SCHOOL OF SCIENCE

GMIT EXAMINATIONS

SESSION: SUMMER 2014/2015

PROGRAMME: **BACHELOR OF SCIENCE (HONS) IN SOFTWARE DEVELOPMENT**

YEAR/STAGE: 4/AWARD

MODULE: **ARTIFICIAL INTELLIGENCE**

INTERNAL EXAMINER(S): **Dr. John Healy**

EXTERNAL EXAMINER(S): **Dr. Michael Schukat**
Mr. Tom Davis

TIME ALLOWED: **2 HOURS**

INSTRUCTIONS TO CANDIDATES:

ATTEMPT ANY 4 QUESTIONS

Attachments: details:	**Yes**	☐	**No**	☐	**If yes, please list**
Special Requirements: details:	**Yes**	☐	**No**	☐	**If yes, please list**
Calculators Permitted:	**Yes**	**X**	**No**	☐	**Not applicable**

1. *"Brute force recursive search algorithms are the most versatile and adaptable mechanisms for traversing a semantic network or search tree."*

Provide a critique of this statement that addresses both the **space and time complexity** of the depth-first approach and show how the weaknesses of the algorithm can be overcome through **depth limitation** and **iterative deepening**. Use diagrams and code snippets to illustrate your answer.

(25 Marks)

2. **Figure 1** depicts a semantic network of nodes interconnected by edges. The starting node is node 'A" and "I" the goal node. Each node is labelled with a letter and a heuristic estimate of distance to the goal node. The actual distance between two nodes is shown as a number along their connecting edge.

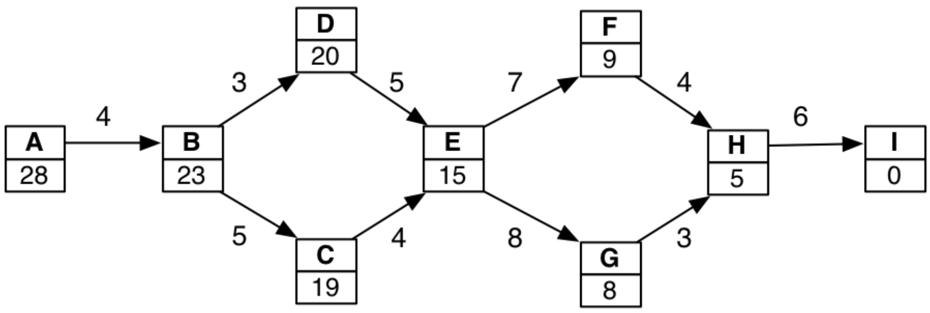

Figure 1

(a) Show how the A* algorithm can find the optimal path from the initial node (A) to the goal node (I). Your answer should show the state of the **OPEN** and **CLOSED** queues for each iteration of the algorithm and also show how the path evaluation function, *f(n)*, is computed.

(15 marks)

(b) Using either pseudocode or Java to illustrate your answer, provide a critique of those parts of the A* algorithm that contribute to its optimality and completeness.

(10 Marks)

3. **Figure 2** below depicts a 4-*ply* game tree, with leaf nodes labelled with a score that represents a goal state.

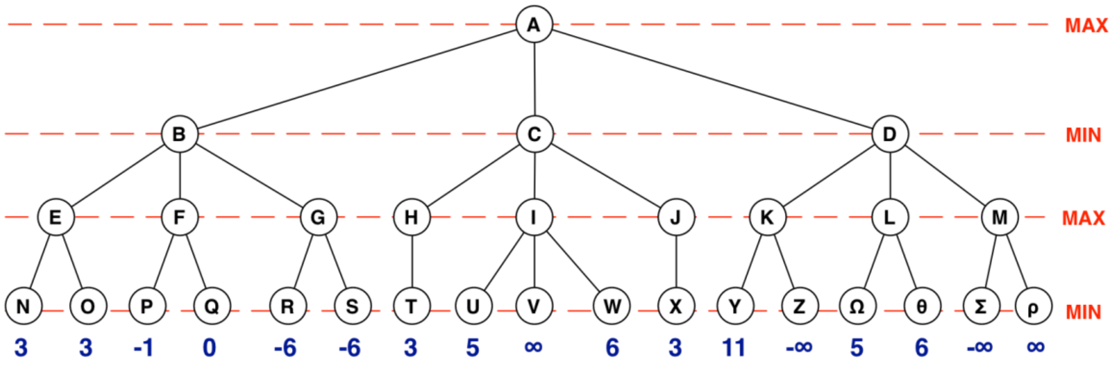

Figure 2

(a) Show, using labelled diagrams, how the ***minimax*** algorithm can determine the best move to make from node 'A'. Your answer should also illustrate how MAX and MIN values are computed at each level.

(10 Marks)

(b) Describe how ***alpha-beta pruning*** can be applied to the game tree in **Figure 2** to reduce the number of nodes to be generated and examined. Your answer should show the pruned game tree, indicate the alpha and beta cut-off points and address the effectiveness of alpha-beta pruning.

(15 Marks)

4. (a) *"Branching factor is the most salient characteristic that determines the effectiveness of a search algorithm on a semantic network."*

Discuss this statement and evaluate implications of **branching factor** for both the space and time complexity of a search strategy.

(13 Marks)

(b) Discuss the application of breadth-first search and its heuristically informed variants to semantic trees and networks. Your discussion should address the impact of each approach on search **optimality, completeness** and **space complexity**. Include diagrams and algorithms, in either pseudocode or Java, with your answer.

(12 Marks)

5. (a) Explain the following terms as they apply to **fuzzy logic**:

- Membership Functions **(5 Marks)**
- Hedges **(5 Marks)**
- Fuzzy Set Operations **(5 Marks)**

(b) Discuss how fuzzy rules are **evaluated** and **aggregated** in the Mamdani inference model. Your answer should include sample rules and diagrams where appropriate.

(10 Marks)

6. (a) Explain the following terms as they apply to **artificial neural networks** (ANNs):

- Activation Functions **(3 Marks)**
- Weight Training **(3 Marks)**

(b) Using a fully labelled diagram, describe the structure of a **perceptron** and show how a perceptron can learn classification tasks.

(**10 Marks)**

(c) Describe the structure and function of a **multilayer back-propagation** neural network. Your answer should include a diagram that illustrates the direction of information flow through the network.

(9 Marks)