

ISPOR Europe 2019

Medical decision analysis with probabilistic graphical models

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Hands-on exercises will be done with [OpenMarkov](#). Participants are invited to bring their own laptops with this software installed.

Approximate schedule

8:00 Presentation of teacher and attendants

8:15 Introduction: History of probabilistic AI in medicine

8:25 Probabilistic diagnosis: traditional approach

- Basic definitions
- Bayes theorem
- *Hands-on exercise 1: diagnosis of one disease with one test*
- Probabilistic diagnosis with two findings: correlation, independence and conditional independence
- The naïve Bayes method: hypotheses and limitations
- Successful applications of the naïve Bayes in medicine

8:45 Probabilistic diagnosis II: Bayesian networks (BNs)

- Definition of BN
- Basic concepts about graphs
- Examples of BNs in medicine
- Causal BNs
- Building BNs with causal knowledge
- Learning BNs from data
- *Hands-on exercise 2: learning a BN with two algorithms*

9:30 Unicriterion decision analysis

- Decision trees, influence diagrams (IDs) and decision analysis networks (DANs)
- *Hands-on exercise 3: optimal strategy for two tests*
- Examples of decision models for medical problems
- Advantages of IDs with respect to decision trees. Advantages of DANs with respect to IDs

10:10 BREAK

10:25 Multicriteria decision analysis

- Effectiveness and utility in medicine. Quality-adjusted life years
- An example with two criteria: cost and effectiveness
- Combination into a single criterion: willingness to pay and net benefit
- Cost-effectiveness analysis (CEA) with deterministic outcomes
- CEA with and uncertain outcomes
- *Hands-on exercise 4: cost-effectiveness analysis of two tests*

11:15 Temporal models

- Markov vs. non-Markov models
- Types of Markov models: Markov chain, hidden Markov model (HMM), Markov ID, Markov DAN, Markov decision process (MDP), partially observable MDP (POMDP), dynamic limited-memory influence diagram (DLIMID)
- Cost-effectiveness analysis with Markov IDs

- Examples of Markov models for medical problems
- *Hands-on exercise 5: cost-effectiveness analysis with a Markov model*
- Comparison of Markov IDs/DANs with other techniques

11:30 Sensitivity analysis

- Classification of sensitivity analysis techniques
- Second-order uncertainty in PGMs
- Unicriterion sensitivity analysis
- Cost-effectiveness sensitivity analysis

11:45 Overview of free and open-source software tools for PGMs

11:50 Conclusions

12:00 End