

PAPUR ARHOLIAD / EXAMINATION PAPER

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LEFEL / LEVEL:	7

MODIWL / MODULE: ACCA7026
ARTIFICIAL INTELLIGENCE
RESIT QUESTION PAPER

AMSER / TIME:	2 HOURS
CYFARWYDDIADAU / INSTRUCTIONS:	ANSWER <u>TWO</u> QUESTIONS OUT OF <u>THREE</u> IN <u>SECTION A</u> ANSWER <u>ALL</u> QUESTIONS IN SECTION B

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Author:		Semester:	
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Section A: [40 Marks]

This section contains **THREE** questions; **Answer** any **TWO** questions from this section.

1. Question One [20 Marks]

Artificial intelligence (AI) is transforming healthcare by enabling systems that can perceive, reason, and act on clinical information. Next-generation Agentic AI systems are distinguished from traditional AI approaches by their advanced autonomy, reasoning mechanisms, and capacity to integrate complex data sources.

- a. Define Agentic AI and explain with an example, how it differs from traditional AI systems used in healthcare, focusing specifically on their *reasoning approach* and *domain flexibility*. [6]
- b. Describe at least TWO key capabilities that an Agentic AI system must possess to operate effectively in dynamic healthcare environments. [2]
- c. Compare Weak AI and Strong AI in the context of patient monitoring system, highlighting differences in reasoning, and adaptability. [8]
- d. Identify and discuss TWO ethical concerns associated with deploying advanced AI systems in patient monitoring. [4]

2. Question Two [20 Marks]

Artificial intelligence (AI) is increasingly applied in healthcare to support decision-making, optimise treatment strategies, and manage operational tasks. Different AI and machine learning approaches are suited to different types of problems.

- a. A hospital patient monitoring system tracks patients' vital signs (heart rate, blood pressure, oxygen saturation) in real time. The system can send alerts to nurses or adjust monitoring frequency to prevent patient deterioration and learns over time which actions improve patient outcomes. Identify and explain the main components of a Reinforcement Learning (RL) system, and provide suitable examples for each component based on the given scenario. [9]
- b. Define the components of the PEAS (Performance Measure, Environment, Actuators, Sensors) framework and identify a key example for each component

in the context of an AI-powered Clinical Appointment Scheduling System used in a general practice (GP) clinic to perform its functions. [6]

- c. For each of the following healthcare scenarios, identify the type of machine learning problem (Supervised-Classification, Supervised-Regression, or Unsupervised Learning) and briefly justify your answer: [5]
- Predicting whether a patient will develop sepsis (serious infection) within 48 hours based on vital signs and lab results.
 - Grouping patients into clusters based on their lifestyle habits and risk factors for diabetes.

3. Question Three [20 Marks]

a. HealthBot is an Natural Language Processing (NLP)-based virtual assistant used by a mental health support platform. It provides guidance on therapy sessions, self-help resources, and appointment scheduling.

Patient: "Hello, I want to book a session with my therapist."

HealthBot: "Sure! Can you tell me your preferred date and time?"

Patient: "Next Wednesday afternoon, please."

HealthBot: "I've scheduled your therapy session for Wednesday, 5th February at 3 PM. You will receive a confirmation email shortly."

Patient: "Thank you. Can you also suggest some stress management exercises?"

HealthBot: "Of course. Here are three exercises you can try: deep breathing, progressive muscle relaxation, and guided meditation. Would you like links to detailed guides?"

Patient: "Yes, please."

HealthBot: "I've sent the links to your email. Let me know if you need any further assistance."

Analyse the conversation and identify the intent, entities, and dialogue management strategies used by the chatbot. Explain how these elements contribute to the effectiveness of the virtual assistant in a mental health support setting. [6]

b. Explain the roles of text preprocessing, feature extraction, and model selection in building NLP-based virtual assistants like HealthBot. For each stage, give an example of how it helps the chatbot understand patient queries and respond correctly. [9]

c. Explain the terms Natural Language Processing (NLP) and Term Frequency–Inverse Document Frequency (TF-IDF). Then, using the following sentence from HealthBot, calculate the Term Frequency (TF) of the word “session.”

“I want to book a therapy session with my therapist next Wednesday”

[5]

Section B [35 Marks]

Question 4: [35 Marks]

A university is developing an automated system to classify handwritten exam answer sheets into four categories: Excellent, Good, Average, Poor.

- Model A: A Convolutional Neural Network (CNN) trained directly on raw image data.
- Model B: Trained on numerical features extracted from the same answer sheets, such as word count, average sentence length, grammar score, and readability index.

The goal is to build a classification model that accurately assigns each answer sheet to the correct category.

- a. Explain the difference between classification and regression problems, and justify why the handwritten answer sheet grading task described above should be treated as a classification problem. **[4]**
- b. Given the two models described Model A: a CNN trained directly on raw image data, and Model B: an ANN trained on handcrafted features extracted from the same images. Which model would be more appropriate for this scenario? Justify your answer. **[4]**
- c. Explain the role of the convolutional layer, pooling layer, and fully connected layer in a Convolutional Neural Network (CNN) used for image-based classification. **[6]**
- d. In the development of a handwritten character recognition system using a neural network, explain the purpose of the training, validation, and test datasets. Based on this scenario, suggest an appropriate data split ratio for these datasets and justify your choice? **[9]**

e. Consider a CNN model is developed for a binary classification task to classify handwritten answer sheets as Excellent and Not Excellent. During evaluation on a representative subset of the test data, the model produced the following results:

- 120 Excellent sheets were correctly classified as Excellent.
- 30 Excellent sheets were incorrectly classified as Not Excellent.
- 20 Not Excellent sheets were incorrectly classified as Excellent.
- 230 Not Excellent sheets were correctly identified as Not Excellent.

Complete the following confusion matrix by identifying the values of True Positive (TP), False Positive (FP), False Negative (FN) and True Negative (TN). [2]

	Predicted		
Actual		Excellent	Not Excellent
	Excellent	?	?
	Not Excellent	?	?

f. Based on the confusion matrix in question e, calculate the accuracy, precision, recall and F1-score of the CNN model and interpret the results. Use the attached Formula sheet (appendix A) for selecting the correct equation. [6]

g. Interpret the results and discuss the academic implications of false positives and false negatives in an automated handwritten exam evaluation system. [4]

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Appendix A: Formula Sheet

$Accuracy = \frac{TP + TN}{TP + TN + FP + FN}$	$Sensitivity = \frac{TP}{TP + FN}$
$Specificity = \frac{TN}{TN + FP}$	$Precision = \frac{TP}{TP + FP}$
$F1\ score = \frac{2 * Precision * Recall}{Precision + Recall}$	$Error\ Rate = \frac{FP + FN}{TP + TN + FP + FN}$
$False\ Positive\ Rate = \frac{FP}{TN + FP}$	$True\ Positive\ Rate = \frac{TP}{FN + TP}$