UNIVERSITY OF BATH

CM500335: Foundations and Frontiers of Machine Learning
Assignment 2: Deep Learning
Frequently Asked Questions

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- At work, we use the TensorFlow/Keras stack for all deep learning-related code. I understand that people have mixed opinions on the topic of TensorFlow 2 vs PyTorch.
  - For the exercises in this unit, we will predominantly use TensorFlow/Keras to provide model answers. However, if you prefer PyTorch, you can complete the same exercise using PyTorch without any issues.
- The report has a maximum word limit of 3,000. However, I have already written 3,300 words and am trying to reduce the length by excluding certain elements such as table contents and titles, figure titles and legends, section titles, and the reference list. Despite my efforts, I am struggling to further reduce the word count without sacrificing important information that demonstrates additional concepts beyond the assigned tasks. Is it acceptable to exceed the limit given these circumstances?
  - Please note that any references you include in your report do not count towards the word count. A margin of +/- 10% is plausible.
- For the first graded assignment covering both writing and presenting the work, were you referring to the critical assessment of the research contributions and applications discussed in the essay? I just want to confirm whether a presentation is expected and ensure that I have understood the requirements correctly.
  - There won't be a PowerPoint presentation (PPT). Instead, the work will be presented as a critical analysis of the research paper.
- For Task 2, can we implement it without Keras/TensorFlow
  - For task 2, you must implement an iterative algorithm to train the single-layer perceptron. You should present a graph showing whether a single-layer perceptron is an effective classification.

The graph should be along the x-axis (iteration) and y-axis (training error). You don't need to use Keras/TensorFlow for this. You should also provide some background on perceptron, e.g., why it was introduced and its importance in deep learning.

- For the first bullet the task requires us to "plot [the filters] on a grid for each layer". If we use the [32,64,128] layer arrangement from Task 4 with 4x4 filters, I believe this works out as no less than 8192 4x4 images for the 3rd layer.

  - For task 4, you need to add three CNN hidden layers with filter sizes 32, 64, and 128. Yes, it is correct, and please add all the necessary information to the report; you can plot graphs like training and testing curves for CNN and a table of performance of other CNN Architectures with [32, 64, 128], [16, 32, 64], etc.

    The choice is really yours here, but the ability to give insight from the obtained results is very important because the exercise asks about including a specified discussion. The deep Dream task is related to the last activity in Week 5. A deep dream can be built by using the model, which is a CNN with 3 hidden layers of filter sizes 32,64, and 128. It will work fine in generating deep dream images at the resolutions provided 28x28.

    The Wikipedia article on DeepDream provides a comprehensive overview of the technique. https://en.wikipedia.org/wiki/DeepDream

    Also, for another practical guide, you can refer to https://www.tensorflow In this tutorial, you will learn how to select specific layers of the InceptionV3 model by their names (e.g., mixed3, mixed5), and then create a "loss" by averaging the activations of each neuron in those layers.

- I wanted to check if we needed to do any parameter tuning on the training parameters for Task 3 (e.g. the batch size, learning rate, and

number of epochs), or if we could use the values that were provided in the Assignment PDF?

  - Some common values used in MLP:
    * batch size: 32.,64,128
    * learning rate (typical values) -> 0.001, 0.01, 0.1 etc.
    * epoch: 100-300

- For task 4.2 the brief says "you need to train four additional CNNs of different depths and widths (again, your choice)". I've done a combination of depths and widths

  - Depending on the computer's resources, these layers take some time. For example, I assume that seven layers would take approximately 100-120 minutes of training time. I suggest you do perhaps 1-3 layers with different combinations. It would be interesting to see whether the deeper model gives you good accuracy. Interesting question -> Is the model prone to overfitting and underfitting issues as we increase the parameters and layers?

    Furthermore, you can plot the model accuracy (x-axis epoch) and (y-axis accuracy)

- In Task 4.2 of Graded Assignment 2, we are asked to train four new CNNs with different depths and widths.Depth can have two meanings in the CNN context - it can mean the depth of a single convolutional layer (i.e. determined by the number of filters in previous layers), or it can mean the number of layers in the network. Am I right in assuming that "depth" means number of layers here, similar to the different numbers of hidden layers for the MLPs in Task 3.2?

  - your interpretation is correct, here, you can consider network depth as the number of hidden layers.

- For Task 5 in Graded Assignment 2 - "Create deep dream images for digit classes 2 and 9". Does this mean using the online Deep Dream generator, or the deep dream image algorithm itself? If the latter, are we to implement the algorithm within the Task 4.1 CNN that we have created? Or use some other pretrained network, such as the GoogLeNet network that was originally used?

  - A Deep Dream built using the CNN that you have created in section 4.1 should be fine

    Please remember that the point of the task is not to create pretty Deep Dream images, but the key is that you explore what your model has learned. Ideally, your Deep Dream images will provide some insight which you can discuss in your report

- Regarding task 6.1, should we aim to find the best parameters for ADAM—including batch size, learning rate, and number of epochs—to achieve the highest accuracy, or is this not necessary?

  - Yes, you could add this as well.

- Can you please give some further clarification on this part of the assignment brief from task 2.2:

  Show what feature w has been learned and discuss why? (Demonstrate w as an image with the same size as inputs).

  - You need to use the resulting weights vector and plot as an image to visualise the feature learned by the perceptron and further need to demonstrate the perceptron model's effectiveness in classifying MNIST digits, for instance, you can show, how well it classifies the pairs of digits (0-1, 2-3, 4-5, 6-7, 8-9) with the accuracies.

- Do we have to provide code implementation for the DeepDream images? Or can we just provide generated images on the report and discuss?

  - The generated images should be sufficient for the report.

- How do we go about submitting the group assignment? Should everyone in the group submit the same files or do we nominate one person to do the submission on their account on behalf of others?

  - Please submit individually all the same files. I have a list of your group members, so there should not be a problem.