RAJARATA UNIVERSITY OF SRI LANKA
FACULTY OF APPLIED SCIENCES

B.Sc. (Four-Year) Degree in Information and Communication Technology
B.Sc. (Four-Year) Degree in Applied Sciences

Fourth Year – Semester 1 Examination – June/July 2018

ICT 4302 – INTELLIGENT SYSTEMS

Time Allowed: 3 hours

ADDITIONAL MATERIAL

None

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 & sections thereof are included in square brackets.
4. This examination accounts for 70% of the module assessment.
5. This is a close book examination.
6. Clearly state any assumptions that you may make.
7. Start answering each question on a fresh page. Clearly number the questions, and parts. Neat and orderly presentation is important.
8. Calculators are allowed.

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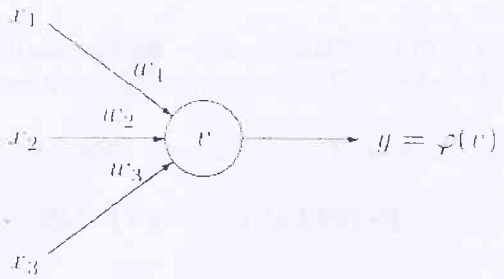
Question 1

(a) (i) Draw the structure of a biological neuron and label the main components. [05 marks]

(ii) Give two applications of artificial neural networks. [04 marks]

(b) Below is a diagram of a single artificial neuron (perceptron):



The neuron has three inputs $\boldsymbol{x} = (\boldsymbol{x_1}, \boldsymbol{x_2}, \boldsymbol{x_3})$ that receive only binary signals (either **0** or **1**).

(i) How many different input patterns this neuron can receive? [04 marks]

(ii) Suppose that the weights corresponding to the three inputs have the following values: [12 marks]

w_1	=	2
w_2	=	−4
w_3	=	1

and the activation of the unit is given by the step-function:

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

Calculate what will be the output value $\boldsymbol{y}$ of the unit for each of the following input patterns:

Pattern	P_1	P_2	P_3	P_4
x_1	1	0	1	1
x_2	0	1	0	1
x_3	0	1	1	1

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Question 2

(a)	(i)	What is supervised learning?	[03 marks]
	(ii)	To simulate adaptive behavior, the abilities of memorization and generalization are essential. Justify the statement with respect to neural networks by using suitable example.	[05 marks]
	(iii)	What is over-fitting in machine learning? Explain how Early-stopping help to identify over-fitting?	[05 marks]
(b)	(i)	What are the limitations of perceptron model.	[02 marks]
	(ii)	Draw multi-layer perceptron neural network	[04 marks]
	(iii)	Explain the principle of the gradient descent algorithm. Accompany your explanation with a diagram.	[06 marks]

Question 3

(a)	(i)	What is Natural Language Processing?	[03 marks]
	(ii)	Give four applications of Natural Language Processing.	[04 marks]
(b)	(i)	Write regular expressions for the following: I. that matches given IP addresses,	[04 marks]

168.120.1.4	✓
192.1.255.255	✓
1983.10.30.0	×
2010.100.30.0.1	×

II. The set of all alphabetic strings

(c)	(i)	What is Morphology?	[02 marks]
	(ii)	Explain inflectional and derivational morphology? Give two examples for each.	[04 marks]
	(iii)	Compute minimum edit distance by dynamic programming and show whether '**drive**' is closer to '**brief**' or to '**drivers**' and what the edit distance is.	[08 marks]

Question 4

(a) (i) Write down the probability of the sentence $S = w_1 w_2 w_3 \ldots w_n$ using the, trigram probability estimation ((state all the assumptions) [05 marks]

(b) (i) Consider the following movie sentiment. [10 marks]

"its rawness and vitality give it considerable punch "

The unigram and bigram counts in positive and negative corpuses are shown in Table 1 and 2. Assume that $P(its| < s >) = 1$ and $P(</s > |punch) = 1$. Compute the probability of the phrase using the language model

I. pertaining to positive sentiments,
II. pertaining to negative sentiments.

(ii) In reference to the above scenario in Question 4b, [05 marks]

I. classify the above movie sentiment as "*positive*" or "*negative*". Justify your answer.

(c) (i) "N-gram models must be smoothed in order to prevent assigning zero probability to any N-gram, even one that was never observed in training data set". Discuss whether you think the above statement is justified. [05 marks]

Table 1 Bigram Counts

Corpus	(its, rawness)	(rawness, and)	(and, vitality)	(vitality, give)	(give, it)	(it, considerable)	(considerable, punch)
Negative	1	1	1	4	1	103	2
Positive	4	4	8	13	1	53	3

Table 2 Unigram Counts

Corpus	(its)	(rawness)	(and)	(vitality)	(give)	(it)	(considerable)	(punch)
Negative	582	10	8	6536	62	2459	205	269
Positive	346	23	24	3565	57	941	271	74

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