26:198:722 Expert Systems

- Some Research Issues
- Belief Functions: Resolving Conflict
- Lauritzen & Spiegelhalter Join Trees
- Assignment 6
- Review

Some Research Issues

- Improving efficiency of algorithms
  - Shenoy, Lepar, Schmidt, Gillett, . . .
- Implementation
  - "On Transformation Between Probability and Spohnian Disbelief Functions"

    Giang and Shenoy
- Defeasible Reasoning
  - Retraction
  - Non-monotonicity

Some Research Issues

- *PURSUIVANT*
- Causal Modeling
  - Event Spaces
- UAI

Some Research Issues

- *PURSUIVANT*
  - Propogation of Uncertain ReaSoning UsIng VAluation NeTworks
  - Software under development

Some Research Issues

- Uncertainty in Artificial Intelligence
  - Annual Conference
  - Proceedings

Belief Functions: Resolving Conflict

- Alternatives to Dempster's Rule
- What is the meaning of the conflict measure in Assignment 5(i) = 0.9902?
- Entropy-based measures of non-specificity and conflict

Lauritzen & Spiegelhalter Join Trees

Assignment 6

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Review

- Objectives
- Strategy
- Independent Studies
- Final Examination
- Evaluation

Objectives

- an enhanced understanding of the nature and role of Expert Systems, their advantages and their limitations
- an understanding of the principal components of expert systems and the range of applicable technologies
- an understanding of the knowledge engineering process and applicable techniques
- an understanding of various methods of machine learning
- familiarity with ID3, C4.5 and certain related algorithms for machine learning
- familiarity with rule-based Expert Systems, and practical experience of issues related to building them
- an understanding of uncertain reasoning in Expert Systems, including Certainty Factors as used in MYCIN, and the methods used in PROSPECTOR, together with their limitations
- an understanding of Pearl's work, leading to Bayes' nets
- familiarity with the Lauritzen-Spiegelhalter, Aalborg and Shenoy-Shafer algorithms for local propagation
- an understanding of probability theory, Dempster-Shafer belief functions, possibility theory and Spohn's epistemic calculus, and their application in Expert Systems
- an introduction to current research in probabilistic and quasi-probabilistic Expert Systems.

Strategy

- Lower level textbook combined with research-type papers
- Review of mathematical background
- Multi-week introduction to Expert Systems and Machine Learning at BS/MS level, but time-compressed
- Lectures on important introductory topics and on technical issues arising from research papers
- “Consciousness-raising” student presentations on less important topics
- Assignments to practice computational and model-building skills
- Programming project to develop awareness of practical development issues using production rules (but not to achieve proficiency)

Independent Studies

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Final Examination

- Five questions (four problems and an Essay)
- Topics:
  - ID3
  - C4.5
  - Conflict Set Resolution
  - Certainty Factors (MYCIN)
  - Odds-Likelihood (PROSPECTOR)
  - Pearl's Scheme
  - Lauritzen & Spiegelhalter's method
  - The Aalborg Architecture
  - The Shenoy-Shafer Architecture
  - Binary Join Trees
  - Belief Functions
  - Possibility Theory
  - Spohn's Epistemic Calculus

Final Examination

- Each student should submit by e-mail before Monday 2 potential questions designed to be answered in 30 minutes by a well prepared student
  - One may be based on any of the above topics
  - The other must be based on one of the final six topics

Final Examination

- Essay:
  - Prepare an outline for an introductory chapter of a new textbook on Expert systems. Discuss the definition and nature of Expert Systems, and their perceived advantages and limitations. Describe the principal components of Expert Systems and the various considerations involved in their design. Discuss sources and types of knowledge and difficulties with knowledge engineering, and consider the potential role of machine learning. Explain various styles of inferencing and related control strategy issues. Write separate paragraphs on four different design choices (e.g., rule based systems, semantic networks, frames, blackboard systems). Finally, introduce the topic of uncertain reasoning.

    This gives you a lot of scope - in 40 minutes or less, show me what you know - do not write for longer than this!

Evaluation