Department of Computer Science & Engineering

University of Asia Pacific (UAP)

Program: B.Sc. in Computer Science and Engineering

Final Examination	**Spring 2021**	**4th Year 1st Semester**
Course Code: CSE 403	**Course Title: Artificial Intelligence and Expert Systems**	**Credits: 3**
Full Marks: 120* (Written)		**Duration: 2 Hours**

* Total Marks of Final Examination: 150 (Written: 120 + Viva: 30)

Instructions:

1. There are **Four (4)** Questions. Answer all of them. All questions are of equal value. Part marks are shown in the margins.
2. Non-programmable calculators are allowed.

1. a) Explain the posterior probability, likelihood and prior probability of class with examples. **[6]**

b) A training dataset of Weather and the corresponding target variable "Playing Cricket" are given below. Convert the dataset into a Frequency Table. Create a Likelihood Table and calculate the posterior probability using Naïve Bayes Theorem to solve the following problem according to your Reg. No.: **[24]**

(If last 2 digits of Reg. No. **mod** 3 = 0), Predict the probability that "Players will play cricket if weather is Sunny".

(If last 2 digits of Reg. No. **mod** 3 = 1), Predict the probability that "Players will play cricket if weather is Cloudy".

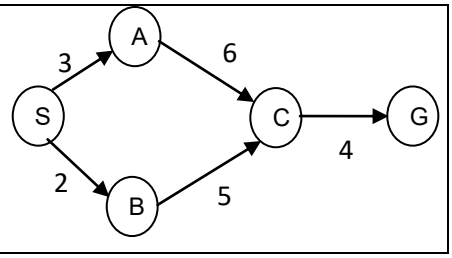
(If last 2 digits of Reg. No. **mod** 3 = 2), Predict the probability that "Players will play cricket if weather is Rainy".

Weather	Playing Cricket
Rainy	No
Sunny	Yes
Cloudy	No
Rainy	No
Sunny	Yes
Sunny	No
Cloudy	Yes
Rainy	Yes

2. a) Differentiate between the admissibility and consistency of a heuristic function. **[6]**

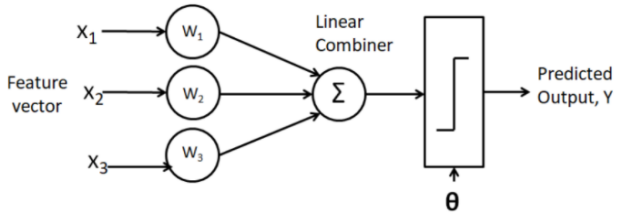
2. **b)** Your target is to reach the goal node 'G' from the start node 'S' with the optimal cost. **Simulate** the following problem with **A* Search algorithm** and **determine** the shortest path with **fringe** for each iteration. The heuristic values of the nodes are given below: **[24]**

Node	h(n)
S	1
A	(Last 2 digits of Reg. No.) **mod** 2 + 3
B	h(A) + 4
C	(Last 2 digits of Reg. No.) **mod** 4 + 2
G	0



3. **a)** Summarize the back-propagation learning process in your own words. **[5]**

b) For the following perceptron, the feature vector is X = [1 1 0] and the desired output is Y = 1. **[10 + 15]**



Here, w_1 = (Last 2 digits of Reg. No.) **mod** 3 – 0.3, $w_2 = w_1 + 0.4$ and $w_3 = w_2 - 0.2$

i) **Measure** the predicted output using the formula:
$Y_p = \text{Step}((x_1 * w_1 + x_2 * w_2 + x_3 * w_3) - \theta)$, where Step(x) is the Step Activation Function whose value is 1 if it is ≥ 0.5, and its value is 0 if it is < 0.5, and the threshold $\theta = 0.3$.

ii) **Update** the weights (w_1, w_2 and w_3) using the formula:
$w_i^{(2)} = (w_i^{(1)} + \alpha * x_i * \varepsilon)$, where i = 1, 2, 3, the learning rate, $\alpha = 0.1$, and ε is the error between the actual output Y_a and the predicted output Y_p.

4. The digit strings representation of ***8-queens states*** are given below: **[10 + 15 +5]**

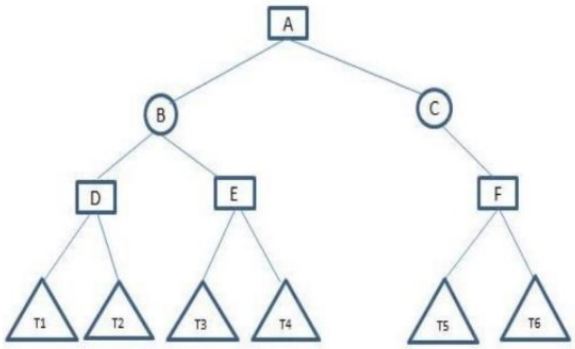
Initial Population	Fitness Score	Crossover Point
14623752	26	(Last 2 digits of Reg. No.) **mod** 4 + 2
72528613	12	
85621537	22	
51643275	19	

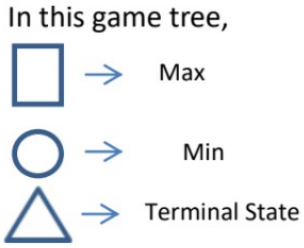
i) Calculate the ***fitness percentage*** from the fitness score. After that, from higher to lower fitness percentage, rank the initial population. Then, select the top three populations and **perform** the ***crossover operation*** according to the crossover point.

ii) Show ***mutation operation*** at the digit = (last 2 digits of Reg. No.) **mod** 3 + 4.

OR

4. Your target is to apply the alpha-beta pruning to prune the following game tree to improve the searching time efficiency. **[30]**





The values for the terminal states are as follows:

T1 = (last 2 digits of Reg. No.) **mod** 4 + 3	T2 = 2
T3 = (last 2 digits of Reg. No.) **mod** 4 + 5	T4 = 4
T5 = T3 - 6	T6 = 9

Illustrate the step by step pruning process with **graphical representations**.

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