
# CS4287 Neural Computing

## Assignment 2: Convolutional Neural Networks (CNNs)

## Autumn Semester AY 23/24

**01/Nov/24 (Week 8) – v1.**

## 1. Objectives

- To compare and contrast two Convolutional Neural Networks (CNNs) for classification based on popular CNN architectures such GoogleLeNet, VGG, Inception, ResNet, Xception, SENet, FCNs, YOLO, and hybrids.
- Explore the impact of varying hyperparameter(s).

## 2. Submission

Submit a **Jupyter notebook** with the code where:

- The book is named CS4287-Assign2-ID1-ID2-ID3
  - Where IDs are the student id numbers of the team members
- The first line in the book is a comment with names and ID numbers of the team members
- The second line in the book should be a comment stating if the code executes to the end without an error.
- The third line in the book should be a comment with a link to the third party source where you opted to reuse an existing implementation.

Every critical line of code MUST be commented by **YOU**- to demonstrate a deep understanding of that code.

**The code cell output actions must show the results of running a code cell.**

I will assume that the code has a critical bug otherwise!

The book must contain text blocks describing:

1. **The Data Set** (**4** marks)
    a. Visualisation of some of the key attributes
    b. Data Correlation and feature engineering if applicable
    c. Any pre-processing such as normalisation applied to the data
2. **The network structureS** and hyperparameters (**6** marks)
    a. Diagram of the two network architectures
    b. Describe weight initialisation, activation function, batch normalisation, regularisation, hyperparameters, transfer learning if leveraged, and more. For example, if opting for ResNet, a few paragraphs on Residual learning is necessary given that this is a distinguishing feature.
3. **The Cost / Loss / Error / Objective function** (**2** marks)
4. **The Optimiser** (**2** marks).
5. **Cross Fold Validation** (**2** marks)
6. **Results** – include plots. It is left to your discretion as to what other metrics to use when presenting the results, and please justify choice (**4** marks).
7. **Evaluation** of the results (**5** marks)
8. **References (pass/fail)**

## 3. Sample Data Repositories

Open Data Repositories

- UC Irvine Machine Learning Data Repository
- Kaggle datasets
- Amazon's AWS datasets

Metaportals that list open data repositories

- Data Portals

- Open Data Monitor
- Quandl

Other

- Wikipedia's listing of data repositories

## 4. Notes and Guidelines

- This assignment **constitutes 25%** of the total marks awarded for this module.
- You will work in a team of 2 or 3.
    - Email me with subject "CS4287 Team" if you are not in a team by CoB Wed. Week 9.
- **Submission deadline is 23:59 Monday 18th November (Week 11).**
- Submission is via the Brightspace Assignment tool.
- You can work in the same teams as you did for Assignment 1.
- You cannot implement the same architecture coded in Assignment 1.
- You may use the same data set as Assignment 1 and refer to those results in the Evaluation section.
- You may build the CNN layer by layer, or opt to use high level functions in frameworks such as Keras or other. See https://keras.io/api/applications/resnet/ for ResNet functions.
- You MAY be required to provide the lecturer with a walk through of your project submission during an interview in Teaching Week 13-15. The project will be awarded an F grade if a walkthrough is not provided when requested to do so.
- Programming language is Python.

## 5. Grading Rubric

| | Beginning [0-9] | Developing [10-13] | Accomplished [14-19] | Exemplary [20-25] |
|---|---|---|---|---|
| **Publication Ready** | Light years away | Skeleton in place | Getting there | Nearly there |
| **Code** | Does not run to completion.<br>Little commentary | Runs to completion<br>Little commentary | Runs to completion<br>Commented but not extensively | Runs to completion<br>Fully commented |
| **Report** | Layout does not follow spec.<br>Messy, lacks cohesion, no depth | Layout partially follows spec.<br>Getting there but discussions frequently lacking in depth | Layout follows spec, depth where necessary | Layout follows spec, depth in all discussions. |
| **Prevention of Plagiarism** | Sources not cited. | Some sources not cited | All sources cited | All sources cited correctly |
| **Data Set** | Linear. Noisy, small, and no indication that team recognise these problems.<br>No visualisations. | Could be linear, noisy and small but efforts made to clean, and data augmentation implemented.<br>Only a few dimensions visualised. | Non-Linear. Representative and any inherent biases identified if any. Data cleaned if required and data augmentation implemented where required. Considerable visualisations. | Rich features. Non-Linear. Representative and any inherent biases identified if any. Data cleaned if required and data augmentation implemented where required. Possibly some feature engineering.<br>Considerable visualisations. |
| **Pre-processing** | Not done but required | Partially done where required | Done fully where required | Done fully where required and explained |
| **Network and hyperparameters** | CNN is overly complex or excessively simple CNN.<br>Little understanding of concepts | CNN is overly complex or excessively simple CNN.<br>Some understanding of core concepts. | CNN model is appropriate. Good understanding of core concepts. | CNN is highly appropriate. Indepth understanding of core concepts communicated. |
| **Loss Function** | Not described | Went with MSE without explaining why | Looked at some alternatives such as Cross Entropy | Excellent discussion on range of alternatives and justified choice. |
| **Optimiser** | Not described | Went with vanilla SGD | Looked at some alternatives such as Adam | Excellent discussion on range of alternatives and justified choice. |
| **Cross Fold Validation** | None | 2-fold | 2-fold | Multiple models, use of development set. |
| **Results** | Not explained, not plotted | Explained and plotted | Explained and plotted. Discusses other metrics but does not calculate values for them. | Explained and plotted. Other metrics calculated such as precision and recall. |

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|---|---|---|---|---|
| **Evaluation** | None | Weak | Checks for overfitting, underfitting, etc. | Checks for overfitting, underfitting, etc. Links results to choice of model and hyperparameters |