



MDS5122 / AIR5011

Assignment 1

Due by: 23:59, Oct 31th, 2025

Instructions:

1. You must submit your assignment on Blackboard. Please upload a PDF file along with your code. The file should be renamed to something like **Adam-123456789-hw1.pdf** (your name, student ID, homework ID). Other parts are compressed into a zip file, and ensure that the PDF file is ranked first during the upload.
2. Your submission must be clearly answered and well-presented to receive full credit. Please detail how you leverage your acquired knowledge to solve the problem and present your proposed solution step by step. Ensure that your solutions are legible and written in English.
3. The programming language is Python, and your code should include necessary comments so that others can easily follow its logic. Copying answers violates academic integrity.
4. Late submissions or instances of plagiarism will not be graded.

A. Image Classification with PyTorch (100 points)

To implement a deep learning application, the easiest approach is to write the code using a modern deep learning framework. The most popular framework in academia is [PyTorch](#). We will write an image classification application on two toy datasets, [CIFAR-10](#) (60,000 images, 32x32) and [tiny-imagenet](#) (110,000 images, 64x64), and experiment with different factors to enhance performance on the val/test dataset. Your code must be written using [PyTorch>=2](#) and [Jupyter Notebooks](#). The notebooks must contain your experimental results and necessary comments.

You may try different network components, optimizers, training schemes, or any other factors you can think of to increase the accuracy. We expect that you build upon a simple network and try to add different factors (at least 5) one by one, experimenting to determine whether the performance increases or not. Please analyze the potential reasons regardless of whether the performance increases or decreases. The accuracy is evaluated on the val/test set and should be as high as possible. You should detail the steps taken to enhance accuracy, including the factors you have considered and evaluated, and explain why you chose to incorporate each factor. Please do not copy the entire code of any famous network for your submission. We expect your network design to be unique and not appear in other places, you may borrow their ideas but do not copy their codes, *e.g.*, do not copy [ResNets](#).

You should include the following parts in your submission to receive the corresponding credits.

Scoring Criteria:

1. Set up the environment and reproduce the accuracy in our code. **(5 points)**
2. What factors did you consider to improve the accuracy? For example, we suggest that you try at least these five factors: (a) residual mechanism, (b) a deeper or wider convolutional neural network, (c) a

better optimizer with improved configurations, (d) more advanced data augmentation methods, and (e) attention layers, among others. We expect high accuracy, if possible. Conducted on the CIFAR-10 dataset. **(25 points)**

3. Conduct similar tasks as in criterion 2, but this time on the tiny-imagenet dataset. You also need to modify the code and prepare the dataset independently. You should use the same train/val split as specified on the website. **(60 points)**
 4. We expect that your submitted code can be successfully run and report decent results; our scoring is based on whether your code and submitted document are clean and well-organized; for example, the paragraphs should be well-organized; the results should be presented in tables and effectively visualized through high-quality figures; and the documents should be written in LaTeX and produced as a PDF file. **(7 points)**
 5. What have you learned through your attempts in this assignment? **(3 points)**
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Appendix

Environment Setup Guide:

0. Assume your computer is running Win10/11. If you are using macOS or Linux, the steps below are still quite similar.
1. Firstly, install [conda](#) on your system. We suggest installing Miniconda because its size is smaller. There are many installation tutorials available on the Internet ([Chinese Tutorials](#), [English Tutorials](#), [Mirror Download](#)), and we assume you have already installed it before proceeding.
2. All commands below are typed into the Command Prompt. To open it, press the “**Windows**” key along with the “**R**” button simultaneously. A small window will pop up in the bottom left corner; type “**cmd**” in the text box and press the “**Enter**” key. After that, a black window will appear where you can type any commands you want and press the “**Enter**” key to execute them.
3. Create the environment with “**conda create python=3.10 -n DL-HW-Py310 -y**” and then activate it with “**conda activate DL-HW-Py310**”
4. Follow [PyTorch's installation guide](#) to install the latest version. For example, on my system, I have CUDA 12.7 installed, so I need to run “**pip3 install torch torchvision --index-url https://download.pytorch.org/whl/cu126**” to install PyTorch. Since CUDA is backward compatible, please install a version that is not newer than the CUDA version you have installed. If you do not have any NVIDIA graphics cards, you can only install the CPU version.
5. Install additional libraries: “**pip3 install matplotlib ipykernel**”. We would expect you to plot some figures using the **matplotlib** library; for example, visualizing the loss curve is a good practice.
6. Install a coding environment. We recommend using [VSCode](#) as the development environment. To run [Jupyter](#) notebook inside VSCode, you may need to follow this [guide](#).
7. After all the steps above are completed, the environment should be perfectly set up.

Tips: For those who do not have computational resources, you can try [Google Colab](#), which is completely free.

If you have any issues, please don't hesitate to contact our TAs.