RAJARATA UNIVERSITY OF SRI LANKA
FACULTY OF APPLIED SCIENCES

B.Sc. (Four-Year) Degree in Information and Communication Technology
Fourth Year - Semester I Examination – September / October 2019
ICT 4302-INTELLIGENT SYSTEMS

Time :Three (03) hours

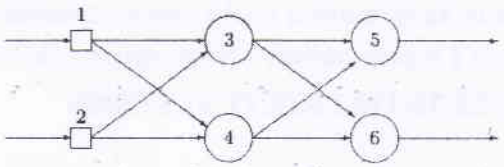
INSTRUCTIONS TO CANDIDATES

1. This paper contains 4 questions on 4 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) Can neural network models generalize? Explain why the question of whether they can or cannot is, or is not, important. (5 marks)

(b) 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}.



The following lists all the weights in the network:

$w_{13} = -2$ $w_{35} = 1$
$w_{23} = 3$ $w_{45} = -1$
$w_{14} = 3$ $w_{36} = 1$
$w_{24} = -1$ $w_{46} = 1$

Each of the nodes 3,4,5 and 6 uses the following activation function:

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

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 and y_6) 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

(10 marks)

(c) Suppose that a credit card company decided to deploy a new system for assessing credit worthiness of its customers. The new system is using a feed-forward neural network with a supervised learning algorithm.

i. Suggest in a form of essay what should the company have before the system can be used? Discuss problems associated with this requirement. (3 marks)

(d) What does the learning rate do in back propagation training? Present your answer while discussing the validity of the statement "Comparatively higher learning rate is preferred at the start of training phase and it should be decayed over the time, OR, comparatively smaller but constant learning rate is preferred during the training phase since because BP practices gradient decent learning". (7 marks)

2.

(a) Single layer Perceptrons are limited in the class of input-output mappings they can perform. Identify that class, and give one simple example of a problem within that class, and one simple example from outside that class. (5 marks)

(b) The Back-Propagation (BP) algorithm is often used for training feed-forward neural networks. Explain why do we need to calculate the gradient in the BP algorithm? (5 marks)

(c) For a BP with a sigmoid (logistic) activation function, why might one avoid setting target output values 0.0 and 1.0, and prefer to use 0.1 and 0.9 (or even 0.2 and 0.8)? (5 marks)

(d) Can problems with reaching to local minima be avoided in BP? Justify your answer. **(5 mark)**

(e) What does the learning rate do in Back Propagation training? What may happen when we use a very large learning rate, and when we use a very small learning rate? (5 marks)

3.

(a) List two challenges in Natural Language Processing. (4 marks)

(b) Explain inflectional and derivational morphology by giving appropriate examples. (6 marks)

(c) Write a regular expression for the language accepted by the Finite State Machine in figure Q3.c. (5 marks)

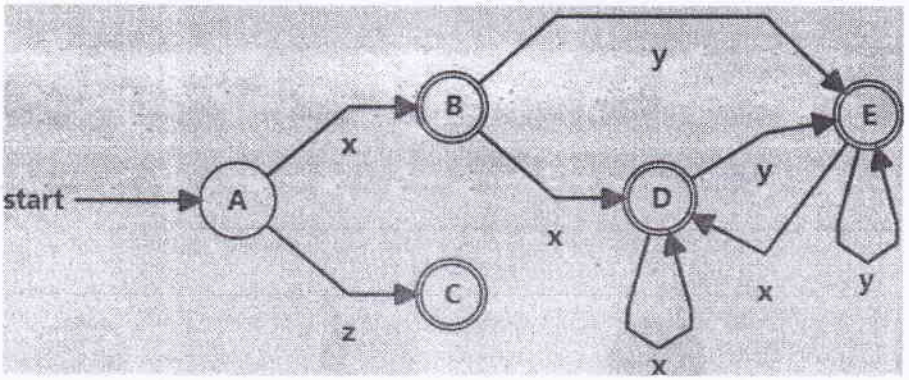


Figure Q3(c): Finite State Machine

(d) Compute the minimum edit distance for "**DISSERTATION**" and "**DISSEMINATION**" using Levenshtein minimum edit distance. (10 marks)

4.

(a) Write down the probability of a sequence of words, $S = P(w_1 \times w_2 \times w_3 \cdots \times w_n)$ using bigram probability approximation (state all the assumptions). (5 marks)

(b) Apply add-one smoothing to the bigram language model trained on the sentence:
"This is the cat that killed the rat that ate the malt that lay in the house that Nimal built."
and find bigram probability of the test sentence: (10 marks)

"This is the house that Nimal built."

(c) Carry out the CKY algorithm for the sentence and find all the possible parse trees. (10 marks)

"Language students study algorithms"

- S → NP VP
- S → VP
- VP → V NP
- VP → V
- NP → NP NP
- NP → NP PP
- NP → N
- PP → P NP
- N → students
- N → study
- V → study
- N → Algorithms
- N → Language

Figure Q4(c): Grammar in Chomsky Normal Form

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