CSC 495 – Hebbian/STDP-Inspired Approach to Mitigate Catastrophic Forgetting

Davidson College
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Instructor

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Student

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Class Meeting Times

TBD

About the Course

Catastrophic forgetting is a critical challenge in the field of deep learning, particularly in the development of continual learning systems, where neural networks lose previously learned information upon acquiring new knowledge. This self-guided course explores the phenomenon of catastrophic forgetting in neural networks and investigates cutting-edge approaches to mitigate its effects. Students will also learn to explore the intersection of neuroscience, machine learning, and cognitive psychology to understand the underlying mechanisms of forgetting and develop innovative solutions.

Throughout the course, students will gain practical skills in implementing and analyzing various techniques, including elastic weight consolidation, synaptic intelligence, and Hebbian/STDP-inspired approaches. By the course's conclusion, students will acquire a deep understanding of the problem of catastrophic forgetting and design and implement a novel algorithm capable of mitigating catastrophic forgetting in a real-world continual learning scenario.

Access Statement

The college welcomes requests for accommodations related to disability and will grant those that are determined to be reasonable and maintain the integrity of a program or curriculum. To make such a request or to begin a conversation about a possible request, please contact the Office of Academic Access and Disability Resources by emailing `AADR@davidson.edu`. It is best to submit accommodation requests within the drop/add period; however, requests can be made at any time in the semester. Please keep in mind that accommodations are not retroactive.

Learning Outcomes

The overall goal of the course is to enable the student to pursue an extended independent research project, with the ultimate goal of publishing the results in a professional venue. The primary learning outcomes in this course are centered around the acquisition of effective research skills. Specifically, by the end of the course, the student will be able to:

- effectively search the relevant computer science literature, and read and understand technical papers at an appropriate level,
- correctly design computational experiments, with a view to answering questions such as "Is algorithm A better than algorithm B for this problem?",
- design and implement algorithms, collect data, determine appropriate visualizations and analyze the results with basic statistical techniques, and
- deliver a presentation for a mixed audience of specialists and non-specialists that summarizes his results in an engaging and effective manner.

Course Expectations and Assessment

- **Time:** The student will have one meeting per week with Dr. Ramanujan. The student will also present weekly at a group meeting. Students enrolled in an independent study course are expected to spend a minimum of twelve hours per week on their project. The student should record their hours worked each day of the semester in a spreadsheet and share this with Dr. Ramanujan. The student is expected to be self-motivated to complete the outlined project and follow the agreed timeline without prompting from the instructor. *The expected time commitment, including meetings, is 12 hours per week. The student will complete all required work for the class by Tuesday, December 17, 2024.*

- **Documentation:** The student is required to document their day-to-day work in a virtual lab notebook. Code must follow good programming practices, including user documentation and the effective use of the git version control system. The student will minimally commit changes to GitHub after each day's work.
- **Final Presentation:** A final presentation in the form of a poster at the Verna Miller Case Symposium is required. The poster presentation should be clear and concise. The student should give themselves plenty of time to prepare and revise their poster and practice their presentation.
- **Code Review:** The student will schedule a Code Review during finals week with Dr. Ramanujan, during which they will step through their codebase, describing changes made and showing documentation created for future users.