University of Roehampton London

School of Arts, Humanities and Social Science

Module title and code: **Deep Learning Applications - CMP020L016**

Title of coursework: **Portfolio coursework**

Learning outcomes:	• LO1: Demonstrate a comprehensive understanding of current developments in deep learning. • LO2: Distinguish deep learning models appropriate for supervised, semi-supervised, and unsupervised learning. • LO3: Demonstrate the ability to use deep learning models to define a workflow to solve a given problem and use such models in a high-level programming language.
Assessment weighting	90
Maximum mark	100
Submission details (e.g. submission link)	**Milestone 1:** A 10-minute presentation on selected deep learning applications through Moodle (e.g., PDF, PowerPoint) **Milestone 2:** A copy of your code file on Moodle. Also, provide a link to your Colab notebook which should include the preparation of the data, defining the deep-learning model, and training and fine-tuning your model. **Milestone 3:** PDF documentation and Colab link for model deployment, including testing and website deployment. **Milestone 4:** A comprehensive project documentation (using the provided template), full code with a link to Colab, and a YouTube video demonstrating the practical aspects of your project.
Word limit (if applicable)	10 pages Maximum
Date set	Open Dataset
Deadline	Milestone 1: 5th March 2024 (verbal feedback in class) Milestone 2: 24th March 2024 (written Feedback) Milestone 3: 7th April 2024 (written feedback) Milestone 4: 15th April 2024 (written feedback)
Feedback and marks	Feedback as specified above, with marking provided after Milestone 4 as detailed in the rubric attached.
Assessment setter's name	Fakhreldin Saeed and Sayed Pouria Talebi

Academic Misconduct:

"Academic integrity and honesty are fundamental to the academic work you produce at the University of Roehampton. You are expected to complete coursework which is your own and which is referenced appropriately. The university has in place measures to detect academic dishonesty in all its forms. If you are found to be cheating or attempting to gain an unfair advantage over other students in any way, this is considered academic misconduct, and you will be penalised accordingly."

Further details about "Student Code of Conduct" and "Disciplinary Regulations" can be found at:

https://www.roehampton.ac.uk/corporate-information/policies/

Assessment introduction:

The objective of this coursework is to provide students with the opportunity to apply deep learning techniques to real-world problems and evaluate their performance. Students will have the freedom to choose the type of problem and the solution they want to implement.

Problem and Solution Selection:

Students are free to choose any **real-world problem** that they think can be solved using deep learning techniques. Some examples of problems that can be tackled include but are not limited to:

- **Time series prediction**: It is a common task in data analysis and forecasting, where the goal is to predict future values of a sequence of data points based on historical observations. Time series data can be found in many fields, including finance, economics, weather, energy consumption, and more.
- **Image and video recognition**: Deep learning models can be trained to recognize objects, people, scenes, and activities in images and videos.
- **Speech recognition**: Deep learning models can be trained to transcribe speech to text, recognize spoken language, and even perform speaker identification.
- **Natural language processing**: Deep learning models can be used to analyse and understand human language, including tasks such as sentiment analysis, machine translation, and text classification.
- **Recommender systems**: Deep learning models can be used to recommend products, movies, music, and more to users based on their preferences and behaviour.
- **Fraud detection**: Deep learning models can be used to identify suspicious patterns in financial transactions and help detect fraud.
- **Healthcare**: Deep learning models can be used to analyse medical images, predict patient outcomes, and aid in drug discovery.
- **Self-driving cars**: Deep learning models can be used to process data from cameras, lidar sensors, and other sources to enable autonomous driving.

Here are some websites to give you an idea of the Deep learning Applications.

- https://builtin.com/artificial-intelligence/deep-learning-applications
- https://www.simplilearn.com/tutorials/deep-learning-tutorial/deep-learning-applications
- https://www.projectpro.io/article/common-applications-of-deep-learning-in-ai/548
- https://www.mygreatlearning.com/blog/deep-learning-applications/
- A Survey of Deep Learning: Platforms, Applications and Emerging Research Trends | IEEE Journals & Magazine | IEEE Xplore

Students are also free to choose **the type of solution (deep learning architecture)** they want to implement. A deep learning architecture refers to the design and configuration of the artificial neural network used for deep learning. There are several types of deep learning architectures, including:

- **Feedforward Neural Networks**: This is the simplest type of deep learning architecture, where data flows in one direction from input layer to output layer, with one or more hidden layers in between. These networks are used for simple tasks such as regression and classification.
- **Recurrent Neural Networks (RNNs):** RNNs are designed to process sequential data, such as time series data or natural language text. They are capable of processing data with variable length and maintaining information about the context and history of the data.
- **Convolutional Neural Networks (CNNs):** CNNs are designed for image recognition and processing tasks. They are particularly effective for analysing spatial data, such as images and videos, by learning local features and patterns.
- **Deep Belief Networks (DBNs):** DBNs are a type of generative deep learning architecture used for unsupervised learning. They can learn complex data distributions and generate new data samples that are similar to the training data.
- **Generative Adversarial Networks (GANs):** GANs are a type of deep learning architecture that involves two neural networks, a generator and a discriminator, that compete with each other. The generator creates synthetic data, while the discriminator evaluates the authenticity of the data.
- **Autoencoders**: Autoencoders are a type of deep learning architecture used for unsupervised learning. They learn to reconstruct the input data by compressing it into a lower-dimensional representation, also known as an encoding, and then decompressing it back to its original form.

These are just a few examples of deep learning architectures. The choice of architecture depends on the type of problem being solved and the type of data being processed. Each architecture has its own strengths and weaknesses and combining multiple architectures can lead to even more powerful deep learning models.

Report/Scientific Paper:

The report should include the following sections:

- **Introduction**: This section should provide an overview of the problem and the solution.
- **Background**: This section should provide general information about the topic.
- **Literature Review:** This section should review the existing literature relevant to the problem and the solution.
- **Methodology**: This section should describe the methodology used to solve the problem, including the type of deep learning model used, the dataset used, the pre-processing and augmentation techniques used, and the training and evaluation processes.
- **Results:** This section should present the results of the evaluation of the solution. This should include the performance metrics used and a discussion of the results.
- **Conclusion:** This section should summarize the main findings and provide recommendations for future work.
- **References:** This section should list all the sources cited in the report.

Instructions for Writing the Report/Scientific Paper:

- The report should be written in a clear and concise manner, with proper grammar and spelling.
- The report should include all relevant information about the problem and the solution, including the methodology used and the results of the evaluation.
- The report should be well-structured, with clear and concise headings and subheadings.
- The report should include proper citations for all sources used, following a recognized citation style, such as the IEEE citation style.
- The report should be written in a technical and scientific style, with proper use of technical terminology.
- The report should be accompanied by appropriate figures and tables to illustrate the results.

Report Template:

- Students should use the IEEE Conference Paper Template (Click Here)

Deliverables (what you will need to submit at Milestone 4):

- Colab/GitHub link with your code and explanations.
- Report (pdf or word document).
- A YouTube link to a 10-15 minute video presentation of your demo.

Additional Information:

- All code should be written in **Python**.
- Use **PyTorch** to build and train your models.
- When utilizing transfer learning, it is possible to use pre-trained models like ImageNet. However, it is important to provide a clear explanation for why you have chosen to use these models.

Marking Scheme: A short a video explaining the assessment criteria can be found at: https://www.youtube.com/watch?v=JrA0Dotq1p8

52-58: Pass work demonstrates:

- acceptable attainment of learning outcomes.
- evidence of some critical evaluation but little originality.
- adequate coverage, and understanding of material largely based on teaching material or core texts.
- some errors or omissions.
- evidence of a basic argument, but insufficiently supported or developed.
- adequate writing, with some problems with organisation.

62-68: Merit work demonstrates:

- convincing attainment of learning outcomes.
- evidence of critical evaluation and development of an independent argument.
- comprehensive up-to-date range of relevant theoretical and empirical material showing wide reading.
- clear understanding of key concepts.
- generally good writing and structure.

72-78: Distinction work in this range demonstrates:

- exemplary attainment of learning outcomes.
- a high level of insight and critical evaluation of the material.
- a comprehensive and up-to-date account of relevant theoretical and empirical material at the forefront of the discipline.
- a thorough understanding and integration of material supporting a cogent argument.
- excellent writing of a high academic standard.

82-88: Distinction work in this range demonstrates:

- attainment beyond the intended learning outcomes.
- an outstanding level of originality and creativity, providing a significant new perspective on the question or topic.
- a clear, elegant and well supported argument, based on the integration and sophisticated critical evaluation of a substantial body of knowledge.
- suitability for publication in high quality journal.

100: An assessment that could not be bettered within the time available.

Assessment Criteria (Rubric):

Criteria	No Submission	Inadequate	Adequate	Good	Very Good	Excellent
Problem and Solution Selection (10%)	No problem or solution presented.	Problem is trivial or solution doesn't utilize deep learning effectively.	Problem is somewhat challenging but solution lacks depth or doesn't address key aspects.	Problem is moderately challenging, and solution leverages deep learning but may need improvement.	Problem is challenging and solution demonstrates thoughtful application of deep learning.	Problem is highly complex and solution exhibits creativity and innovation in using deep learning for a significant impact.
Introduction (10%)	No introduction or irrelevant information.	Introduction is vague or lacks context.	Introduction provides basic context but lacks clarity or organization.	Introduction clearly defines the problem, goal, and application with engaging context.	Introduction is captivating, clearly outlining the project's significance and context.	Introduction provides exceptional context and sets the stage for a compelling study.
Background (5%)	No background information or it's inaccurate/misleading.	Background information is limited or irrelevant.	Background information provides some context but lacks depth or accuracy.	Background information provides a good overview of the relevant field and related concepts.	Background information is comprehensive, accurate, and demonstrates a strong understanding of the field.	Background information is exceptional, insightful, and relevant to the chosen problem and solution.
Literature Review (5%)	No literature review or it's irrelevant/misleading.	Literature review is limited or focuses on irrelevant works.	Literature review lacks depth or analysis of key works.	Literature review includes key references and provides basic analysis, but may miss important details.	Literature review is comprehensive, well-cited, and provides critical analysis of relevant research.	Literature review is exceptional, demonstrating in-depth understanding and critical evaluation of related work's strengths and weaknesses.
Data Acquisition & Exploration (10%)	No data or it's irrelevant/inaccessible.	Data source is unclear or inappropriate.	Data source is appropriate but pre-processing is inadequate.	Data source is appropriate, pre-processing is reasonable, and exploration provides some insights.	Data source is appropriate, pre-processing is thorough, and exploration yields valuable insights.	Data source is exceptional, pre-processing is meticulous, and exploration reveals insightful findings.
Model Development & Training (15%)	No model or it's not deep learning based.	Model selection is inappropriate or explanation is lacking.	Model selection is somewhat relevant but hyperparameter tuning is inadequate.	Model selection is appropriate, hyperparameter tuning is reasonable, and training process is explained.	Model selection is well-justified, hyperparameter tuning is thorough, and training process is explained with insights.	Model selection is exceptional, hyperparameter tuning is insightful, and training process demonstrates advanced techniques.

Fine-tuning & Evaluation (10%)	No evaluation or it's irrelevant/inadequate.	Evaluation is limited or uses inappropriate metrics.	Evaluation uses basic metrics but lacks analysis or justification.	Evaluation uses relevant metrics with some analysis and attempts to address limitations.	Evaluation is comprehensive, uses appropriate metrics, includes insightful analysis, and addresses limitations well.	Evaluation is exceptional, uses advanced metrics, provides deep analysis, and demonstrates mastery of evaluation techniques.
Results (10%)	No results or they're unclear/misinterpreted.	Results are limited or presented without context.	Results are presented but lack clarity or meaningful discussion.	Results are clear, understandable, and accompanied by some discussion of their significance.	Results are presented effectively, discussed thoroughly, and their implications are well-explored.	Results are exceptionally well-presented, discussed with insightful interpretations, and their broader implications are thoughtfully considered.
Quality of Code & Explanations (10%)	No code or it's unusable/unexplained.	Code is poorly written or explanations are inadequate.	Code is functional but could be improved, explanations are basic.	Code is well-written, documented, and explanations are clear.	Code is exceptional, well-organized, documented, and explanations are insightful.	Code demonstrates mastery of the programming language and best practices, and explanations are exceptionally clear and insightful.
Conclusion & Recommendations (5%)	No conclusion or recommendations, or they are vague/unfounded.	Conclusion summarizes findings inadequately and recommendations are limited or missing.	Conclusion summarizes findings somewhat but lacks insight, and recommendations are basic.	Conclusion provides a clear and well-supported summary of findings and offers insightful recommendations for future work.	Conclusion provides a thoughtful and impactful summary of findings, offers well-justified recommendations for future work, and considers broader implications.	Conclusion is exceptional, offering insightful interpretations, proposing impactful recommendations, and considering ethical and societal implications.
Quality of Report & Presentation (10%)	No report or presentation, or they are poorly done.	Report and presentation are poorly organized, lack clarity, and communication is ineffective.	Report and presentation are somewhat organized but clarity and communication are inconsistent.	Report and presentation are well-organized, clear, and communicate effectively.	Report and presentation are exceptional, engaging, and demonstrate a strong understanding of the project and communication skills.	Report and presentation are outstanding, captivating, and demonstrate exceptional communication skills and mastery of content presentation.