

# Syllabus for CSE 701 SEM: Some Recent Progresses in Machine Learning (Spring 2023)

**Instructor:** Kaiyi Ji, kaiyiji@buffalo.edu, Davis Hall 338G

**Location and time:** Talbrt 103. Every Wednesday 4:00PM - 6:50PM.

**Office hours:** On demand. Email me for appointments.

**Course textbook and material:** No required textbooks. Some suggested references:

- Z. Allen-Zhu, Y. Li, and Z. Song. "A convergence theory for deep learning via over-parameterization," ICML, 2019.
- L. Bottou, F.E Curtis and J. Nocedal. "Optimization methods for large-scale machine learning," Siam Review, 2018.
- I. Goodfellow, Y. Bengio, A. Courville. "Deep learning," MIT press, 2016.

**Course description:** Machine learning (ML) and artificial Intelligence (AI) is transforming society and promoting various innovations in computer vision, language processing, 5G networks, edge computing, autonomous systems, healthcare etc. In this seminar, we will review some recent breakthroughs and progresses in the theoretical foundations, algorithms and applications of modern machine learning. The first part of this topic will include various new optimization algorithms such as adaptive gradient methods, bilevel optimizers, federated optimizers and their applications in ML. The second part will discuss the generalization analysis of training overparameterized models and neural networks. The final part will talk about recent hot topics in modern ML such as meta-learning, continual learning and contrastive learning. All students in this seminar are expected to read, discuss, present and write summaries of selected papers on such topics.

**Course objective:** This course is to help students understand the algorithmic design and theoretical analysis (including optimization theory and statistical theory) in modern machine learning, and further learn how to use them to various applications such as overparameterized models, deep learning, adversarial learning, meta-learning, continual learning, contrastive learning, etc. Some other skills such as presentation, paper summary are also practiced.

**Prerequisites:** Familiar with linear algebra and probability. Basic knowledge of optimization, statistics and machine learning concepts. Students should have taken CSE 474/574 Introduction to Machine Learning or related courses.

**Course requirements:**

- Finish the required reading before each lecture.
- Write a short summary (at most 1 page) of the paper(s) presented in each lecture. It needs to summarize the problem, algorithms, technical contributions and experiments. The summary is due every Monday, 11:59 pm (1 day before the next lecture). No late submission will be accepted.
- Present one of the selected papers throughout the semester. Each presentation should last for 30-50 min and contain 20-40 slides, and should give a brief introduction to the background, motivation, problem, algorithm, theory and experiments. You are encouraged but not mandatory to share the slides before the presentation and a link to your slides will be posted on the course website if you do.

- Each lecture involves at most three presentations. See course schedule!

**Grading Policy:**

- 30% for class participation.
- 35% for short summaries.
- 35% for presentation.

The seminar is graded in S/U. Satisfactory score  $\geq 70\%$  and unsatisfactory score  $< 70\%$ .

**Course Schedule:** Find the latest schedule on the course website.

**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>.

**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: <http://www.buffalo.edu/studentlife/who-we-are/departments/accessibility.html>.

**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

**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.