

# Tutorial 3

## Backpropagation

### BT3017

Due date: 13<sup>th</sup> Feb 2021 (Monday) 2359 hrs

Semester 2, AY21/22, School of Computing, National University of Singapore

**IMPORTANT:**

*For this tutorial, you are supposed to submit your project file to LUMINUS.*

*Instruction for submission:*

- *Create a folder using the following naming convention:*  
*StudentNumber\_yourName\_Tut3*
- *Put your python file and also the results in this folder.*
- *Zip your folder. Name your zip file using the following convention:*

*StudentNumber\_yourName\_Tut3.zip*

*For example, if your student number is A1234567B, and your name is Chow Yuen Fatt, for this tutorial, your file name should be A1234567B\_ChowYuenFatt\_Tut3.zip*

- *Submit the zip file in the “Tutorial-3 Submit Here” folder in Luminus.*

Note: you should not need to pay for the website recommended.

## Q1

Download a piece of code from the following website:

<https://machinelearningmastery.com/implement-backpropagation-algorithm-scratch-python/>

Study the code and the data wheat-seeds.csv, then answer the following questions.

- (a) What is the maximum value of the dataset?
- (b) What is the minimum value of the dataset?
- (c) There was a scaling done on the data before the machine learning process. Write down the formulae used for the scaling and state what would be the max and min values after the scaling.
- (d) What does the function `cross_validation_split` do?
- (e) What does the function `accuracy_metric` do?
- (f) What was the non-linear perceptron activation function used?  
  
Name the function in the code that perform this activation.
- (g) In the function “`transfer_derivative`”, explain why the return value is  
$$\text{output} * (1 - \text{output})$$
- (h) In the function “`backward_propagate_error`”, explain what is “errors”.
- (i) In the function “`backward_propagate_error`”, explain what is “`neuron['delta']`”
- (j) Modify the code so that the total training error (a scalar) for epochs at 100, 200, 300, 400, 500 will be printed out.

## Q2

Modify the code so that the neural network has two hidden layers. The added hidden layer will be in-between the existing hidden layer and the output layer. Also, the added hidden layer has 3 neurons.