RMIT UNIVERSITY

Deep Learning
COSC 2779
Assignment 2

Assessment Type	Group assignment. Submit online via Canvas → Assignments → Assignment 2. Marks awarded for meeting requirements as closely as possible. Clarifications/updates may be made via announcements/relevant discussion forums.
Due Date	Week 11, Friday 09 October 2020, 05:00pm
Marks	50%

1 Overview

In this assignment you will design and create an end-to-end deep learning system for a real-world problem. This assignment is designed for you to apply and practice skills of critical analysis and evaluation to circumstances similar to those found in real-world problems. *This is a group project - maximum two students per group.*
In this assignment you will:

- Design and Create an end-to-end machine learning system.
- Apply multiple algorithms to a real-world machine learning problem.
- Analyse and Evaluate the output of the algorithms.
- Research into extending techniques that are taught in class.
- Provide an ultimate judgement of the final trained model(s) that you would use in a real-world setting.

This assignment has the following deliverables:

1. A report (of no more than 5 pages , plus up to 2 pages for appendices) critically analysing your approach and ultimate judgement.
2. Your Python scripts, Jupyter notebooks, and software used to build your learning system and produce the models and results.
3. An independent evaluation of your model and ultimate judgement.
4. Online *live interview* with the course coordinator.

2 Learning Outcomes

This assessment relates to all of the learning outcomes of the course which are:

- Discuss and critically analyse a variety of neural network architectures; Evaluate and Compare approaches and algorithms on the basis of the nature of the problem/task being addressed.
- Synthesise suitable solutions to address particular machine learning problems based on analysis of the problem and characteristics of the data involved.
- Communicate effectively with a variety of audiences through a range of modes and media, in particular to: interpret abstract theoretical propositions, choose methodologies, justify conclusions and defend professional decisions to both IT and non-IT personnel via technical reports of professional standard and technical presentations.
- Develop skills for further self-directed learning in the general context of neural networks and machine learning; Research, Discuss, and Use new and novel algorithms for solving problems; Adapt experience and knowledge to and from other computer sciences contexts such as artificial intelligence, machine learning, and software design.

3 Assessment details

3.1 Task

Using deep learning in real-world settings involves more than just running a data set through a particular algorithm. In this assignment, you will design, analyse and evaluate a complete machine learning system.

The key aspect of this assignment is the ***design***, ***analysis***, and ***evaluation*** of your methodology, investigation, and results. This assignment focuses on both the accuracy of your model, *and* your understanding of your approach and model.

For this assignment you have a choice of your project. You may select this project from the list in Section 4, or you may negotiate a project with the course co-ordinator. Regardless of the problem you choose, you must conduct the following tasks:

1. Conduct a review to identify the most suitable approaches to solve the problem.
2. Investigate various Deep Learning solutions to the problem.
3. Make an ultimate judgement.
4. Evaluate your ultimate judgement against independent testing data.
5. Produce a report of your design, investigation, evaluation and findings.

4 Suggested Projects

4.1 Stance classification in Tweets

Stance classification is a subcategory of opinion mining, where the task is to automatically determine whether the author of a piece of text is in favour or against a given target. Automatically detecting stance has widespread applications in information retrieval, text summarization, and textual entailment. An example instance of Stance classification is shown below:

- **Tweet**: *"Be kind to the earth beneath your feet."*
- **Target**: Climate Change is a Real Concern
- **Stance**: Favour

Stance detection is related to, but not the same as sentiment analysis. In sentiment analysis, we are interested in whether a piece of text is positive, negative, or neutral based on just the content of the language used. However, the stance of a piece of text is defined with respect to a target topic, and can be independent of whether positive or negative language was used.

This project is to develop a Deep learning model to classify tweets that are about one of five politically-charged targets: "Atheism", "the Feminist Movement", "Climate Change is a Real Concern", "Legalization of Abortion", or "Hillary Clinton". Given the text of a tweet and a target, models must classify the tweet as either FAVOUR or AGAINST, or NEITHER (if the tweet does not express support or opposition to the target topic). The data set, contains a collection of 2,814 training and 1,249 test set tweets. The original dataset is from "Semeval-2016 Task 6: Detecting Stance in Tweets. Saif M. Mohammad et. al. In Proceedings of the International Workshop on Semantic Evaluation (SemEval-16). June 2016."

The data set is available on canvas. This data set can be combined with other data sets that you might obtain from the internet to improve performance.
Licence agreement: The dataset can only be used for the purpose of this assignment. Sharing or distributing this data or using this data for any other commercial or non-commercial purposes is prohibited.

REQUIREMENTS

- Should develop a DL based solution and demonstrate your knowledge on advanced DL techniques when applicable.
- You may use pretrained networks in parts of your solution. However the entire solution should not be a pretrained network. There *should be* significant, clearly identifiable sections of your approach that is trained using the provided data by yourself.
- A thorough investigation should be conducted to check the strengths and weaknesses of your model when applied to real-world data. You *should* use independent test data to conduct this investigation which may be: collected from the internet yourself or tweets made up by you simulating real scenarios.

4.2 Inferring Distance in Images

Inferring Distance (or depth) from images is an important problem in computer vision with many applications including surveillance, autonomous cars, VR/AR, and telepresence. With the current pandemic situation such technology can also be utilized to enforce social distancing etc.

When depth has to be estimated from camera images, stereo vision is a common choice. These methods treat depth estimation as a purely geometrical problem, generally completely ignoring the content of the images. On the other hand, when only a single image is available, it is not possible to use geometry. Instead, algorithms have to rely on pictorial cues: cues that indicate depth within a single image, such as the apparent size of known objects. Pictorial cues require knowledge of the environment, which makes them difficult to program. As a result, pictorial cues have seen relatively little use in computer vision until recently when deep learning became popular.

This project is to develop a Deep learning model based system to estimate the distance from the camera to *multiple-people* in the field of view. A data set collected by a RMIT researcher is made available to you. This dataset contains images and depth ground-truth under limited environmental scenarios with only one person per frame.

The data set is available on canvas. This data set can be combined with other data sets that you might obtain from the internet to improve performance.
Licence agreement: The dataset can only be used for the purpose of this assignment. Sharing or distributing this data or using this data for any other commercial or non-commercial purposes is prohibited.

REQUIREMENTS

- The system should be able to predict depth for *images with multiple people* in the frame. For example if there are two people on a test frame, the system should predict the distance for both of them.
- *A regression framework that can just predict depth of one person in the image will not be considered as adequate.*
- The images in the provided dataset also has information on the bounding box of the person in frame. However this information will NOT be avaialbe at test time.
- You may use pretrained networks in parts of your solution. However the entire solution should not be a pretrained network. There *should be* significant, clearly identifiable sections of your approach that is trained using the provided data by yourself.
- A thorough investigation should be conducted to check the strengths and weaknesses of your model when applied to real-world data. You should use independent test data to conduct this investigation which may be collected from the Internet yourself or captured by you simulating real scenarios.

4.3 Negotiated Project

You may propose and negotiate a project and machine learning problem to investigate, with the course co-ordinator. This project must meet a number of constraints:

- Should be suitable for application of deep learning.
- The project must be of a suitable complexity and challenge that is similar to the suggested projects. As part of the negotiation, the scope and deliverables of the project will be set.
- The data set to be used in the project must be available without restrictions before the start of the negotiation process.
- The proposed project must be independent of previously or concurrently assessed work. You may not conduct a project if you have already been assessed on the work, or are concurrently being assessed on the work.

In general, negotiations will take place via email, during consultation hours, or by appointment. Please note, that the course co-ordinator is not available outside of business hours.

All negotiated projects must be finalised by no later than ***5pm Tuesday Week 9***. This is the absolute deadline. If you wish to conduct a negotiated project, ***begin the negotiation process early***. A negotiated project may be denied *before* the deadline if there is insufficient time for the negotiation process.

5 Submission

You have to submit all the relevant material as listed below via Canvas.

1. **A report** (of no more than 5 pages , plus up to 2 pages for appendices) critically analysing your approach and ultimate judgement. Should be in PDF format.

2. Your **code** (Jupyter notebooks) used to perform your analysis. Should be a ZIP file containing all the support files.

3. (online via MSTeams) A **Live online interview** with the instructor in week 12. A schedule will be released and the time can be further negotiated.

The submission portal on canvas consists of two sub-pages. page one for report submission and the second page for code and other file submission. More information is provided on canvas. Include only source code in a zip file containing your name. We strongly recommend you to attach a README file with instructions on how to run your application. Make sure that your assignment can run only with the code included in your zip file! Include a PDF version of your report.

After the due date, you will have 5 business days to submit your assignment as a late submission. Late submissions will incur a penalty of 10% per day. After these five days, Canvas will be closed and you will lose ALL the assignment marks.

Assessment declaration:
When you submit work electronically, you agree to the assessment declaration - `https://www.rmit.edu.au/students/student-essentials/assessment-and-exams/assessment/assessment-declaration`

6 Teams

The students are given the opportunity to form teams (*maximum of two members*). The teams must be formed before end of week 8 and if students have not formed teams by then the team membership will be decided by the course coordinators. Any issues that result within the team should be resolved within the team if possible; if this is not possible, then this should be brought to the attention of the course coordinators as soon as possible (before end of week 10). Marks are awarded to the individual team members, according to the contributions made towards the project.

Each team should establish a private GitHub repository and is required to use this repository to develop the application. The instructor should be added to this GitHub repository and he/she will use the repository logs to monitor activity and contributions of each individual member of the team.

Each team is also encouraged to use other collaborative tools such as Microsoft Teams.

7 Academic integrity and plagiarism (standard warning)

Academic integrity is about honest presentation of your academic work. It means acknowledging the work of others while developing your own insights, knowledge and ideas. You should take extreme care that you have:

- Acknowledged words, data, diagrams, models, frameworks and/or ideas of others you have quoted (i.e. directly copied), summarised, paraphrased, discussed or mentioned in your assessment through the appropriate referencing methods
- Provided a reference list of the publication details so your reader can locate the source if necessary. This includes material taken from Internet sites. If you do not acknowledge the sources of your material, you may be accused of plagiarism because you have passed off the work and ideas of another person without appropriate referencing, as if they were your own.

RMIT University treats plagiarism as a very serious offence constituting misconduct. Plagiarism covers a variety of inappropriate behaviours, including:

- Failure to properly document a source
- Copyright material from the internet or databases
- Collusion between students

For further information on our policies and procedures, please refer to the following: `https://www.rmit.edu.au/students/student-essentials/rights-and-responsibilities/academic-integrity`.

8 Marking guidelines

A detailed rubric is attached on canvas. In summary:

- Literature Review 20%
- Approach 40%;
- Ultimate Judgment & Analysis 10%;
- Report & Code 10%;
- Live Interview 20%;

Literature review: A through literature review should be conducted to identify the state-of-the-art DL techniques relevant to the problem. A thorough investigation *must* include evidence to justify your proposed methodology.
A good literature review:

- Should follow a logical structure.
- Should **not** just provide a list of related papers. Papers should be discussed in relation to why are they relevant for this problem, what is good about them and what are the limitations.
- Papers should be summarised in your own words. **Directly copying sentences from the reviewed paper is considered as plagiarism and significant penalties will apply**.
- Will discuss literature from peer-reviewed sources. *Wikipedia* or web discussion forums are **not** considered as peer-reviewed sources.

Approach: You are required to use a suitable deep learning based approach to solve the problem. Each element of the approach need to be *justified* using data analysis, performance analysis and/or published work in literature. *This assignment isn't just about your code or model, but the thought process behind your work.* The elements of your approach may include:

- Setting up the evaluation framework
- Selecting CNN architecture, loss function and optimization procedure.
- Hyper-parameter setting and tuning
- Identify problem specific issues/properties and solutions
- Demonstrate your skills on advanced concepts in deep learning.

Ultimate Judgement: You must make an *ultimate judgement* of the "best" model that you would use and recommend in a real-world setting for this problem. It is up to you to determine the criteria by which you evaluate your model and determine what is means to be "the best model". You need to provide evidence to support your ultimate judgement and discuss limitation of your approach/ultimate model if there are any. You should use independent test-data to conduct this investigation (may not apply to some negotiated projects).

Critical Analysis & Report: Finally, you must compile a report describing and analysing the approach that you have taken to find a suitable model and make your ultimate judgement. Your report ***must*** be no longer that 5 pages , plus an additional 2 pages for appendices. The appendices must only contain references, figure, diagram, or data tables that provide evidence to support the conclusions and statements in your report.

Any over length content, or content outside of these requirements will not be marked. For example, if you report is too long, ONLY the first 5 pages pages of text will be read and marked.

In this report you should describe elements such as:

- Your final selected approach
- Why you selected this approach
- Parameter settings and other approaches you have tried.
- Limitation and improvements that are required for real-world implantation.

This will allow us to understand your rationale. We encourage you to explore this problem and not just focus on maximising a single performance metric. By the end of your report, we should be convinced about your ultimate judgement and that you have considered all reasonable aspects in investigating this problem.

Remember that good analysis provides *factual statements, evidence and justifications for conclusions* that you draw. A statements such as:

> *"I did xyz because I felt that it was good"*

is not analysis. This is an unjustified opinion. Instead, you should aim for statements such as:

> *"I did xyz because it is more efficient. It is more efficient because . . . "*

Live Interview: The instructor will conduct a short interview (20min) with you about the tasks in week 12. This is compulsory and if not completed, will lead to the assignment not being assessed and a mark of 0 given. A schedule will be released and the time can be further negotiated.