INSTRUCTIONS:

Answer all questions. Each question is worth 10 marks. The total for the paper is 100.

Most questions require only brief answers: point form answers are fine where appropriate.

PLEASE NOTE

Examination candidates may only bring authorised materials into the examination room. If a supervisor finds, during the examination, that you have unauthorised material, in whatever form, in the vicinity of your desk or on your person, whether in the examination room or the toilets or en route to/from the toilets, the matter will be reported to the head of school and disciplinary action will normally be taken against you. This action may result in your being deprived of any credit for this examination or even, in some cases, for the whole unit. This will apply regardless of whether the material has been used at the time it is found.

Therefore, any candidate who has brought any unauthorised material whatsoever into the examination room should declare it to the supervisor immediately. Candidates who are uncertain whether any material is authorised should ask the supervisor for clarification.
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Q1. String algorithms

(a) What are the two features that a problem must have if we want to use dynamic programming in its solution?  
2 marks

(b) Define the longest common subsequence problem, and describe how it fits the dynamic programming model.  
3 marks

(c) Illustrate how a dynamic programming solution to LCS would work for the strings 011 and 110.  
5 marks

Q2. Optimisation algorithms

(a) What is the defining principle behind greedy algorithms?  
2 marks

(b) What is the principle behind iterative improvement algorithms?  
3 marks

(c) Illustrate these two principles using the travelling salesman problem.  
5 marks

Q3. Uninformed search

(a) Describe the difference between breadth-first search and uniform-cost search.  
2 marks

(b) Construct a simple scenario where breadth-first and uniform-cost search give different solutions.  
3 marks

(c) What is the principle behind bidirectional search?  
2 marks

(d) Describe three problem features that can cause problems for bidirectional search.  
3 marks

Q4. Informed search

(a) What is the difference between informed search and uninformed search?  
2 marks

(b) Describe how A* uses heuristics to guide its search procedure.  
3 marks

(c) What does it mean for a heuristic to be admissible? Why is this important in an application of A*?  
3 marks

(d) What is the principle behind Simplified Memory-bounded A*?  
2 marks
Q5. Game-playing

(a) What is meant by *incompleteness* in the context of AI?  
(b) Describe the **three** usual approaches to dealing with incompleteness.  
(c) What is the role of *look-ahead* in a game-playing AI?  
(d) What level of *look-ahead* is used in a typical evaluation function?  
(e) Describe two reasons why a game-playing AI might vary the level of look-ahead used across its game tree.

Q6. Sequential decision problems (SDPs)

(a) What is the role of a *policy* in the context of an SDP?  
(b) What is the *transition model* in the context of an SDP?  
(c) Describe in general terms how the optimal policy for a problem varies with the details of the transition model.  
(d) Describe the operation of the *policy iteration* algorithm for solving SDPs.

Q7. Learning agents

(a) What are the **four** basic components of a learning AI agent?  
(b) What are the **four** main connections between these components?  
(c) What is *inductive learning*?

Q8. Reinforcement learning

(a) What is the difference between *passive learning* and *active learning*?  
(b) Describe the operational behaviour of *temporal-difference learning*.  
(c) What is meant by *exploration* and *exploitation* in the context of learning?  
(d) What is the conflict between exploration and exploitation, and how is it usually resolved?
Q9. Logical agents

(a) Define the resolution principle in the context of propositional logic. 2 marks

(b) Describe and illustrate with an example the main way in which first-order logic is more expressive than propositional logic. 3 marks

(c) What is the frame problem in the context of logical agents? 2 marks

(d) Describe and illustrate with an example what it means to unify two sentences in first-order logic. 3 marks

Q10. Planning and acting

(a) Describe briefly how a partial-order planner works. 4 marks

(b) What are the two principal sources of uncertainty for planning agents? 2 marks

(c) What are the two principal ways that planning agents deal with uncertainty? 4 marks

END OF PAPER