

Homework 5

AMATH 482/582, Winter 2024

Assigned Feb 28, 2024. Full version due on Mar 14, 2024 at midnight.

LATE REPORTS WILL NOT BE ACCEPTED.

DIRECTIONS, REMINDERS AND POLICIES

Read these instructions carefully:

You are required to upload a PDF report to Canvas along with a zip of your code.

Please see the page limit guidelines in each of the options. Minimum font size 10pts and margins of at least 1-inch on A4 or standard letter size paper.

L^AT_EX(Overleaf is a great option) is recommended to prepare your reports. A template is provided on Canvas in Homework/Files. You are also welcome to use Microsoft Word or any other software that properly typesets mathematical equations and properly allows you to include figures.

This is an individual project and should represent your work. You are welcome to discuss your assignments with your peers and seek their advice but these should be clearly stated in the acknowledgments section of your reports. This also includes any significant help or suggestions from the TAs or any other faculty in the university. You don't need to give all the details of the help you received, just a sentence or two.

Your homework will be graded based on how completely you addressed the problem that you chose to work on, as well as the neatness, usability, and coolness of the submitted document. **The homework is worth 20 points and will be a balance of the overall layout and the specific technical things related to your work.**

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FINAL HOMEWORK ASSIGNMENTS OPTIONS

Pick the **most suitable option** for the final homework for the course:

1. **Computational Notebook:** Write a “Computational Notebook” that summarizes, explains, and investigates the main data analysis approaches and tools, i.e., the theory, algorithms, and implementation, covered during the course. The aim of this assignment is that the notebook will serve you as a reference to data analysis and machine learning methods from now on. Organize the notebook to address four different major topics that we discussed during the course: Transforms and Time-Frequency Analysis, Dimension Reduction, Intro to Machine Learning, Intro to Deep Learning. Along with the theory, be sure to include motivation and **graphical** expositions of the tools applied to examples and various datasets (suitable plots, graphics, tables) and explain them thoroughly.

Completeness of the discussion, **usefulness** of the notebook and **coolness** will be the major criteria for its evaluation. The page limit for this option is **16** pages. The document could include code / pseudo code snippets (not more than 10% of the document) to demonstrate practical aspects but **should not include** full code examples. These can be provided in a separate zip file.

2. **Data Analysis Problem:** Pick a problem and data from your research/interest and study it with the various methods introduced in the course. Submit a **report** on your investigations. In particular, make sure to explain the **data**, the **problem** and the **methods** from the course that you will be applying. Include **graphical** expositions of the findings (suitable plots), tables and explain them thoroughly.

Discuss how these data analyses contributed to the understanding of the problem. In addition, include a discussion on how methods learned in class **contributed** to the solution of the problem and what are the possible **extensions**. Include all the **results**, also the unsuccessful ones and explain why they did not work and what could be a possible **extension** that will make them work better. The page limit for this option is **8** pages.

3. **Published Data Analysis Approach:** Find a data analysis tool or solution of a problem which were published in a journal and is relevant to the material covered in class, examples: **Dynamic Mode Decomposition and Its Variants**, **Visualizing and Understanding Convolutional Networks**, etc. **Describe** (with illustrations and derivations) and **implement** the approach or analysis described in the paper. Reproduce some of the figures in the paper. Suggest possible improvements of the method, further investigation or describe methods that were introduced to extend the method that you covered. The page limit for this option is **8** pages.

4. **Training CNN:** Your goal in this assignment will be to design, train and test a Convolutional Neural Network (CNN) to classify images in FashionMNIST data set and to visualize the feature maps of your network. The page limit for this option is **6** pages as in standard reports. This assignment will have a separate assignment sheet.