# Department of Computer Science & Engineering

## University of Asia Pacific (UAP)

**Program: B.Sc. in Computer Science and Engineering**

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| **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".

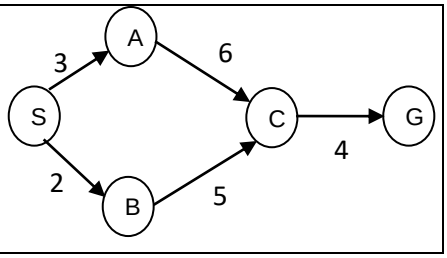
(If last 2 digits of Reg. No. **mod** 3 = 2), Predict the probability that "Players will play cricket if weather is Rainy".

| 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]**

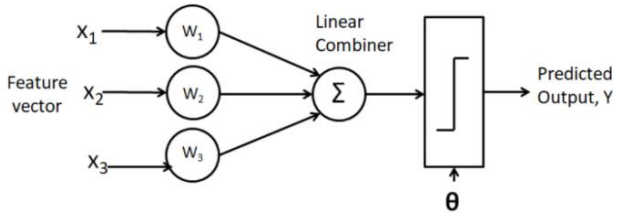
**b)** Your target is to reach the goal node 'G' from the start node 'S' with the optimal cost. **Simulate** the following problem with **A* Search algorithm** and **determine** the shortest path with **fringe** for each iteration. The heuristic values of the nodes are given below: **[24]**

| 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) M**easure** 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 $\varepsilon$ 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]**

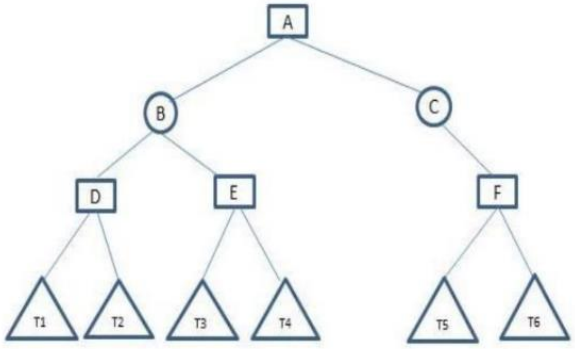
| Initial Population | Fitness Score | Crossover Point |
|---|---|---|
| 14623752 | 26 | (Last 2 digits of Reg. No.) **mod** 4 + 2 |
| 72528613 | 12 | |
| 85621537 | 22 | |
| 51643275 | 19 | |

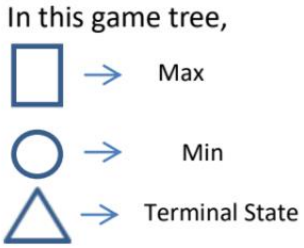
i) Calculate the ***fitness percentage*** from the fitness score. After that, from higher to lower fitness percentage, rank the initial population. Then, select the top three populations and **perform** the ***crossover operation*** according to the crossover point.

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

**OR**

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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