MONASH University
Information Technology

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Information Technology

FIT5047- Intelligent Systems

Exam and Study Topics

Agenda

- **Topics**
- **Practice questions and Mock exam**
- **About the exam**
- **Staff consultation**

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Topics

Topics

- **LN1: Introduction to AI**
- **LN2: Intelligent Agents**
- **LN3: Problem solving as search, Game playing**
- **LN4: Knowledge representation: propositional and predicate calculus**
- **LN5: Probability**
- **LN6: Bayesian networks**
- **LN7: Machine learning: supervised and unsupervised**

LN1 and LN2

- **LN1: Introduction to Artificial Intelligence**
  - Definition
  - Problems attacked in AI
  - Turing test
  - History and state of the art
- **LN2: Agents**
  - Rationality
  - PEAS (Performance measure, Environment, Actuators, Sensors)
  - Environment types
  - Agent types

LN3 – Problem solving as search

- **Problem formulation: state description (with initial state), goal test, operators, cost function**
- **Search: Control strategies**
  - Tentative
    - > Backtrack
    - > Graphsearch (BFS, UCS, DFS, DLS, ID-DFS, Greedy BestFS, A and A*)
  - Irrevocable
    - > Hill climbing, simulated annealing
    - > Genetic algorithms – fitness function, crossover and mutation
- **Game playing**
  - Minimax, $\alpha\beta$ algorithm

LN4 – Knowledge representation (I)

- **Propositional logic**
  - Syntax and semantics
    - > Example: (HUNGRY ∨ ¬PASS_EXAM) ⇒ SAD
  - Logical equivalence
  - Validity and Satisfiability
  - Inference:
    - > Forward and backward reasoning
    - > Resolution-refutation

LN4 – Knowledge representation (II)

- **First-order logic**
  - Syntax and semantics
    - > Example:
      - » *Not every Bayesian Network (BN) can represent (CR) every joint distribution (JD) of the same variables (SV).*
        $\neg\{\forall x\ \forall y\ JD(y) \wedge BN(x) \wedge SV(x,y) \Rightarrow CR(x,y)\}$ OR
        $\exists x\ \exists y\ JD(y) \wedge BN(x) \wedge SV(x,y) \wedge \neg CR(x,y)$
      - » *Jim's spouse is female*:
        $\forall x\ SPOUSE(Jim,x) \Rightarrow FEMALE(x)$
  - Well formed formulas
  - Logical equivalence

LN4 – Knowledge representation (III)

- **Inference: resolution refutation systems**
  - Unification and substitution
    - > Unify takes two atomic sentences p and q and returns a substitution that makes them look the same
      - » unify(p,q)= θ where subst(θ,p)=subst(θ,q)
  - Converting wffs to clauses
  - Resolution refutation
    - > Provides a complete, algorithmic FOL proof procedure
      - » Unify the complementary literals and apply the mgu to the rest of the resolvent

$$p_1 \vee \ldots \vee \underline{\mathbf{p_j}} \vee \ldots \vee p_n \qquad q_1 \vee \ldots \vee \underline{\mathbf{q_k}} \vee \ldots \vee q_m$$

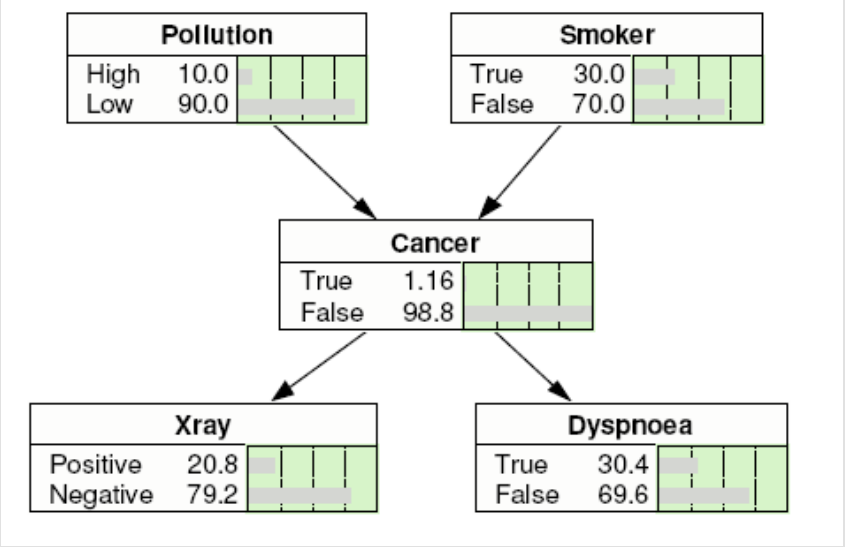
$$\text{subst}(\theta, p_1 \vee \ldots \vee p_{j-1} \vee p_{j+1} \vee \ldots \vee p_n \vee q_1 \vee \ldots \vee q_{k-1} \vee q_{k+1} \vee \ldots \vee q_m)$$

LN5 – Probability

- **Probability Theory**
  - Random variables
  - Joint and marginal probabilities
  - Conditional probability
  - Normalization
  - Product rule, Chain rule, Bayes rule
  - Independence, Conditional independence

LN6 – Bayesian Networks (I)

- **Capabilities**
  - Encode dependency structure between random variables
  - Allow us to easily update our beliefs given new evidence



- **Representation and inference**
  - Definitions
  - Joint probability distributions
  - Conditional Probability Tables (CPTs)

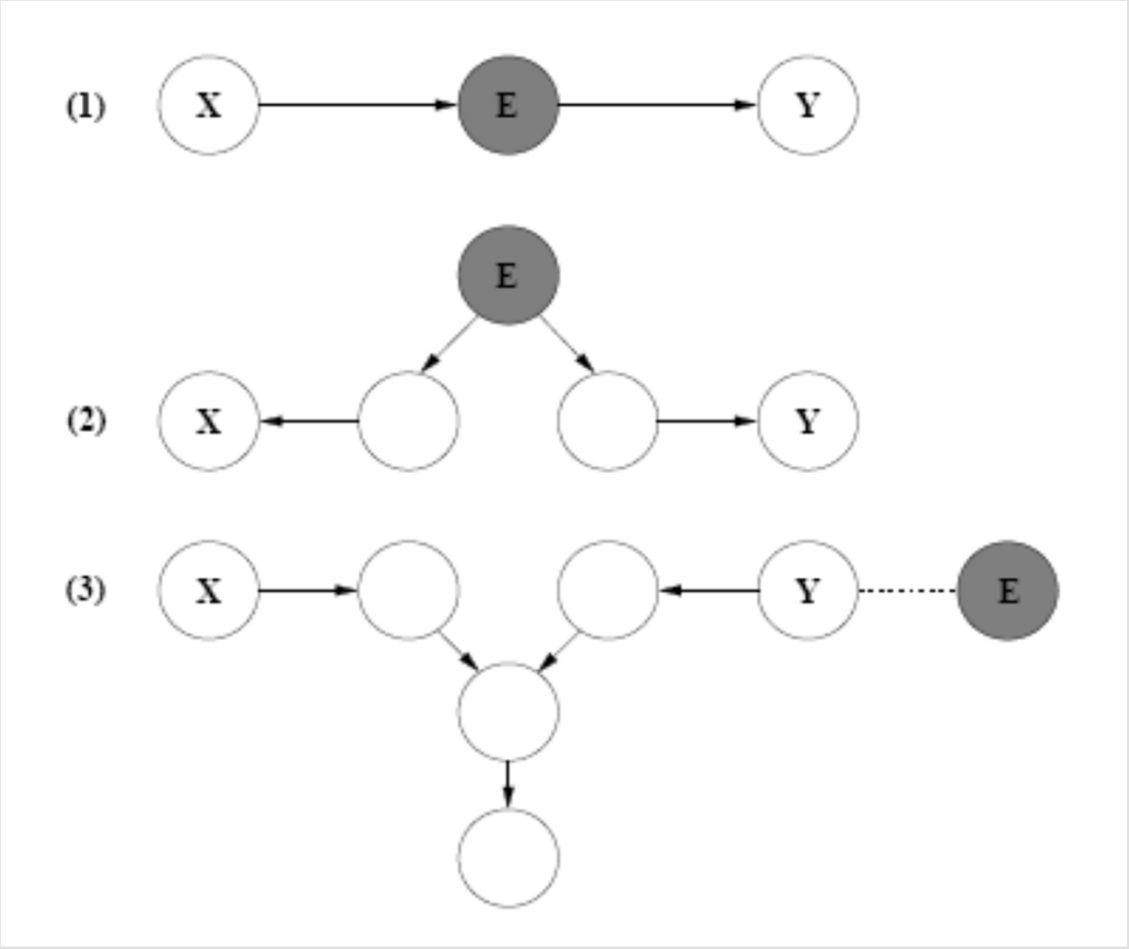
LN6 – Bayesian Networks (II)

- **Conditional independence and D-separation**

Chain

Common cause

Common effect



LN6 – Bayesian Networks (III)

- **Decision Networks**
  - Select the action that maximizes expected utility

$$EU(A \mid E) = \sum_i \Pr(O_i \mid E, A) U(O_i \mid A)$$

- **Exact inference**
  - Inference by enumeration

LN7 – Machine learning

- **Principles and concepts**
- **Supervised Learning**
  - Determining classifier performance
  - Decision Trees
    > Entropy and Information Gain
  - Naïve Bayes classifier
    > MLE, ELE
  - K Nearest Neighbour
  - Regression
  - Classification with thresholds
    > Linear regression, Logistic regression
  - Artificial Neural Networks
- **Unsupervised Learning**
  - K means algorithm

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Practice Questions and Mock Exam

Types of Questions

- **Tutorials**
  - Solutions to tutorials are on moodle
  - *Warning:* Avoid being dependent on the sample solutions
- **Labs**
- **Practice questions and mock exam (posted on moodle in Scheduled Final Assessments)**
- **Mainly reasoning questions**

About the Exam

- **10 minutes reading time**
- **2 hours duration**
- **You will need a calculator**
- **eExam: closed-book and invigilated**
- **Handwritten answers only**
- **100 total marks**
- **Marks are roughly proportional to time in lectures**
  - But we can't represent everything in a 2-hour exam

Exam Technique

- **Use your reading time to plan your attack!**
- **Maximize your expected utility by**
  - doing easy, high mark questions first
  - followed by easy, low mark questions
  - then hard, high mark questions
  - finally hard, low mark questions
  - If you finish early, review

Staff Consultation Week 14

https://monash.zoom.us/j/86085534520?pwd=aVNBNVVFM3RYbWxMRlhaWGdmNVp6Zz09

Day	Date: Time	Name
Monday	Jun 6: 5 - 7 pm	Bruce
Tuesday	Jun 7: 3 - 5 pm	Julian
Tuesday	Jun 7: 5 - 7 pm	Mohaimen
Wednesday	Jun 8: 3 - 5 pm	Ingrid
Thursday	Jun 9: 10 am - 12 pm	Trang

All the best for the Exam