

ECE4078 2023 Lab Information

Project: PenguinPi Goes Grocery Shopping

During the lab project, you will develop an intelligent robot ([PenguinPi](#)) that navigates an unknown environment and locates target objects with its camera. You will be working as teams of 3 for the labs (except for M1). Your lab project lead is Dr Leimin Tian (Leimin.Tian@monash.edu).

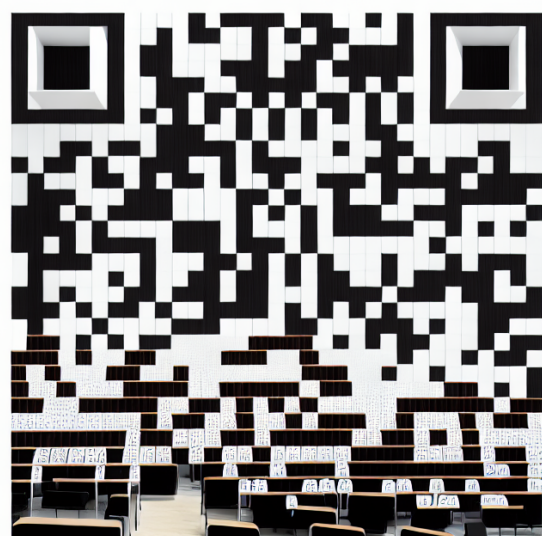
There are 5 lab milestones and a final demo. Each milestone counts as 4% of your total unit grade (total 20%). The final demo counts as 60% of your total unit grade. The remaining 20% are your practicals. There are no final exams.

For each lab milestone (see Lab Timeline below), you will design and implement a key component of the robot. There is no single “right” solution. You are encouraged to design your own approach and explore possible improvements. These components are reused in later sessions and together they enable the robot to perform the final demo, in which the PenguinPi robot navigates a “supermarket” to shop for items on its shopping list.

Materials of every week, such as instructions, helper scripts, and marking guides, will be published before each week’s labs at: https://github.com/tianleimin/ECE4078_Lab_2023. Slack is the main communication channel of this unit, the Slack workspace URL is: <https://ece4078-2023.slack.com/> (you’ll need to join the workspace first with your Monash email). **Lab contents may be updated continuously.** Keep an eye out on the repo and the Slack announcements for the latest info.



Lab Repo



Slack Workspace

(QR arts generated by <https://huggingface.co/spaces/huggingface-projects/QR-code-AI-art-generator>)

Course schedule

- Lab 01: Mon 1pm-4pm in 303, Woodside
- Lab 04: Tue 1pm-4pm in 107, Woodside
- Lab 02: Wed 8am-11am in G15, Woodside
- Lab 05: Thu 8am-11am in 203, Woodside
- Lab 03: Thu 3pm-6pm in G15, Woodside
- Lecture & Practical: Fri 2pm-4pm in G31, LTB

Lab Timeline

Week	Date	Lab Sessions	Milestones	ITP Metrics
1	Jul 24	No lab in Week 1 (Python coding quiz)		Team formation open
2	Jul 31	Set-up, introduction, robot teleoperation		Team formation finalised
3	Aug 7	Calibration, ARUCO markers	M1 (marked individually)	
4	Aug 14	SLAM		
5	Aug 21	SLAM		1st team survey (M2 individual scaling)
6	Aug 28	Computer vision: object recognition & localisation	M2	
7	Sep 4	Computer vision		
8	Sep 11	Navigation & planning	M3	
9	Sep 18	Navigation & planning		2nd team survey (M3&M4 individual scaling)
Mid-semester break (Sep 25 - 29)				
10	Oct 2	Integration and improvement	M4	
11	Oct 9	Trial run of final demo	M5	
12	Oct 16	Final demo	Final demo	Final team survey (M5&final individual scaling)
SWOTVAC (Oct 23 - 27)				

General information

1. **Working as a team:** You will be working as teams of 3 people for the labs except for M1. All the team members will be from the same lab session. The teams will be formed using ITP Metrics with adjustments based on programming experiences and availability. During the semester, there will be three team surveys to help us understand the team dynamics. The results can also be used to scale the scores an individual team member receives in M2-M5 and in the final demo.
2. **Taking the robot home:** From week 3 onwards, each team can take a robot kit home to work on it outside of the lab sessions. Each robot has an ID number printed on the outside of its carrying box and on its frame, which will be used to log robot ownership and replacement / repairs. Make good use of the time and take good care of your robot. Make sure to bring your robot to the lab sessions fully charged and don't leave everything to the last moment. Let your demonstrators know if your robot is broken and a repair can be arranged, but beware of possible delays. You will need to return the robot and its accompanying parts at the end of the semester.
3. **Simulator environment:** A simulator environment (Ubuntu 18 required) is provided to support your development. However, all the lab milestones and the final demo will only be marked on the physical robot in a physical arena during the lab sessions.
4. **Live demo marking (code submission):** Before a lab session where a milestone is to be marked, you are required to submit your implementation (self-contained with a readme) on Moodle. The code submission deadline of your team will be right before your lab session (e.g., for teams attending Monday's lab the deadline will be Monday 1pm). During a lab session where a milestone is to be marked, the teams in that lab session will be called to the marking arena in random order. The team members will then be asked to download their submission from Moodle to the local computer and run the codes downloaded for live demo marking. You are not allowed to make any changes to the downloaded codes. However, your code can take in command line arguments during execution, such as calibration parameters. During each marking slot, only the team performing the milestone is permitted near the arena.
5. **Live demo marking (map submission):** For milestones where you are required to submit a map or other types of outcomes generated during the live marking, you are required to submit these outcomes during your live demo marking session and show to your demonstrator that the required file has been submitted. No changes can be made to the submitted files. Your demonstrator will then mark the submitted files after the lab session. The demonstrators may review the codes you submitted during or after the lab session too. You may be required to explain your implementation to the demonstrators during or after the milestone marking.
6. **Being inside a threshold to get the mark:** If in a milestone your robot is required to reach a certain radius threshold around a target, the whole robot has to be within the radius and not touching the line edge to get the mark.
7. **Learn Python:** Both the lab and the practicals use Python as the programming language. The coding quiz in Week 1 is designed to help gauge your level of programming experiences. If you find these quiz questions difficult, it is strongly recommended that you try to improve your programming skills with available resources online. The lab also makes use of ROS (Robot Operating System) in part of the backends, mainly for the simulator, but you are not required to learn it.

8. **Use Slack to communicate:** Slack is the main channel of communication for this unit. The Slack workspace URL is: <https://ece4078-2023.slack.com/> (join it via this Slack invite link using your Monash email address: https://join.slack.com/t/ece4078-2023/shared_invite/zt-1zau5tvgz-NCDU~VI2BSqsrxgw919_QQ) The teaching team will post weekly course info and updates in the *#announcements* channels. Please ask your questions in the relevant *#qna* channels. *Don't DM the demonstrators*, they won't reply to DM questions as we want to make sure the same information is provided to all. If you want to ask a question anonymously, please submit your question in this anonymous Google form and a slack bot will post on your behalf: <https://forms.gle/tL4mgu2X8FpT9XAP7>
9. **Generative AI tools:** Generative AI and other AI tools, such as ChatGPT or Copilot, are allowed. However, you are required to clearly state in the readme accompanying your submission on which tool you have used, which part of your implementation or design you used it for, and to what extent.
10. **The robot has to do the work:** You are not allowed to guess / brute-force possible ground-truth maps and/or coordinates in your robot's navigation, localisation, or other functions unless explicitly permitted for a specific task. Similarly, you are not allowed to infer object poses by manually measuring the arena, using grid marks on the floor, or taking 3rd person overview photos for the robot. The robot has to rely on its own camera and motion model for all the tasks.
11. **Autonomous means no human intervention:** You are not allowed to interfere with the robot or objects in the marking arena, such as picking up the robot or an object or moving them manually, unless explicitly permitted for a specific task. If a robot is required to perform an autonomous action, such as navigation, you are not allowed to interfere with the robot's execution, such as manually pausing/resuming an action, unless explicitly permitted.
12. **Don't modify the hardware:** You are not allowed to modify the robot's hardware, such as installing additional sensors or replacing the onboard camera, unless it's for purely appearance / aesthetic reasons or for permitted fixes.