CSE 676 A: Deep Learning

Course Syllabus

1 Introduction

Course description. Deep Learning algorithms learn multi-level representations of data, with each level explaining the data in a hierarchical manner. Such algorithms have been effective at uncovering underlying structure in data, e.g., features to discriminate between classes. They have been successful in many artificial intelligence problems including image classification, speech recognition and natural language processing. The course, which will be taught through lectures and projects, will cover the underlying theory, the range of applications to which it has been applied, and learning from very large data sets. The course will cover connectionist architectures commonly associated with deep learning, e.g., **basic neural networks**, **convolutional neural networks**, and **recurrent neural networks**.

Course objective and learning outcomes. This course is to help students understand basic components in deep learning including loss functions, optimization, various neural network architectures, modern deep learning paradigms, and further learn how to use them in practical problems such as emotion recognition from facial expressions, fake news detection, language translation service, audio signal denoising. Some other skills such as mathematical analysis, presentation, report writing, programming, etc.

1.1 Materials & Textbooks (Optional)

- ***Pattern Classification***, *David G. Stork, Peter E. Hart, and Richard O. Duda*

- ***Pattern Recognition and Machine Learning***, *Christopher Bishop*

- ***Attention Is All You Need*** *Ashish Vaswani, Noam Shazeer, Niki Parmar, Jakob Uszkoreit, Llion Jones, Aidan N. Gomez, Lukasz Kaiser, and Illia Polosukhin*

- ***Deep Learning***, *Goodfellow Ian, Yoshua Bengio, and Aaron Courville*

2 Course Outline[1]

- **1/25, 1/30, 2/1, 2/6**

  – Math and Linear Regression

- **2/8, 2/13, 2/15, 2/20**

  – Softmax Regression, MLP and Convex Optimization

- **2/22, 2/27, 2/29, 3/5**

  – Convolutional Neural Networks

- **3/7 (this date is subject to adjustment)**

  – In-person Midterm (Coverage on all previous lectures)

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[1]Subject to change based on class progress and feedback.

- **3/12, 3/14, 3/26, 3/28**
  - Recurrent Neural Networks and Transformer
- **4/2, 4/14, 4/9, 4/11**
  - Continual Learning and Meta-Learning
- **4/16, 4/18, 4/23**
  - Bilevel Optimization and Applications
- **4/25, 4/30, 5/2, 5/7**
  - Project Presentation
- **5/14 at Academ 322**
  - Final exam (Coverage on all lectures after midterm)

Date for exams, deadlines of projects and assignments:

- Midterm exam: 03/12/2024 (this date is subject to adjustment)
- Final exam: 05/14/2024
- Programming assignment: from 3/11 - 3/22; deadline at 11:59pm on 3/22 (this date is subject to adjustment)
- Project report: 05/10/2024 (this date is subject to adjustment)

3 Course Logistics

3.1 Course Information

- **Semester**: Spring 2024
- **Number of credits**: 3 units
- **Location**: Academ 322
- **Course Piazza**: link

3.2 Office Hours

Course Instructor: *Dr Kaiyi Ji*

- **Office**: Davis Hall 338G
- **Research Area**: Optimization for machine learning, Multi-task learning, Continual Learning, federated learning.
- Interested in participating in our research? Reach to us by email.

Course Hours: (01/24/2024 - 05/07/2024)

- Session A
- Time: Tuesday and Thursday 12:30PM - 1:50PM

Office Hours:

- My office hours: 4:00pm - 6:00pm on Friday
- My Office Hour Zoom Link
- TA: Yifan Yang (email:yyang99@buffalo.edu)
- TA office hours: 2-4PM on Friday at Davis hall 301A

3.3 What makes up your grade?[2]

We will have

- **Attendance**: 5 percent (Random Pop Quiz)

- **Programming Assignment**: 20 percent (One)

- **Midterm**: 20 percent
    - Multiple Choices [Only 1 correct answer]
    - Numerical Questions [Only 1 correct answer]

- **Final**: 25 percent
    - Multiple Choices [Only 1 correct answer]
    - Numerical Questions [Only 1 correct answer]

- **Project**[3]: 30 percent
    - Group Project (# of people determined by the final enrollment)
        * Learn to work as a team
    - List of project and detail given after the first week of Course.
    - Present the project in the course. [20-30 minutes]

Note: All deadlines related to projects and assignments will be fixed on day 1 of the course and **there will no extensions**.

3.4 Grading Rubric

Percentage score (S)	Letter Grade
$93 \leq S \leq 100$	A
$88 \leq S < 93$	A -
$83 \leq S < 88$	B +
$78 \leq S < 83$	B
$73 \leq S < 78$	B-
$68 \leq S < 73$	C +
$63 \leq S < 68$	C
$56 \leq S < 63$	D
$0 \leq S < 56$	F

The cutoffs may be changed at the end of the semester only if it helps ALL students.

4 Final Project for MS degrees

If you score a B+ and above for the course, you may use the project as you master project.

5 Academic Integrity

Students are expected to write all summaries and homework independently, based on paper reading, presentation and in-class discussion. Directly paraphrasing others' work or solution is regarded as plagiarism, which will result in an F grade. Any reference (including online resources) used in your presentation must be clearly cited. Academic integrity is required in your learning process. This course follows the departmental and university policies on academic integrity, which can be found at `https://engineering.buffalo.edu/computer-science-engineering/information-for-students/academics/academic-integrity.html`.

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[2]The logistic is subject to change based on the overall pace and the performance of the class.

[3]No extension on the project, which you should work on from the first week of class.

6 Accessibility Resources

If you have any disability and need reasonable accommodations, please contact the Office of Accessibility Resources in 60 Capen Hall, 716- 645-2608 and the instructor during the first week of this course. The office will provide you with accommodation information, whose details be found at: `https://engineering.buffalo.edu/computer-science-engineering/information-for-students/academics/academic-integrity.html`.

7 Counseling Services

You may experience some issues that prevent you from usual study. These might include anxiety, high stress, alcohol/drug issues, health concerns, or unwanted sexual experiences. Counseling, Health Services, and Health Promotion can be helpful here, as listed below.

- Counseling Services:

  - 120 Richmond Quad (North Campus), phone 716-645-2720
  - 202 Michael Hall (South Campus), phone: 716-829-5800

- Health Services: Michael Hall (South Campus), phone: 716- 829-3316

- Health Promotion: 114 Student Union (North Campus), phone: 716- 645-2837

8 Sexual Violence

UB is committed to be against all forms of discrimination and sexual harassment. If you have experienced gender-based violence (intimate partner violence, attempted or completed sexual assault, harassment, coercion, etc.), UB has resources to help. This includes academic accommodations, health and counseling services, housing accommodations, reporting to police, etc. Please contact UB's Title IX Coordinator at 716-645-2266 for more information. For confidential assistance, you may also contact a Crisis Services Campus Advocate at 716-796-4399.