University of Lincoln Assessment Framework CMP9137M Assessment Item 1 - Briefing 2021-2022

Module Code & Title: CMP9137M Advanced Machine Learning

Contribution to Final Module Mark: 50%

Description of Assessment Task and Purpose:
This assessment comprises two tasks on machine learning as explained in section "format for assessment" (below). Your submission should include a concise report of maximum 6 pages using font sizes 11 and excluding cover sheet, references and appendixes. The report should describe your proposed solutions on both tasks, it should include a set of relevant references from the literature, and it should include the source code of your solutions as an appendix.

Learning Outcomes Assessed:
- [L01] Critically appraise a range of machine learning techniques, identifying their strengths and weaknesses, and electing appropriate methods to serve particular roles.
- [L02] Analyse the "state of the art" in machine learning, including an understanding of current applications.
- [L03] Use machine learning software to solve complex real-world problems in an application domain of interest.

Knowledge & Skills Assessed:
- *Subject Specific Knowledge, Skills and Understanding*: e.g. Literature searching, referencing, project planning, techniques and skills subject-specific knowledge.
- *Professional Graduate Skills*: e.g. independence and personal responsibility, adaptability, verbal communication, written communication, creativity, critical thinking, IT skills, problem solving, effective time management, working under pressure to meet deadlines.
- *Emotional intelligence*: e.g. self-awareness, self-management, motivation, resilience, self-confidence.

Assessment Submission Instructions:
The deadline for submitting this work is included in the School Submission dates on Blackboard.

You must make a single electronic submission with your report in PDF format (only), which must be uploaded to the assignment submission area on Blackboard for this component.

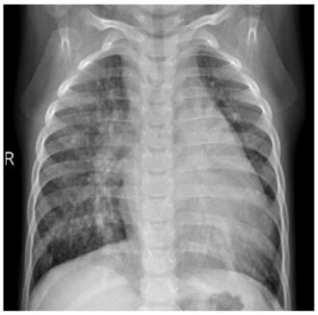
DO NOT include this briefing document with your submission.

Date for Return of Feedback:
See the "Hand in Dates" spreadsheet on Blackboard.

Format for Assessment:

TASK 1:

You are required to use Machine Learning techniques to tackle the problem of "**Detection of Pneumonia in Medical Images**". According to NHS records (https://aqua.nhs.uk/wp-content/uploads/2020/11/Respiratory-thematic-report-revised-20201130.pdf), there were 272 thousand hospitalisations of Pneumonia in England in 2019. In the USA, it is one of the top 10 causes of death (https://www.medicalnewstoday.com/articles/282929#heart-disease). Diagnosing Pneumonia requires careful analyses of chest radiographs by highly trained specialists exposed to large amounts of images every day. Solutions to automate early diagnoses would help in diagnosing such a disease. This task consists of creating image classifiers to predict whether there is pneumonia (see image on the right) or not (see image on the left) in an input image.



The dataset used in this task is from the following Kaggle competition:

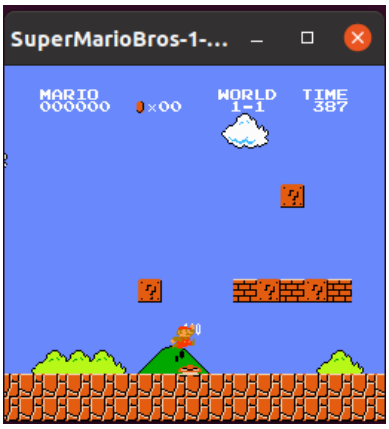
https://www.kaggle.com/c/rsna-pneumonia-detection-challenge

You are expected to explore a range of machine learning classifiers, inspired by the various models and categories explored within the module and beyond (i.e. from reading and literature). At least two of the deep learning classifiers discussed in the lectures and/or workshops should be included as baselines. In addition, at least one of your proposed classifiers should attempt to go beyond the module in terms of architectural, approach, and/or algorithmic details.

You will then investigate their performance, compare and critique them to justify your recommended classifier(s). This should include metrics such as TP/FP rates, Precision-Recall, F-measure, and any other relevant metrics. In this assignment you are free to train any classifier, to do any pre-processing of the data, and to implement your own algorithm(s) instead of only using libraries. While you are encouraged to make your own implementations, you can use libraries (such as Tensorflow or Pytorch) to train your your deep neural networks. But you should clearly mention your resources, acknowledge appropriately, and compare between classifiers and their results in your report.

TASK 2:

You are required to use Machine Learning to tackle the problem of "**Game Learning**". Your goal in this task is to train Deep Reinforcement Learning (DRL) agents that receive image-inputs from a game simulator, and that output game actions to play the game autonomously. The following simulator will be used to play the game of SuperMarioBros 1-1-v0: https://github.com/Kautenja/gym-super-mario-bros



You are required to use your knowledge acquired in the module regarding DRL agents, and knowledge acquired from additional recommended readings. This will be useful for investigating the performance of those agents, and for comparing and criticising them so you can recommend your best agent. You are expected to evaluate your agents using metrics sush as Avg. Reward, Avg. Q-Value, Avg. Game Score, Avg. Steps Per Episode, and Training and Test Times.

You are expected to train at least three different agents (in addition to any baseline provided in the module), which can differ in their state representation (CNN, CNN-RNN, CNN-Transformer) and/or different learning algorithms. Once you have decided the agents that you want to report, you should train them with three different seeds and average their results. If you report learning curves, they should be based on those average results instead of using a single seed (run). You are expected to justify your choices in terms of architectures, hyperparameters and algorithms.

In this assignment, you are free to train any DRL agent, in any programming language, to pre-process the data, and to implement your own solutions whenever possible. While you are free to use libraries, you should not use fully available solutions. So please mention your resources used, acknowledge appropriately, and compare between agents in your report.

Feedback Format:
Written and numerical feedback will be provided via Blackboard, and additional feedback can be provided upon request in a meeting or via email.

Additional Information for Completion of Assessment:
This assessment is an individual assessment component. Your work must be presented according to the Lincoln School of Computer Science guidelines for the presentation of assessed written work. Please make sure you have a clear understanding of the grading principles for this component as detailed in the accompanying Criterion Reference Grid.

If you are unsure about any aspect of this assessment component, please seek the advice with a member of the delivery team.

Assessment Support Information:
Assessment support will take place at the initial and final lectures/workshops of the semester.

Important Information on Dishonesty & Plagiarism:
University of Lincoln Regulations define plagiarism as 'the passing off of another person's thoughts, ideas, writings or images as one's own...Examples of plagiarism include the unacknowledged use of another person's material whether in original or summary form. Plagiarism also includes the copying of another student's work'.

Plagiarism is a serious offence and is treated by the University as a form of academic dishonesty. Students are directed to the University Regulations for details of the procedures and penalties involved.

For further information, see www.plagiarism.org