NATIONAL SCHOOL OF BUSINESS MANAGEMENT

BSc in Management Information Systems (Special) – 17.2/18.1

BSc (Hons) Software Engineering – 17.2/18.1

BSc (Hons) Computer Science – 17.2/18.1

4th Year 1st Semester Examination

23 May 2021

CS403.3 - Artificial Intelligence

Instructions to Candidates

1) This paper consists of 4 questions in 8 pages. Answer all the questions.
2) Time allocated for the examination is three (03) hours and 30 minutes (including downloading and uploading times)
3) Weightage of Examination: 60% out of final grade
4) Download the paper, provide answers to the questions in a word document
5) Please upload the document with answers (Answer Script) to the submission link before the submission link expires
6) Answer script should be uploaded in PDF format
7) Under any circumstances E-mail submissions would not be taken into consideration for marking. Incomplete attempt will be counted as a MISSED ATTEMPT.
8) The naming convention of the answer script- Module Code_Subject name_IndexNo
9) You must adhere to the online examination guidelines when submitting the answer script to N-Learn.
10) Your answers will be subjected to Turnitin similarity check, hence, direct copying and pasting from internet sources, friend's answers, etc. will be penalized.

Question 1 [25 marks]

(a) Check whether the following statements are valid, satisfiable, or unsatisfiable.

i) $(A \Rightarrow B) \Rightarrow (\neg A \Rightarrow \neg B)$ [2]

ii) $(A \cup B) \cup (A \cup B)$ [2]

iii) $(A \Rightarrow B) \Rightarrow ((A \cap C) \Rightarrow B)$ [3]

(b) Using resolution refutation prove ¬U, given the following: [6]

i) $\neg(P \cap \neg Q)\ \neg(\neg S \cap \neg T)$

ii) $\neg(T \cup Q)$

iii) $U \Rightarrow (\neg T \Rightarrow (\neg S \cap P))$

(c) Write down the following first-order sentences in English and state whether they are true or false. Assume x and y are natural numbers 0, 1, 2,..., ∞ [4]

i) $\forall x\ \exists y\ (x \geq y)$

ii) $\exists y\ \forall x\ (x > y)$

(d) Convert the following sentences to first order logic. Define the relations you use clearly. [4]

(i) A child of a human is a human

(ii) Peter is a human

(iii) Peter is Sam's parent

(iv) Child and parent are inverse relations

(e) Use backward chaining on above (d) to prove that Sam is a human. [4]

Question 2 [25 marks]

(a) It is planned to hold a tennis tournament tomorrow at the BRC grounds. In the previous years it has rained 5 days each year at BRC. It has been forecasted by the Department of Weather that it will rain tomorrow. When it actually rains, the Department correctly forecasts rain 20% of the time. When it doesn't rain, it incorrectly forecasts rain 10% of the time. What is the probability that it will rain on the day of the cricket match? Show the calculations of your answer. Assume the number of days per year is 365.

[6]

(b) Consider the following tables of probability values on selling two types of ice-creams (i1 and i2). q1, q2, q3, q4 are the four quarters (seasons of the year) and r1, r2 are the two regions (states) that are considered. s1, s2 and s3 represent the number of scoops of ice-creams in each type of ice cream. The flavours of ice creams are represented as f1 or f2.

Calculate the probability that the ice cream sold in the quarter 3 in region r1, and is of type i2 which has a s1 number of scoops and f1 flavour. You need to show your calculations and any equations used. [7]

P(q)

P(q1)	P(q2)	P(q3)	P(q4)
0.10	0.50	0.25	0.15

P(r)

P(r1)	P(r2)
0.6	0.4

p.t.o.

P(i|q,r)

	P(i1|qa,rb)	P(i2|qa,rb)
q1,r1	0.5	0.5
q1,r2	0.7	0.3
q2,r1	0.6	0.4
q2,r2	0.8	0.2
q3,r1	0.4	0.6
q3,r2	0.1	0.9
q4,r1	0.2	0.8
q4,r2	0.3	0.7

P(s|i)

	P(s1|ix)	P(s2|ix)	P(s3|ix)
i1	0.6	0.2	0.2
i2	0.2	0.3	0.5

P(f|i)

	P(f1|ix)	P(f2|ix)
i1	0.3	0.7
i2	0.6	0.4

p.t.o.

(c) Suppose a BNS concert is planned for Christmas Eve 2021 at NSBM University. Assume the organizing committee is going to pick a theatre with a capacity of 500 audience. Suppose the fee that BNS would charge is 200,000 LKR.

Based on the past experience of similar events, the price of a ticket will be 500 LKR per person. The size of the audience is uncertain and based on the previous experience it can be as of the following probabilities.

Audience quantity	Probability
300	50%
400	30%
500	20%

Moreover, it can be expected that audience members will purchase confectionery either prior to the show or during the interval. The contribution is uncertain and it is estimated as follows,

	Probability
Contribution of 50 LKR per person	30%
Contribution of 60 LKR per person	50%
Contribution of 100 LKR per person	20%

Using the concept of expected values (Expected value = outcome * Probability), advise the organizing committee whether it is worth engaging BNS for the concert.

[7]

(d) Assume with Perfect Information, the committee can know the exact quantity of the audience. Therefore, calculate the maximum value of perfect information.

[5]

Question 3 [25 marks]

(a) Consider a dataset of Corona patients at IDH during the previous 15 months. Records of their symptoms (Eg: fever, headache, diarrhea, etc...) are collected. The task is to decide whether a new patient suffers from illnesses such as Corona, Pneumonia or etc…

i) A neural network is supposed to be utilized to solve this issue. Two options are considered,

1. Either to train a separate neural network for each illness.
2. Or to share a single neural network for all the diseases, in which separate output neurons are used for each illness. (Here the neural network will possess a shared hidden layer)

What is the option you would choose? Justify your choice using a maximum of five sentences. [3]

ii) Several features of the patients are difficult to identify (eg: dizziness) and some are easy to extract (eg: body temperature). As a result, initially a classification algorithm can be utilized to predict the existence of an illness within a patient. If the classifier can predict the existence of a disease in a particular patient with 80% confidence, further examinations will be conducted to extract more features. In this regard, what you would recommend from neural networks, naive bayes or decision trees as the best approach for classification (Justify your answer with a maximum of 3 sentences.)

[3]

(b) Apply K- means clustering to the following dataset. (Assume k=3). Use manhattan distance (|xi-xj|+|yi-yj|) to calculate the distances. You need to do clustering for **two** iterations. Calculations must be shown. Round off the values to one decimal point. [7]

A = (3,9) B = (4,5) C = (2,11) D = (8,3)

E = (7,3) F = (6,4) G = (9,4) H = (5,7)

p.t.o.

(c)

i) Why Convolutional Neural Networks are mostly used in image recognition tasks compared to Recurrent Neural Networks?

(Use a maximum of **two** sentences to provide an answer for this question.) [2]

ii) Out of Supervised Learning and Unsupervised Learning, which is better? (Justify your answer with a maximum of **five** sentences.) [2]

iii) Give an example for a task environment considering its key elements. [4]

iv) For the following payoff grid, find all the best responses and the Nash Equilibrium. [4]

Player1 \ Player 2	l	c	r
U	3,5	7,2	4,3
M	2,3	1,0	2,9
D	3,11	5,5	3,2

Question 4 [25 marks]

Consider the diagram **Q4. fig1** and answer the following questions**.** The trees in the right (G1, G2, G3, G4, G5) are constructed by traversing the graph in the left.

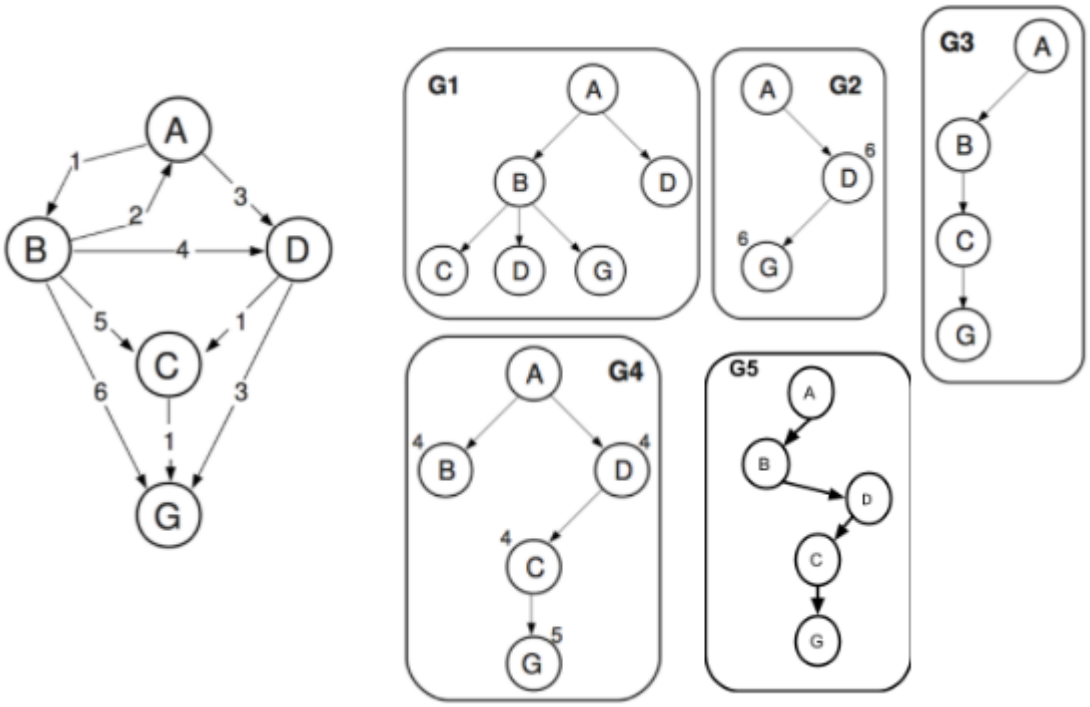
(a) Identify which algorithm is used, explain the reasons for your answers.

[2*5]

(b) Check whether the path is optimal, explain. If it is not optimal, mention why the algorithm is suboptimal.

[2*5]

(c) If a heuristic is used in the provided graphs, identify suitable values for a heuristic function. [5]



Q4. fig1

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