DM533 (5 ECTS - 2nd Quarter) Introduction to Artificial Intelligence

Introduktion til kunstig intelligens

Marco Chiarandini
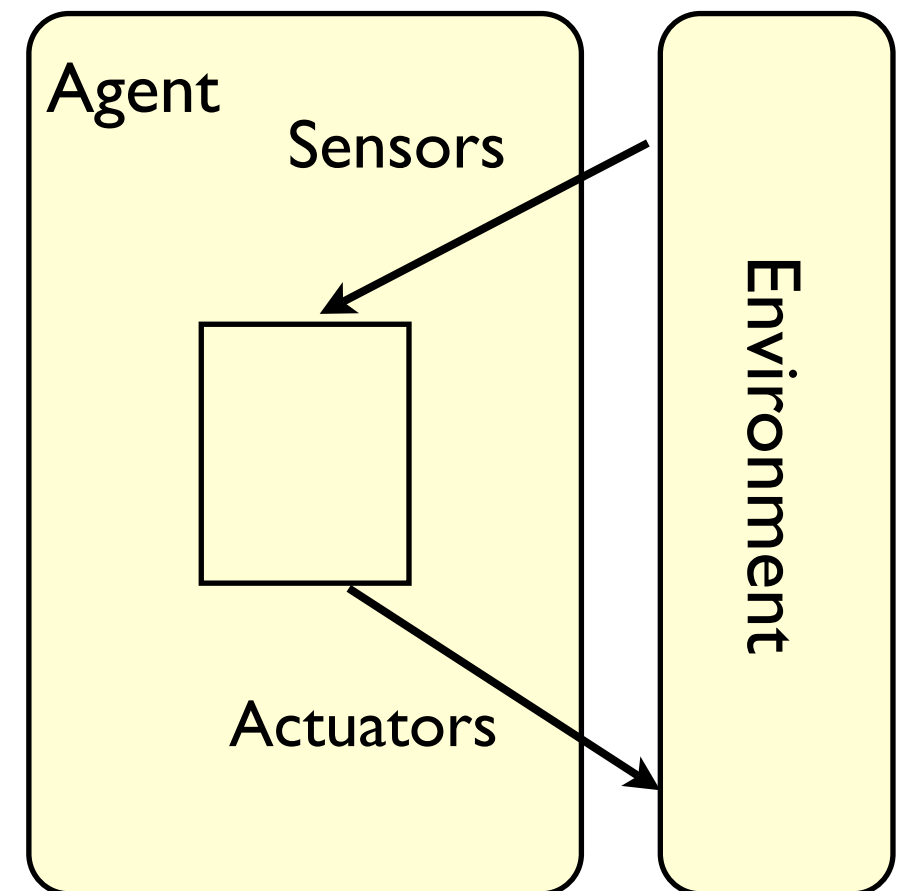
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What is AI?

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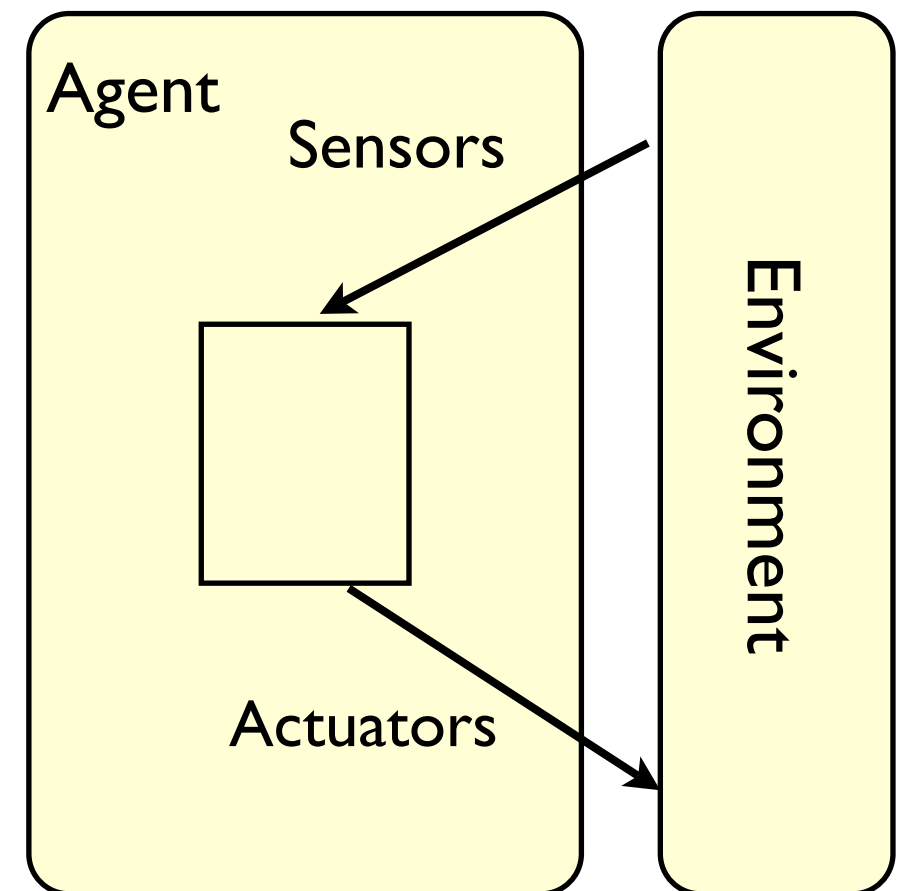Rationality: acting so as to achieve the best outcome, or when there is uncertainty, the best expected outcome

➡ In complicated environments, perfect rationality is often not feasible

History

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

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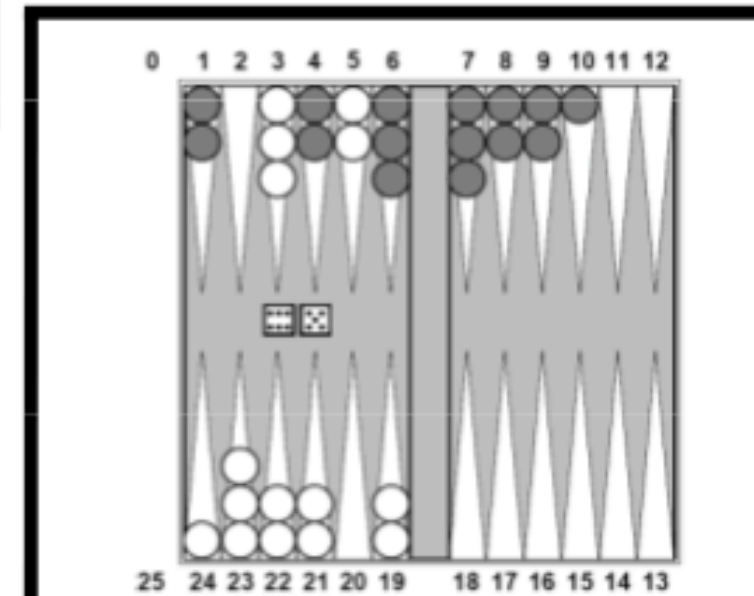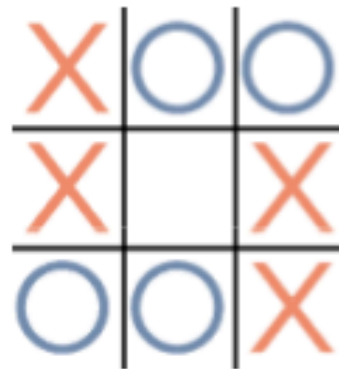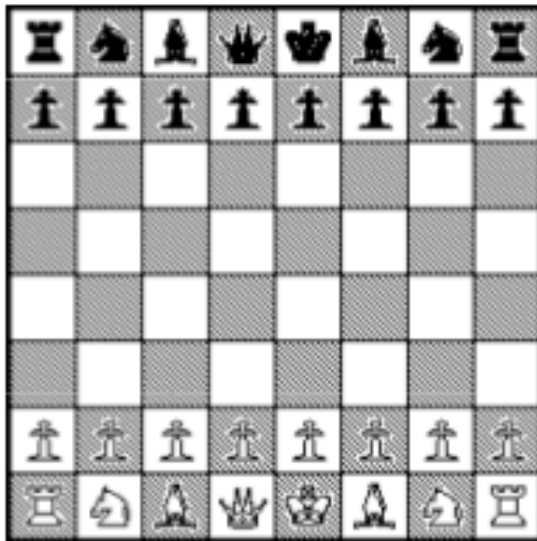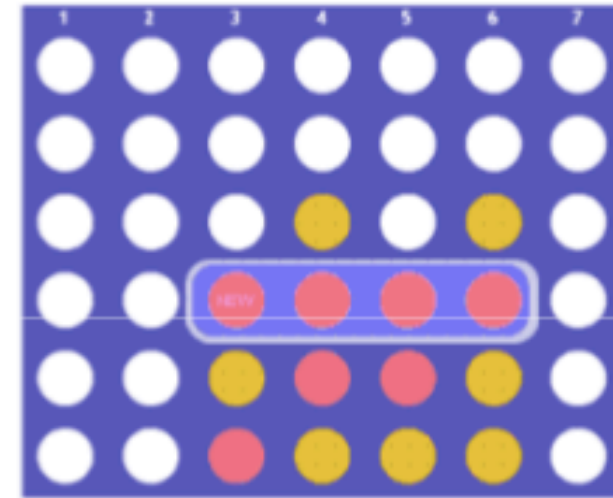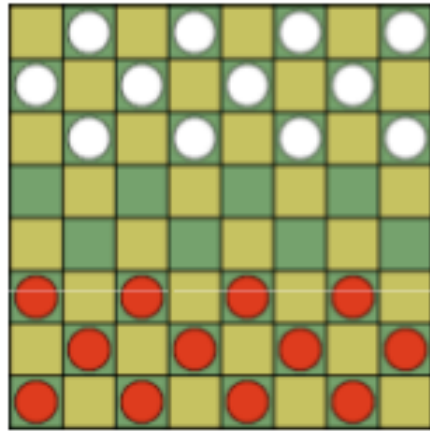
Contents

1. Introduction, Philosophical aspects (2 lectures)

2. Problem Solving by Searching (2 lectures)

   - Uninformed and Informed Search

   - Adversarial Search: Minimax algorithm, alpha-beta pruning

3. Knowledge representation and Inference (3 lectures)

   - Propositional logic, First Order Logic, Inference

   - Constraint Programming (Comet or Prolog)

4. Decision Making under Uncertainty (4 lectures)

   - Probability Theory + Utility Theory

   - Bayesian Networks, Inference in BN,

   - Hidden Markov Models, Inference in HMM

5. Machine Learning (4 lectures)

   - Supervised Learning: Classification and Regression, Decision Trees

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2. Problem Solving by Searching

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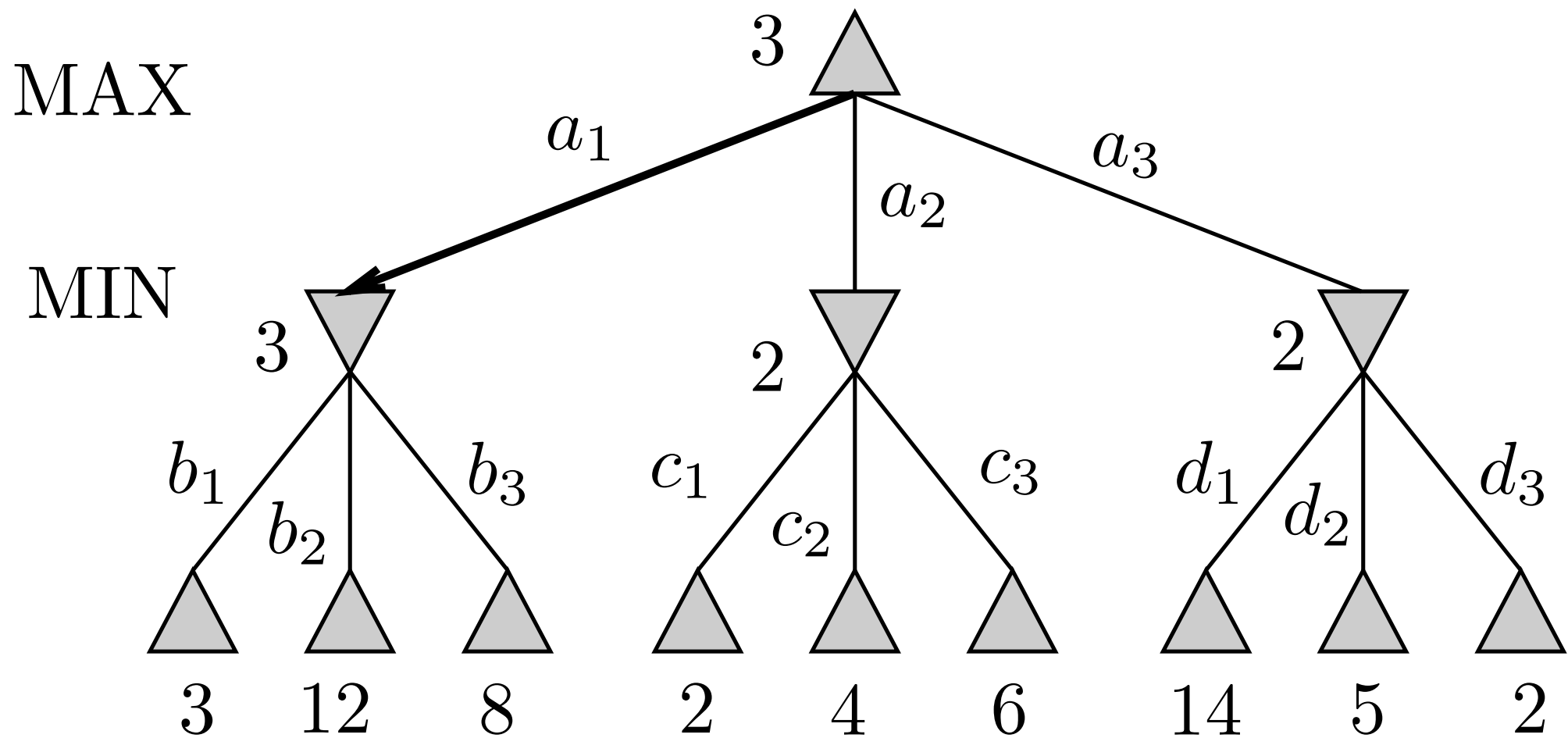# 2. Problem Solving by Searching

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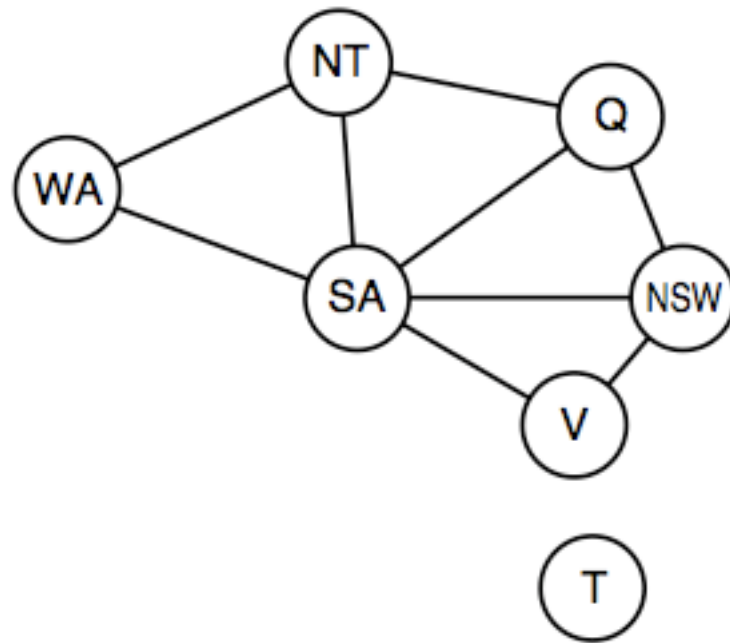- Adversarial Search: Minimax algorithm, alpha-beta pruning

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$$Diff(wa, nt) \wedge Diff(wa, sa) \wedge$$
$$Diff(nt, q) Diff(nt, sa) \wedge$$
$$Diff(q, nsw) \wedge Diff(q, sa) \wedge$$
$$Diff(nsw, v) \wedge Diff(nsw, sa) \wedge$$
$$Diff(v, sa) \Rightarrow Colorable()$$

$$Diff(Red, Blue) \quad Diff(Red, Green)$$
$$Diff(Green, Red) \quad Diff(Green, Blue)$$
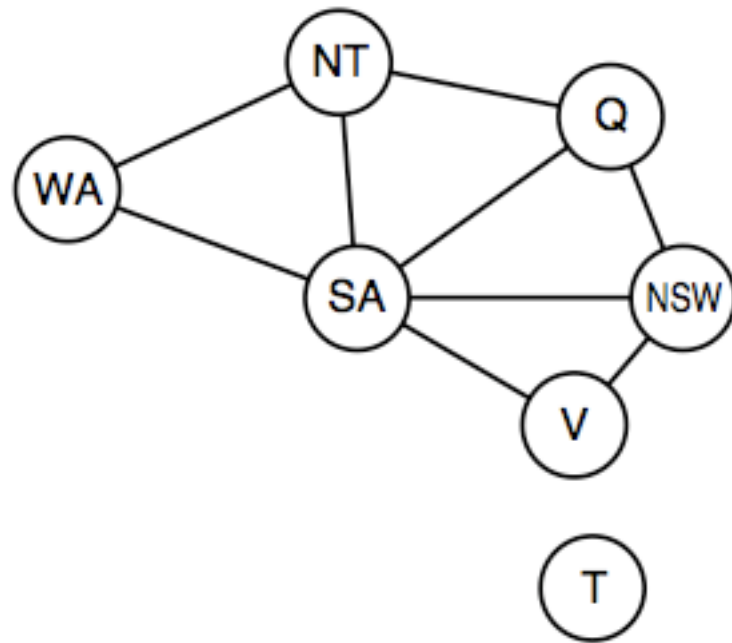$$Diff(Blue, Red) \quad Diff(Blue, Green)$$

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Finding a solution to the
Constraint Satisfaction Problem
corresponds to infer coloring in FOL

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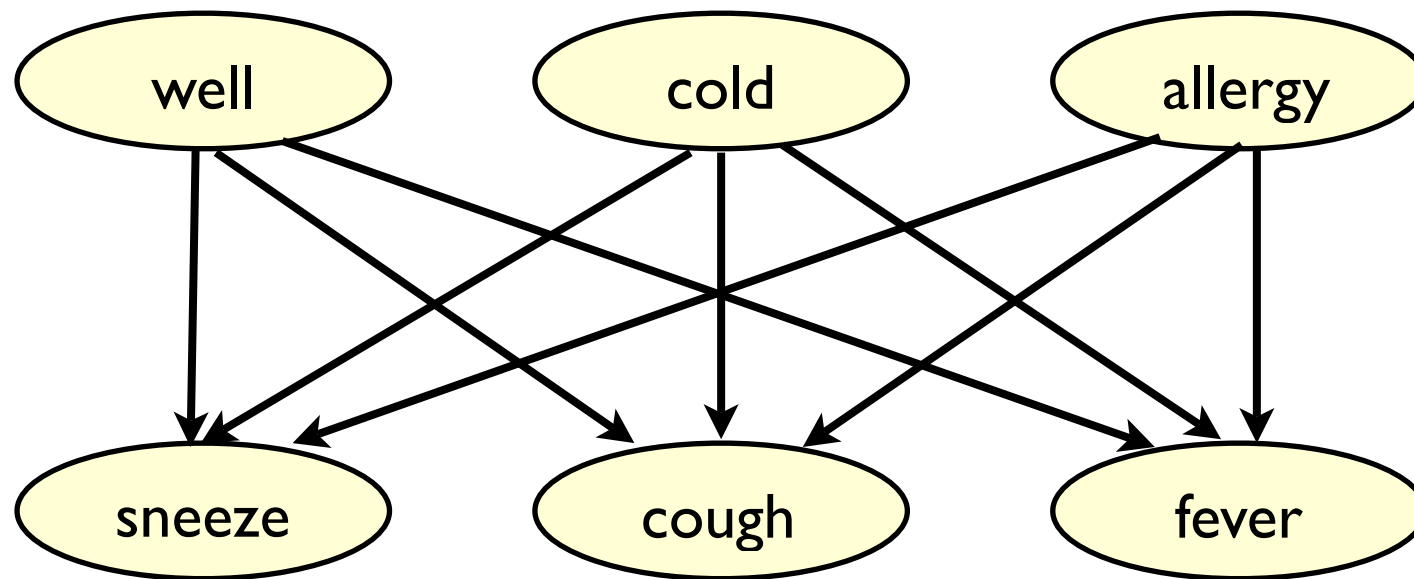| Diagnosis	Well	Cold	Allergy
P(C)	0,90	0,05	0,05
P(sneeze|C)	0,10	0,90	0,90
P(cough|C)	0,10	0,80	0,70
P(fever|C)	0,00	0,70	0,40

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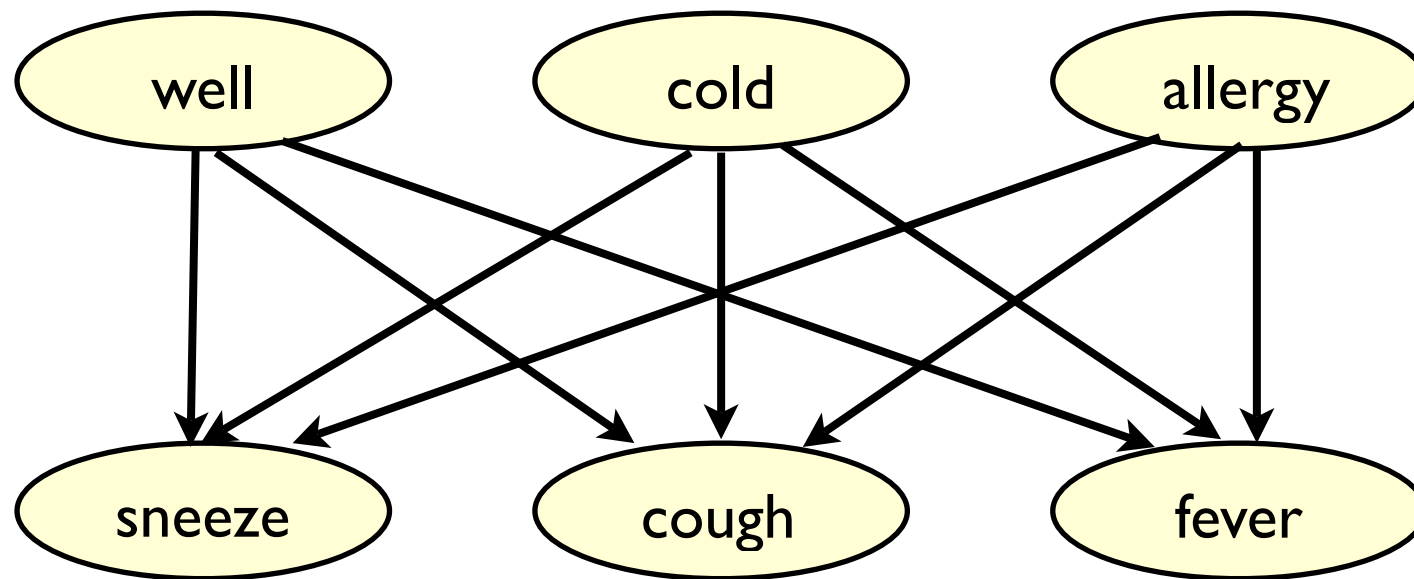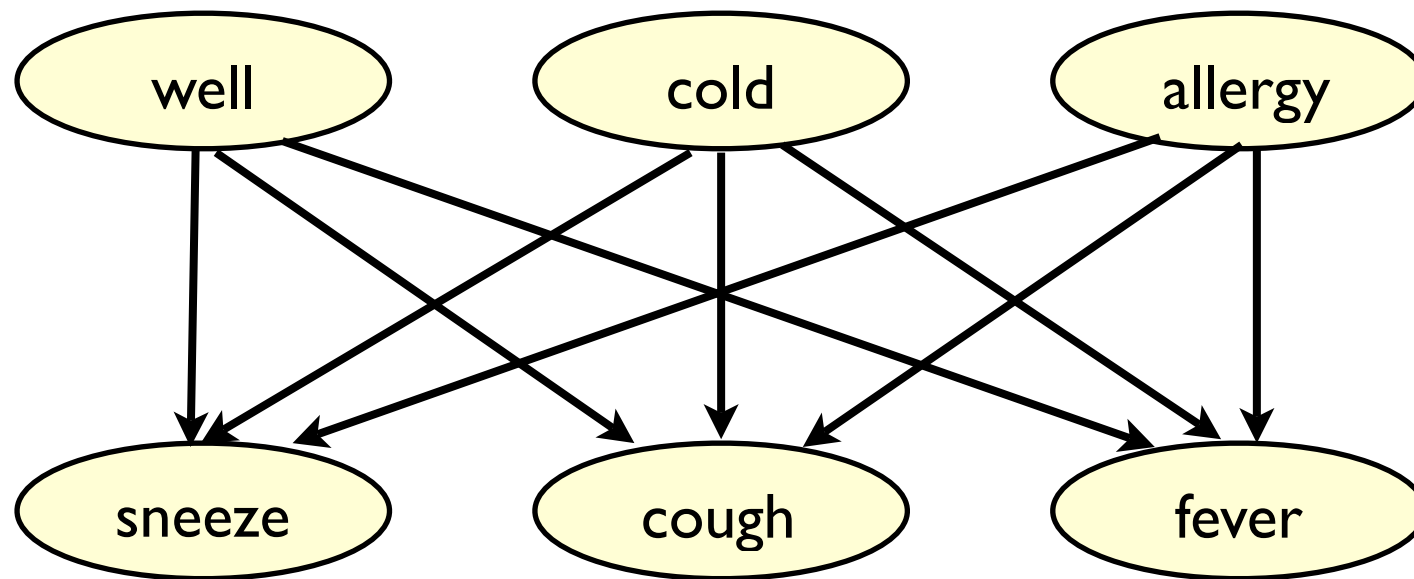- Hidden Markov Models, Inference in HMM

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Given that we observe x={sneeze, cough, not fever}
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DM533   Artificial Intelligence - L0

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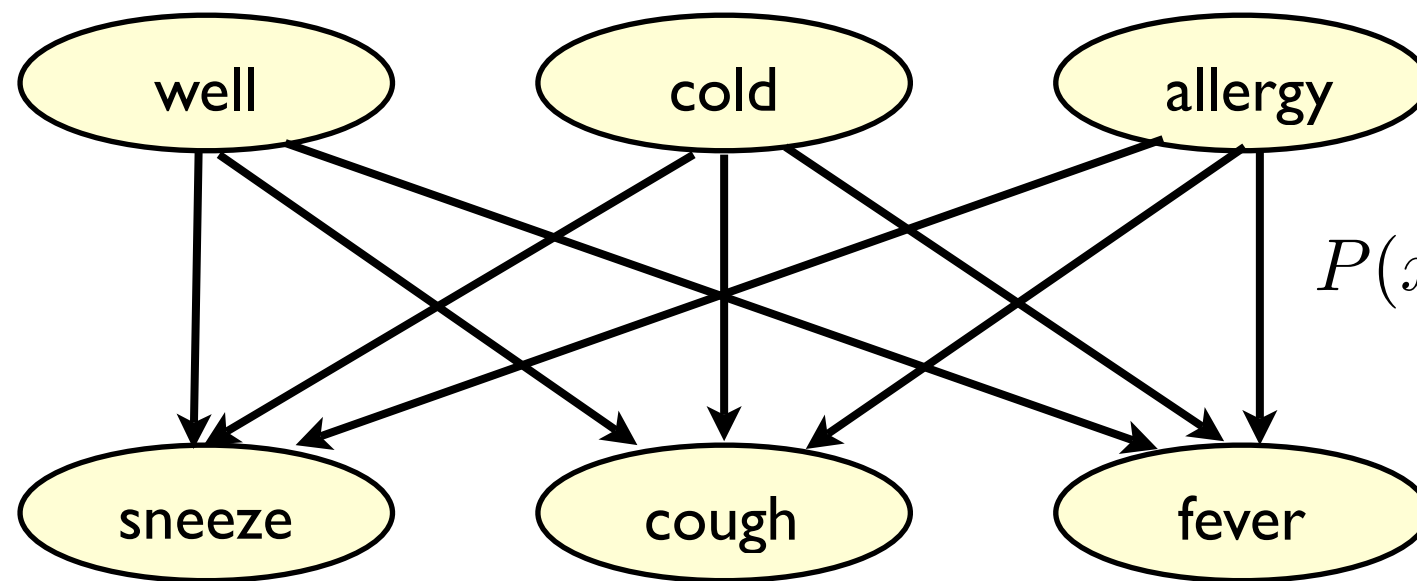$$P(x_1, \ldots, x_n) = \prod_{i=1}^{n} P(x_i|C)$$

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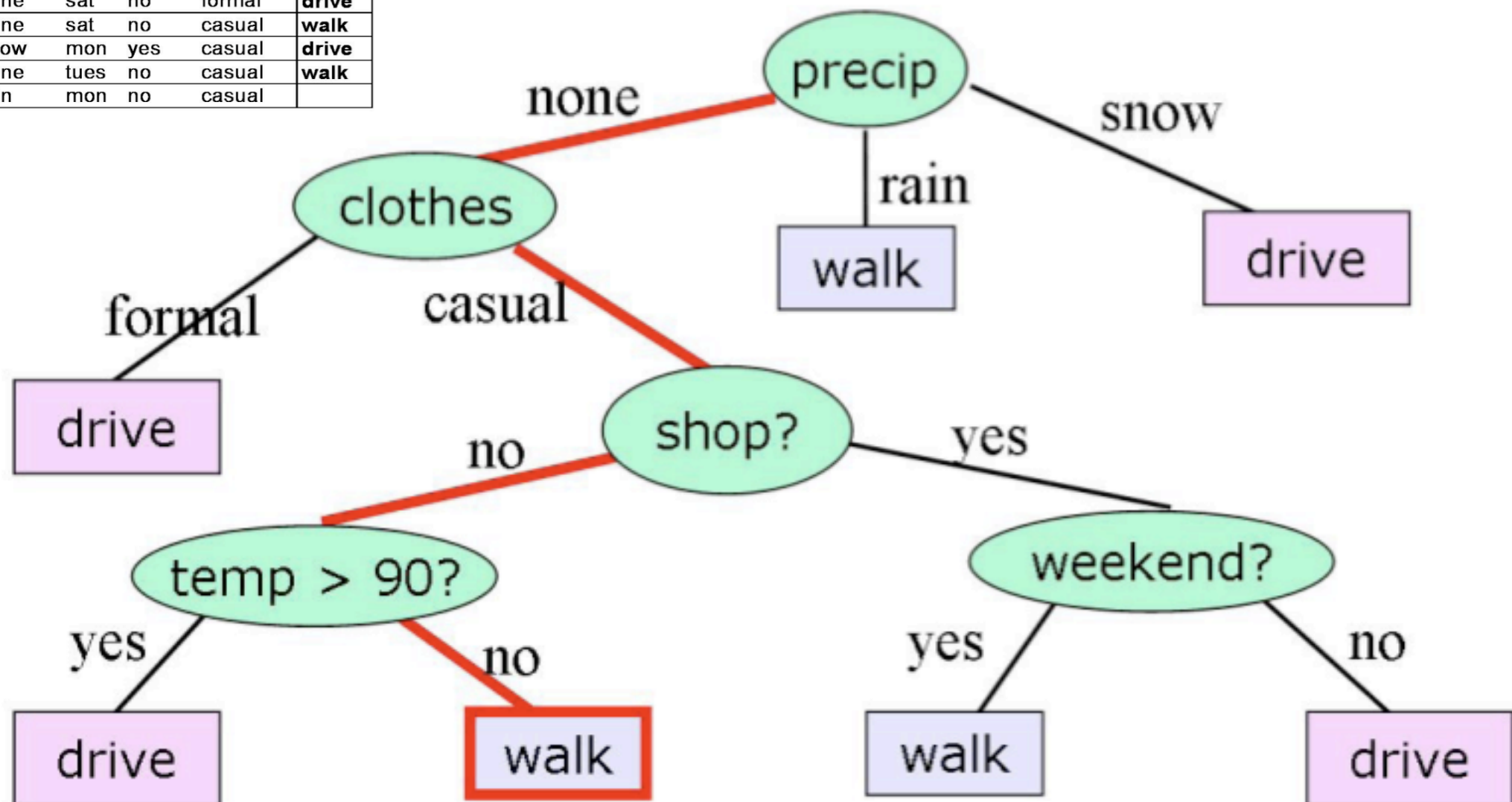
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71	none	fri	yes	formal	drive
36	none	sun	yes	casual	walk
62	rain	weds	no	casual	walk
93	none	mon	no	casual	drive
55	none	sat	no	formal	drive
80	none	sat	no	casual	walk
19	snow	mon	yes	casual	drive
65	none	tues	no	casual	walk
58	rain	mon	no	casual	

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Prerequisites

- ✓ DM502, DM503 Programming (Programmering)
- ✓ DM527 Discrete Mathematics (Matematiske redskaber i datalogi)
- ✓ MM501 Calculus I
- ✓ DM509 Programming Languages (Programmeringssprog)
- ✓ ST501 Science Statistics (Science Statistik)

Final Assessment (5 ECTS)

▸ A three hours written exam

- closed book with a maximum of two two-sided sheets of notes.

- external examiner

▸ 3 written and programming homeworks

- pass/fail grading

- internal examiner

- [Prolog|Comet] (for 3.) and [Java|Python] and [R]

Course Material

▸ **Text book**

- Russell, S. & Norvig, P. *Artificial Intelligence: A Modern Approach* Prentice Hall, 2003

▸ **Slides**

▸ **Source code and data sets**

▸ **www.imada.sdu.dk/~marco/DM533**