Spring 2022

ITNPAI1- Assignment (Compulsory)

Submission due: Tuesday 12th April '22 | Demonstrations: 8th, 11th, 12th April '22

Brief

The assignment is divided into two main tasks: 1) image denoising [50%] and 2) image classification [50%] and involves the development of the algorithms. Your task is to develop the algorithms, preparation of the results and write a combined report. The report for both parts should include

1. a brief introduction to the problem (you may cite a couple of current literature),
2. description of your algorithm,
3. short description of the libraries/function you have used in work,
4. presentation of the results,
5. key findings from the results and associated discussions and
6. conclusions.

You need to demonstrate (**compulsory**) the code and answer related questions on designated days. If you fail to demonstrate (/absent), entire corresponding task(s) will be marked as zero.

The submission should include:

1. A PDF report – with two marked sections
2. A GitHub repository* consisting of two folders (one for each part of the assignment) which should include all Python code in Jupyter Notebook format.

TASK A: Image denoising

Image denoising is a fundamental image processing problem and the basis for a pre-processing step for many advanced computer vision tasks. Your task is

1. To write codes (must be well commented) with the following denoising methods (You can make use of any library you want). **[15]**
    a. Mean filter
    b. Median filter
    c. Wavelet
    d. Deep learning (you are free to choose any pre-trained model you want – but you need to justify why did you select this model). You are not expected to train a new model for this part.

    The input to your code will be original and noisy images. The output will be denoised images.
2. Compare the original and denoised images using two metrics (use any library), such as, **[5]**
    a. Mean Squared Error (MSE) and
    b. Structural SIMilarity (SSIM) index
3. Generate and report results (some sample images and graphs/tables) using the given dataset of 25 original and noisy images. Data acknowledgement: The Berkeley Segmentation Dataset and Benchmark https://www2.eecs.berkeley.edu/Research/Projects/CS/vision/bsds/ **[5]**
4. Write a report as described at the beginning of the brief. **[20]**
5. Demonstrate your code and answer questions. **(COMPULSORY)** **[5]**

Total for TASK A **[50]**

TASK B: Image classification

Image classification is an important task for computer vision applications. Image classification algorithms made advancements from traditional feature-based methods to deep learning-based techniques. Deep learning, particularly the convolutional neural network, has been a success story in the last decade and significantly improved classification accuracy. In this task, you need to build a CNN architecture and optimise it for classification. Following tasks are to be carried out. You can use CSM Jupyter Hub or Google Colab (https://colab.research.google.com/) with the GPU option enabled where suitable. Please use Keras deep learning framework for this part of the assignment.

1. Write code (must be well commented) to build a basis CNN architecture **[15]**

- Load the CIFAR10 small images classification dataset from Keras inbuilt datasets (https://keras.io/api/datasets/cifar10/). Display 10 random images from each of the 10 classes (the images should change in every run).
- For the classification (10 image classes), write Python code to create a basic CNN network of your choice (can be anything from practical 7, LeNet, AlexNet etc.)
- Train and test the network and report the training loss, training accuracy and test accuracy for various epochs.

2. CNN architecture improvements **[10]**

- Improve the architecture by changing the parameters, including but not limited to, learning rate, epochs, size of the convolution filters, use of average pooling or max pooling etc.
- Improve the architecture by introducing more convolutional and corresponding subsampling layers.

For both 1. and 2. your code should accept a single image on the trained network and produce the output class.

3. Write a report as described at the beginning of the brief. **[20]**

4. Demonstrate your code and answer questions. (**compulsory**) **[5]**

Total for PART B **[50]**

Submission

The assignment is worth 100% of the overall grade for ITNPAI1 and is compulsory. It should be in the order of 2,500 words in length (excluding the figures, tables and references). It should be submitted as a PDF and python codes (through Github*) by the deadline mentioned in the beginning, using the ITNPAI1 Assignment page on Canvas. Provide the Github repository link on the report as well as on the comment section of the assignment submission page.

*Instructions for Github

Github is a popular software version control system where one can share codes. An account could be easily obtained by registering (in case you don't have one) on this website: https://github.com/. Once you have the account follow the steps below:

1. Create a **private** repository for this assignment and **share** with the following usernames: ***dbhowmik, sandyCarmichael, Teymoor-Ali***.

2. Regularly commit your code to the repository throughout the assignment period. Do not try to commit in one go at the end. As GitHub is a version control system it is always good to commit (/save) the code in regular intervals so that your code is not lost accidentally.
    a. Regular commit to the repository is necessary and would avoid the questions of 'Academic Misconduct'.
    b. After the submission deadline, we may monitor the commits in the end if there are reasonable doubts about academic misconduct.

Referencing

You must follow the IEEE referencing style details which can be found here: https://ieeeauthorcenter.ieee.org/wp-content/uploads/IEEE-Reference-Guide.pdf

Plagiarism

Work which is submitted for assessment must be your own work. Plagiarism means presenting the work of others as though it were your own. The University takes a very serious view of plagiarism, and the penalties can be severe (ranging from a reduced mark in the assessment, through a fail mark for the module, to expulsion from the University for more serious or repeated offences). Consequently, we check submissions carefully for evidence of plagiarism and pursue those cases we find. Further details about the university policy on academic misconduct can be found here: https://www.stir.ac.uk/media/stirling/services/academic-registry/documents/policy-and-procedure-academic-integrity-misconduct.docx

Late submission

If you cannot meet the assignment hand-in deadline and have good cause, please see Dr Bhowmik to explain your situation and ask for an extension (any extension request will **strictly** be treated according to the university guidelines). Coursework will be accepted up to seven days after the hand-in deadline (or expiry of any agreed extension), but the mark will be lowered by three marks per day or part thereof. After seven days, the work will be deemed a non-submission. Please note that the demonstrations days are fairly fixed and won't be extended unless there is a compelling reason.

Marking and feedback

Marks will be given for each of the two tasks following the University of Stirling's common marking scheme for postgraduate students (https://bit.ly/3vnCuRH). Please note that the marking scheme is not linear, which means achieving higher grades will be increasingly challenging and should meet the expectations of the common marking scheme.

Written feedback will be provided along with the marks on or before Tuesday 3rd May 2022 (within three weeks of the submission deadline). If you are not satisfied with the marks and feedback, you are welcome and encouraged to discuss individually with Dr Bhowmik.

Note

Students should be aware that a copy of their coursework will be retained in Canvas and it may be used anonymously to create an exemplar answer for future students. If you do not wish your coursework to be used for this purpose, please inform the module co-ordinator upon submission using the Comments box.