IJCAI 2019 Tutorial

Medical decision analysis with probabilistic graphical models

Presenter: Francisco Javier Díez, PhD
Dept. Artificial Intelligence, UNED, Spain
fjdiez@dia.uned.es.

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

Approximate schedule

8:30 – 8:45 Presentation of teacher and attendants

8:45 – 8:55 Introduction: History of probabilistic AI in medicine

8:55 – 9:15 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

9:15 – 10:00 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*

10:00 – 10:40 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

10:40 – 10:55 BREAK

10:55 – 11:35 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*

11:35 – 12:00 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

12:00 – 12:10 Sensitivity analysis
- Classification of sensitivity analysis techniques
- Second-order uncertainty in PGMs
- Unicriterion sensitivity analysis
- Cost-effectiveness sensitivity analysis

12:10 – 12:20 Overview of free and open-source software tools for PGMs

12:20 – 12:30 Conclusion