

University of Ruhuna- Faculty of Technology
Bachelor of Information and Communication Technology Honours Degree
Level 4 (Semester I) Examination, February 2023
Academic year 2021/2022

Course Unit: ICT 4133 Artificial Intelligence (Written) Duration: 2 hours

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IMPORTANT INSTRUCTIONS:

1. The medium of this examination is English.
2. This is a closed book examination.
3. This question paper contains **seven (07) pages** including this instruction page.
4. This examination consists of **four (04) questions** that are given equal marks.
5. You must answer **all four (04) questions** in this examination.

- 1)
- a) What is **Artificial Intelligence (AI)**? Explain the contribution of **Computer Engineering** to the field of AI with two (02) key points.
[20 marks]
- b) Agent is a function from precept sequences to actions.
- i. **“An agent can act rationally without thinking rationally.”**
Do you agree with the above statement? Justify your answer with reference to two terms of **“acting rationally”** and **“thinking rationally”**.
[15 marks]
- ii. Set up **PEAS description** of the task environment for a scenario of playing chess.
[15 marks]
- iii. **“Both Chess and Robocup are Sequential.”**
Do you agree with the above statement? Justify your answer.
[20 marks]
- c) Express three (03) **features of an expert system** by considering a situation where a medical doctor diagnoses a disease.
[30 marks]
- 2)
- a) Briefly describe **two classes of search strategies**. Give two (02) examples for each class of search strategies.
[20 marks]
- b) Search techniques using different data structures are universal problem-solving methods.
- i. The 8-Puzzle involves moving the tiles on the board into a particular configuration. The empty square on the board represents a space. The player can move either to left, right, top or bottom a tile into the space, freeing that position for another tile to be moved into and so on.

7	2	4
5		6
8	3	1

Figure 2.1: Initial State

1	2	3
4	5	6
7	8	

Figure 2.2: Goal State

Plan the *initial state*, *actions* and *transition model* with reference to the 8-Puzzle in Figure 2.1 and Figure 2.2.

[15 marks]

- ii. A robot is assigned to explore a state space shown in Figure 2.3 where each node represents a state, and each directed link represents an operation.

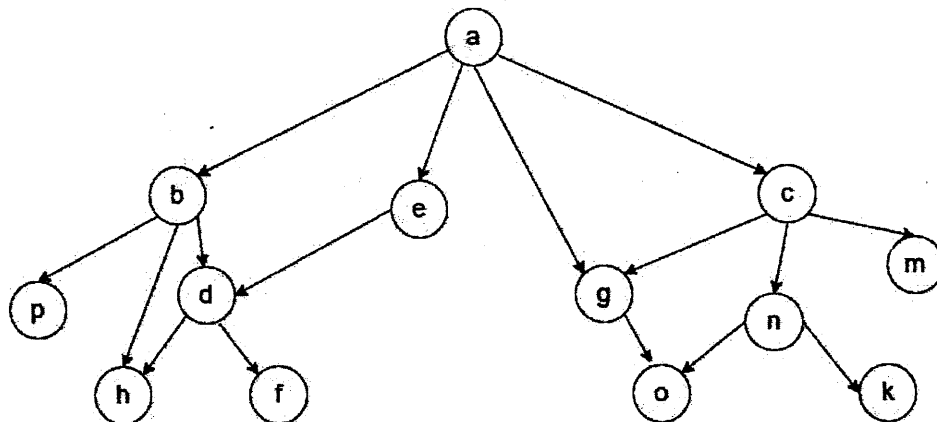


Figure 2.3

The robot wants to start from “a”. Explore the nodes of state space in order that they are expanded using *Breadth First Search* and *Depth First Search* algorithms. Assume that the search considers child nodes from left to right and nodes can be revisited.

[32 marks]

- c) *Greedy best-first search* tries to expand the node that is closest to the goal, on the grounds that this is likely to lead to a solution quickly. It evaluates nodes by using the heuristic function; $f(n) = h(n)$.

If the goal is to reach Bucharest in a route finding problem in Romania, clearly state the stages of *Greedy best-first search* to find a path from *Arad* to *Bucharest* shown in Figure 2.4 using straight-line distance heuristic - h_{SLD} .

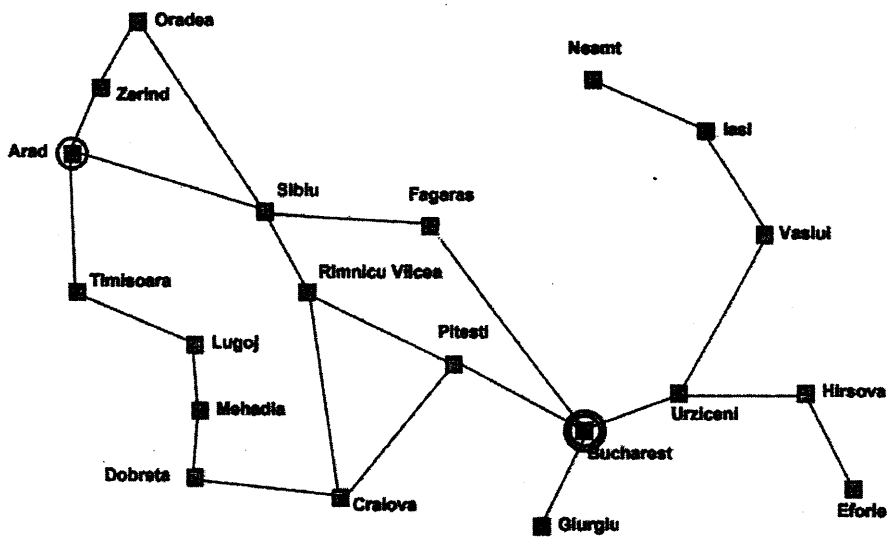


Figure 2.4

Use given h_{SLD} values in the Table 2.1 to Bucharest from each city.

Arad	366	Mehadia	241
Bucharest	0	Neamt	234
Craiova	160	Oradea	380
Drobeta	242	Pitesti	100
Eforie	161	Rimnicu Vilcea	193
Fagaras	176	Sibiu	253
Giurgiu	77	Timisoara	329
Hirsova	151	Urziceni	80
Iasi	226	Vaslui	199
Lugoj	244	Zerind	374

Table 2.1

[33 marks]

3)

- a) Distinguish between *propositional logic* and *predicate logic* with two (02) key points for each. Hence comment on “*Logic is a knowledge representation technique*”.

[10 marks]

- b) Propositional logic is one of the oldest as well as one of the simplest forms of logic.

- i. Symbolize the following argument by giving your scheme of abbreviation in *propositional logic*.

Amali or Kamal is clever but, both of them are not clever. Therefore, Amali is clever if and only if Kamal is not clever.

[10 marks]

- ii. Show the conclusion in the above argument in above 3) b) i) is valid using *Truth table*.
[20 marks]

- iii. Simplify the following complex argument using *inference rules/equivalencies* in propositional logic.

$$(\neg A \wedge \neg B \wedge \neg C) \vee (\neg A \wedge B \wedge \neg C)$$

[13 marks]

- c) Consider the following sentences:

1. **If a film is romantic, boys love it.**
2. **Korean films are not romantic.**
3. **All Sinhala films are romantic.**
4. **“Gajaman” is a Sinhala film.**

- i. Represent each of the above sentences as *well-formed formula* in *predicate logic*.

[12 marks]

- ii. Convert formulae into *clause form*.

[12 marks]

- iii. Prove that *boys like the film “Gajaman”*.

[23 marks]

4)

- a) **“Both Supervised Learning and Reinforcement Learning have been used to fine-tune ChatGPT, but the Reinforcement Learning component specifically makes ChatGPT unique.”**

Do you agree with the above statement? Justify your answer.

[6 marks]

b) In general, AI theories and artifacts are made up of inspirations taken from the real world.

i. What is the real-world inspiration for *Artificial Neural Network (ANN)*? Discuss four (04) properties of an ANN.

[10 marks]

ii. Model the mathematical function for a neural network consisting of six input nodes and one output node. Hence, derive the mathematical function for n number of input neurons.

[12 marks]

iii. Identify which of the following is/are true? In each case, justify your answer.

[12 marks]

a. There can be seen so many applications for unmanned aerial vehicles at present.

b. Convolutional Neural Networks are not very similar to ordinary Neural Networks.

c. Future of AI would lead to a society which exhibits man machine coexistence.

c) Natural Language Processing (NLP) is to analyze, understand and generate human languages just like humans do.

i. What do you mean by *syntax* and *semantic* in NLP? Provide examples for each.

[10 marks]

ii. Consider the following probabilistic context-free grammar:

$S \rightarrow NP VP$

$NP \rightarrow lions$

$NP \rightarrow meat$

$VP \rightarrow V$

$VP \rightarrow V NP$

$V \rightarrow eat$

$V \rightarrow grow$

Draw a *tree* showing how the S nonterminal can produce the sentence "*lions eat meat*".

[16 marks]

iii.

a. Briefly describe the following topics in NLP.

[9 marks]

- I. N-gram character models
- II. Word Tokenization and Sentence Tokenization
- III. tf-idf

b. *“Together, machine translation and speech recognition are two of the big successes of natural language technology”*. Support this statement with two (02) key points.

[25 marks]

.....**End of the paper**.....