DI 504: Foundations of Deep Learning

A Guide to Your Project

During this semester you will develop a project focusing on implementing and improving a deep learning solution for a problem of your choice. Here are some suggestions for choosing your topic:

1. Work on a topic that you know. You are encouraged to work on topics that are related to your thesis.
2. Do a literature review. Reading about your research area can help you find a topic for the project. (Papers with code[1] is a good place to start. Keep in mind for most complex tasks, the best performant model will test and exceed the limits of your hardware.)
3. Check on the public datasets available online. There are many publicly available datasets online. You can check either the helper libraries of PyTorch (like Torchtext[2]) or websites like Kaggle[3] to find datasets.
4. Make sure whether learning deep features is necessary to achieve success. If your problem can be solved with machine learning, using raw features, this will not be a deep learning project. Look for datasets with complex features that need to be distilled down.
5. Lastly, if you have trouble when choosing a topic, feel free to ask your instructor or teaching assistant.

Important Note: You cannot submit a proposal that you have already worked on or submitted for another course's requirement. To be more specific, you can't submit the same proposal you have already submitted for the other deep learning courses.

You are going to do a literature review in the area. You can focus on finding a dataset before or after your literature review, but you should have a rough idea about your problem domain.

Then, you can either implement a paper from scratch and make a marginal improvement on the method or propose a novel project. While considering your project topic, please keep in mind that:

- This is a 1-2 month project that you have to finish by yourself. After finishing the project, you need to submit a detailed project report. You are required to pay attention to the quality of the project report.
- You can use any dataset that is related to the problem you chose. Please keep in mind that it is a short project, and there are limited resources. If you want to work on a large dataset or a model, you can work on it at your own risk.
- During the project, you need to set up a project repository which will contain your code files and notebooks for reporting certain results. You can refer to public code blocks as long as you give proper references. You can also use any version of PyTorch.
- Grading will be based on effort. The paper that you want to implement may have a public code base. In that case, you should implement the paper and propose marginal improvements. Failing to implement such changes or improve the model performance is not important. As long as you prove that you worked on your project, you will get the points for the project.

[1] https://paperswithcode.com/
[2] https://pytorch.org/text/stable/datasets.html
[3] https://www.kaggle.com/datasets

First Part Deliverable: Project Proposal

(Deadline: 08.05.2025)

You are required to submit a project proposal including the project topic description and a brief overview of your plans for implementing the project. A maximum of two pages is sufficient to submit at this phase. You can ask any questions you have in the meantime before submitting your final project proposal. Based on your proposal, we will give you feedback (whether it is accepted or any revision is required). Your project proposal must include:

- An introduction to your problem, dataset, it's scope and depth (attributes, size and how the dataset was collected).
- A literature review on your problem. (Minimum 2, maximum 3 papers.) The review should answer the following questions:
  - Has your dataset or a similar one been used in any paper? What was the preprocessing techniques used? (If any.)
  - What solution approach do the respective authors bring forward? How did they formulate and implement their solutions? (Which model was used, how was it trained etc.)
  - Which metrics were utilized to validate the model performance? Do they compare model performance with a baseline? What is that baseline? And what is the performance level compared to it?
  - Is there a code base available for any of the papers? Are you going to focus on implementing any particular paper from scratch?
- A solution strategy informed by the literature. Outline which steps you plan to follow, and why. If you are going to replicate a paper, also mention what you plan to add as a potential improvement.

Second Part Deliverable: Project Presentation

(Deadline: TBA)

Presentation: You should prepare a presentation about your problem, what has been done in the literature, your efforts in solving the problem, and any preliminary results you have reached. It should take a maximum of 8 minutes. Last two weeks of lectures will be dedicated to your presentations.

Final Deliverables: Final Report and Codebase

(Tentative Deadline: End of Finals)

Project Report: should clearly explain what your project is, your efforts and experiments. The paper report should be a maximum of 7 pages long and should follow the IEEE conference format[4]. Your report should include;

- Introduction: where you define your problem.
- Literature review: A minimum of three papers is expected to be read and referenced properly. It is important to select papers which are peer-reviewed. Check the reference fields properly. Ensure that there are no missing fields (some Arxiv papers have already been published. Use these publication names instead of referencing to Arxiv).

[4]https://www.ieee.org/conferences/publishing/templates.html

- Dataset and its details: You need to give details about your dataset and present a descriptive analysis.
- The method that you are going to use: Ensure to utilize hyperparameter optimization and report the details of the steps. You can use existing solutions such as Optuna[5] or Weights & Biases[6].
- Results you obtained: You need to make a comparison using well-known metrics with a baseline method. You can make an ablation study if it applies to your study.
- Conclusion and Discussion
- References

Codebase and Implementation Details: You are expected to submit either multiple Jupyter notebook files or your entire ready-to-run project zip along with some documentation. Please don't submit pre-trained weights and datasets. If they are large files, give the links to the original download locations (if they are not available just upload it to the cloud).

Your Jupyter notebooks (*.ipynb) should contain cell outputs. Your outputs should highlight how your data looks raw and processed, (if visualisable), network definition, graphs about the training loop (track loss over epochs), performance evaluation metrics etc.

As a best practice, enrich your code with comment lines (or markdown blocks) explaining what each step does. This ensures us and others can look at your code and understand what each part does.

[5]https://optuna.org/
[6] https://wandb.ai/