University of Aberdeen

School of Natural and Computing Sciences

Department of Computing Science

MSc in Artificial Intelligence

2020 – 2021

Assessment Item 2 of 2 Briefing Document – Individually Assessed (no teamwork)

Title: CS5062 – Machine Learning	Note: This assessment accounts for 50% of your total mark of the course.

Learning Outcomes

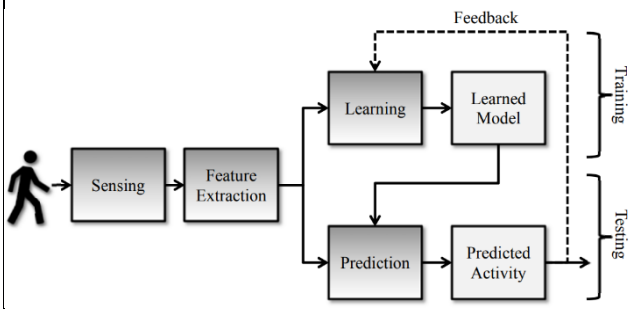
On successful completion of this component a student will have demonstrated competence in the following aspects:

- Be able to use existing machine learning tools, frameworks, and libraries to build solutions for real-world or benchmark problem solving.
- Be able to perform data pre-processing for machine learning.
- Be able to critically examine the strengths and limitations of machine learning algorithms when solving a specific problem.
- Be able to write reports for machine learning solutions.

Information for Plagiarism: The source code and your report may be submitted for plagiarism check (e.g., Turnitin). Please refer to the slides available at MyAberdeen for more information about avoiding plagiarism before you start working on the assessment. Please also read the following information provided by the university: https://www.abdn.ac.uk/sls/online-resources/avoiding-plagiarism/

Application Problem Definition: Human Activity Recognition

The objective of this assessment is to analyse a large dataset concerning human activity recognition. More specifically, the sensing signals, from accelerometer and gyroscope, is used to recognise human activities (e.g. walking, standing, and sitting etc.) and therefore the task is multi-class sequence classification problem. Human Activity Recognition (HAR) is an active research field for understanding human daily activities so as to conduct health management. The dataset can be downloaded from MyAberdeen. It is based on data from a research project that investigates how to detect anomalies and events in pressurised water reactors. The dataset includes six classes (walking, walking upstairs, walking downstairs, sitting, standing, and laying) and a number of features, which will need to be utilised throughout this assessment. The task is to develop a set of classification models for automatically classifying human activities, based on sequential sensing data



(features). No prior knowledge of the domain problem is needed or assumed to fulfil the requirements of this assessment.

Feature information in the dataset include:

- 3-axial linear acceleration (three features)
- 3-axial angular velocity (three features)

Activities: During the data collection, videos were recorded and then the data are manually labelled as one of the six classes (walking, walking upstairs, walking downstairs, sitting, standing, and laying).

Unit of measurement or range of values of each feature are not relevant. However, features can be at different scales and/or measured in different units.

Report Guidance & Requirements

Your report must conform to the below structure and include the required content as outlined in each section. Each subtask has its own marks allocated. You must supply a written report, along with the corresponding code, containing all distinct sections/subtasks that provide a full critical and reflective account of the processes undertaken.

This assessment centres around machine learning and focuses on multi-class sequence classification problem, which is an important problem that machine learning experts are facing in real-world situations. The task requires you to expand and elaborate upon the principles of machine learning on how these techniques can be used in real-world problem – "Human Activity Recognition (HAR)".

Task: Develop learning-based model(s) for sequence classification (50/50)

The problem we aim at tackling has been clearly described and defined earlier. This task includes a number of subtasks, each of which bears its own marks.

Subtasks:

1. Develop learning-based model(s) to classify the sequential data provided in the dataset. The model(s) can be obtained by using simple RNN, LSTM, bi-direction recurrent network, CNN, and reinforcement learning. The settings of implementing model(s) can be chosen by yourself, such as the number of layers, activation functions, and optimisers, etc. However, different settings may lead to different performance. You should provide a comprehensive explanation on how to implement the model(s) including the steps of importing data, processing data, and building model(s) (**20 marks**)
2. To inspect the intermediate results of the training process, you need to show training loss and training accuracy. The confusion matrix of each model, based on the predictions of your developed model(s) and corresponding labels in the provided dataset, must be plotted as well. Use the following three metrics to report the model's performance, i.e. Precision/Recall, Accuracy and Area under the curve (AUROC). When reporting performance, please only use the test set to evaluate the performance (**15 marks**)
3. Justification and evaluation: you are required to analyse, comment, and elaborate on your findings of the experimental results. Ideally, you can provide some deep explanation on why the experimental results are obtained. For example, the different parameter settings of

networks (e.g. layers, activation functions, optimisers) may lead to different results. You can have a comprehensive discussion about it. This is only an example and you can find other points to have a deep exploration. (**15 marks**)

Useful Information

- Please describe and justify each step that is needed to reproduce your results by using code-snippets, screenshots and plots. When using screenshots or plots generated in Python please make sure they are clearly readable
- As the provided dataset is a subset of a real-life problem, the performance expected might not be as high as you might think. Therefore, as long as your implementations and justifications are correct the performance achieved will not have any effect on your marks whatsoever
- If you use open source code, you must point out where it was obtained from (even if the sources are online tutorials or blogs) and detail any modifications you have made to it in your tasks. You should mention this in both your code and report. *Failure to do so will result in zero marks being awarded on related (sub)tasks*

Marking Criteria

- Quality of the report, including structure, clarity, and brevity
- Reproducibility. How easy is it for another MSc AI student to repeat your work based on your report and code?
- Quality of your experiments, including design and result presentation (use of figures and tables for better reporting)
- Configured to complete the task and the parameter tuning process (if needed)
- In-depth analysis of the results generated, including critical evaluation, insights into data, and significant conclusions
- Quality of the source code, including the documentation of the code

Submission Instructions

You should submit a PDF version of your report along with your code via MyAberdeen by 23:59 on Sunday 29th November 2020. The name of the PDF file should have the form "CS5062_Assessment2_< your Surname>_<your first name>_<Your Student ID>". For instance, "CS5062_Assessment2_Smith_John_4568985.pdf", where 4568985 is your student ID.

You should submit your code and any associated files along with your report. If you have additional files that you wish to include then these should also be included in your submission.

If you have more than two files to submit, please compress all your files into one "zip" file (other format of compression files will not be accepted). Please try to make your submission files less than 10MB as you may have issues when uploading large files to MyAberdeen.

Any questions pertaining to any aspects of this assessment, please address them to the course coordinators Dewei Yi (dewei.yi@abdn.ac.uk.) and Mingjun Zhong (mingjun.zhong@abdn.ac.uk).