

Project Specification

301119 Advanced Machine Learning

Due Date: Friday of Week 12

Aim

This project requires us to construct and analyse a deep learning method using knowledge obtained from the unit and from external sources.

Method

To complete this project:

1. Read through this specification
2. Complete the data analysis required by the specification
3. Write up your analysis using your favourite word processing/typesetting program, making sure that all of the working is shown and that it is presented well.
4. Include the student declaration text on the front page of your report. Please make sure that your name and student number is clearly displayed on the front page.
5. Submit the report as a PDF by the due date.

Due date and Submission

The project report is due in by 11:59 p.m. on the Friday of week 12. The report must be submitted as a PDF file using the assignment submission facilities in the Project section of 301116 in vUWS.

Report Format

Once the required analysis is performed, write up the analysis as a report. Remember that the assessor will only see the report and will be marking the analysis based on your report. Therefore the report should contain a clear and concise description of the procedures carried out, the analysis of results, and any conclusions reached from the analysis.

The required analysis in this specification covers material presented in lectures and labs and also requires further investigation into topics not covered. Students should use the computer software python and the deep learning module pytorch to carry out the majority of the required analysis and then present the results from the analysis in the report.

Marks

This project is worth 30% of your final grade, and so the project will be marked out of 30. The project consists of five parts where each part contributes equally to your final mark.

There are five parts to the project, each will be marked using the following criteria:

Marks	Criteria Satisfied
0	The method does not lead to insightful analysis.
1	The method is flawed, but the analysis would have provided insight had the method been correct.
2	The method provides the reader with some understanding of the data.
3	The correct method leads to partially correct results and analysis.
4	The correct method leads to correct results and analysis.
5	The correct method leads to correct results and analysis, with an insightful aim and conclusion.
6	The correct method leads to correct results and analysis, with an insightful aim and conclusion. Limitations of the analysis are identified and suggestions for further analysis are provided.

If a report is submitted late, the maximum mark it can achieve will be reduced by 10% (3 marks) per day. E.g., if a report is submitted five days late, it can receive at most 15 marks.

Declaration

The following declaration must be included in a clearly visible and readable place on the first page of the report.

By including this statement, we the authors of this work, verify that:

- I hold a copy of this assignment that we can produce if the original is lost or damaged.
- I hereby certify that no part of this assignment/product has been copied from any other student's work or from any other source except where due acknowledgement is made in the assignment.
- No part of this assignment/product has been written/produced for us by another person except where such collaboration has been authorised by the subject lecturer/tutor concerned.
- I am aware that this work may be reproduced and submitted to plagiarism detection software programs for the purpose of detecting possible plagiarism (**which may retain a copy on its database for future plagiarism checking**).
- I hereby certify that we have read and understand what the School of Computing and Mathematics defines as minor and substantial breaches of misconduct as outlined in the learning guide for this unit.

Note: An examiner or lecturer/tutor has the right not to mark this project report if the above declaration has not been added to the cover of the report.

Project Description

The Soundbored company have found that their customers are getting frustrated with their automated telephone system. Their customers say that they waste too much time trying to get the system to recognise spoken numbers (e.g. credit card numbers, street addresses) when speaking into the phone. You have been hired to improve the system. The system currently is a big lookup table that compares the customer statements to many examples (similar to kNN) and achieves 62% accuracy. Your task is to design a Convolutional Network that will achieve greater accuracy. Your project has been split into five tasks listed below. The Soundbored company want you to complete each task and write up a report detailing investigation and results. Any programs must be written in python, and deep learning is to be performed using the pytorch module.

1. Examine the data and write a description of it, including any interesting features that you notice. Load data into a structure that pytorch can use for training and testing. Research data preprocessing methods for CNNs and describe any preprocessing you apply to the data and why it is used.
2. Design and train a CNN using the data. Write a description of your CNN design choices and explain why you chose that design (e.g. number of layer, size of filters). Provide the test accuracy and include evidence of model convergence in the report.
3. Describe the ReLU and Leaky ReLU activation functions. Compute the training accuracy for the CNN where the activation functions are 1) ReLUs and 2) Leaky ReLUs. Perform a hypothesis test to determine if there is a difference in the mean accuracy between the two.
4. Research the use of dropout layers for CNNs and write up how they can help in training a CNN. Add a dropout layer to the CNN and compute the accuracy. Perform a hypothesis test to determine if there is a difference in the mean accuracy with and without a dropout layer.
5. Research the use of batch normalisation for CNNs and write up how they can help in training a CNN. Add batch normalisation to the CNN and compute the accuracy. Perform a hypothesis test to determine if there is a difference in the mean accuracy with and without batch normalisation.

Write up a report containing your code and analysis of the data with each section clearly labelled. Clearly annotate your code and make sure to state any conclusions you make from each piece of analysis. Remember that you are classifying spectrograms of spoken numbers; make sure that the conclusion of each section refers back to this.