Faculty of SET / School of Computer and Mathematical Sciences

COMP SCI 3007/7059/7659
Artificial Intelligence
Review Lecture

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Acknowledgement of Country

We acknowledge and pay our respects to the Kaurna people, the traditional custodians whose ancestral lands we gather on.

We acknowledge the deep feelings of attachment and relationship of the Kaurna people to the country and we respect and value their past, present and ongoing connection to the land and cultural beliefs.

Exam format

- Exam is 50% of the course.
  - 40% hurdle - you need 48/120 marks minimum to pass the exam.
  - If you achieved < 30/50 marks from the assignments, you need to score more in the exam.
- Sorry, no cheat sheet!
- Bring a pencil + an eraser can help with the drawing questions.
  - But sharpen your pencil and draw clear, don't smudge over it!
- Check the exam time and location yourself on MyAdelaide.
  - also please check this page regarding the exam rules. No replacement exam will be given if you got time/location wrong.
- Check the replacement exam application information.

Mark distribution

- Q1: multiple choice questions (10 marks):
  - 5 questions (2 marks EA)
  - Only one correct answer each question
- Q2: Problem solving with search (25 marks):
  - 3 sub-questions = 3 topics
- Q3: Learning and neural networks (25 marks):
  - 2 sub-questions
- Q4: Statistical Inference and Bayesian Networks (22 marks):
  - 2 sub-questions
- Q5: Markov Decision Process (13 marks):
  - 1 sub-question
- Q6: Probabilistic inference over time (25 marks):
  - 2 sub-questions

1 mark is approx. 1 minute

Topics not examined

- Large Language Models
- Explainable AI

Assignment already tested elements:
- Calculating BFS/UCS/A-star tree expansion
- Reinforcement Learning
- KD-Tree

*BFS/UCS/A star related concepts **will be** examined.

No coding questions.

What do we want to evaluate

- Your understanding of the taught concepts:
    - Direct questions: explain concepts by their definition.
    - Concept understanding question:
        - Can you generalise the taught concepts beyond their definition?
    - Drawing questions: draw graphs to show your understanding.
        - Make sure you attempted this type of questions aforehand, you won't have enough time if it is the first time you solve these questions in the exam.
    - Calculation: show you understand the concepts via calculation.
        - Some questions will have formula supplied – still you need to know how to use them.
        - Make sure you attempted this type of questions aforehand.
        - For some questions, pre-computed quantities will be given.
        - You need a calculator to do simple calculation.
        - Intermediate steps will be marked, don't skip them.
            - If you don't have time to finish the calculation or the final result is wrong, intermediate steps get you some marks – provided they are clear, complete and correct.

Search Algorithms

- Basic Search Algorithms – their differences
    - Breadth-first Search
    - Depth-first Search
    - Uniform Cost Search
- Describing Searches
    - ~~Complexity~~
    - Completeness
    - Optimality
- What is an admissible search?
- What is heuristic?
- ~~Constraint satisfaction problem~~

# Adversarial Search and Monte Carlo Tree Search

- Minmax algorithm
- α-β Pruning
- UCT algorithm on the tree.
    - Please memorise the equation ☺
    - don't worry about the calculation.

Statistical Inference and Bayesian Networks

- The probability basics
- Marginalisation
- Conditional probability
- Bayes' rule
  - Please memorise the equation ☺
- Independence vs conditional independence
- Chain rule
- Global semantics vs local semantics
  - Types of local semantics and their graph representation
- Markov blanket

Exact inference

- Inference by enumeration
- ~~Variable Elimination~~
- You want to know how to draw the conditional probability tables.
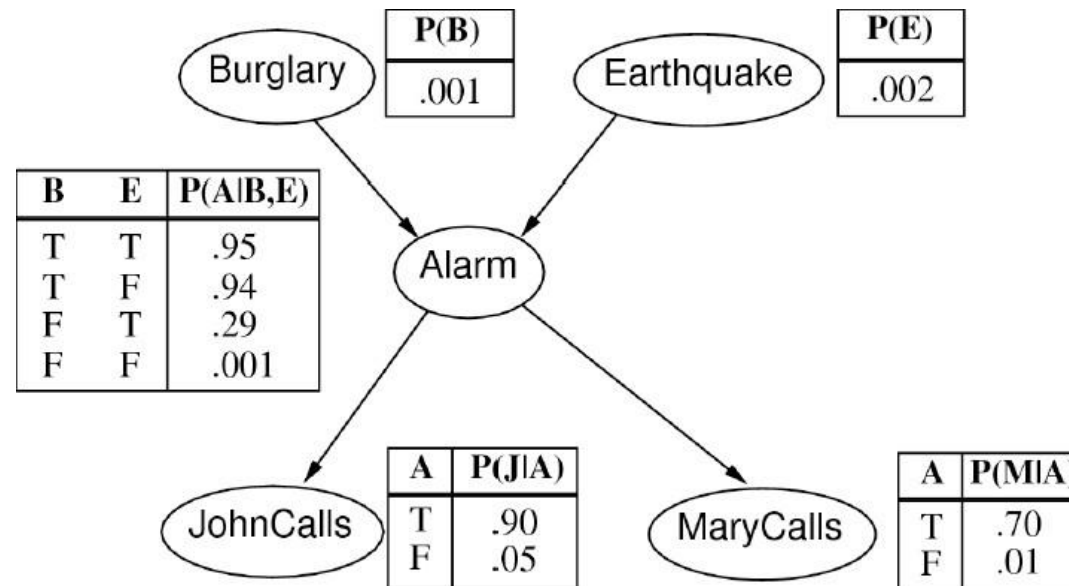
Approximate Inference

- Direct sampling & reject sampling

- Gibbs sampling
  - Direct/understanding questions
  - No calculation

Markov Decision Process

- Transition model
- Utility vs reward
- Optimal policy
- Bellman equations
- Value iteration

Probabilistic Inference Over Time

- HMM
- Transition model/observation model
- First order Markov assumption/sensory Mark assumption
- Filtering
- Representing HMM in matrix form
- (Smoothing and Viterbi) or Kalman filter
  - Either one or the other (in main or RAA) – exclusive question
  - Understanding type question, no calculation or derivation.

Learning and Neural Networks

- Forms of learning/KNN
  - Direct/understanding questions
- Decision tree algorithm (will be tested in the main exam)
  - Will be changed in RAA
- Performance Assessment and Overfitting
  - Direct/understanding questions
- Neural Networks
  - Activation functions
    - Softmax vs sigmoid – similarity and differences
  - How to compute network outputs from inputs
  - Perceptron network structure & mathematical equivalence
- ~~Understanding Neural Networks~~

Tutorial questions

- You are safe to ignore:
  - Tutorial 1 (Search): Q2, Q3 – too complex/assignment tested,
  - Tutorial 4 (HMM): Q3 – a bit too much.
  - Tutorial 5 (Learning): Q3, Q10, Q11 - out of scope for this year.

- It pays to attempt all the tutorial questions yourself (not just the listed below)!
  - Tutorial 5-Q6 is a good example, the calculation will be dialled down in exam.
  - Tutorial 3 (Bayesian)-Q5 says "optional", but you'd want to know how to build a graph and a table from the question.
  - Generally, the exam questions' level of complexity will be lower than the tutorial questions as we keep in mind you don't have a lot of time and under a lot of stress in the exam condition.

You won't get exact same questions in the exam though ☹

Main vs RAA

- Some questions will be shared – values will be changed.
- Some other questions will be exclusive.
  - RAA is not finalised but will be before you take the main exam.
  - RAA is supposed to be harder than the main exam:
    - you know the "some questions" already.
    - and you have more time preparing the RAA.

We said...

- As a piece of general advice, past exam papers are only for your reference about the exam style and possible question types, you should not assume there will be identical or very similar questions in this year's exam.

- Why did we say this?
  - **Observation**: past students tend to **overfit** the given exam questions; we want you to show that you can generalise beyond that.
  - Some of the past exam questions are still relevant, but don't expect it would be word for word.

We sincerely hope you achieve good grades in the exam. Best of luck!