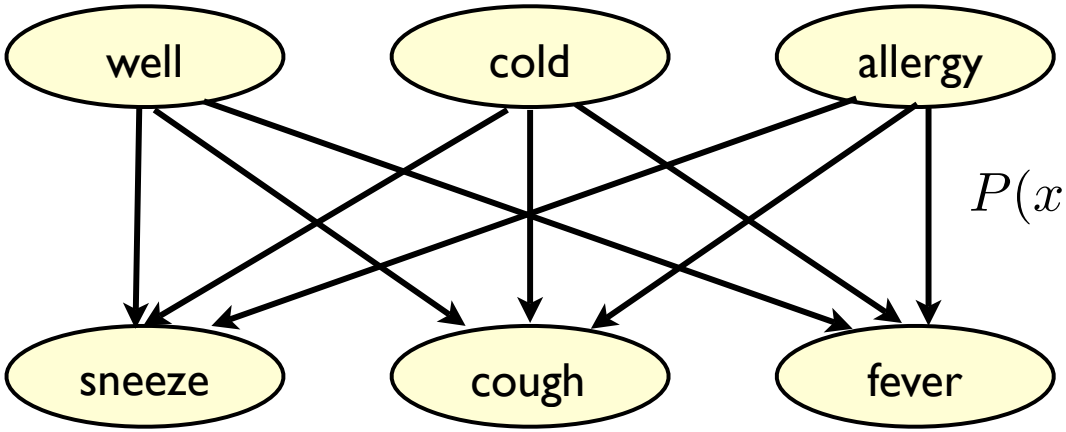
PRECOND: $At(p,from) \wedge Plane(p) \wedge Airport(from) \wedge Airport(to)$

EFFECT: $\neg At(p,from) \wedge At(p,to)$

Plan = $Load(C1,P1,SFO)$, $Fly(P1,SFO,JFK)$, $Unload(C1,P1,JFK)$
$Load(C2,P2,JFK)$, $Fly(P2,JFK,SFO)$, $Unload(C1,P1,JFK)$

4. Uncertain Knowledge

- Decision Theory
- Probabilistic Graphical Models
- Multiagent Environments, Game Theory



$$P(x_1, \ldots, x_n) = \prod_{i=1}^{n} P(x_i|C)$$

Diagnosis	Well	Cold	Allergy
P(C)	0,90	0,05	0,05
P(sneeze|C)	0,10	0,90	0,90
P(cough|C)	0,10	0,80	0,70
P(fever|C)	0,00	0,70	0,40

Given that we observe x={sneeze, cough, not fever}
which class of diagnosis is most likely?

4. Uncertain Knowledge

- Decision Theory
- Probabilistic Graphical Models
- Multiagent Environments, Game Theory

	Prisoner B Stays Silent	**Prisoner B Betrays**
Prisoner A Stays Silent	Each serves 6 months	Prisoner A: 10 years Prisoner B: goes free
Prisoner A Betrays	Prisoner A: goes free Prisoner B: 10 years	Each serves 5 years

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Prerequisites

- ✓ DM502, DM503 Programming (Programmering)
- ✓ DM527 Discrete Mathematics (Matematiske redskaber i datalogi)
- ✓ DM528 Combinatorics, Probability and Randomized Algorithms
- ✓ DM509 Programming Languages (Programmeringssprog)
- ✓ ST501 Science Statistics (Science Statistik)

Final Assessment (5 ECTS)

- 2/3 homeworks including programming
  - pass/fail grading
  - internal examiner
  - programming in [Java|Python]
- A three hour written exam
  - closed books with a maximum of two two-sided sheets of notes.
  - external examiner

Course Material

- Text book
  - Russell, S. & Norvig, P. *Artificial Intelligence: A Modern Approach* Prentice Hall, Third Edition, 2010
- Slides
- Source code and data sets
- www.imada.sdu.dk/~marco/DM828