COMS 6998: Continual Learning and Memory Models

Lectures:	Wednesday 2:10-4:00
Lecture Room:	Uris 333
Instructor:	Richard Zemel
Office hours:	Tuesday 4:00-5:00 CEPSR 619, and by appointment
Teaching Assistants:	Todd Morrill, Tom Zollo

Overview

This is an advanced seminar course that will focus on foundational ideas, recent work, and applications addressing the long-standing aim in machine learnings to develop models that can continuously improve and learn new tasks and abilities while retaining old ones. Students will read, present and discuss research papers as well as obtain experience developing a system in the course project. Evaluation will be based mainly on a project involving original research by the students, as well as presentations and participation in discussions.

Pre-requisites

This course is designed to bring students to the current state of the art, so that ideally, their course projects can make a novel contribution. A previous course in neural networks/deep learning is required, such as COMS 4776 or the equivalent. Another course in relevant machine learning is strongly recommended, such as: COMS 4771 (Machine Learning); STCS 6261 (Foundations of Graphical Models); COMS 4775 (Causal Inference). Familiarity with linear algebra, basic multivariate calculus, the basics of probability, and programming skills is expected.

Course requirements and grading

The grading in the class will be divided up as follows:

Class presentations and participation	35%
Project proposal	10%
Project presentations	15%
Project report and code	40%

Class Format

(1). Paper Discussion: For each class, we will assign two required readings to discuss in class. The discussion of the papers will be led by students, and we will conduct it as a role-playing discussion, where students will sign up to play a role for a given paper. This is inspired by Alec Jacobson and Colin Raffel's Role-Playing paper reading seminars (https://colinraffel.com/blog/role-playing-seminar.html). There will be 2 students per role per paper, which means each student will sign up for a role roughly every other week.

The presenters are not expected to prepare a full-blown presentation, but instead have a small number of slides containing notes and supplemental images. To minimize time spent context switching or dealing with screen sharing/projector dongles, students will contribute slides to a shared Google Slide document for the given paper. Each set of slides must be titled with a role name or emoji and student name to make organization and assigned speaker easy during the class.

Any student who is not presenting in a class must still read the two papers and is required to submit at least two in-depth question or observation about one of the papers-of-the-week. After the presentations of a paper is finished, discussion will be seeded based on points raised in the presentations and the submitted questions and observations.

The marks for class presentations and participation will be based on: clear and succinct presentations; comments beyond the paper; degree of difficulty; participation in class discussion.

The roles for each paper are as follows:

- **Author**. You are among the original authors of the paper. You'll give a short, high-quality conference presentation on the main contributions of the paper. Some paper will be more technical than others. You should focus on high level aspects but also present relevant details. Clear explanations of important technical details will be valuable here.
- **Scientific Reviewer.** The paper has not been published yet and is currently under review at a top conference where you have been assigned as a peer reviewer. Complete a full review of this paper answering all prompts of the official review form of the top venue in this research area, e.g., NeurIPS or ACL. This includes recommending whether to accept or reject the paper. Please maintain a polite and considerate voice when sharing limitations about the work (as if the readers of the reviews might be yourself!) and even better if you can suggest constructive and concrete action items to improve the paper.
- **Archeologist.** This paper was found buried underground in the desert. You are an archeologist who must determine where this paper sits in the context of previous

and subsequent work. Find and report on one older paper cited within the current paper that substantially influenced the current paper and one newer paper that cites this current paper.

- **Researcher.** You are a researcher who is working on a new project in this area. Propose an imaginary follow-up project not just based on the current but only possible due to the existence and success of the current paper.
- **Wild card role.** Besides the four main roles above, we will include one "wild card role". Depending on the type of paper you can choose a role that you'd like to play such as:
  - **Hacker:** You want to replicate the approach described in the paper as faithfully as possible. Are the methods and experimental conditions described in sufficient detail to be replicated? Were usable resources (code, data, etc.) released? If so, spend 30 min. looking through them to see how well documented they are and how easy they will be to use. Are the models open or closed. Is the training data documented, and is the test data available? Can you find some challenging examples for the system, and even possibly make a small modification or extension to it?
  - **Science Communicator/Illustrator.** You are a tech journalist that would like to disseminate the scientific content of the article to a wider audience. You can write a short description of the main technical advances (without hype) and/or propose a visual illustration of the technical approach.
  - **Industry Practitioner.** You work at a company or organization developing an application or product of your choice. Make a convincing pitch for why you should be paid to implement the method in the paper, and discuss at least one positive and negative impact of this application, and any concerns you have about it.

(2). Course Project: There is a final project that you will be working on throughout the semester. You are strongly encouraged to form teams of 2-4 students for the final project.

More information will be made available soon about the project expectations and timelines.