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Student Number

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Family Name _____

First Name _____



**School of Electrical
Engineering, Computing and
Mathematical Sciences**

Mid-Semester Test (Open Book)

11th of April 2022

COMP3010 Machine Learning

Examination Duration 75 Minutes

Total Marks 100

Supplied by the University

None

Supplied by the Student

Materials

Any text books, lecture notes or written materials are permitted.

Internet access is not allowed except for access to Blackboard and IRIS.

Instructions to Students

You can type with any editor or write by hand. In either way, you need to save or scan the document of your answers as a pdf file and submit the pdf file through Blackboard. Both the Word and the PDF files of the assessment paper are provided. If you write by hand, you should print the pdf file and write your answers clearly and neatly, and make sure the scanned pdf file is clear. Messy handwriting, or poor quality of the scanned pdf file may get marks deducted or get zero marks if the pdf file is not readable. You can write on extra pages if extra space is needed. Even if the system is still open for submission after the due time, late submission will get zero marks. Multiple attempts are allowed but only the last attempt will be marked, which means, if the last attempt is late, it will get zero marks. **During the assessment period, internet access is not allowed except for access to Blackboard. Searching for answers from websites or sharing answers with others are contract cheating and are not permitted. Also, you need to sign the student declaration form on the next page.**



Faculty of Science and Engineering

Unit Code: COMP3010_____

Unit Name: Machine Learning_____

Unit Coordinator: Senjian An_____

Mid-Semester Test

(Assessment Title)

STUDENT DECLARATION:

I declare that this assessment item is my own unassisted work, except where acknowledged, and it has not been submitted in any form for assessment or academic credit elsewhere.

I certify that I have read and understood Curtin University policies on Plagiarism and Copyright and declare that this assessment item complies with these policies.

I certify that I have adhered to the time duration limit prescribed for the completion of this assessment item.

I recognise that should this declaration be found to be false, disciplinary action could be taken and penalties imposed in accordance with Curtin University policy.

Full Name of Student: _____

Student ID Number: _____

Signature: _____

Date: _____

Question 1 – Linear Models and Multilayer Perception (20 marks)

Consider a house price prediction problem based on three different type of features: the number of bed rooms, the land size and the location (x,y).

- With this example, describe the limitations of linear models. [8 marks]
- With this example, define a neuron and describe how neurons can be organised to define a nonlinear model which can approximate any nonlinear mapping between the input (i.e., the features) and the output (i.e., the house price). [12 marks]

Answer:

Question 2 – Implementation of Neural Networks (20 Marks)

Consider an image classification problem with 10 classes (e.g. the 10 digits), and the input image size is 30x30.

Question 2.1: Multilayer Perception (MLP)

Suppose you are implementing an MLP network with three hidden layers where the first and the third hidden layers share both their weights and biases, and a linear output layer. Define the MLP model with `nn.sequential()`.

[10 marks]

Question 2.2: Convolutional Neural Network (CNN)

Suppose you are implementing a CNN with one convolutional hidden layer with a 3x3 convolution kernel, and a linear output layer. Define the CNN model with `nn.sequential()`.

[10 marks]

Answer:

Question 3 – Convolution and max Pooling (20 Marks)

Given below is an input matrix of shape 7 X 7

1	2	4	1	4	0	1
0	0	1	6	1	5	5
1	4	4	5	1	4	1
4	1	5	1	6	5	0
1	0	6	5	1	1	8
2	3	1	8	5	8	1
0	9	1	2	3	1	4

Figure 1. Input matrix for convolution and max pooling.

Consider a 3x3 convolution kernel in Figure 2.

0	0	1
0	1	0
1	1	0

Figure 2. A 3x3 convolution kernel.

Question 3.1. What will be the output after applying a max pooling of size 3 X 3 with a stride of 2?

[10 marks]

Question 3.2. What will be the output after convolution with a stride of 3 and the kernel in Figure 2?

[10 marks]

Answer:

Question 4 – Regularisation (15 Marks)

List out two regularisation methods which are commonly used to prevent overfitting in the training of neural networks, and briefly explain how these methods are used in training of neural networks.

Answer:

Question 5 – Cross-validation (15 Marks)

Briefly describe 1) what is cross-validation? 2) What is it used for? and 3) when cross-validation should be used?

Answer:

Question 6 – Universal Approximation (10 Marks)

Briefly explain 1) what does “ A neural network with one hidden layer is a universal approximator” mean?, and 2) why this is important?

Answer:

END OF ASSESSMENT