THE UNIVERSITY OF WESTERN AUSTRALIA

Achieve International Excellence

Computer Science & Software Engineering

SEMESTER 1, 2011 EXAMINATIONS

CITS4211
Artificial Intelligence

FAMILY NAME: _____ GIVEN NAMES: _____

STUDENT ID: ☐☐☐☐☐☐☐☐ SIGNATURE: _____

This Paper Contains: **6** pages **(including title page)**
Time allowed: **2 hours 10 minutes**

INSTRUCTIONS:

Answer all questions. The marks for the paper total 100.

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Supervisors Only - Student left at:

Q1. **Search algorithms**

(a) Define the terms *completeness* and *optimality* as they apply to search algorithms in AI. **2 marks**

(b) Briefly describe *breadth-first* and *depth-first* search. **2 marks**

(c) Why is the space complexity of depth-first search much better than breadth-first? **2 marks**

(d) Briefly describe *iterative deepening* search, and describe how it attempts to get the best performance features of both breadth-first and depth-first. **4 marks**

Q2. **Informed search algorithms**

(a) What is the fundamental difference between an *informed* search algorithm and an *uninformed* one? **2 marks**

(b) What does it mean for a heuristic to be *admissible*? Describe briefly why this is important in the performance of A*. **3 marks**

(c) Given two admissible heuristics h_1 and h_2, what does it mean if h_1 *dominates* h_2? In what way will A* using h_1 out-perform A* using h_2? **3 marks**

(d) What problem does *simplified memory-bounded A** attempt to solve? **2 marks**

Q3. **Game-playing algorithms**

(a) What is meant by *look-ahead* in the context of game-playing algorithms? **1 mark**

(b) What is an *evaluation function* in the context of game-playing algorithms? What degree of look-ahead do evaluation functions typically use? **2 marks**

(c) Describe briefly what is meant by the *horizon problem* in algorithms that use look-ahead. **2 marks**

(d) Describe briefly what is meant by the *quiescence problem* in algorithms that use look-ahead. **2 marks**

(e) Describe briefly how α-β *pruning* improves the performance of algorithms that use look-ahead. **3 marks**

Q4. **Learning agents**

(a) Describe briefly the **four** basic components of a learning AI agent, and their roles. **4 marks**

(b) Describe briefly the **two** principal goals of the learning element in such an agent. **1 mark**

(c) What is a *decision tree* in the context of learning agents? Describe briefly how an agent might induce a decision tree from a set of data. **3 marks**

(d) Describe briefly **two** plausible rules that such an agent could use to order the attributes of the data when inducing a decision tree. **2 marks**

Q5. **Sequential decision problems**

(a) Describe briefly what is meant by a *sequential decision problem* (SDP). **2 marks**

(b) What **two** features of SDPs usually render traditional search algorithms ineffective? **2 marks**

(c) What is meant by *discounting* in the context of SDPs? For what kind of problems is discounting especially important? **3 marks**

(d) Describe briefly the *value iteration* algorithm for solving SDPs. **3 marks**

Q6. **Reinforcement learning**

(a) What is the principal difference between *passive learning* and *active learning*? **2 marks**

(b) What is the principal operational difference between *adaptive dynamic programming* and *temporal difference learning*? **2 marks**

(c) What is meant by *exploration* and *exploitation* in the context of learning? What roles do they normally play for a learning agent? **4 marks**

(d) What are the **two** principal advantages of using an implicit representation for a decision mechanism vs. an explicit representation? **2 marks**

Q7. **Planning**

(a) What are the **three** principal differences between a *searching algorithm* and a *planning algorithm*? **3 marks**

(b) Describe briefly how a *partial-order planner* works. What is its principal operational advantage? **3 marks**

(c) What does it mean if a new action added to a plan *clobbers* an existing action? What are the two usual ways that clobbering is avoided? **4 marks**

Q8. **Logical agents**

(a) What are the **two** components of the decision-making apparatus of a *logical AI agent*? Why is it important to keep the two components separate as far as possible? **4 marks**

(b) Define the terms *sound* and *complete* in the context of an inference system. Which is generally regarded as more important, and why? **3 marks**

(c) Describe briefly the *forward chaining* and *backward chaining* proof methodologies. Why does backward chaining often out-perform forward chaining? **3 marks**

Q9. **First-order logic**

(a) Describe briefly the principal limitation of propositional logic vs. first-order logic (FOL). Give an example (in English) of a statement that can be captured in FOL but that is difficult to say in propositional logic. **4 marks**

(b) Define *quantifier duality* in FOL. **2 marks**

(c) Describe briefly the **two** restrictions that apply to existential instantiation in FOL, that do not apply to universal instantiation. **2 marks**

(d) Describe briefly the *frame problem* in the context of knowledge representation. **2 marks**

Q10. **Knowledge engineering**

(a) What is the fundamental dichotomy in the use of logics in AI? **4 marks**

(b) How is that dichotomy resolved in the specific case of *temporal logics*? **3 marks**

(c) How is that dichotomy resolved in the specific case of *description logics*? **3 marks**

END OF PAPER