

Course Syllabus

CP493 – A – Directed Research Project I

Physics and Computer Science Department, Faculty of Science, Waterloo Campus

Fall | 2024 | 3 Hours Lecture | 0.5 Credit

I acknowledge that in Kitchener, Waterloo, Cambridge and Brantford we are on the traditional territory of the Neutral, Anishnaabe, and Haudenosaunee peoples.

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Office Hours: by email

Course Information

Calendar Description:

An in-depth investigation of a computer science subject under faculty supervision, including the submission of a formal report.

Pre-requisites:.

Registration status: Year 4 Honours Computing and Computer Electronics, or Computer Science, and permission of the department..

Text Book:

See Course Tools and Learning Materials

IMPORTANT INFORMATION RE: OPT OUT DEADLINE – Friday, September 20th.

Students have until this point to use the resources at no charge. They will be sent several email communications from the Hawk Shop with clear cut opt out instructions in advance of the opt out deadline. If your course is using both an e-text and courseware, students are opting out of both resources if they choose to opt out

SEPT 25TH – activating permanent license if you did not opt out

on or after this date students who have remained opted in will have to convert the license for their digital resources from temporary to permanent by clicking on the link in their course on MyLS. We send students an email on this date to advise however should a student contact you and suggest they can't access their resources this is typically the fix for this issue.

BILLING

Students will be billed for their DTA resources approximately one month after the start of classes on their LORIS account.

SUPPORT

If you and/or your students are having issues with accessing the content or any other digital textbook access concerns, please email digitaltextaccess@wlu.ca

This email is monitored daily during business hours and you will receive a prompt response. Please note email volumes are substantially higher during the first few weeks of classes so there may be a 24-48 hour turnaround time on your response.

Course Location/Time:

Section	Location	Day&Time
Lecture CP493 – A	TBD	TR 10:30 am - 11:20 am

Course Overview and Approach

This research project explores the use of Yahboom robots to apply machine learning techniques in industrial applications. With their modular design and programmable interface, Yahboom robots are an ideal platform for investigating how robotics can be enhanced through artificial intelligence to automate tasks and improve efficiency. Utilizing ROSMASTER X3, Transbot ROS Robot, and Jetson Nanos, the goal of this project is to test a range of machine learning applications, dedicating many hours per week to research.

The initial focus will be on training machine learning models for real-time object detection and classification using the robots' cameras and sensors. These models will allow the robots to identify objects, an essential skill in industrial settings such as material sorting, quality control, and process monitoring. The robots will use sensor data to make real-time decisions and execute precise actions, simulating tasks commonly found in automated assembly lines.

A key part of the project will involve programming the robots for autonomous navigation. By using reinforcement learning, the robots will be able to navigate through complex environments, avoid obstacles, and perform tasks like item retrieval or autonomous inspections in industrial facilities.

The robots will also perform repetitive tasks such as transporting materials, simulating scenarios where robotics can reduce physical strain on human workers. Another focus will be edge AI computing, where machine learning algorithms are processed directly on the robots, without reliance on external servers. This approach ensures real-time decisionmaking in dynamic industrial environments, while also enhancing data privacy and reducing latency. Edge AI is particularly relevant in time-sensitive operations, where delays could impact performance.

Yahboom robots with machine learning have vast industrial applications. In manufacturing, they can be used for assembling components, sorting materials, and conducting quality inspections, reducing human error and improving production speed. Their ability to navigate autonomously and handle hazardous tasks makes them valuable in warehouses and chemical plants, where safety is a concern.

Additionally, the project will explore collaborative robotics (“cobots”) for human-robot interaction, allowing Yahboom robots to assist workers with repetitive or dangerous tasks. The project will also explore multi-robot interactions, such as replacing pets or coordinating multiple robots in industrial tasks. These robots can increase productivity while ensuring a safer and more efficient working environment.

In conclusion, this project will demonstrate how machine learning and Yahboom robots can revolutionize industrial processes through object detection, autonomous navigation, and automation. By integrating intelligent robotics into industries like manufacturing and logistics, this research will provide insights into the potential of robotics to make industries safer, more efficient, and adaptable to modern challenges.

Student Evaluation

Course Assessment and Marks Distribution:

Course Assessment	Marks
Report Dec 4th, 2024, 11:59 PM (Firm deadline)	60%
Video Presentation – Dec 4th, 2024, 11:59 PM (Firm deadline)	10%
Code files Dec 4th, 2024, 11:59 PM (Firm deadline)	30%

Course Goals and Learning Outcomes

This course's goals and learning outcomes ensure students acquire the theoretical knowledge and practical skills necessary for successful AI, deep learning and data analytics development.

Course Tools and Learning Materials:

1. Text Book: Artificial Intelligence: A Modern Approach (4th Edition). By Stuart Russell and Peter Norvig. Pearson, 2020. ISBN 978-0134610993. Kaggle, project ideas and computing resources <https://www.kaggle.com/>
2. Google Colab, computing resources <https://colab.research.google.com/>
3. Gradio, Build & Share Machine Learning Apps <https://www.gradio.app/>
4. H2O LLM Studio, A framework and no-code GUI designed for fine-tuning state-of-the-art large language models (LLMs) <https://h2o.ai/platform/ai-cloud/make/llm-studio/>
5. AAAI (Association for the Advancement of Artificial Intelligence)
6. IJCAI (International Joint Conference on Artificial Intelligence)
7. Artificial Intelligence, an Elsevier journal
8. Annals of Mathematics and Artificial Intelligence, a Springer journal
9. Machine Learning, a Springer journal
10. Journal of Heuristics, a Springer journal
11. Computational Intelligence, a Wiley journal
12. LNAI (Lecture Notes in Artificial Intelligence), a Springer series
13. Canadian Artificial Intelligence Association Canadian Conference on Artificial Intelligence
14. ACM Special Interest Group on Artificial Intelligence ACM Special Interest Group on Artificial Intelligence
15. Journal of Artificial Intelligence Research

Important information regarding group work submission:

1. **The use of generative AI is not permitted in this course.** Using generative AI to aid in or fully complete your coursework will be considered academic misconduct, and Senate Policy 12.2 Student Code of Conduct: Academic Misconduct will be applied.
2. Group size: maximum of 3-4 people in each group.
3. A group member must submit an Excel file to the Group-ID folder containing the names and students' IDs on behalf of the group. **Failure to do so will result in random group formulation. Once the groups are formed, they cannot be changed.**
4. A group member must verify the submission before uploading it to the MyLS folder. Incorrect submission will be marked **ZERO**. Late submissions will be marked with **ZERO**.
5. All assignment submissions will be on MyLS **only**.
6. All assignment submissions must be typesetted (LaTeX, Word).
7. All assignment submissions **must be by .pdf file attachment only**.
8. Please upload only one .pdf file for the entire assignment.
9. Use the following naming schemes for your .pdf files:
CP422-A1-GroupID.pdf CP422-A2-GroupID.pdf (these are dash characters, not underscores)
10. Your submissions should have a cover page, all pages should be numbered, and on each page, include a header with your GroupID, course code, submission date, and A1/A2
11. Submissions that violate the above requirements will not be accepted/marked.
12. Assignments are marked on correctness and style, including documentation.
13. Group Assignment / Group Project - All group members must collaborate and contribute equally. Group members who do not show individual contributions will be awarded **ZERO** in the final assignment marks. All efforts must be demonstrated over the MyLS Group forum. **This is a MUST, and the Group forum will be reviewed frequently.**

Deferred Exams

Deferred final examinations may be granted in limited circumstances and for legitimate, documentable reasons only. All appeals for deferred exams must be directed to **the petitions committee in the faculty in which the course is offered rather than the one in which you are registered**. Decisions about deferred final exams **are made by the faculty petitions committee and not by individual course instructors**. Students should be directed to review university and faculty-specific regulations, which can be found here.

For all courses offered through the Department of Physics and Computer Science, **no deferrals of midterm tests / Exam will be granted, except for religious accommodations**. Students requesting accommodations for religious observances **must submit a Student Request for Accommodations for Religious Observances within two weeks of the start of term**.

If a student must miss a midterm test / Exam due to illness, an Illness Self-Declaration online form, must be submitted before the missed midterm test / Exam. **Redistribution of course grades may be considered by the course instructor.**

For cases other than illness and religious accommodations, **if the student is unable** to provide a valid reason for not participating in the midterm test / Exam (to be decided upon by course instructor, in line with university policies), **a grade of zero will be assigned to the midterm test / Exam**. Students are advised to consult the academic calendar for university regulations regarding grade reassessment in the event they are unhappy with an instructor's decision regarding a missed midterm test / Exam.

University and Course Policies (senate approved)

1. **Accessibility:** Contact [Accessible Learning](#) if you require academic accommodations because of a disability. Review the [Registration](#) page for information about intake and documentation requirements. Deadlines: Students are responsible for meeting posted deadlines for registering with Accessible Learning and booking accommodated exams. Accessible Learning cannot guarantee accommodations for requests received after posted deadlines.
2. **Plagiarism:** Wilfrid Laurier University uses software that can check for plagiarism. If requested to do so by course instructors, students are required to submit their written work in electronic form and have it checked for plagiarism. (Approved by Senate May 14, 2002).
3. **Academic Integrity:** Laurier is committed to a culture of integrity within and beyond the classroom. This culture values trustworthiness (i.e., honesty, integrity, reliability), fairness, caring, respect, responsibility and citizenship. We are responsible for upholding this culture in our academic and nonacademic behaviour. The University has a defined policy for academic misconduct. As a Laurier student, you are responsible for familiarizing yourself with this policy and the accompanying penalty guidelines, some of which may appear on your transcript if there is a finding of misconduct. The relevant policy can be found at Laurier's academic integrity website, along with resources to educate and support you in upholding a culture of integrity. Ignorance is not a defence.
4. **Classroom Use of Electronic Devices:** Read WLU policy [9.3 Classroom Use of Electronic Devices](#).
5. **Late Assignment Policy:** late assignments will be marked with **ZERO**.
6. **Final Examinations:** Students are strongly urged not to make any commitments (i.e., vacation) during the examination period. Students must be available for examinations during the examination periods of all the terms for which they register. Refer to the Handbook on Undergraduate Course Management for more information.
7. **Foot Patrol, the Wellness Centre, Student Food Bank:**

Kitchener/Waterloo Resources:

- [Waterloo Student Food Bank](#): All students are eligible to use this service to ensure they're eating healthy when overwhelmed, stressed or financially strained. Anonymously request a package online 24-7. All dietary restrictions accommodated.

- [Waterloo Foot Patrol](#): 519.886.FOOT (3668). A volunteer operated safe-walk program, available Fall and Winter daily during evening hours. Teams of two are assigned to escort students to and from campus by foot or by van.
- [Waterloo Student Wellness Centre](#): 548.889.3239. The Centre supports the physical, emotional, and mental health needs of students. Located on the 2nd floor of the Student Services Building, booked and same-day appointments are available Mondays and Wednesdays from 8:30 am to 7:30 pm, and Tuesdays, Thursdays and Fridays from 8:30 am to 4:15 pm. Contact the Centre at 548.889.3239, wellness@wlu.ca or @LaurierWellness. After hours crisis support available 24/7. Call 1-844-437-3247 (HERE247).

Frequently encountered problems with assignment/project submission:

Problem: In the group assignment / project, some team members did not contribute at all to the group assignments.

Solution: The concerned team member(s) **must** email the instructor **and cc'd ALL team members** about the incident. If the email is sent only to the instructor, the instructor will not consider it as a valid concern. A valid concern must be emailed to the instructor and all team members. The instructor will allow 2-3 days for the members to respond. If there is no response, the members who did not contribute will be awarded **ZERO**, and there will be **NO remedy. NO concerns will be considered if reported shortly (~a week) before or after the submission deadline.**

Problem: I completed my assignment but did not upload my program by the deadline because my Internet connection was down (or because FTP did not work, etc.)

Solution: Do not wait until the last hour to submit the assignment. If you are trying to submit the assignment from home, and your Internet goes down, that is unfortunate, but we cannot do anything about it. Try to submit it 3 hours before the deadline.

Problem: I submitted the wrong file.

Solution: You can always download your submission and verify it contains the correct files. This does not take more than three minutes. You may resubmit as often as you like; the newly submitted file will replace the existing file in MyLS. If you resubmit your assignment after the deadline, it will be considered late and marked **ZERO**.

Problem: My assignment is similar to another group's because we "worked together" on it.

Solution: You are only allowed to work with your group. Do not give your work to another group. Suppose you are charged with plagiarism, and it is your first offense. In that case, your submitted work will receive a mark of **ZERO**, **ten final marks will be deducted from your final mark total, a letter will go into your permanent record, and copies will be sent to the Chair of Physics & Computer Science, and the Dean of Faculty of Science.** It is usually appropriate to ask others—the TA, the instructor, or other students—for hints and debugging help or talk about problem-solving strategies and program structure. The critical point, however, is embodied in the following rules:

Rule 1: You must indicate on your submission any assistance you received. If you use such assistance without giving proper credit, you may be guilty of plagiarism. In addition to providing proper citations—usually as part of the comments at the beginning of the program/solution—it is also essential to ensure that the assistance you receive consists of general advice that does not cross the boundary of having someone else write the actual code/solution. It is fine to discuss ideas and strategies, but you should be careful to write your programs on your own.

Rule 2: You must not share the program code/assignment solution with other students. In particular, you should not ask anyone to give you a copy of their code/assignment solution or, conversely, show your code/assignment solution to another student who asks you for it. Similarly, it would help if you did not discuss your algorithmic strategies/assignment solution to the extent that you and your collaborators turn in precisely the same code. Discuss ideas together, but do the coding/solution on your own.

Rule 3: You must not look at other years' solution sets or program code/ assignment solutions. Beyond being a clear violation of academic integrity, using old solution sets is dangerous. Most assignments change in various ways yearly as we seek to improve them. Each year, however, some student turns in a solution to an assignment from some prior year, even though that assignment has since changed so that the old solution no longer makes sense. Submitting a program that perfectly solves last year's assignment while failing to solve the current one is particularly damaging evidence of an academic integrity violation. Whenever you seek help on an assignment, your goal should be improving your level of understanding and not simply getting your program to work.

Rule 4: You must be prepared to explain any program code/solution assignment you submit at any time. We may perform the following procedure to detect academic violations. **We may use plagiarism detection tools.** We archive all submissions from this semester and previous semesters and cross-compare for unusual resemblance. We do not target specific students, and all assignments are subject to the same scrutiny. Any similarity detected by the tools is then examined more closely by the course's staff, and appropriate actions will be taken. The tools are adept at identifying all variants of improper collaboration, from major to minor.

Rule 5: All submissions are subject to automated plagiarism detection.