



**SCHOOL OF COMPUTING AND ENGINEERING SCIENCES
BACHELOR OF INFORMATICS AND COMPUTER SCIENCE
ICS 3202: ARTIFICIAL INTELLIGENCE
END OF SEMESTER EXAMINATION**

DATE: **6th December 2022**

Time: **2 Hours**

INSTRUCTIONS

1. Answer Question 1 (**Compulsory**) and any other **Two** Questions.
2. **In the calculations, show your workings for full marks.**

QUESTION One: - COMPULSORY	30 Marks
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- a. An ICS student is in the process of developing a machine learning solution for a Classification task. As such they need to prepare their data and then use it for training alongside a relevant algorithm.
 - i. During data preparation they have to handle missing values. Discuss any two ways for handling missing values. **(2 Marks)**
 - ii. Assuming they opt to use kNN algorithm, what are some of the metrics to adhere to when picking the value of k? **(2 Marks)**
 - iii. Apart from kNN, what other four classical algorithms would be applicable is the task described above? **(2 Marks)**
- b. Using a relevant diagram, describe a perceptron. **(3 Marks)**
- c. List any four-activation functions that can be used in an artificial neural network e.g. the one from question “d” above **(2 Marks)**
- d. Suppose you are training a neural network model and notice it is overfitting on the training data, what three ways can be used to reduce chances of overfitting. **(3 Marks)**

e. By providing relevant supporting examples, discuss each of the following three terms and demonstrate how they differ from each other. **(6 Marks)**

- i. Supervised Learning
- ii. Reinforcement Learning
- iii. Unsupervised Learning

f. Draw a truth table for the following propositional formula **(4 Marks)**

$$(\sim p \text{ or } \sim q) \Rightarrow (\sim q \wedge \sim r)$$

g. Translate the sentences below into first order predicate logic. **(6 Marks)**

- i. All students are smart.
- ii. There exists a student.
- iii. There exists a smart student.
- iv. Every student likes some student.
- v. Every student likes some other student.
- vi. There is a student who is liked by every other student.

QUESTION TWO**15 Marks**

- a. What are the building blocks of Artificial Intelligence **(2 Marks)**
- b. Using a relevant diagram, describe the key components of an AI agent. **(4 Marks)**
- c. You've been appointed to assist in developing an AI used by a self-sailing public boat sponsored by R4M Auto Inc. Given that a Task environment can be described using four main areas, use relevant examples to describe the four areas for this task environment **(4 Marks)**
- d. Two students working on an IS Project plan to create AI agents with a goal of predicting share prices; these agents will later be set free in the same environment. Describe the two ways in which these agents can be deployed/set up **(2 Marks)**
- e. You are provided with the following confusion matrix for a Binary Classification task.

	<i>Positive</i>	<i>Negative</i>
<i>Positive</i>	<i>130</i>	<i>17</i>
<i>Negative</i>	<i>10</i>	<i>125</i>

Using the values in the confusion matrix, calculate the following performance metrics. Show your working / formulas for each. **(3 Marks)**

- i. Accuracy:
- ii. Precision:
- iii. Recall:

QUESTION THREE**15 Marks**

- a. NLP applications range from sentiment classification, Machine Translation and Social Media Monitoring. However, the same is not 100% true when dealing with Low resource Languages such as *Swahili, Zulu, Kinyarwanda* etc. What are some of the emerging techniques being used to resolve challenges for low resource NLP applications? **(3 Marks)**
- b. Suppose you are doing a multiclass classification task where the raw input is a single string containing the text of the entire document. Using a diagram describe the pipeline to go from the raw input to a predicted class with possibility of improving the model in future. **(6 Marks)**
- c. In an NLP pipeline, Bag of Words (BoW) can be used for feature extraction. Given the following corpus of tweets by customers, generate a vocabulary and the corresponding vectors when using BoW. Do not perform any stop word removal on the given corpus. **(4 Marks)**

Review 1: This movie is very scary and long

Review 2: This movie is not scary and is slow

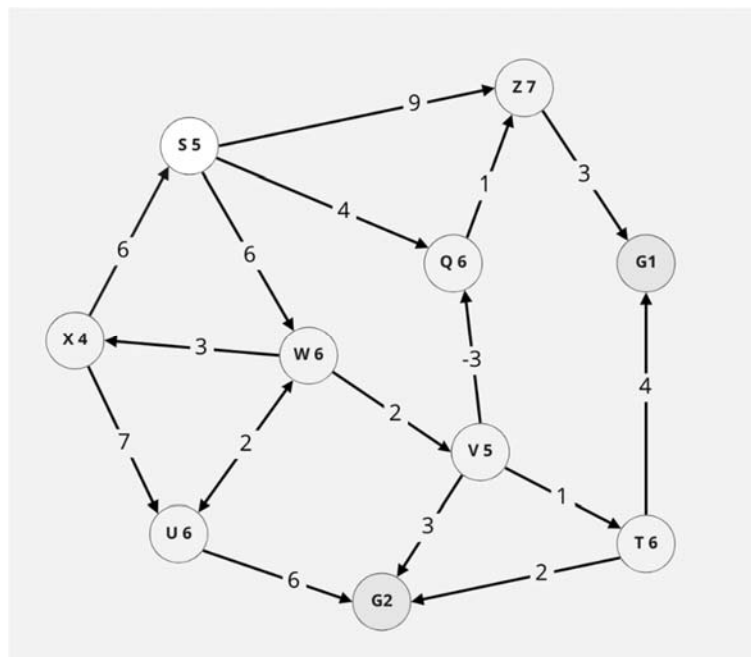
Review 3: This movie is spooky and good

- d. Referring to the examples in question ‘c’ above, what are the drawbacks of using a Bag-of-Words (BoW) Model. **(2 Marks)**

QUESTION FOUR

15 Marks

- a. Describe the three steps followed by Problem Solving Agents when attempting to reach a Goal State? **(3 Marks)**.
- b. Company XYZ deploys sales-agents across Kenya every 2 to 3 months. To ensure efficient deployment and travel of sales-agents from Nairobi to other destinations, the company plans to develop some sort of intelligent agent that can return efficient pathways that sales-agents can use while traveling.
- i. During development, the company discovers lots of loops returned by initial prototypes of the intelligent agent. Advice on ways of how this huddle in development can be overcome. **(2 Marks)**
- ii. Describe the Goal state and the Initial State for the problem above. **(2 Mark)**
- c. The graph below presents one Starting Point ‘S’ and 2 Possible Destination points G1, G2. Use the provided Heuristics (Indicated within the node e.g for node S the value is 5, and for Z the value is 7).



- i. By **showing** your expansion approaches from the source 'S' to the other nodes, write in the final A-star scores for all nodes. **(5 Marks)**

Node	Score
S	
X	
Z	
U	
V	
W	
Q	
G1	
G2	
S	

- ii. State the pathways to the specified goals when using the following algorithms **(3 Marks)**.
- Greedy Search (To G2)
 - A-Star Search (To G1)
 - Iterative Deepening Depth First Search (Consider shortest path to any goal with a Limit of 3)

QUESTION FIVE

15 Marks

- There are many ways of defining what we might look for in a fair artificial intelligence system. Describe any two criteria which can be used to describe fairness in AI models. **(1 Mark)**
- In their research paper titled *A Framework for Understanding Sources of Harm throughout the Machine Learning Life Cycle*, HARINI SURESH and JOHN GUTTAG discussed various types of bias that may arise during development and deployment of AI systems. By using/providing relevant examples, discuss any 5 types of bias in AI systems. **(10 Marks)**.
- What are some of the ethical concerns with the recent adoption of AI in business sectors such as prediction of cryptocurrency prices **(4 Marks)**