

CM4107 AI Coursework 1

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Outline

This coursework consists of 60% of the total mark for this module.

The **aim** of this coursework involves a comparative study of different values of hyper parameters used in the Artificial Neural Network (ANN) implementation from lab week3 and the k-Nearest Neighbour (kNN) implementation from lab week4. This requires that you develop an understanding of the principal theories, concepts and methods used in the development of intelligent systems and to use that knowledge to evaluate and interpret results from a range of AI models applied to multiple datasets.

A secondary aim is to test your ability to apply and transfer your knowledge to create a new model by combining the ANN and kNN.

Submission deadline: 25th Oct 5pm

1 Comparative Study - Setup of Datasets

You should select 2 datasets from the list provided. It is important that you select and organise your training and test sets appropriately.

- MNIST: introduced in lab 3 and can be downloaded from moodle CW area. For more information on the dataset refer to <http://yann.lecun.com/exdb/mnist/>
- Wine: download from moodle CW area. For more details about this dataset have a look at <https://www.kaggle.com/danielpanizzo/red-and-white-wine-quality>
- Digits: download from moodle CW area. For more details about this dataset <https://www.kaggle.com/c/digit-recognizer>
- Sonar: introduced in lab 2 and can be download also from moodle CW area.
- Breast Cancer: download from moodle CW area. Details about this dataset appear at <https://goo.gl/HckAQ8>

Task (10 Marks): Maximum half page to explain:

- what datasets were selected and what is the classification task
- what are the key properties of the dataset
- how were the csv files organised for training and testing

2 The Neural Network

Provide a paragraph to explain your understanding of each hyper-parameter's role on a neural network's performance. You should consider hyper-parameters such as:

- epoch (the number of training iterations on the full dataset);
- batch size (the number of examples considered within a single epoch before updating network parameters); and
- learning rate (the amount of moderation used to manage by how much we adjust the weights).

Carry out an evaluation to study each of these hyper-parameters on the basic neural network (implemented in lab 3) and for each of the 2 data sets, find the optimal hyper-parameter settings for:

- Number of epochs
- Learning rate
- Batch size

A graph should be provided for each, comparing at least five different values for each hyperparameter. The y-axis of the graph should be accuracy, while the x-axis is devoted to the parameter setting.

A second paragraph should then be provided to discuss the results, and to explain why you think the parameter is optimal in these conditions. You should consider reporting your results using sentences such as: "we can see that with increasing epochs on the overall accuracy of the model decreased on dataset X because <your reason>; whilst in dataset Y we observe that <your observation>" etc.

Task (20 Marks): Maximum one page which needs to be organised as follows:

- Paragraph detailing students understanding of hyperparameters.
- A graph for each hyperparameter comparing the different values.
- Paragraph explaining the results.

3 Part 2 - kNN

Provide one paragraph detailing your understanding of the kNN algorithm, the role of the hyper-parameter k and the differences between unweighted and weighted voting in kNN.

Carry out an evaluation to compare weighted and unweighted kNN algorithms (implemented in lab 4) at different values of k . Provide a single graph, to present your results from the comparison. You should aim to include at least five different values of k . The y-axis will detail accuracy, while the x-axis will be different values of k .

A second paragraph should be provided, discussing the results and your understanding of them. For example, an extemporized version of 'weighted kNN has less meaning at lower values of k , so we do not observe much improvement in performance. However, at higher values of k we can see improved accuracy as it is able to consider information relevance based upon neighbour distance'.

Task (20 Marks): Maximum one page which needs to be organised as follows:

- Paragraph detailing understanding of weighted and unweighted kNN.
- Graph comparing weighted and unweighted kNN at different values of k .
- Paragraph explaining the results.

4 Part 3 - Combining ANN and kNN

Using the optimal parameters from previous parts of the coursework; develop a hybrid system which improves data representation. The idea is that you make use of the hidden layer activation for each training instance and use that as input into the kNN. This should be introduced with a paragraph discussing how you modified the ANN code to access the hidden layer representation. You may also want to include a figure to help your explanation.

A table should be provided, comparing accuracy of the hybrid system against the kNN and neural network. This will demonstrate that the improvement in representation over the course of training is due to improved representation as gained from the network.

Task (10 Marks): Maximum one page which needs to be organised as follows:

- Paragraph detailing understanding of the hybrid system functionality.
- Table comparing the results of the ANN, kNN and hybrid.
- Paragraph explaining the results.

5 How to Submit

Please follow these guidelines:

- Submit by the due date
- The write-up including figures, tables and references must use the IEEE style file template provided (cm4017-cw1-template.doc - you can download this from the coursework section).
- All files should be submitted as a single zip file named using your surname-firstname-matriculation.
- Use the dropbox to submit your coursework. This consists of your write-up using the Word template file (max 3 pages); plus any ipynb files that evidence your coding effort.
- Please also use Turnitin to evidence that your submission contains non plagiarised material.