

DSA5204 Project Instructions

January 18, 2022

1 Preface

Deep learning is a rapidly advancing field, with novel developments coming out every few months. Hence, be it for practical applications or academic research, it is important to learn how to learn from recent work in cutting-edge research. The course project serves this purpose.

2 Instructions

2.1 Project Format

Your project will be based on understanding, reproducing, and extending one recent research paper on deep learning published in a reputable machine learning publication avenue, an example list of which will be provided in Section 3. Your goal is to understand the technical content of the paper, reproduce the main results, and extend some of the results presented in the paper.

Your selected publication may fall into any of these categories

1. Application: a novel method to solve a particular problem, e.g. computer vision, machine translation, medical imaging, scientific discovery, etc.
2. Algorithm Development: a novel algorithm for optimization, regularization, etc that are aimed at solving a class of deep learning problems.
3. Theoretical Analysis: a theoretical analysis on certain aspects of deep learning, including training algorithms, generalization bounds, etc.

Reproduction. For application or algorithm papers, reproducing means coding up your own implementation of the methodologies introduced there. You are expected to explore different datasets and/or architectures than what is presented in the paper to fully evaluate the methodologies. For theoretical papers, reproducing means a complete exposition of the proof of the main result(s). Note that copy-paste of all the proofs is not accepted.

Extension. Extensions may be in the form of improved algorithms or methodologies for applications, alternative proofs of theoretical results, or extension of the results into more general scenarios, different datasets. Note that although you are not expected to do significant extensions in the short amount of time available, some reasonable extension should be attempted.

Graded components:

1. Proposal (10%, as homework 2)
2. Final Presentation (20%)
3. Final Report (30%)

2.2 Detailed Requirements

2.2.1 Proposal

Due: 25 Feb 2022 (Homework 2)

You will write a 2 page proposal on your project, including the following information:

1. The full citation of the publication(s) chosen and the type of project (application, algorithm development or theoretical analysis)
2. An introduction to the problem the paper is aimed at solving
3. What background reading you expect to do to understand the paper
4. What you plan to reproduce and/or extend from the paper
5. How you would evaluate your results
6. The planned division of the work amongst your group members - this will be subject to change, but you should include a provisional plan

2.2.2 Final Presentation

Presentation Date: 9, 16 April 2022 (Last 2 Lectures)

You will prepare a 10 minute presentation to the class on your findings from the project, including the technical content of the research paper and your reproduction/extension results. There will be 5 minutes of questions from the audience.

The presentation should be aimed at an audience who knows the basics of deep learning, but are not experts in the area of the research paper. Hence, clarity of presentation is key! The presentation will be graded on the following items:

1. Content
2. Delivery
3. Q&A and audience engagement (peer reviewed)

A more detailed project presentation instruction document will be uploaded closer to the date.

2.2.3 Final Report

Due: 30 Apr 2022

You will submit a final report of your findings. The report should be a significantly expanded version of your proposal, and should contain the following:

1. detailed background information
2. technical approach in the paper
3. your reproduction of the results (illustrated with figures, tables, where necessary)
4. A section detailing the role of each group member in the entire project, and your evaluation of each member's contributions with respect to their designated work. A template for this will be sent out later.

Additional points to note, if applicable to your project topic

- Did you try the method on different datasets?
- Did you take care of the hyper-parameter choices?
- Include detailed analysis of results and any insights gained
- Include a list of references (>10) at the end of the project report

Your report should be 5-6 pages long, excluding references. Please do not exceed the page limit. You should also submit any code you developed as an attachment in your submission, or as an external repository link.

The project will be graded based on the following:

1. Clarity of written content
2. Literature review, appropriate references
3. Technical depth of understanding
4. The breadth of reproduction and extension work
5. Creativity and style

Marks may be adjusted for individual members if significant deviations from planned work is observed. This is to ensure that all group members participate actively in the project.

2.3 Collaboration

The project will be a collaborative effort:

1. The project will be completed in groups of 5-7 students. Please form your own groups on Luminus, under class groups. Self-enrollment is enabled. If you wish to be assigned a group, please enroll in the “assign me” group. **Please form your groups (or enroll in “assign me”) by the end of week 3.**
2. You only need to submit one project proposal and final report per group. The grade will be shared by the group.
3. The final presentation will be group-based as well. Each group will prepare one presentation. All members are encouraged to participate, but you may also decide amongst your group members if you prefer some representative(s) to do the presentation. The grade will be shared by the group, barring any modulations as described above.

3 Research Paper Sources

You may select any papers on deep learning accepted for publication at a reputable machine learning conference or journal, such as (but not limited to)

- International Conference on Machine Learning (ICML)
- Neural Information Processing Systems (NeurIPS)
- International Conference on Learning Representations (ICLR)
- Conference on Computer Vision and Pattern Recognition (CVPR)

You may also choose journal papers, e.g. those from Journal of Machine Learning Research (JMLR), IEEE Transactions on Pattern Recognition and Machine Intelligence (TPAMI), Neural Networks, etc. As long as the paper is of good quality, and has sufficient technical depth, it will be fine for this project. This will be checked when you submit the project proposal.

4 Computational Resources

For application and algorithm development projects, you may require GPU computational resources. You may look for the following sources:

- NSCC <https://www.nsc.sg/>
- NUS HPC <https://nusit.nus.edu.sg/hpc/>
- Google colab <https://colab.research.google.com/>