

## COMP2240: Operating Systems

Callaghan

Semester 2 - 2018



## OVERVIEW

### Course Description

Introduces computer operating system principles, using practical examples. Topics include tasking and processes, process coordination and synchronisation, resource scheduling, physical and virtual memory organisation, security issues, communications and networking, and distributed operating systems. The Unix operating system is used as a case study where appropriate.

### Assumed Knowledge Contact Hours

SENG1120

Callaghan

Lecture

Face to Face On Campus

2 hour(s) per Week for Full Term

Tutorial

Face to Face On Campus

2 hour(s) per Week for Full Term starting Week 2

### Unit Weighting Workload

10

Students are required to spend on average 120-140 hours of effort (contact and non-contact) including assessments per 10 unit course.

# COURSE OUTLINE

# CONTACTS

**Course Coordinator**      **Callaghan**  
Dr Nasimul Noman  
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(02) 4042 0488  
Consultation: Monday 12:00~14:00

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**School Office**      **School of Electrical Engineering and Computing**  
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9.00am-1.00pm and 2.00pm-5.00pm (Monday to Friday)

# SYLLABUS

**Course Content**

1. Hardware overview.
2. Processes and process scheduling including multi-processors.
3. Concurrency control using hardware and software techniques.
4. Memory Management.
5. Virtual memory.
6. I/O and disk management.
7. File systems and file manipulation.
8. Security mechanisms.
9. Networking.
10. Process migration

**Course Learning Outcomes**

**On successful completion of this course, students will be able to:**

1. Develop an understanding of the structure and function of operating systems, including the kernel, process scheduling, memory management, input/output device management, file systems, interprocess communication, networks and distributed systems, protection, security and recovery
2. Develop an understanding of how OS abstractions are realized on conventional hardware
3. Gain familiarity with various design issues in operating systems and the corresponding primitive methods and algorithms dealing with these issues.
4. Develop essential programming skills of programming with consideration of concurrency and multithreads etc
5. Gain familiarity with some real operating systems.

**Course Materials**      **Lecture Materials:**

- Students enrolled in this course can login at <http://uonline.newcastle.edu.au> to access the Blackboard site used to support this course. You need to visit the Blackboard

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site on a regular basis for up to date lecture materials.

**Multi-Media Resource:**

- Every week a couple of videos on core concepts will be released in the blackboard. Students are expected to watch those videos before they attend the weekly lecture. The basic ideas learnt from these videos will enable students to have a better engagement in the lectures and tutorials.

**Recommended Reading:**

- A selection of publicly available lecture notes and other types of material may be added to the list of learning materials and texts if required. The information regarding such materials will be announced in Blackboard.

**Required Text:**

- Operating Systems: Internals and Design Principles (9th Edition), Global Edition by William Stallings, Pearson Education, 2017. ISBN: 9781292214290.  
OR  
Operating Systems: Internals and Design Principles (8th Edition), Global Edition by William Stallings, Pearson Education, 2014. ISBN-10: 1292061359, ISBN-13: 978-1292061351.

# COMPULSORY REQUIREMENTS

In order to pass this course, each student must complete ALL of the following compulsory requirements:

## Contact Hour Requirements:

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## Course Assessment Requirements:

- Assessment 4 - Formal Examination: Minimum Grade / Mark Requirement - Students must obtain a specified minimum grade / mark in this assessment item to pass the course. Students whose overall mark in the course is 50% or more, but who score less than 40% in the compulsory item and thus fail to demonstrate the required proficiency, will be awarded a Criterion Fail grade, which will show as FF on their formal transcript. However, students in this position who have scored at least 25% in the compulsory item will be allowed to undertake a supplementary 'capped' assessment in which they can score at most 50% of the possible mark for that item.

## Pre-Placement Requirements:

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# SCHEDULE

| Week                    | Week Begins | Topic   | Learning Activity | Assessment Due                       |
|-------------------------|-------------|---|-------------------|--------------------------------------|
| 1                       | 30 Jul      | Operating System Overview                                 |                   |                                      |
| 2                       | 6 Aug       | Processes and Threads                                     |                   |                                      |
| 3                       | 13 Aug      | Scheduling  |                   | Assignment 1 Out                     |
| 4                       | 20 Aug      | Real-time System Scheduling and Multiprocessor Scheduling |                   |                                      |
| 5                       | 27 Aug      | Concurrency: Mutual Exclusion and Synchronisation         |                   |                                      |
| 6                       | 3 Sep       | Concurrency: Deadlock and Starvation                      |                   | Assignment 1 Due<br>Assignment 2 Out |
| 7                       | 10 Sep      | Memory Management I                                       |                   |                                      |
| 8                       | 17 Sep      | Memory Management II                                      |                   | Midterm Exam                         |
| Mid Semester Break      |             |   |                   |                                      |
| Mid Semester Break      |             |   |                   |                                      |
| 9                       | 8 Oct       | Disk and I/O Scheduling                                   |                   | Assignment 2 Due<br>Assignment 3 Out |
| 10                      | 15 Oct      | File Management   |                   |                                      |
| 11                      | 22 Oct      | Security and Protection                                   |                   |                                      |
| 12                      | 29 Oct      | Course Review   |                   | Assignment 3 Due                     |
| 13                      | 5 Nov       |   |                   |                                      |
| Semester 2 Examinations |             |   |                   |                                      |
| Semester 2 Examinations |             |   |                   |                                      |
| Semester 2 Examinations |             |   |                   |                                      |

# ASSESSMENTS

This course has 5 assessments. Each assessment is described in more detail in the sections below.

|   | Assessment Name          | Due Date | Involvement | Weighting | Learning Outcomes |
|---|--------------------------|----------|-------------|-----------|-------------------|
| 1 | Programming Assignment 1 | Week 6.  | Individual  | 10%       | 1                 |

|   |                          |              |            |     |               |
|---|--------------------------|--------------|------------|-----|---------------|
| 2 | Programming Assignment 2 | Week 9.      | Individual | 15% | 2, 3          |
| 3 | Programming Assignment 3 | Week 12.     | Individual | 15% | 1             |
| 4 | Final Examination*       | Exam Period. | Individual | 45% | 1, 2, 3, 4, 5 |
| 5 | Midterm test             | Week 8       | Individual | 15% | 1, 3, 5       |

\* This assessment has a compulsory requirement.

**Late Submissions** The mark for an assessment item submitted after the designated time on the due date, without an approved extension of time, will be reduced by 10% of the possible maximum mark for that assessment item for each day or part day that the assessment item is late. Note: this applies equally to week and weekend days.

## Assessment 1 - Programming Assignment 1

**Assessment Type** Written Assignment  
**Purpose** This programming assignment meets the course objectives of knowledge acquisition and design of solutions by requiring the development of programs that demonstrate understanding of the topics and concepts in operating systems.  
**Description** In this programming assignment students will be required to implement scheduling algorithms and compare their performance. In this assessment emphasis will be given in providing correctness of programs following the algorithmic procedures which were delivered in lectures and are in the textbook.  
**Weighting** 10%  
**Length** Students will have around 2 weeks to complete this  
**Due Date** Week 6.  
**Submission Method** Online  
**Assessment Criteria** Detailed assessment criteria for each assessment task and any other additional material will be available on the course Blackboard site no less than two weeks prior to the due date of each assessment.  
**Return Method** Online  
**Feedback Provided** Online - .

## Assessment 2 - Programming Assignment 2

**Assessment Type** Written Assignment  
**Purpose** This programming assignment meets the course objectives of knowledge acquisition and design of solutions by requiring the development of programs that demonstrate understanding of the topics and concepts in operating systems.  
**Description** In this programming assignment students will be required to implement solutions for handling concurrency, race condition and deadlock by using semaphores and monitors. In this assessment emphasis will be given in providing correctness of programs following the algorithmic procedures which were delivered in lectures and are in the textbook.  
**Weighting** 15%  
**Length** Students will have around 2 weeks to complete this  
**Due Date** Week 9.  
**Submission Method** Online  
**Assessment Criteria** Detailed assessment criteria for each assessment task and any other additional material will be available on the course Blackboard site no less than two weeks prior to the due date of each assessment.  
**Return Method** Online  
**Feedback Provided** Online - .

## Assessment 3 - Programming Assignment 3

**Assessment Type** Written Assignment  
**Purpose** This programming assignment meets the course objectives of knowledge acquisition and design of solutions by requiring the development of programs that demonstrate understanding of the topics and concepts in operating systems.  
**Description** In this programming assignment students will be required to implement memory management

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|                            |  |
|----------------------------|--|
| <b>Weighting</b>           | algorithms and disk scheduling algorithms and compare their performance. In this assessment emphasis will be given in providing correctness of programs following the algorithmic procedures which were delivered in lectures and are in the textbook. |
| <b>Length</b>              | 15%  |
| <b>Due Date</b>            | Students will have around 3 weeks to complete this   |
| <b>Submission Method</b>   | Week 12.   |
| <b>Assessment Criteria</b> | Online   |
|                            | Detailed assessment criteria for each assessment task and any other additional material will be available on the course Blackboard site no less than two weeks prior to the due date of each assessment.   |
| <b>Return Method</b>       | Online   |
| <b>Feedback Provided</b>   | Online - .   |

## Assessment 4 - Final Examination

|                                 |  |
|---------------------------------|--|
| <b>Assessment Type</b>          | Formal Examination   |
| <b>Purpose</b>                  | The final formal exam is designed to test the individual student's knowledge of the course material and their ability to describe, analyse and hypothesize from this material. |
| <b>Description</b>              |  |
| <b>Weighting</b>                | 45%  |
| <b>Compulsory Requirements</b>  | Minimum Grade / Mark Requirement - Students must obtain a specified minimum grade / mark in this assessment item to pass the course..  |
| <b>Due Date</b>                 | Exam Period.   |
| <b>Submission Method</b>        | Formal Exam  |
| <b>Assessment Criteria</b>      |  |
| <b>Return Method</b>            | Not Returned   |
| <b>Feedback Provided</b>        | No Feedback - .  |
| <b>Opportunity to Reattempt</b> | Students WILL be given the opportunity to reattempt this assessment.<br>Refer to course outline for details.   |

## Assessment 5 - Midterm test

|                            |  |
|----------------------------|--|
| <b>Assessment Type</b>     | In Term Test   |
| <b>Purpose</b>             | The purpose and benefit of the class exam is to provide the students with regular feedback on student learning.  |
| <b>Description</b>         | This test highlights the areas of concern and may stimulate discussion with tutors and lecturers. Mid-term exam is not the only one way of doing this and students should actively participate in tutorials and engage in lecture discussions during the whole term. |
| <b>Weighting</b>           | 15%  |
| <b>Due Date</b>            | Week 8   |
| <b>Submission Method</b>   | Specific Location<br>Venue and time of the midterm test will be announced in the blackboard.   |
| <b>Assessment Criteria</b> |  |
| <b>Return Method</b>       | In Class   |
| <b>Feedback Provided</b>   | Returned Work - .  |

In 2018, the University of Newcastle will undergo its 5 yearly accreditation cycle with Engineers Australia and the Australian Computer Society. Part of this routine process is the collection of a sample of student assignments over a 1+ year period. The objective is to provide the accrediting panel an indication of educational rigour across all courses. In 2017, we will commence collecting sample assignments from each and every assessment task, across the full spectrum of marks. They will be provided to the panel but not de-identified. If you object to your assignment being retained with your name associated, please indicate this on the submission, and if retained, we will de-identify your paper. All papers will be destroyed at the completion of the accreditation process.

# GRADUATE PROFILE STATEMENTS

This course builds students capacity in the following University of Newcastle Bachelor of Computer Science Graduate Profile Statements:

|    | University of Newcastle Computer Science Graduate Profile Statements  | Taught | Practised | Assessed | Level of Capability |
|----|---|--------|-----------|----------|---------------------|
| 1  | Knowledge of basic science and computer science fundamentals.   |        |           |          |                     |
| 2  | In depth technical competence in the discipline of computer science   | ☑      | ☑         | ☑        | 2                   |
| 3  | An ability to carry out problem analysis, requirements capture, problem formulation and integrated software development for the solution of a problem.  |        |           |          |                     |
| 4  | Capacity to continue developing relevant knowledge, skills and expertise in computer science throughout their careers.  |        |           |          |                     |
| 5  | An ability to communicate effectively with other Computer Scientists, Software Engineers, other professional disciplines, managers and the community generally.                                       | ☑      | ☑         | ☑        | 2                   |
| 6  | Ability to undertake and co-ordinate large computer science projects and to identify problems, their formulation and solution.  |        |           |          |                     |
| 7  | Ability to function effectively as an individual, a team member in multidisciplinary and multicultural teams and as leader/manager with capacity to assist and encourage those under their direction. |        |           |          |                     |
| 8  | Understanding of social, cultural, global and business opportunities of the professional computer scientist; understanding the need for and principles of sustainability and adaptability             |        |           |          |                     |
| 9  | Understanding of professional and ethical responsibilities and a commitment to them.  |        |           |          |                     |
| 10 | Understanding of entrepreneurship; need of and process of innovation, as well as the need of and capacity for lifelong learning.  |        |           |          |                     |

This course builds students' capacity in the following University of Newcastle Bachelor of Engineering Graduate Profile Statements (based on 2011 Engineers Australia revised Stage 1 Competency Standards for Professional Engineers - Graduate Attributes):

| University of Newcastle Bachelor of Engineering Graduate Profile Statements  | Taught | Practised | Assessed | Level of capability |
|--|--------|-----------|----------|---------------------|
| 1.1 Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline. |        |           |          |                     |

|   |   |   |   |   |
|---|---|---|---|---|
| 1.2 Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline. |   |   |   |   |
| 1.3 In-depth understanding of specialist bodies of knowledge within the engineering discipline.   | ☑ | ☑ | ☑ | 2 |
| 1.4 Discernment of knowledge development and research directions within the engineering discipline.   |   |   |   |   |
| 1.5 Knowledge of engineering design practice and contextual factors impacting the engineering discipline.   |   |   |   |   |
| 1.6 Understanding of the scope, principles, norms, accountabilities and bounds of sustainable engineering practice in the specific discipline.                    |   |   |   |   |
| 2.1 Application of established engineering methods to complex engineering problem solving.  |   |   |   |   |
| 2.2 Fluent application of engineering techniques, tools and resources.  |   |   |   |   |
| 2.3 Application of systematic engineering synthesis and design processes.   |   |   |   |   |
| 2.4 Application of systematic approaches to the conduct and management of engineering projects.   |   |   |   |   |
| 3.1 Ethical conduct and professional accountability.  |   |   |   |   |
| 3.2 Effective oral and written communication in professional and lay domains.   | ☑ | ☑ | ☑ | 2 |
| 3.3 Creative, innovative and pro-active demeanour.  |   |   |   |   |
| 3.4 Professional use and management of information.   |   |   |   |   |
| 3.5 Orderly management of self, and professional conduct.   |   |   |   |   |
| 3.6 Effective team membership and team leadership.  |   |   |   |   |



# ADDITIONAL INFORMATION

## Grading Scheme

This course is graded as follows:

| Range of Marks | Grade                 | Description  |
|----------------|-----------------------|--|
| 85-100         | High Distinction (HD) | Outstanding standard indicating comprehensive knowledge and understanding of the relevant materials; demonstration of an outstanding level of academic achievement; mastery of skills*; and achievement of all assessment objectives.          |
| 75-84          | Distinction (D)       | Excellent standard indicating a very high level of knowledge and understanding of the relevant materials; demonstration of a very high level of academic ability; sound development of skills*; and achievement of all assessment objectives.  |
| 65-74          | Credit (C)            | Good standard indicating a high level of knowledge and understanding of the relevant materials; demonstration of a high level of academic achievement; reasonable development of skills*; and achievement of all learning outcomes.            |
| 50-64          | Pass (P)              | Satisfactory standard indicating an adequate knowledge and understanding of the relevant materials; demonstration of an adequate level of academic achievement; satisfactory development of skills*; and achievement of all learning outcomes. |
| 0-49           | Fail (FF)             | Failure to satisfactorily achieve learning outcomes. If all compulsory course components are not completed the mark will be zero. A fail grade may also be awarded following disciplinary action.  |

\*Skills are those identified for the purposes of assessment task(s).

## Communication Methods

Communication methods used in this course include:

- Blackboard Course Site: Students will receive communications via the posting of content or announcements on the Blackboard course site.

## Course Evaluation

Each year feedback is sought from students and other stakeholders about the courses offered in the University for the purposes of identifying areas of excellence and potential improvement.

As a result of student feedback, the following changes have been made to this offering of the course:

- Minor adjustment and update in the lectures for improving the delivery.

## Academic Misconduct

All students are required to meet the academic integrity standards of the University. These standards reinforce the importance of integrity and honesty in an academic environment. Academic Integrity policies apply to all students of the University in all modes of study and in all locations. For the Student Academic Integrity Policy, refer to <https://policies.newcastle.edu.au/document/view-current.php?id=35>.

## Adverse Circumstances

You are entitled to apply for special consideration because adverse circumstances have had an impact on your performance in an assessment item. This includes applying for an extension of time to complete an assessment item. Prior to applying you must refer to the Adverse Circumstances Affecting Assessment Items Procedure, available at <https://policies.newcastle.edu.au/document/view-current.php?id=236>. All applications for Adverse Circumstances must be lodged via the online Adverse Circumstances system, along with supporting documentation.

## Important Policy Information

The 'HELP for Students' tab in UoNline contains important information that all students should be familiar with, including various systems, policies and procedures.

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**Other Information**

1. The course is delivered in a semi-flip mode. Every week a couple of videos on core concepts will be released in the blackboard. Students are expected to watch those videos before they attend the lectures. The lectures are delivered with the assumption that students are familiar with those concepts in the video. The basic ideas learnt from these videos will enable students to have a better engagement in the lectures and tutorials.
2. Students are strongly advised to attend lectures and workshops in order to gain a full understanding of the theoretical and practical skills required in this discipline.
3. The teaching schedule is subject to change. Changes will be posted on Blackboard.
4. Detailed assessment criteria for each assessment task and any additional material will be available on the course Blackboard site no less than two weeks prior to the due date of each assessment.
5. The assignments and midterm will be returned but it is strongly recommended that students should keep a copy of any material submitted.
6. The marks will be available in Blackboard. If you have any questions about the marking, discuss it with your demonstrator and if necessary with the course coordinator.

*This course outline was approved by the Head of School. No alteration of this course outline is permitted without Head of School approval. If a change is approved, students will be notified and an amended course outline will be provided in the same manner as the original.*

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