UNSW Course Outline

MTRN3100 Robot Design - 2024

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General Course Information

Course Code : MTRN3100
Year : 2024
Term : Term 2
Teaching Period : T2
Is a multi-term course? : No
Faculty : Faculty of Engineering
Academic Unit : School of Mechanical and Manufacturing Engineering
Delivery Mode : In Person
Delivery Format : Standard
Delivery Location : Kensington
Campus : Sydney
Study Level : Undergraduate
Units of Credit : 6

Useful Links

Handbook Class Timetable

Course Details & Outcomes

Course Description

Mobile robotic systems play an increasingly important role in modern societies. MTRN3100 aims at developing skills on how to design and implement the capabilities of a mobile robotic platform. The course begins with an introduction to robot design, locomotion, and sensing methods. Then, primary localisation and kinematics for mobile robots are studied in detail. The

course further delves into different techniques for path planning and computer vision in mobile robotics. Finally, more advanced topics such as Kalman-Filter-based localisation and SLAM are introduced. The course includes both theories covered in the lectures and assessed in the quizzes and practices trained in the labs and assignments. Students will integrate the introduced techniques into a problem-solving project.

Course Aims

This course enables students to explore relevant aspects of autonomous mobile robotic systems. These include the implementation of functions such as selecting, understanding, and installing the sensing capabilities of the robot, processing of the sensor measurements for performing perception, and applying low- and high-level control processes to enable the robotic platform to operate in complex contexts.

This course allows students to apply the concepts introduced in the course, in combination with previously acquired knowledge (from subjects related to Programming, Mathematics, Control, Mechanics, and Electronics), in order to solve the complex course projects that involve tasks such as the full design and implementation of a small robotic platform to give it the intelligence to operate in an unknown context. The intelligence of the platform involves performing perception tasks such as obstacle detection, mapping, planning and visualisation for human interaction with the intelligent agent. All these components of the agent are implemented by the students.

Relationship to Other Courses

Provides useful baseline knowledge for future MTRN courses

Course Learning Outcomes

Course Learning Outcomes
CLO1 : Apply relevant theoretical knowledge pertaining to mobile robots including locomotion, perception and localisation utilising onboard sensors, navigation and path planning, for complex problem-solving
CLO2 : Apply general computer vision techniques for feature/object detection and tracking, for complex problem-solving
CLO3 : Demonstrate professional and hands-on skills in mechatronics design, fabrication, and implementation by completing practical activities
CLO4 : Collaborate effectively within a team via participation in a problem-solving competition

Course Learning Outcomes	Assessment Item
CLO1 : Apply relevant theoretical knowledge pertaining to mobile robots including locomotion, perception and localisation utilising onboard sensors, navigation and path planning, for complex problem-solving	• Quiz • Lab • Project_Group • Project_Individual
CLO2 : Apply general computer vision techniques for feature/object detection and tracking, for complex problem-solving	• Quiz • Lab • Project_Group • Project_Individual
CLO3 : Demonstrate professional and hands-on skills in mechatronics design, fabrication, and implementation by completing practical activities	• Lab • Project_Group • Project_Individual
CLO4 : Collaborate effectively within a team via participation in a problem-solving competition	• Project_Group

Learning and Teaching Technologies

Moodle - Learning Management System | Moodle - Learning Management System | Microsoft Teams | Ed (https://edstem.org)

Learning and Teaching in this course

GitHub and Moodle will be used for laboratory tasks.

EdSTEM will be used for class forum

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates
Quiz Assessment Format: Individual	20%	Start Date: Week 5 Due Date: Not Applicable
Lab Assessment Format: Individual	25%	Start Date: Not Applicable Due Date: Weekly after lab sessions
Project_Group Assessment Format: Group	30%	Start Date: Week 5 Due Date: Week 8 and Week 12
Project_Individual Assessment Format: Individual	25%	Start Date: Not Applicable Due Date: Week 10: 29 July - 04 August

Assessment Details

Quiz

Assessment Overview

One paper-based short-answer quiz (predominantly multi-choice questions, some mathematical working required). Closed book. One hour.

Course Learning Outcomes

- CLO1 : Apply relevant theoretical knowledge pertaining to mobile robots including locomotion, perception and localisation utilising onboard sensors, navigation and path planning, for complex problem-solving
- CLO2 : Apply general computer vision techniques for feature/object detection and tracking, for complex problem-solving

Detailed Assessment Description

In-person closed book paper-based assessment to assess knowledge gained from Weeks 1-4. Assessment will be 1 hour and will be held in Week 5.

Assessment Length

Up to 60 minutes

Submission notes

Paper-based quiz

Assessment information

Students should contact the lecturer well in advance if they cannot sit the quiz during the scheduled time.

Assignment submission Turnitin type

This is not a Turnitin assignment

Lab

Assessment Overview

In-lab and post-lab assessments to be completed weekly. Short-answer and multi-choice questions answered verbally to demonstrators and through online Moodle quiz.

Course Learning Outcomes

- CLO1 : Apply relevant theoretical knowledge pertaining to mobile robots including locomotion, perception and localisation utilising onboard sensors, navigation and path planning, for complex problem-solving

- CLO2 : Apply general computer vision techniques for feature/object detection and tracking, for complex problem-solving
- CLO3 : Demonstrate professional and hands-on skills in mechatronics design, fabrication, and implementation by completing practical activities

Detailed Assessment Description

Weekly tasks to be completed during labs and after labs.

See Moodle page for exact mark breakdown.

Assessment Length

N/A

Submission notes

Moodle and Lab Demonstration

Assignment submission Turnitin type

This is not a Turnitin assignment

Project_Group

Assessment Overview

One group robot design project - designing and building a robot to traverse a maze. Mid-point in-person assessment to verify basic functionality carried out in lab session. Final assessment constitutes several driving tasks assessed through in-person demonstration.

Course Learning Outcomes

- CLO1 : Apply relevant theoretical knowledge pertaining to mobile robots including locomotion, perception and localisation utilising onboard sensors, navigation and path planning, for complex problem-solving
- CLO2 : Apply general computer vision techniques for feature/object detection and tracking, for complex problem-solving
- CLO3 : Demonstrate professional and hands-on skills in mechatronics design, fabrication, and implementation by completing practical activities
- CLO4 : Collaborate effectively within a team via participation in a problem-solving competition

Detailed Assessment Description

Mid-point assessment undertaken during lab sessions in Week 8.

Final assessment undertaken during lab sessions in Week 12.

Verbal feedback during assessments.

Assessment Length

N/A

Submission notes

Moodle and Lab Demonstration

Assessment information

All students need to be present for the demonstration for Gateway 1.

At least one student per group needs to be present for the final demonstration.

Assignment submission Turnitin type

This is not a Turnitin assignment

Project_Individual

Assessment Overview

One individual assessment involving coding a task for robotic perception. Code to be submitted online.

Course Learning Outcomes

- CLO1 : Apply relevant theoretical knowledge pertaining to mobile robots including locomotion, perception and localisation utilising onboard sensors, navigation and path planning, for complex problem-solving
- CLO2 : Apply general computer vision techniques for feature/object detection and tracking, for complex problem-solving
- CLO3 : Demonstrate professional and hands-on skills in mechatronics design, fabrication, and implementation by completing practical activities

Detailed Assessment Description

Assessment in Week 10. Coding task based on lectures in second half of the term.

Marks and feedback returned no later than 2 weeks after submission date.

Submission notes

Submitted online through GitHub

Assessment information

Zero marks if not submitted within 5 days of deadline.

Assignment submission Turnitin type

Not Applicable

General Assessment Information

Gen AI may be used for coding tasks, as long as it is attributed and clearly delineated in the comments of the file.

Marks will be returned within 2 weeks of submission. For those assessments with a set submission date, a submission made after 5 days will result in an absolute fail (0 marks).

Grading Basis

Standard

Course Schedule

Attendance Requirements

Students are strongly encouraged to attend all classes and review lecture recordings.

Course Resources

Recommended Resources

Lecture notes and assignment specifications will be available to students via Teams.

There will be no textbook required for this course. The students are suggested to read the following if they want to expand their learning:

- R. Siegwart, I. R. Nourbakhsh, D. Scaramuzza. Introduction to autonomous mobile robots. The MIT Press. Second edition. 2011.

UNSW Library website: https://www.library.unsw.edu.au/

UNSW Bookshop Print: https://www.bookshop.unsw.edu.au/details.cgi?ITEMNO=9780262015356

Moodle: https://moodle.telt.unsw.edu.au/login/index.php

Course Evaluation and Development

Feedback on the course is gathered periodically using various means, including the UNSW myExperience process, informal discussion in the final class for the course, and the School's Student/Staff meetings. Your feedback is taken seriously, and continual improvements are made to the course based, in part, on such feedback.

Example changes made based on last year's feedback include:

- Lower weighting for the quiz
- Increased hands-on labs.
- Improved coverage of fundamental mechatronics engineering content

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Convenor	Will Midgley		510G, J17	02 9385 4230	(email to organise a meeting)	Yes	Yes
Lecturer	Leo Wu					No	No
Head demonstrator	Mitchell Torok					No	No

Other Useful Information

Academic Information

I. Special consideration and supplementary assessment

If you have experienced an illness or misadventure beyond your control that will interfere with your assessment performance, you are eligible to apply for Special Consideration prior to, or within 3 working days of, submitting an assessment or sitting an exam.

Please note that UNSW has a Fit to Sit rule, which means that if you sit an exam, you are declaring yourself fit enough to do so and cannot later apply for Special Consideration.

For details of applying for Special Consideration and conditions for the award of supplementary assessment, please see the information on UNSW's Special Consideration page.

II. Administrative matters and links

All students are expected to read and be familiar with UNSW guidelines and polices. In particular, students should be familiar with the following:

- Attendance
- UNSW Email Address
- Special Consideration
- Exams
- Approved Calculators

- Academic Honesty and Plagiarism
- Equitable Learning Services

III. Equity and diversity

Those students who have a disability that requires some adjustment in their teaching or learning environment are encouraged to discuss their study needs with the course convener prior to, or at the commencement of, their course, or with the Equity Officer (Disability) in the Equitable Learning Services. Issues to be discussed may include access to materials, signers or note-takers, the provision of services and additional exam and assessment arrangements. Early notification is essential to enable any necessary adjustments to be made.

IV. Professional Outcomes and Program Design

Students are able to review the relevant professional outcomes and program designs for their streams by going to the following link: https://www.unsw.edu.au/engineering/student-life/student-resources/program-design.

Note: This course outline sets out the description of classes at the date the Course Outline is published. The nature of classes may change during the Term after the Course Outline is published. Moodle or your primary learning management system (LMS) should be consulted for the up-to-date class descriptions. If there is any inconsistency in the description of activities between the University timetable and the Course Outline/Moodle/LMS, the description in the Course Outline/Moodle/LMS applies.

Academic Honesty and Plagarism

UNSW has an ongoing commitment to fostering a culture of learning informed by academic integrity. All UNSW students have a responsibility to adhere to this principle of academic integrity. Plagiarism undermines academic integrity and is not tolerated at UNSW. *Plagiarism at UNSW is defined as using the words or ideas of others and passing them off as your own.*

Plagiarism is a type of intellectual theft. It can take many forms, from deliberate cheating to accidentally copying from a source without acknowledgement. UNSW has produced a website with a wealth of resources to support students to understand and avoid plagiarism, visit: student.unsw.edu.au/plagiarism. The Learning Centre assists students with understanding academic integrity and how not to plagiarise. They also hold workshops and can help students one-on-one.

You are also reminded that careful time management is an important part of study and one of the identified causes of plagiarism is poor time management. Students should allow sufficient time for research, drafting and the proper referencing of sources in preparing all assessment tasks.

Repeated plagiarism (even in first year), plagiarism after first year, or serious instances, may also be investigated under the Student Misconduct Procedures. The penalties under the procedures can include a reduction in marks, failing a course or for the most serious matters (like plagiarism in an honours thesis or contract cheating) even suspension from the university. The Student Misconduct Procedures are available here:

www.gs.unsw.edu.au/policy/documents/studentmisconductprocedures.pdf

Submission of Assessment Tasks

Work submitted late without an approved extension by the course coordinator or delegated authority is subject to a late penalty of five percent (5%) of the maximum mark possible for that assessment item, per calendar day.

The late penalty is applied per calendar day (including weekends and public holidays) that the assessment is overdue. There is no pro-rata of the late penalty for submissions made part way through a day. This is for all assessments where a penalty applies.

Work submitted after five days (120 hours) will not be accepted and a mark of zero will be awarded for that assessment item.

For some assessment items, a late penalty may not be appropriate. These will be clearly indicated in the course outline, and such assessments will receive a mark of zero if not completed by the specified date. Examples include:

- Weekly online tests or laboratory work worth a small proportion of the subject mark;
- Exams, peer feedback and team evaluation surveys;
- Online quizzes where answers are released to students on completion;
- Professional assessment tasks, where the intention is to create an authentic assessment that has an absolute submission date; and,
- Pass/Fail assessment tasks.

Faculty-specific Information

Engineering Student Support Services – The Nucleus - enrolment, progression checks, clash

requests, course issues or program-related queries

Engineering Industrial Training – Industrial training questions

UNSW Study Abroad – study abroad student enquiries (for inbound students)

UNSW Exchange – student exchange enquiries (for inbound students)

UNSW Future Students – potential student enquiries e.g. admissions, fees, programs, credit transfer

Phone

(+61 2) 9385 8500 – Nucleus Student Hub

(+61 2) 9385 7661 – Engineering Industrial Training

(+61 2) 9385 3179 – UNSW Study Abroad and UNSW Exchange (for inbound students)

School-specific Information

Short Extensions

Short extensions are not currently applicable to Mechanical and Manufacturing Engineering Courses.

Review of Results

The purpose of a review of results is if there was a marking error. Review of results is for when you have cause to believe that there is a marking error. Review of Results cannot be used to get feedback. If you would like feedback for assessments prior to the final exam, you are welcome to contact the course convenor directly. No feedback will be provided on final exams.

Use of AI

The use of AI is prohibited unless explicitly permitted by the course convenor. Please respect this and be aware that penalties will apply when unauthorised use is detected, such as through Turnitin. If the use of generative AI, such as ChatGPT, is allowed in a specific assessment, they must be properly credited, and your submissions must be substantially your own work.

School Contact Information

Location

UNSW Mechanical and Manufacturing Engineering

Ainsworth building J17, Level 1

Above Coffee on Campus

Hours

9:00–5:00pm, Monday–Friday*

*Closed on public holidays, School scheduled events and University Shutdown

Web

School of Mechanical and Manufacturing Engineering

Engineering Student Support Services

Engineering Industrial Training

UNSW Study Abroad and Exchange (for inbound students)

UNSW Future Students

Phone

(+61 2) 9385 8500 – Nucleus Student Hub

(+61 2) 9385 7661 – Engineering Industrial Training

(+61 2) 9385 3179 – UNSW Study Abroad and UNSW Exchange (for inbound students)

(+61 2) 9385 4097 – School Office**

**Please note that the School Office will not know when/if your course convenor is on campus or available

Email

Engineering Student Support Services – current student enquiries

- e.g. enrolment, progression, clash requests, course issues or program-related queries

Engineering Industrial Training – Industrial training questions

UNSW Study Abroad – study abroad student enquiries (for inbound students)

UNSW Exchange – student exchange enquiries (for inbound students)

UNSW Future Students – potential student enquiries

- e.g. admissions, fees, programs, credit transfer

School Office – School general office administration enquiries

- NB: the relevant teams listed above must be contacted for all student enquiries. The School will only be able to refer students on to the relevant team if contacted

Important Links

- Student Wellbeing
- Urgent Mental Health & Support
- Equitable Learning Services
- Faculty Transitional Arrangements for COVID-19
- Moodle
- Lab Access
- Computing Facilities
- Student Resources
- Course Outlines
- Makerspace
- UNSW Timetable
- UNSW Handbook