Georgia Tech Europe

CS4863 Special Topic: Introduction to Research in Machine Learning, Robotics and Vision

Credits	Semester Credit Hours: 3 2 Lecture hours -- 2 Credit hour 3 Lab hour -- 1 Credit hour
Instructor	Prof. Cédric Pradalier, GT-Europe, Adjunct in SoIC Stéphanie Aravecchia, GT-Europe, Adjunct in ECE
Bibliography	Research papers to be updated every semester based on the list of selected research projects.
Assessment	Bibliography report: 20%, Methodology report: 20% Result report: 20% Final abstract: 20% Final presentation: 20%
Learning Objectives:	As part of this class, students will learn about the methodology of conducting a research project on practical use-cases in the field of machine learning, image processing, robotics or computer vision, from the bibliography to the final abstract preparation and conference presentation. The students will select a research project among those proposed by the academic team, which will either be the replication of a research paper, the application of a state-of-the-art methodology to a known problem, or the design of a new solution to a known problem from the state-of-the-art. From this project, the students will start with surveying the state-of-the-art, then designing a methodology to solve the problem (or replicate the results), learning to implement this methodology, and lastly learning how to evaluate and present the results. Finally, the students will prepare a small abstract

summarizing their research, and we will organize a small conference-like session where the students will review each-other's paper and present their work.

Academic integrity: Students are encouraged to discuss the problem sets and readings outside the class. The research topics may be addressed in teams of at most two students.

Suspected cases of honor code violations will be handled through the Office of Student Integrity. If you have a question about collaboration policy, please ask.

Learning accommodations: If needed, we will make classroom accommodations for students with documented disabilities. These accommodations must be arranged in advance and in accordance with the Office of Disability Services (http://disabilityservices.gatech.edu).

Excused absences policy:

http://www.catalog.gatech.edu/rules/4/

Pre-requisites: This is a research class with a strong CS component, hence it assumes a familiarity with programming in python, C or C++, and computers, as well as a reasonable background in math, in particular linear algebra and geometry. Some projects may have some mechanical design or simulation aspects, experience or at least appeal for these topics will be required. Support will always be available for technical issues.

Linear Algebra: most project will require being at ease with manipulating matrices. Some specific projects may require more.

Programming: the projects will probably require a significant amount of programming in C++, Python or Matlab. The students are expected to either know these languages or have the motivation to learn them on the fly. Depending on the research topic selected, there may be more or less skills needed.

Environment: most projects will probably require some Linux knowledge. The students are expected to either know this OS or have the motivation to learn it on the fly.

Weekly organization: Every week will include two 1-hour lecture sessions and one 3-hour group session. The first lecture will discuss the practical methodological tools to conduct the research projects (bibliography research, methodological design), the second lecture will be a concrete implementation in the computer room. The group session is dedicated to team work on the research topic, with a time slot allocated to individual supervision to discuss progress on the research topic with the academic supervisor. PhD candidates from Prof. Pradalier's team will also be involved in the individual supervision. The students are expected to allocate another 3 per week on studying and conducting their individual research topic.

Infrastructure: The research topic will be listed and prepared by Prof. Pradalier's team before the beginning of the semester. To conduct the research projects, a number of High-Performance Computers equipped with GPUs (10x3090, 1x2080, 2x1080, 3xK20c) configured for CUDA, Tensorflow, Pytorch, will be made available to the students. The computer room cluster (29x12 cores will also be accessible). Close to 20 robotic platforms will also be usable for research projects (13 Turtlebots, 1 Clearpath Husky, 1 Clearpath Kingfisher, 1 magnetic crawler, 1 Kinova Jaco2).

Description and Class Schedule:

Week Nr	**Class 1**	**Class 2**	**Item due Sunday evening**
1	Introduction, Description of the research projects	Attribution of the project to students or student pairs.	
2	Fundamentals on how to conduct a research project	Intro to linux	
3	Conducting a bibliography survey	Intro to scholar, arxiv, bibliographic tools	
4	Reporting the state-of-the art	Intro to latex	Bibliography report
5	Design of the research methodology	Working on remote servers SSH + GPU access, GIT	

Week Nr	**Class 1**	**Class 2**	**Item due Sunday evening**
6	Implementation and debugging tools	Compiling & debug, error reporting	
7	Experiment design / review of available metrics	Table data management (CSV, python, pandas, ...)	Methodology Report
8	Visualizing, evaluating and presenting results	Plotting (matplotlib, matlab)	
9	Project: Research implementation	Project: Research implementation	
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10	Project: Research implementation	Project: Research implementation	
11	Project: Research implementation	Project: Research implementation	Result Report
12	Preparing a research paper	Project: Research abstract	Code upload
13	Project: Research abstract	Project: Research abstract	Abstract submission
14	Reviewing articles	Conference scheduling	Article review
15	Review feedback	No-class	Final Presentation
Finals	Class mini-conference		