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**RAJARATA UNIVERSITY OF SRI LANKA  
FACULTY OF APPLIED SCIENCES**

**B.Sc. (Honors) Degree in Information Technology  
B.Sc. (4 Year) Degree in Applied Sciences**

**Fourth Year - Semester I Examination – January/February 2021**

**ICT 4302 – INTELLIGENT SYSTEMS**

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**Time: Three (03) hours**

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**INSTRUCTIONS TO CANDIDATES**

1. This paper contains 4 questions on 5 pages (including the cover page).
2. Answer **ALL** questions.
3. The total marks obtainable for this examination is 100. The marks assigned for each question and sections thereof are included in brackets. All questions carry equal marks.
4. This examination accounts for 70% of the module assessment.
5. This is a closed-book examination.
6. Clearly state any assumptions that you may make.
7. Calculators are allowed.

1.
  - a) Define in your own words?
    - I. Intelligence
    - II. Agent
    - III. rationality

(06 marks)
  - b) To what extent the following computer systems are instances of artificial intelligence:
    - I. Web search engines
    - II. Supermarket bar code scanners
    - III. Voice-activated telephone menus

(03 marks)
  - c) Name recently popular three (03) AI techniques.
 

(03 marks)
  - d) Your goal is to navigate a robot out of a maze. The robot starts in the center of the maze facing north. You can turn the robot to face north, east, south, or west. You can direct the robot to move forward a certain distance, although it will stop before hitting a wall.
    - I. Formulate this problem. How large is the state space?
 

(08 marks)
    - II. In navigating a maze, the only place we need to turn is at the intersection of two or more corridors. Reformulate this problem using this observation. How large is the state space now?
 

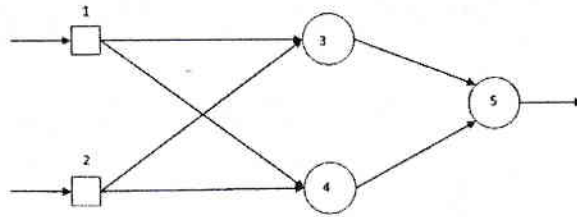
(05 marks)
2.
  - a)
    - I. Perceptron may be used to perform numerous logic functions. Demonstrate the implementation of the binary logic functions AND, and OR.
 

(04 marks)
    - II. A basic limitation of the perceptron is that it cannot implement the EXCLUSIVE OR function. Explain the reason for this limitation.
 

(02 marks)
  - b) Can neural network models generalize? Explain why the question of whether they can or cannot is, or is not, important.
 

(04 marks)

- c) The following diagram represents a feed-forward neural network with one hidden layer: A weight on connection between nodes  $i$  and  $j$  is denoted by  $w_{ij}$ . Bias of each neuron is denoted by  $b_i$ .



The following lists all the weights in the network:

$$\begin{array}{lll} w_{13} = -2 & w_{35} = 1 & b_5 = 1 \\ w_{23} = 3 & w_{45} = -1 & \\ w_{14} = 3 & b_3 = 1 & \\ w_{24} = -1 & b_4 = 1 & \end{array}$$

Each of the nodes 3, 4, and 5 uses the following activation function:

$$\phi(v) = \begin{cases} 1 & \text{if } v \geq 0 \\ 0, & \text{otherwise} \end{cases}$$

Where  $v$  denotes the weighted sum of a node. Each of the input nodes (1 and 2) can only receive binary values. Calculate the output of the network ( $y_5$ ) for each of the input patterns:

Pattern	Node 1	Node 2
$P_1$	0	0
$P_2$	1	0
$P_3$	0	1
$P_4$	1	1

(15 marks)

3.

- a) List two applications of Natural Language Processing.

(02 marks)

- b) What are the main challenges in language processing? (Give at least two challenges.)

(02 marks)

c) Explain inflectional and derivational morphology by giving appropriate examples.  
(04 marks)

d) Write a regular expression for the followings:

I. That matches the given date patterns.

1983/08/20	✓
1983-12-06	✓
2100/1/1	×
2017-09-30	✓
1899/1 /1	×
2017/9/30	✓
2021.12.13	✓
2022 10 19	✓
1900/0/0	×
1999/12/32	×
2021-8-31	✓

(04 marks)

II. To detect HTML tags, for example:

```
<html>
  <body>
    Content goes here...
  </body>
</html>
```

(03 marks)

e) Compute the minimum edit distance for “**TRADITIONALLY**” and “**CONVENTIONAL**” using Levenshtein minimum edit distance.  
(10 marks)

4.

a) Write down the probability of a sequence of words,  $S = P(w_1 \times w_2 \times w_3 \dots \times w_n)$  using trigram probability approximation (state all the assumptions).  
(05 marks)

- b) Consider the phrase, "no reason to believe her". The unigram and bigram counts in two books are given in Table 1 and Table 2 respectively. Assume that  $P(\text{no} | < s >) = 1$  and  $P(< /s > | \text{him}) = 1$ .

Compute the probability of the phrase using the language model.

- I. Pertaining to Text 1.
- II. Pertaining to Text 2
- III. From which book has the phrase been extracted?

Table 1: Bigram Counts

Book	(no, reason)	(reason, to)	(to, believe)	(believe, him)
Text 1:	5	22	10	2
Text 2:	2	7	2	1

Table 2: Unigram Counts

Book	no	reason	to	believe	him
Text 1:	488	53	4063	89	633
Text 2:	484	64	4542	25	1058

(10 marks)

- c) Explain why smoothing is important for the practical application of N-gram language models. Illustrate your answer with a suitable example.

(05 marks)

- d) How do you evaluate the performance of a language model?

(05 marks)

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