CS5260: Neural Networks and Deep Learning II

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1. Course Description

This course gives a graduate-level introduction to deep learning and in-depth coverage of new and advanced methods in deep neural networks, as well as their underlying theory. It emphasizes approaches with practical relevance and discusses a number of recent applications of deep learning in areas like recommender systems, computer vision, natural language processing and robotics. The methods and platforms for implementation and evaluation of deep learning systems would be discussed. Furthermore, learners will practise employing deep learning to deal with a few applied examples using distributed computing environments. An open research project is a major part of the course.

2. Tentative Schedule

Week 1 (January 15th):
Adversarial Machine Learning

Week 2 (January 22th):
Deep Reinforcement Learning

Week 3 (January 29th):
Generative Adversarial Networks
Tutorial 1: Adversarial Machine Learning

Week 4 (February 5th):
Neural Architecture Search
Tutoria 2: Deep Reinforcement Learning

Week 5 (February 12th):
Public holiday, no class

Week 6 (February 19th):
Mixture of Experts
Tutorial 3: Generative Adversarial Networks

Week 7 (March 5th):
Contrastive Learning/Self-Supervised Learning
Tutorial 4: Neural Architecture Search

Week 8 (March 12th):
Latest on Transformers: New Techniques after BERT
Tutorial 5: Mixture of Experts

Week 9 (March 19th):
Advanced deep learning optimizers and convergence
Tutorial 6: Contrastive Learning/Self-Supervised Learning

Week 10 (March 26th):
Background for distributed deep learning, TPU Pod, and Google's MLPerf results
Tutorial 7: Latest on Transformers: New Techniques after BERT

Week 11 (April 2nd):
Public holiday, no class

Week 12 (April 9th):
Distributed optimization: large-batch training (LARS & LAMB)
Tutorial 8: Advanced deep learning optimizers and convergence

Week 13 (April 16th):
Student presentation (5 minutes per team) or poster session
Tutorial 9: guidance on final project (we may cancel it if the presentations run out of time)

3. Evaluation and Grading

Weekly homework (40%)
Please form a team of 2-4 students for the final project
1. Each team gives a talk or presents a poster (20%)
2. Each team finishes a report (40%)

The workload can be reduced (depending on the feedback from the students)
- Homework requirement and deadline
    - Around **8** assignments (weeks 3, 4, 6, 7, 8, 9, 10, 12). Each assignment will take one or two hours to finish for most students.
    - Every week, TA will give a brief introduction of assignments in the tutorial.
    - The assignments are published by Jupyter notebook, which can be run on google colab. Each assignment will have several tasks, e.g., implementing some key functions/algorithms.

- Finish the tasks according to the instructions. Only change the code in the required snippets and **DO NOT** change others or add new code/text snippets.
- Submission: rename the assignment file as "StudentNumber_your-Name_assignment_1.ipynb". e.g., 'a0100000J_Wang-Wenjie_assignment_1.ipynb'. And submit it to **Luminus**. We will create a new folder for each assignment.
- In addition to the ".ipynb" file, you may need to submit another ".py" file. More details can be found in the assignments.
- The submission deadline for each assignment is 23:59pm on Friday of the next week.
- Please follow the instructions strictly, otherwise you might be **penalized**.
- If you have any questions on assignments, please contact Wenjie Wang (wangwenjie@u.nus.edu) and Yiyuan Xiong (yiyxio@gmail.com).
- Final project report
  - Send it to yang.you.cs@gmail.com before 1st of May
  - Use NeurIPS format
    - https://nips.cc/Conferences/2020/PaperInformation/StyleFiles
    - The report should have at most 9 pages (contents & references)

4. Module Information
- Class Time: Friday 6:30-8:30pm
- Tutorial Time: Friday 8:30-9:30pm (From 3rd week)
- Location: zoom (due to COVID-19)