Department of Computer Science & Engineering

University of Asia Pacific (UAP)

Program: B.Sc. in Computer Science and Engineering

Final Examination	**Spring 2020**	**4th Year 1st Semester**
Course Code: CSE 403/407	**Course Title: Artificial Intelligence and Expert Systems**	**Credits: 3**
Full Marks: 120* (Written)		**Duration: 2 Hours**

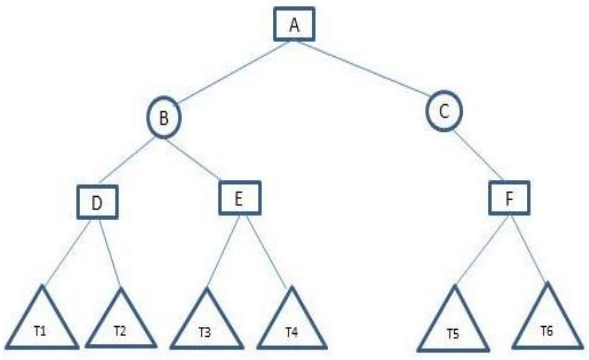
* Total Marks of Final Examination: 150 (Written: 120 + Viva: 30)

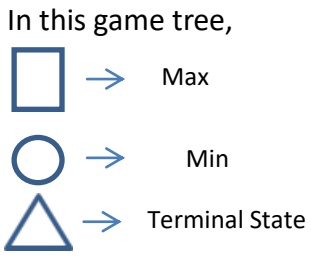
Instructions:

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. Your target is to prune the following game tree in order to improve the searching time efficiency. Which algorithm do you think is the best for this problem and what is the required condition for pruning? Consider the values of the terminal states as follows. Here **% refers** to **mod** operation. **Illustrate** the step by step pruning process with **graphical representations**. 2 + 28

T1 = (Last 2 digits of your ID) % 3 + 2	T2 = - 7
T3 = - 10	T4 = (Last 2 digits of your ID) % 4 + 1
T5 = T1 + 5	T6 = - (T4 + 1)



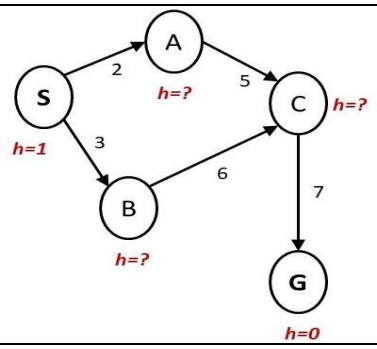


OR

1. a) "Consistency is one of the requirements for a good heuristic function". Justify your answer with example. 5

1. b) Your target is to reach the goal node 'G' from start node 'S' with the optimum cost. **Simulate** the following problem with **A* algorithm** and **determine** the shortest path with **fringe** for each iteration. The heuristic values of the nodes are as follows. Here, **% refers** to **mod** operation. 25

Node	H (n)
A	(Last 2 digits of your ID) % 3 + 2
B	(Last 2 digits of your ID) % 4 + 1
C	(Last 2 digits of your ID) % 2 + 3



2. Your plan is to execute the Genetic Algorithm (GA) for one run to solve a given problem f(x) = 3x-1. Consider 2 pairs of individuals (4 population like A, B, C and D), where the genotype representation (bit string) of the population are as follows: 30

Population A = 1st digit of your age	Population B = 2nd digit of you age
Population C = (A + B) + 1	Population D = C + Min(A, B) + 1

For example, if someone's **age** is **24**, then the value of the 4 populations will be as follows. In this case, the range of X is **X: 2 ~ 10**, so he/she may use **4-bit** representation.

Population A = 2	Population B = 4
Population C = (2+4)+1 = 7	Population D = 7 + Min(2, 4) + 1 = 10

Execute the algorithm for one run explaining the 3 operators (selection, crossover and mutation) and **measure** the improve fitness value for each iteration. For selection, you may use Roulette-Wheel Technique.

3. a) The probability of raining on Sunday is 0.7. The Probability Transition Matrix is given bellow. Can you **predict** the probability of raining on Tuesday? Here **/ refers** to **division** operation and **SQRT** means square root operation. For example, if the last two digits of someone's ID is **25** then: 25

Sunday	Next Day	Probability Distribution
rain	rain	A = 1 – B = 1 - 0.25 = 0.75
rain	sun	B = (Last two digit of ID) / 100 = 25 / 100 = 0.25
sun	rain	C = {SQRT(Last two digit of ID)} / 10 = SQRT(25) / 10 = 0.5
sun	sun	D = 1 – C = 1 – 0.5 = 0.5

If the last two digits of someone's ID includes one/two "**zero**" element, then he/she will use "**2**" instead of "**zero**". For example, if the last two digits of someone's ID is **10**, then B = **12** / 100 = 0.12 and so on respectively.

b) For the following joint distribution, find the conditional probability of P(*cavity* | ¬ *toothache*). Indicate *query variable*, *evidence variable* and *hidden variable*. 3 + 2

A = Last two digits of ID / 100	B=1-A
C = 0.576	D = 0.144

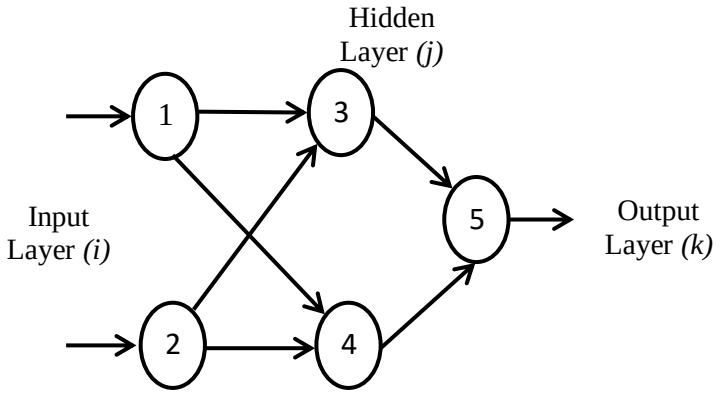
	¬ toothache	
	catch	¬ catch
cavity	A	B
¬ cavity	C	D

4. **a)** The weights in a neural network are called "adjustable synaptic weights". Why? 3

b) For the following back propagation neural network (BPNN), the input vector, X = [0, 1] and output vector, Y = [1, 0]. Assume that the threshold value $\theta_3 = \theta_4 = \theta_5 = 0$, learning rate $\alpha = 0.1$. Consider the weights as follows. Here, **% refers** to **mod** operation. Find out: 27

i) Predicted output of the hidden layer (neuron 3 and 4)
ii) Predicted output of the output layer (neuron 5)
iii) Updated weight of output layer (W_{35}) after one iteration

W_{13} = 0.3	W_{14} = (Last 2 digits of your ID) % 3 – 0.5
W_{23} = (Last 2 digits of your ID) % 2 – 0.2	W_{24} = 0.2
W_{35} = - 0.4	W_{45} = 0.5



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