



UNIVERSITY OF LONDON

MSc Data Science

DSM150 Neural Networks

Midterm coursework assignment

The coursework is worth 100 marks, weighted at 50% of the final mark.

Introduction

In this coursework you practice the universal deep learning workflow as outlined in Deep Learning with Python (DLWP, 1st ed., Chapter 4.5). You will work with one of TensorFlow's built-in datasets, you will implement, train, and evaluate a neural network to solve a classification/regression problem. The goal is to understand each stage of the deep learning process – from defining a problem, overfitting analysis, regularisation, to final evaluation.

Submission requirements

- Submit two files:
 - o The HTML export of your Jupyter Notebook.
 - o The original .ipynb file.
- Do not submit any data files.
- Your notebook must read as a report, not merely a sequence of code cells. Use clear markdown headings, subheadings, tables, and explanatory text throughout.
- You may reuse code from Deep Learning with Python (DLWP), AI, or the course video notebooks, but you must reference any code that is not your own.
- The HTML report (excludes code, tables, plots, figures and references.) must be between 2,000 and 3,000 words. Submissions exceeding this limit will not be marked.

Plagiarism reminder

Copying text, code, or analysis from other students, online sources, or generative AI tools without clear acknowledgement constitutes plagiarism and will result in disciplinary action under the University's academic integrity policy. You are expected to demonstrate your own understanding through original explanations, reasoning, and experimentation.

Background

This coursework is designed to help you apply the concepts introduced in the Neural Networks module to a practical deep learning task. It directly aligns with the module's learning outcomes by guiding you through the universal workflow of model development. This coursework prepares you to design and evaluate and debug deep learning systems for data science problems.

The assignment

For your midterm coursework, choose one dataset from TensorFlow Datasets (e.g., MNIST, Reuters, IMDB, or Boston Housing Prices) and then follow the eight sections below. These sections correspond to the universal workflow in DLWP (your reference book), chapter 4 subchapter 4.5. In some sections you may need to do additional exercises – for example, in Section 5 you must develop two models and compare them.

1. Defining the problem and assembling a dataset (5%)

- What is the task? Input/label semantics; class balance or target distribution.
- Size of the training data, validation and test set.
- Baseline(s): Statement and explanation of common sense baseline.

2. Choosing a measures of success (5%)

- Identify the appropriate performance metric(s) for the chosen task (e.g., accuracy, MAE, MSE, etc).
- Justify why these metrics are appropriate for the dataset and problem.

3. Deciding on an evaluation protocol (5%)

- pick one of the learned methods and justify the reason.

4. Preparing your data (15%)

- Show shapes and datatypes of the training and the validation set after preprocessing.

5. Develop and compare two small models that does better than a baseline (20%)

○ Developing the models

- Model 1: has 2 intermediate layers, each layer has equal number of hidden units (for example: intermediate layer one has 16 units. Intermediate layer two has also 16 units).
- Model 2: has 1 intermediate layer and number of hidden units is equal to the sum of hidden unites in two intermediate layers of model one (for example: the intermediate layer has $16+16 = 32$ units).

○ Comparing the models

- Identify optimal epochs based on the validation plots for both models and explain your rationale.
- Discuss overfitting for both models.
- Discuss which model is better in your opinion .

6. Scaling up: develop a model that overfits (20%)

- Explain how you conclude that the model overfits.

7. Regularising your model and tuning your hyperparameters using the each of these below methods (20%).

- Add dropout.

- Try different architectures: add or remove layers.
- Add L1 and/or L2 regularisation.
- Try a combination of at least two methods.

8. Final Model & Test Evaluation (10%)

- Choose the best model, train the model on the train and the validation part of the data and evaluate it one last time on the test set.

Instructions

- Work exclusively in a Jupyter Notebook.
- You may only use DLWP Part 1 layers (Chapters 1–4); i.e., restrict your models to the TensorFlow Sequential API with Dense and Dropout layers.
- Your notebook should read as a report, not just a sequence of code cells. Use markdown headings, subheadings, tables, etc.
- You may reuse code from DLWP, AI and the video notebooks, but you must reference any code that is not your own.

How this coursework will be graded

Your coursework will be assessed based on the technical quality, clarity of explanation, and depth of your discussions when required. Marks will reflect how effectively you apply the universal deep learning workflow to your chosen dataset, including the quality of your baselines, model design, validation process, and interpretation of results. You will also be graded on presentation and communication, including the structure, readability, and reproducibility of your Jupyter Notebook. Proper referencing of reused code and adherence to academic integrity guidelines are mandatory.

Below you can see the state of projects for 3 different categories of marks:

- **50–59:** Basic implementation, correct workflow steps, limited discussion, minimal reflection (readability of the codes and the report).
- **60–69:** Correct models, coherent explanations, reasonable regularisation choices, more expanded discussion, good structure.
- **70+:** Strong analytical depth, insightful interpretation of results, excellent justification of decisions, clear evidence of understanding model behaviour, high-quality reflection

References

Chollet, F. *Deep learning with Python*. (Manning Publications, 2017) first edition. Chapter 1 – 4.

[END OF COURSEWORK ASSIGNMENT]