HOME ASSIGNMENT 01

Deep Learning Foundations

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Due by **4th December, 2024 at 23:59 CET**

Winter Semester 2024/25

Submission Details

- Please submit a single compressed folder (.zip) containing one PDF file with all text responses and one Jupyter Notebook for the coding tasks. Please keep all generated outputs in the Jupyter Notebook so we can grade your submission without rerunning your code.
- For each answer/code snippet, clearly state what task you are referencing. If you are not confident in an answer, try nonetheless, as it is possible to receive partial points.
- You may work in groups of up to three students. Add all team members' names and matriculation numbers at the top of the PDF file **and** your notebook.
- You may use online resources for help, but copying online resources is prohibited. Cite or link any resources you use.
- If you have any questions, create a post in the forum.

1 Convolutional Neural Networks [50 points]

In this task, you will implement image segmentation using a pre-trained CNN model. You will apply it to the Oxford-IIT Pet dataset[1].

The general setup is described in `DL_Assignment_1_Task_1.ipynb`. Feel free to modify the structure as needed and add or remove cells. In either case, you will need to complete these steps:

- Apply at least three transforms for data augmentation.
- Plot four images, their masks, the transformed versions, and the transformed mask.
- Train the CNN to predict the segmentation masks of a given image.
- Visualize the predicted segmentation masks given by the model after training.
- Evaluate the trained model using at least Intersection over Union (IoU), Dice Coefficient, and Pixel Accuracy. We recommend using torchmetrics[2].

2 Recurrent Neural Networks [35 points]

In this task, you will use Recurrent Neural Networks to classify gyroscopic sensor data[3] into one of six human activities (walking/sitting/standing/...). We will provide preprocessed tensor-data for this task. For this task, you are free in your choice of frameworks and libraries as long as you:

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[1] https://www.robots.ox.ac.uk/ vgg/data/pets/

[2] https://torchmetrics.readthedocs.io/en/v0.9.3/

[3] https://drive.google.com/drive/folders/1gRKqjJ6tDj_TmMCpQcjkja9nc8cW21OP?usp=sharing

- Load the data and explore it: At least print the shape and write down the meaning of each dimension.
- Use an RNN with at least one hidden layer.
- Train the RNN for at least 5 epochs on the human activities dataset using a suitable loss function.
- Perform validation after each epoch.
- Compute the final test accuracy for your best model checkpoint (selected via validation performance). A suitable classifier should achieve >80% accuracy on the test set.

3   Pen & Paper Exercises [15 points]

1. Optimizers: Explain in your own words what problems are solved by momentum, learning rate, and learning rate decay.
2. Dropout: Explain in your own words how dropout regularization is used during training.
3. Convolutions: Given a 10x10 image and a stride of 2, what filter size is needed to end with a 5x5 feature map?