Deep Learning – Autumn 2019

Assignment 1 – Building Neural Network Architectures

PART B – Computer Vision Neural Network Building

The Brief:

Given your great work with the proof-of-concept Neural Network in the parking, management has decided that this is indeed a promising avenue for many of their business units. The business would now like you to assist them to build an image detection algorithm for their online fashion arm.

The company runs a large online fashion blogging and image sharing website. They are currently exploring advertising partnerships with a range of companies. Ideally, they want to be able to have targeted offers though banner ads and emails. For example, a user that is uploading lots of images of dresses or a user that is viewing lots of images from other users of dresses should receive a custom banner ad or email for this item.

However, the company currently does not know what sort of images users are uploading or viewing as there has been no requirement for users to label their uploads. Management are very hesitant to enforce this as they feel it will reduce user activity which is the lifeblood of a content website.

They have taken a sample of fashion clothes items and had a team manually label them.

Management is interested in an automated system to detect what type of object is in the image. When analysing the results of your model, they are also quite interested in an analysis of which items your model performs best and worst on and the implications of this.

The Technical brief:

You must train a Convolutional Neural Network model that is able to undertake accurate multiclass object detection on the given dataset. You will firstly benchmark an existing architecture with existing weights, then undertake transfer learning and then finally build your own architecture.

Part 1 – Transfer Learning:

For this component, your tasks are:

1. Train ResNet50 which is available built in to Keras as a benchmark. Use the weights from ImageNet (Freeze all layers).
2. Adding 2 dense layers at the end of the architecture
    a. Note the scores of this new model. Did this assist?
3. Unfreeze the last 2 layers of your model and retrain on your data

a. Note the scores of this new model. Did this assist?

Part 2 – Your Own Model:

You should now build and train your own CNN model. At a minimum, you should have:

- 5 layers
  - Ideally of more than one type (Not just 5 convolution layers….)
- A form of regularisation
- An appropriate cost function.

As in Part AT1A, your code should follow the feed-forward/back-pop paradigm. You will need to decide and discuss all elements of your architecture (Number of layers, size of layers, types of layers, activations, learning rate, optimiser, regularisation methods, other optimisation methods etc)

There will necessarily be a component of hyperparameter tuning. You should note the methodology you use (Grid, Random, Advanced Bayesian/AutoML/Genetic algorithms), the hyperparameters you tune and discuss the results.

Comment on the results. Are they better result than the benchmark network?

Part 3 – Do your best:

Once you have built a basic model of your own it is time to try to do the best to fit the business brief. This may involve trying out more benchmark networks with prebuilt weights, deeper transfer learning or continuing to build out your own network. The choice is yours.

Regardless of the path you choose, remember to document your experiments, decisions and results.

The Data:

You will be given a choice for the dataset to use for this assignment. There will be advantages and disadvantages for your learning path to either set however there will be no effect on the possible marks you can achieve.

Option 1: MNIST Fashion Dataset

Link Here

This is a dataset that we have used previously in class which contains 60,000 images that are 28*28 and greyscale.

For this dataset, you should be able to do a lot of training locally and iterate faster. Therefore, you will be able to try out more architectural and optimisation choices. There are

also many examples available to benchmark against. A quick google will find a number of blog posts on this dataset. Though beware of the temptation to simply take what others have done.

However, the reduction in complexity of the task has the downside that this that it is less 'realistic' and it is likely that your improvements will be more marginal as you are able to achieve very good results with relatively small effort. Additionally, there may be less of an improvement in using deep learning over traditional ML methods.

Option 2: DeepFashion Dataset

Link Here

This dataset contains ~289,000 images across 50 categories. They are much higher quality, larger, colour and are far more realistic. We will only use the categorical prediction task rather than the attributes, texture, fabric, bounding boxes etc.

This task has the advantage of being more realistic and will necessarily involve utilisation of cloud GPU resources which is a useful learning outcome.

However, there are less available resources and benchmarks for this and students of less technical backgrounds may find them spending more time in the infrastructure set up and management rather than model building and optimising.

Some resources and advice will be provided for how to do this (such as through google colab) however it is important to note that **I cannot provide deep assistance** on your specific technical set up, given the myriad of ways this can be done.

The technology:

You will need to use Keras for part 1 and part 2. However, you are free to utilise TensorFlow once you have built your own CNN that meets minimum requirements and for any work done for part 3.

Submission requirements:

- Fully commented and explained notebook with the results of your work. You may find it easier to utilise an alternate editor/IDE for your experimental work, however the final 'data story' and code should be presented in a notebook. The notebook should be able to be run by who you hand over the notebook to.
    - Please ensure you save out your weights/parameters and have a cell that reads in these so the retraining doesn't have to happen to see the results of the network.
- A report following the CRISP-DM style of data projects. See the assessment brief for further details of this requirement. It is important to outline key steps and findings from your methodology.
    - The wordcount should not exceed 1500 words.

Some Handy Resources:

- A basic but thorough guide to keras for cnns that also includes some nice theory
  - (here)
- A very long tutorial and blog post on transfer learning. Of particular interest will be the parts about 'off the shelf' models and how to fine tune them
  - (here)
- Some articles on getting started with google colab (though the main page is the best resource)
  - Youtube playlist from TensorFlow. Video 3 discusses Keras and a great example to work through.
    - (here)
  - How to convert your keras model to a TPU model to train on google colab tpu
    - (here)
- A guide to auto-keras and auto-ml
  - (here)