



**UNSW**

## UNSW Course Outline

# COMP9242 Advanced Operating Systems - 2024

Published on the 25 Aug 2024

## General Course Information

**Course Code :** COMP9242

**Year :** 2024

**Term :** Term 3

**Teaching Period :** T3

**Is a multi-term course? :** No

**Faculty :** Faculty of Engineering

**Academic Unit :** School of Computer Science and Engineering

**Delivery Mode :** In Person

**Delivery Format :** Standard

**Delivery Location :** Kensington

**Campus :** Sydney

**Study Level :** Undergraduate, Postgraduate

**Units of Credit :** 6

### Useful Links

[Handbook Class Timetable](#)

## Course Details & Outcomes

### Course Description

The course provides students with a deep understanding of modern operating system technology, implementation techniques and research issues.

This course builds upon the basic operating systems course (COMP3231/9201/3891/9283), which provides an understanding of the underlying operating systems which students have implicitly relied upon in developing applications in foundational courses within Computer Science and Engineering, and will rely on in their future careers when developing systems and applications. Advanced operating systems enables students to specialise in operating systems, giving them the skills and insight to become highly competent developers or researchers in the general “systems” space, including operating systems, network systems, embedded and cyberphysical systems. The course produces graduates who are highly sought-after by technology companies and systems researchers.

## Course Aims

The course aims to produce future technical leaders in industry and research, it is unapologetically elitist. It develops general “systems skills”, the ability to design, implement and understand a complex software system. It specifically provides a thorough understanding of low-level system software and its interaction with hardware, the trade-offs that determine system performance, techniques to assess performance correctly, and the impact of system design on security.

# Course Learning Outcomes

Course Learning Outcomes
CLO1 : Design and construct low-level operating system code
CLO2 : Analyse the performance trade-offs in developing high-performance low-level OS code
CLO3 : Understand and be capable of developing OS code inside a variety of OS environments, including monolithic, microkernels, and virtual machines, including device drivers
CLO4 : Create benchmarks to evaluate the performance of OSs and application stacks
CLO5 : Evaluate research published in the field of operating systems at a level commensurate with their experience

Course Learning Outcomes	Assessment Item
CLO1 : Design and construct low-level operating system code	<ul style="list-style-type: none"><li>• Project Milestones</li><li>• Final Project Submission</li></ul>
CLO2 : Analyse the performance trade-offs in developing high-performance low-level OS code	<ul style="list-style-type: none"><li>• Final Project Submission</li></ul>
CLO3 : Understand and be capable of developing OS code inside a variety of OS environments, including monolithic, microkernels, and virtual machines, including device drivers	<ul style="list-style-type: none"><li>• Project Milestones</li><li>• Final Project Submission</li></ul>
CLO4 : Create benchmarks to evaluate the performance of OSs and application stacks	<ul style="list-style-type: none"><li>• Final Project Submission</li></ul>
CLO5 : Evaluate research published in the field of operating systems at a level commensurate with their experience	<ul style="list-style-type: none"><li>• Final Exam</li></ul>

## Learning and Teaching Technologies

Moodle - Learning Management System | Echo 360 | EdStem

## Other Professional Outcomes

<https://www.unsw.edu.au/engineering/student-life/student-resources/program-design>

# Assessments

## Assessment Structure

Assessment Item	Weight	Relevant Dates
Project Milestones Assessment Format: Individual	35%	Start Date: Week 1 Due Date: Almost weekly throughout the term
Final Project Submission Assessment Format: Group	30%	Start Date: Week 1 Due Date: Week 10
Final Exam Assessment Format: Individual	35%	Start Date: 22 Nov – 5 Dec 2024 Due Date: 22 Nov – 5 Dec 2024

## Assessment Details

### Project Milestones

#### Assessment Overview

The project consists of approximately weekly milestones where students work to evolve their project towards a functional microkernel-based operating system. Each milestone broadly specifies additional functionality required to be demonstrated in order to meet the milestone. Students have a large degree of design freedom within each milestone.

After familiarisation milestones, students are expected to pair up and contribute to the same code base, but passing a milestone is assessed individually.

Milestones are assessed via demonstrations. When demonstrating, a student is expected to:

- show a working solution,
- explain how the code works, and
- explain any design decisions made.

Lab demonstrators are available daily. Labs are provided for students to discuss proposed solutions, seek help, receive feedback, and demonstrate their projects for assessment purposes.

The project milestones form the heart of the course and it is where the majority of the time is spent in the course. We expect approximately 10 hours per week focused on project related work, notwithstanding introducing difficult bugs.

#### Course Learning Outcomes

- CLO1 : Design and construct low-level operating system code
- CLO3 : Understand and be capable of developing OS code inside a variety of OS

environments, including monolithic, microkernels, and virtual machines, including device drivers

#### **Detailed Assessment Description**

A detailed description of the project, its milestones, and resources used is available on the course website <https://www.cse.unsw.edu.au/~cs9242/current/project/index.shtml>

#### **Generative AI Permission Level**

##### **No Assistance**

This assessment is designed for you to complete without the use of any generative AI. You are not permitted to use any generative AI tools, software or service to search for or generate information or answers.

For more information on Generative AI and permitted use please see [here](#).

### **Final Project Submission**

#### **Assessment Overview**

The project culminates with a final code submission and final report. The final code is partially assessed via a series of autotests to verify required functionality, with the remaining code assessment being based on a high-level review of the students design which is based on a combination of code inspection and report content.

The final report of approximately 15 pages in length will be assessed for clarity and coverage of issues students identify in achieving the project milestones, their designs, and their evaluation of their systems.

Feedback is provided via code testing results and explicit report feedback.

#### **Course Learning Outcomes**

- CLO1 : Design and construct low-level operating system code
- CLO2 : Analyse the performance trade-offs in developing high-performance low-level OS code
- CLO3 : Understand and be capable of developing OS code inside a variety of OS environments, including monolithic, microkernels, and virtual machines, including device drivers
- CLO4 : Create benchmarks to evaluate the performance of OSs and application stacks

#### **Detailed Assessment Description**

A detailed description of the project and its final submission is available on the course website <https://www.cse.unsw.edu.au/~cs9242/current/project/index.shtml>

### Assignment submission Turnitin type

Not Applicable

### Generative AI Permission Level

No Assistance

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## Final Exam

### Assessment Overview

The final exam is in the form of a 24h take-home exam. Students will be given one day to read and analyse two recent research papers relevant to the material covered in the course, and submit a critical report on it.

### Course Learning Outcomes

- CL05 : Evaluate research published in the field of operating systems at a level commensurate with their experience

### Detailed Assessment Description

A detailed description is available at <https://cgi.cse.unsw.edu.au/~cs9242/current/exam/index.shtml>

### Hurdle rules

A minimum score of 40% in the final exam is required to pass; otherwise, the overall mark will be capped at 45%.

### Generative AI Permission Level

No Assistance

This assessment is designed for you to complete without the use of any generative AI. You are not permitted to use any generative AI tools, software or service to search for or generate information or answers.

For more information on Generative AI and permitted use please see [here](#).

# General Assessment Information

## Grading Basis

Standard

## Requirements to pass course

A minimum score of 40% in the final exam is required to pass; otherwise, the overall mark will be capped at 45%.

# Course Schedule

Teaching Week/Module	Activity Type	Content
Week 1 : 9 September - 15 September	Lecture	Introduction (Microkernels and seL4) , seL4 API and usage
Week 2 : 16 September - 22 September	Lecture	Caches (What every OS designer must know), OS Execution Models
Week 3 : 23 September - 29 September	Lecture	Why Threads are a Bad Idea (for most purposes), Why Events are a Bad Idea (for high-concurrency servers), Virtual Machines (Introduction and principles)
Week 4 : 30 September - 6 October	Lecture	Performance Measurement and Analysis, Real-Time Systems Introduction
Week 5 : 7 October - 13 October	Lecture	Unix and Linux Internals, Security Fundamentals
Week 6 : 14 October - 20 October	Lecture	-- Flex week – no lecture --
Week 7 : 21 October - 27 October	Lecture	Microkernel Design and Implementation (with focus on seL4), Secure Operating Systems Information Leakage (timing channels and speculation)
Week 8 : 28 October - 3 November	Lecture	SMP and Locking
Week 9 : 4 November - 10 November	Lecture	Multicore Operating Systems
Week 10 : 11 November - 17 November	Lecture	Formal verification and seL4, seL4 in the real world, seL4-related research at UNSW, Exam preparation (0.5h)

# Attendance Requirements

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

# General Schedule Information

The authoritative lecture schedule (subject to change) is available on the course web site <https://www.cse.unsw.edu.au/~cs9242/current/lectures.shtml>

**Only an indicative schedule is provided here!**

# Course Resources

## Prescribed Resources

The central portal for all things related to the course is the course web site <https://www.cse.unsw.edu.au/~cs9242/current/>

# Course Evaluation and Development

Student feedback is actively sought throughout the course, and acted upon where appropriate. This includes both myexperience surveys and other more-targetted surveys. The course is transparent with the feedback it receives and publishes past surveys together with responses from the course convenors. You can view the evaluation and evolution of the course at <https://www.cse.unsw.edu.au/~cs9242/surveys/>

## Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Convenor	Kevin Elphinstone					Yes	No
Lecturer	Gernot Heiser					No	No
	COMP9242 Contact					No	Yes

## 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 Plagiarism

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](http://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](http://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 Contact Information**

**CSE Help! - on the Ground Floor of K17**

- For assistance with coursework assessments.

**The Nucleus Student Hub** - <https://nucleus.unsw.edu.au/en/contact-us>

- Course enrolment queries.

**Grievance Officer** - [grievance-officer@cse.unsw.edu.au](mailto:grievance-officer@cse.unsw.edu.au)

- If the course convenor gives an inadequate response to a query or when the courses convenor does not respond to a query about assessment.

**Student Reps** - [stureps@cse.unsw.edu.au](mailto:stureps@cse.unsw.edu.au)

- If some aspect of a course needs urgent improvement. (e.g. Nobody responding to forum queries, cannot understand the lecturer)

You should **never** contact any of the following people directly:

- Vice Chancellor
- Pro-vice Chancellor Education (PVCE)
- Head of School
- CSE administrative staff
- CSE teaching support staff

They will simply bounce the email to one of the above, thereby creating an unnecessary level of indirection and a delay in the response.