Multiagent Aspects of Deep RL – COMP 5801G (x 4900G)

Term Winter 2025

Course Instructor: Zinovi Rabinovich	**Office Location:** Room 5410, Building 13 (Herzberg)
Email: Zinovi.Rabinovich@carleton.ca	**Class Location:** Check Carleton Central
Student Hours: Thursday/14:30-15:30/Office	**Class Time:** TR 13:05-14:25
Prerequisites: (for UGs) COMP 3105 or 3106	**Preclusions:** None
Best ways to contact: in class or email	**Department/Unit:** School of Computer Science

Topics Covered and Learning Outcomes

Deep (Reinforcement) Learning has been successfully applied in a variety of domains, but the presence of multiple learners (potentially with distinct purposes/optimality criteria) engenders critical non-stationarity in the system. We will study a variety of approaches that deal with, acknowledge and exploit this effect: cooperative learning and its federated point of view, learning to communicate, and behaviour/strategy manipulation. The course will have the format of a reading seminar with a mini-project (we'll aim for publication potential).

The course will largely divide into three portions.

First portion is introductory: we will review some basic and up-to-date multi-agent learning algorithms, striking at the issues of cooperative learning, basic learning to communicate, and learning in games.

Second portion is participatory (seminar-style): students of the course will be provided with a choice of recent papers on the above topics and tasked to present them in class. It will be necessary to expand the reading beyond the papers themselves, as the presentation will have to contain the necessary background for the paper. This second portion will allow students to discover research-edge topics, such as emergent coommunication, federated learning, manipulation and machine teaching, and others.

Third portion is applied (project): students will be asked to organise into groups of up-to 3 people, choose among a set of suggested subjects (or introduce one of their own accord, as long as it aligns with the course) and implement it. It is suggested that the graduate students of the course should aim at a publishable result.

The idea behind this course structure is to provide students both with information on recent advances in MultiAgent (Reinforcement) Learning, and foster soft and specific research skills, including (but not limited to) project design, literature review, presentation skills and practical experience in coding and training multi-agent algorithms. Notably, however, the course will not teach coding, but rather give an opportunity to further the skill.

Topics to be Covered:
Exact scheduling will depend on the number of students signed up for the course. However, there will be in any case the following periods:

- Overview and introductory lectures
- First batch of seminar talks
- Project Design Presentations and Defence
- Second batch of seminar talks
- Project Outcome Presentations and Defence

We will also endeavour to invite guest speakers, though it depends on their and time-slot availability.

Week	Topic/content	Reading/Prep for Class
0	RL Basics, Games: Models and Solution Concepts	MARL Book Chapters 2-4
1	Intro, MARL: Basic Games and Foundationals	MARL Book Ch. 1,5,6
2	MARL Foundations, Deep RL	MARL Book Ch. 6,7
3	MARL Foundations, Deep RL	MARL Book Ch. 7, 8
4	MARL Foundations, Deep RL	MARL Book Ch. 9
5	Seminars 1-4	TBD
6	Project Theme Defences	
7-11	Seminars 5-24	TBD
12-13	Project Final Presentations	

Important dates and deadlines can be found here: link, including class suspension for fall, winter breaks, and statutory holidays.

Assessments

Grade Breakdown

Component	Grade Value	Date/Deadline
Participation	15%	Weekly + online
Seminar Presentation	35%	As cooperatively scheduled Weeks 5,7-11
Project Defence Presentations (x2)	15%	Week 6 and Weeks 12-13
Project RnD	35%	Weeks 12-13

Late and Missed Work Policies

Late Work and **Missed Work**
As our projects aim at a paper-level research, their schedule will echo the same process. In particular, all relevant materials will have to be delivered as per schedule without delays. As with real papers, technical problems do not exempt you from timeliness, so if you wait until the last minute and then have issues with your connection or code or your computer, you will still receive a mark of zero.

Consequently, you are advised to:

- periodically upload/commit you progress (e.g. upload your progress at least daily)
- attempt to submit your final submission at least one hour in advance of the due date and time

You will be submitting your project source-code, and it will have to be appropriately documented and packaged.

You are expected to demonstrate good programming practices at all times, as experiment reproducibility is a key feature of modern research.
Nonetheless, following similar practices of the research community publications and presentations, should there be some circumstance beyond your control that prevents you from keeping the deadline, you will be allowed to submit a recording of your presentation (seminar or defence) at no more than 1 week delay.

Long-term accommodation. Approved long-term accommodation, where circumstace has lifted within 2 weeks before the end of the semester, will grant the possibility to submit the missing presentation material by the end of the semester. If the circumstance persists, then only the project RnD will be taken into account. If the project RnD cannot be complete by the end of the semester, there is no recourse but to drop the course.

Learning Materials and other Course/Lab Resources

Students are not required to purchase textbooks or other learning materials for this course.

Learning Materials	Options for Purchasing (Source)	Approximate Costs (Link)
MARL Book by Albrecht et al	MIT Press	Free Download
Exercise Set	Barcelona Summer School 2024	Free Online
Barcelona Summer School Recordings	YouTube	Online
Code Base	MARL Book Official GitHub	Free Online
MARL Code Base	MARL Book Official GitHub	Free Online
Extended Python MARL	UoE Agents Group GitHub	Free Online

SCS Laptop Requirement (only applies to on-campus courses)
Every student that has been enrolled in a 1000-level (i.e., first year) course offered by the School of Computer Science after the 2020/2021 school year is required to have a laptop. This includes COMP1001, COMP1005, and COMP1006. For more information, please visit https://carleton.ca/scs/scs-laptop-requirement/ and then review the requirements at https://carleton.ca/scs/scs-laptop-requirement/laptop-specs/.

Academic Accommodations and Regulations

Carleton is committed to providing academic accessibility for all individuals. You may need special arrangements to meet your academic obligations during the term. The accommodation request processes are outlined on the Academic Accommodations website (https://students.carleton.ca/course-outline/).

Statement on Chat GPT/Generative AI usage

As our understanding of the uses of AI and its relationship to student work and academic integrity continue to evolve, students are required to discuss their use of AI in any circumstance not described here with the course instructor to ensure it supports the learning goals for the course.

In general, you are permitted to use AI tools to assist you in creating presentations and writing code. However, you bear the full responsibility for the outcome. In particular, if you are unable to address a question wrt presentation/paper/task element, *you* will lose marks. If the AI tool "halucinates" a statement (and they do far more frequently than you may expect), you will bear the responsibility for its falsehood and/or lack of support. To slightly paraphrase a quote from

"Harry Potter and the Chamber of Secrets": Never blindly trust anything that can think for itself if you don't know where it keeps its brain ... or how it works.

Statement on Academic Integrity

Students are expected to uphold the values of academic integrity, which include fairness, honesty, trust, and responsibility. Examples of actions that that compromise these values include but are not limited to plagiarism, accessing unauthorized sites for assignments or tests, unauthorized collaboration on assignments or exams, and using artificial intelligence tools such as ChatGPT when your assessment instructions say it is not permitted.

Misconduct in scholarly activity will not be tolerated and will result in consequences as outlined in Carleton University's Academic Integrity Policy (see here). A list of standard sanctions in the Faculty of Science can be found here. Additional details about this process can be found on the Faculty of Science Academic Integrity website. Students are expected to familiarize themselves with and abide by Carleton University's Academic Integrity Policy.

Student Rights and Responsibilities

Students are expected to act responsibly and engage respectfully with other students and members of the Carleton and the broader community. See the 7 Rights and Responsibilities Policy for details regarding the expectations of non-academic behaviour of students. Those who participate with another student in the commission of an infraction of this Policy will also be held liable for their actions.

Student Concerns

- **Undergraduate Academic Advisors**
  The Undergraduate Advisors for the School of Computer Science are available in Room 5302HP; or by email at scs.ug.advisor@cunet.carleton.ca. The undergraduate advisors can assist with information about prerequisites and preclusions, course substitutions/equivalencies, understanding your academic audit and the remaining requirements for graduation. The undergraduate advisors will also refer students to appropriate resources such as the Science Student Success Centre, Learning Support Services and Writing Tutorial Services.

- **Graduate Academic Advisors**
  The Graduate Advisors for the School of Computer Science are available in Room 5302 HP; or by email at grad.scs@carleton.ca. The graduate advisors can assist with understanding your academic audit and the remaining courses required to meet graduation requirements.

- **SCS Computer Laboratory**
  Students taking a COMP course can access the SCS computer labs. The lab schedule and location can be found at: https://carleton.ca/scs/tech-support/computer-laboratories/. All SCS computer lab and technical support information can be found at: https://carleton.ca/scs/tech-support/. Technical support staff may be contacted in-person or virtually, see this page for details: https://carleton.ca/scs/tech-support/contact-it-support/.

- **Other Concerns**
  If a concern arises regarding this course, your first point of contact is me: Email or drop in during student hours and I will do my best to address your concern. If I am unable to address your concern, the next points of contact are (in this order):

1. The Undergraduate Chair of the Department (if applicable)
2. The Departmental Chair or Director
3. Office of the Dean of Science (odscience@carleton.ca)

Note: You can also bring your concerns to Ombuds services.