COMP8430

Advanced Computer Vision and Action

Session 1, In person-scheduled-weekday, North Ryde 2025

School of Computing

Contents

General Information

Unit convenor and teaching staff
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Credit points
10

Prerequisites
COMP6420

Corequisites

Co-badged status

Unit description
Computer vision is at the centre of AI technology, and the ability of an AI agent to take actions depends on it. Robots need it to navigate in a dynamic environment and self-driving cars need it to navigate on a road without causing harm to itself and others. This unit will expose students to fundamentals of computer and human vision, image formation, low-level image processing, and reinforcement learning techniques. Students will also gain an understanding of various computer vision tasks such as object detection and image style transfer, and in linking computer vision and image formation to other modalities like language (such as in text to image generation). Students will also apply computer vision to learning actions carried out by AI agents, including robots, in contexts such as game-playing or following instructions. In doing so they will gain advanced skills involving cutting-edge deep learning models and related technologies.

Learning in this unit enhances student understanding of global challenges identified by the United Nations Sustainable Development Goals (UNSDGs) Industry, Innovation and Infrastructure; Sustainable Cities and Communities

Important Academic Dates

Information about important academic dates including deadlines for withdrawing from units are available at https://www.mq.edu.au/study/calendar-of-dates

Learning Outcomes

On successful completion of this unit, you will be able to:

ULO1: Identify the key computer vision applications that match current and emerging industry needs.

ULO2: Explain the main techniques that are used to develop and implement computer vision applications, and how they link to the ability of AI to act in the world.

ULO3: Implement computer vision applications using common tools and libraries used in industry.

ULO4: Design AI and robotic agents that can act in environments using reinforcement learning techniques.

ULO5: Design computer vision applications using advanced deep learning techniques.

ULO6: Apply computer vision methods and techniques to industry applications using real data.

ULO7: Apply good practice in the development, monitoring, and deployment of computer vision systems

General Assessment Information

The assessment of this unit consists of three assignments and a final exam. You will submit the solutions to the three assignments via iLearn by the due date. The final examination is a closed book examination, and will be taken in person during the exam period.

Late Assessment Submission Penalty

Unless a Special Consideration request has been submitted and approved, a 5% penalty (of the total possible mark of the task) will be applied for each day a written report or presentation assessment is not submitted, up until the 7th day (including weekends). After the 7th day, a grade of '0' will be awarded even if the assessment is submitted. The submission time for all uploaded assessments is **11:55 pm**. A 1-hour grace period will be provided to students who experience a technical concern. For any late submission of time-sensitive tasks, such as scheduled tests/exams, performance assessments/presentations, and/or scheduled practical assessments/labs, please apply for Special Consideration. For example, if the assignment is worth 8 marks (of the entire unit) and your submission is late by 19 hours (or 23 hours 59 minutes 59 seconds), 0.4 marks (5% of 8 marks) will be deducted. If your submission is late by 24 hours (or 47 hours 59 minutes 59 seconds), 0.8 marks (10% of 8 marks) will be deducted, and so on.

Assessments Release Datas

The assignments will be released no later than the dates listed below.

- Assignment 1 - 03/03/2025
- Assignment 2 - 14/04/2025
- Major Project (Phase 1) - 10/03/2025
- Major Project (Phase 2) - 31/03/2025
- Major Project (Phase 3) - 28/04/2025

Assessments where Late Submissions will be accepted

- Assignment 1 - YES, Standard Late Penalty applies
- Assignment 2 - YES, Standard Late Penalty applies
- Major Project - YES, Standard Late Penalty applies
- Exam - NO, unless Special Consideration is Granted

Supplementary Exam

If you receive Special Consideration for the final exam, a supplementary exam will be scheduled after the normal exam period, following the release of marks. By making a special consideration application for the final exam you are declaring yourself available for a resit during the supplementary examination period and will not be eligible for a second special consideration approval based on pre-existing commitments. Please ensure you are familiar with the policy prior to submitting an application. Approved applicants will receive an individual notification one week prior to the exam with the exact date and time of their supplementary examination.

Requirements to Pass this Unit

To pass this unit, you must achieve a total mark equal or greater than 50%. This unit does not have hurdle assessments.

Special Consideration

The Special Consideration Policy aims to support students who have been impacted by short-term circumstances or events that are serious, unavoidable and significantly disruptive, and which may affect their performance in assessment. If you experience circumstances or events that affect your ability to complete the assessments in this unit on time, please inform the convenor and submit a Special Consideration request through ask.mq.edu.au.

Assessment Tasks

Name	Weighting	Hurdle	Due
Assignment 1	20%	No	11/04/2025

Name	Weighting	Hurdle	Due
Assignment 2	20%	No	23/05/2025
Major Project	40%	No	Week 12, during the SGTA class in which you are registered
Examination	20%	No	Examination Period

Assignment 1

Assessment Type [1]: Programming Task
Indicative Time on Task [2]: 20 hours
Due: **11/04/2025**
Weighting: **20%**

Implement a practical computer vision application using deep learning techniques.

On successful completion you will be able to:

- Identify the key computer vision applications that match current and emerging industry needs.
- Explain the main techniques that are used to develop and implement computer vision applications, and how they link to the ability of AI to act in the world.
- Design computer vision applications using advanced deep learning techniques.

Assignment 2

Assessment Type [1]: Programming Task
Indicative Time on Task [2]: 20 hours
Due: **23/05/2025**
Weighting: **20%**

Implement an AI agent using reinforcement learning

On successful completion you will be able to:

- Explain the main techniques that are used to develop and implement computer vision applications, and how they link to the ability of AI to act in the world.

- Design AI and robotic agents that can act in environments using reinforcement learning techniques.

Major Project

Assessment Type [1]: Project
Indicative Time on Task [2]: 40 hours
Due: **Week 12, during the SGTA class in which you are registered**
Weighting: **40%**

Design, implement, deploy, evaluate, and implement monitor an industrial grade computer vision application that uses realistic data, requires advanced deep learning techniques, and integrates a robotic agent.

On successful completion you will be able to:

- Identify the key computer vision applications that match current and emerging industry needs.
- Explain the main techniques that are used to develop and implement computer vision applications, and how they link to the ability of AI to act in the world.
- Implement computer vision applications using common tools and libraries used in industry.
- Design computer vision applications using advanced deep learning techniques.
- Apply computer vision methods and techniques to industry applications using real data.
- Apply good practice in the development, monitoring, and deployment of computer vision systems

Examination

Assessment Type [1]: Examination
Indicative Time on Task [2]: 2 hours
Due: **Examination Period**
Weighting: **20%**

Demonstrate an understanding of a selection of topics covered in the unit.

On successful completion you will be able to:

- Identify the key computer vision applications that match current and emerging industry

needs.

- Explain the main techniques that are used to develop and implement computer vision applications, and how they link to the ability of AI to act in the world.
- Implement computer vision applications using common tools and libraries used in industry.
- Design AI and robotic agents that can act in environments using reinforcement learning techniques.
- Design computer vision applications using advanced deep learning techniques.
- Apply computer vision methods and techniques to industry applications using real data.

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[1] If you need help with your assignment, please contact:

- the academic teaching staff in your unit for guidance in understanding or completing this type of assessment
- the Writing Centre for academic skills support.

[2] Indicative time-on-task is an estimate of the time required for completion of the assessment task and is subject to individual variation

Delivery and Resources

During most of the weeks, there will be 2 hours of lectures and 2 hours of Practicals. All the required software will be installed in the computers of the PC labs allocated for the Practicals but you are free to bring your own device and install the software.

Lectures and practicals start on Week 1.

Delivery Modes

All lectures and Practicals are delivered in campus. The lectures will also be recorded and recordings of the lecture will be available via iLearn. There will not be recordings of the Practical sessions.

Methods of Communication

We will communicate with you via your university email or through announcements in iLearn. Queries to convenors can be made via the Contact tool in iLearn or sent to xiaohan.yu@mq.edu.au from your **university email** address.

Reading

Every week there will be a list of required and recommended readings. The list will be maintained in iLearn.

Most of the contents of the unit will be based on the following books:

- François Chollet (2021). Deep Learning with Python, 2nd Edition. Manning Publications. Available in the library.
- Valliappa Lakshmanan, Martin Görner, Ryan Gillard (2021), Practical Machine Learning for Computer Vision. O'Reilly. Available in the library.
- Ayyadevara, Reddy (2024), Modern Computer Vision with PyTorch - Second Edition
- Rajalingappaa Shanmugamani (2018), Deep Learning for Computer Vision: expert techniques to train advanced neural networks using TensorFlow and Keras. Pakt Publishing. Available in the library.
- Hu (2023), The Art of Reinforcement Learning

Software

The main software for this unit is Anaconda for Python 3.11 with the following packages:

1. numpy
2. scipy
3. pandas
4. scikit-learn
5. scikit-image
6. gensim
7. pytorch
8. tensorflow
9. opencv
10. pillow
11. gymnasium, Stable-Baselines2

Unit Web Page

Note that the majority of the unit materials is publicly available while some material requires you to log in to iLearn to access it.

The unit will make extensive use of discussion boards hosted within iLearn. Please post questions there, they will be monitored by the staff on the unit.

Unit Schedule

The following schedule is tentative and is only an indication of the actual contents. The final schedule will be available in iLearn.

Week	Topic
1	Review of Basic Computer Vision
2	Managing your Computer Vision Project
3	Transfer Learning
4	Generative Adversarial Networks
5	DeepDream and Neural Style Transfer
6	Visual Embeddings
7	Introduction to Reinforcement Learning
	RECESS
8	Deep Reinforcement Learning
9	Practical Reinforcement Learning for Computer Vision and Action
10	Advanced Object Detection
11	Image Generation from Text
12	Guest Lecture
13	Review for Exam

Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central (https://policies.mq.edu.au). Students should be aware of the following policies in particular with regard to Learning and Teaching:

- Academic Appeals Policy
- Academic Integrity Policy
- Academic Progression Policy
- Assessment Policy
- Fitness to Practice Procedure
- Assessment Procedure
- Complaints Resolution Procedure for Students and Members of the Public
- Special Consideration Policy

Students seeking more policy resources can visit Student Policies (https://students.mq.edu.au/support/study/policies). It is your one-stop-shop for the key policies you need to know about throughout your undergraduate student journey.

To find other policies relating to Teaching and Learning, visit Policy Central (https://policies.mq.e

du.au) and use the search tool.

Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: https://students.mq.edu.au/admin/other-resources/student-conduct

Results

Results published on platform other than eStudent, (eg. iLearn, Coursera etc.) or released directly by your Unit Convenor, are not confirmed as they are subject to final approval by the University. Once approved, final results will be sent to your student email address and will be made available in eStudent. For more information visit connect.mq.edu.au or if you are a Global MBA student contact globalmba.support@mq.edu.au

Academic Integrity

At Macquarie, we believe academic integrity – honesty, respect, trust, responsibility, fairness and courage – is at the core of learning, teaching and research. We recognise that meeting the expectations required to complete your assessments can be challenging. So, we offer you a range of resources and services to help you reach your potential, including free online writing and maths support, academic skills development and wellbeing consultations.

Student Support

Macquarie University provides a range of support services for students. For details, visit http://students.mq.edu.au/support/

Academic Success

Academic Success provides resources to develop your English language proficiency, academic writing, and communication skills.

- Workshops
- Chat with a WriteWISE peer writing leader
- Access StudyWISE
- Upload an assignment to Studiosity
- Complete the Academic Integrity Module

The Library provides online and face to face support to help you find and use relevant information resources.

- Subject and Research Guides
- Ask a Librarian

Student Services and Support

Macquarie University offers a range of Student Support Services including:

- IT Support

- Accessibility and disability support with study
- Mental health support
- Safety support to respond to bullying, harassment, sexual harassment and sexual assault
- Social support including information about finances, tenancy and legal issues
- Student Advocacy provides independent advice on MQ policies, procedures, and processes

Student Enquiries

Got a question? Ask us via the Service Connect Portal, or contact Service Connect.

IT Help

For help with University computer systems and technology, visit http://www.mq.edu.au/about_us/offices_and_units/information_technology/help/.

When using the University's IT, you must adhere to the Acceptable Use of IT Resources Policy. The policy applies to all who connect to the MQ network including students.

Changes from Previous Offering

New robots are provided for this unit. The SGTA will be performed in a group level where each group would share the use of a robot for learning and project implementation. Fundamental knowledge of operating robots such as ROS and Linux would be covered in the SGTA.

Unit information based on version 2025.02 of the Handbook