

# THE HONG KONG UNIVERSITY OF SCIENCE & TECHNOLOGY

Department of Computer Science and Engineering

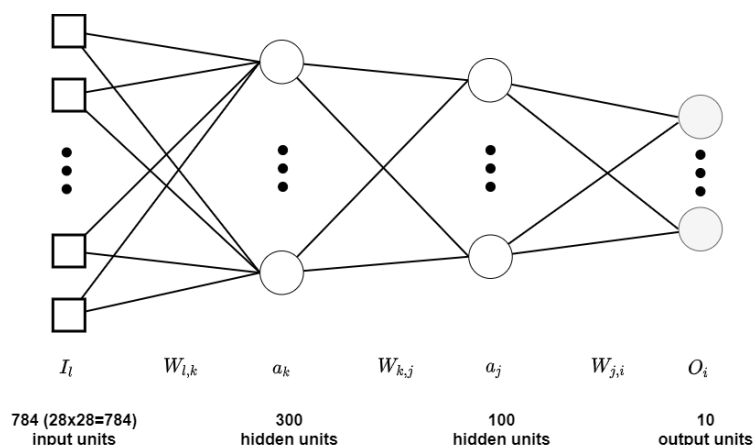
COMP4331: Introduction to Data Mining

Fall 2021: Assignment 3

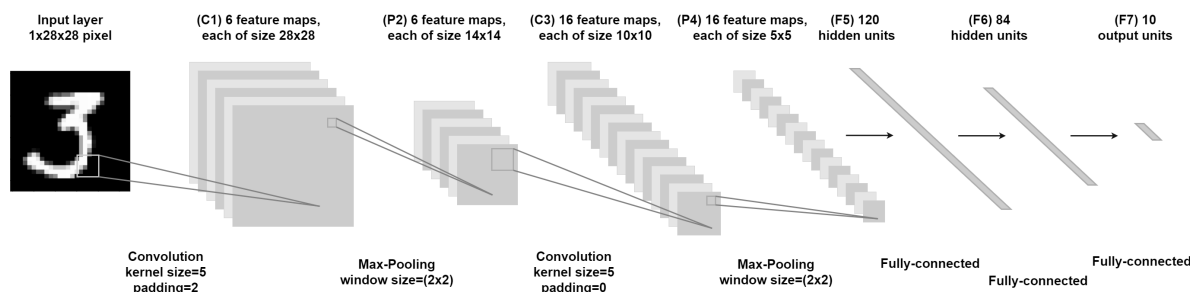
Due time and date: 11:59pm, November 27 (Sat), 2021.

**Q1.** In this assignment, you will use the MNIST dataset, which contains handwritten digits. Partial codes and TODO instructions for questions Q1 (a), (c), (d), (f) are provided in `assignment3.ipynb`. Follow the TODO instructions to complete these questions and show the required outputs in `assignment3.ipynb`.

- (a) Build the following multilayer perceptron (MLP) by adding codes for `__init__(self)` and `forward(self, x)`.

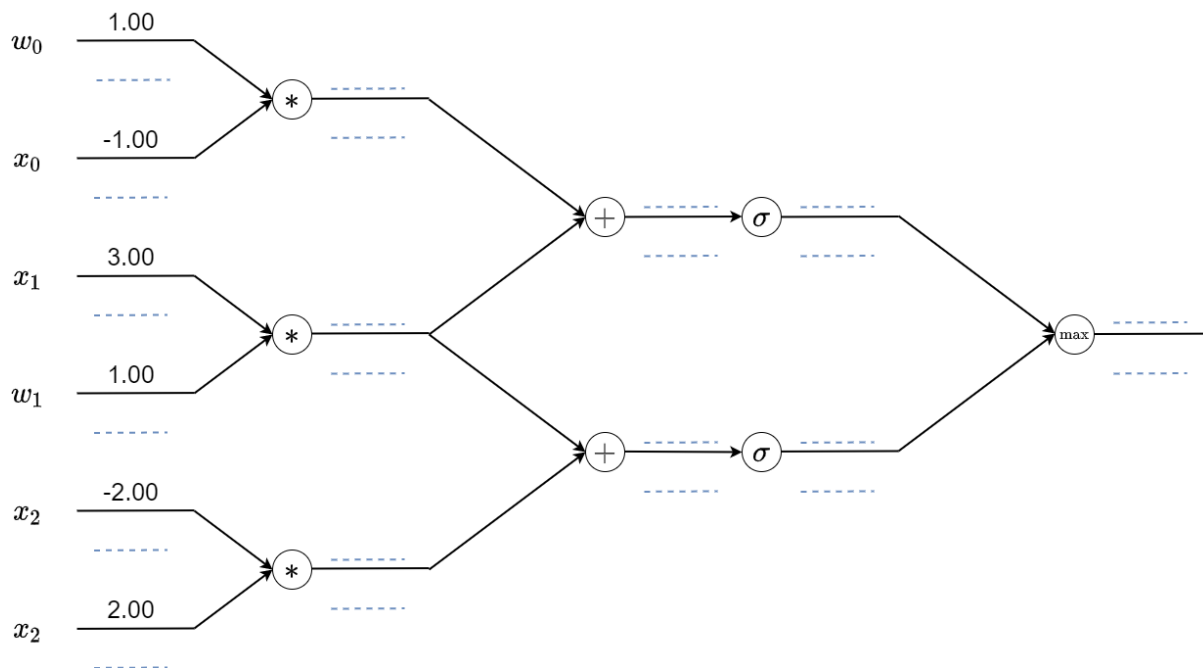


- (b) How many parameters (including the bias) need to be learned in this MLP?
- (c) Load training data with `batch_size=25` and testing data with `batch_size=1000`. Train the MLP for 3 epochs. Report the trained MLP's accuracy on the training set and accuracy on the testing set.
- (d) Next, build the following convolutional neural network (CNN) by adding codes for the `__init__(self)` and `forward(self, x)`.



- (e) How many parameters (including bias) need to be learned in this CNN?
- (f) Load training data with `batch_size=200` and testing data with `batch_size=1000`. Train the CNN for 3 epochs. Report the trained CNN's accuracy on the training set and accuracy on the testing set.

**Q2.** The following shows the computational graph for  $f(\mathbf{w}, \mathbf{x}) = \max(\sigma(w_0*x_0 + w_1*x_1), \sigma(w_1*x_1 + w_2*x_2))$ , where  $\mathbf{w} = [w_0, w_1, w_2]$  and  $\mathbf{x} = [x_0, x_1, x_2]$ ,  $\sigma(x) = \frac{1}{1+e^{-x}}$  is the sigmoid function (with derivative is  $\frac{d\sigma(x)}{dx} = (1 - \sigma(x))\sigma(x)$ ). As in the lecture notes, obtain the forward and backward propagation results (4 decimal places) for the given  $\mathbf{w}$  and  $\mathbf{x}$ . Write your answer in the figure, and then scan it to the report.



## Submission Guidelines

Please submit

- a report `report.pdf` containing your results for Q1 (b), (c), (e), (f), and Q2.
- a python notebook `assignment3.ipynb` containing your code and outputs for Q1 (a), (c), (d), (f).

Zip all the files to `YourStudentID_assignment3.zip` (e.g., `12345678_assignment3.zip`). Please submit the assignment by uploading the zip file to Canvas. Note that the assignment should be clearly legible, otherwise you may lose some points if the assignment is difficult to read. Plagiarism will lead to zero point on this assignment