School of Science, Computing and Engineering Technologies

SWINBURNE UNIVERSITY OF TECHNOLOGY

Unit Outline

COS30008

Data Structures and Patterns

Swinburne Vietnam - Semester September 2024

Please read this Unit Outline carefully. It includes:

PART A Unit summary

PART B Your Unit in more detail

PART C Further information

PART A: Unit Summary

Unit Code(s)		COS30008
Unit Title		Data Structures and Patterns
Duration		1 Semester or equivalent
Total Contact Hours		48
Requisites:		
	Pre-requisites	COS20007 Object-Oriented Programming, or COS30016 Programming in Java, or COS20011 Software Development in Java
	Co-requisites	Nil
	Concurrent pre-requisites	Nil
	Anti-requisites	Nil
	Assumed knowledge	Nil
Credit Points		12.5
Campus/Location		Da Nang
Mode of Delivery		Blended
Assessment Summary		Assignments (individual) 25%, Midterm (individual) 25%, Final Examination (individual) 50%

Aims

COS30008 – Data Structures and Patterns studies the design, implementation, and application of data structures as a means for algorithmic problem solving. Each problem exhibits specific characteristics with respect to resource requirements, data representation, and software architecture. The study of data structures is primarily concerned with the following questions:

- How can a given problem be effectively expressed?
- What are suitable data representations for specifying computational processes?
- What is the impact of data and its representation with respect to time and space consumption?
- What are the reoccurring structural artefacts in software and how can we identify them in order to facilitate problem solving?

Unit Learning Outcomes

Students who successfully complete this unit should be able to:

1. Solve problems using object oriented design and implementation techniques.
2. Interpret the trade-offs and issues involved in the design, implementation, and application of various data structures with respect to a given problem.
3. Design, implement, and evaluate software solutions using behavioural, creational, and structural software design patterns.
4. Explain the purpose and answer questions about data structures and design patterns that illustrate strengths and weaknesses with respect to resource consumption.
5. Assess the impact of data structures on algorithms.
6. Evaluate algorithm designs and perform best-, average-, and worst-case analysis.

Swinburne Engineering Competencies for this Unit of Study

This Unit of Study will contribute to you attaining the following Swinburne Engineering Competencies:

- **Basic Science**: Proficiently applies concepts, theories and techniques of the relevant natural and physical sciences.
- **Maths and IT as Tools**: Proficiently uses relevant mathematics and computer and information science concepts as tools.
- **Discipline Specific**: Proficiently applies advanced technical knowledge of the specific discipline within that context.
- **Emerging Disciplinary Trends**: Interprets and applies current or emerging knowledge from inside and outside the specific discipline.
- **Professional Practice**: Appreciates the principles of professional engineering practice in a sustainable context.
- **Engineering Methods**: Applies engineering methods in practical applications.
- **Problem Solving**: Systematically uses engineering methods in solving complex problems.
- **Design**: Systematically uses engineering methods in design.
- **Communication**: Demonstrates effective communication to professional and wider audiences.

Graduate Attributes

This unit may contribute to the development of the following Swinburne Graduate Attributes:

- Communication skills
- Teamwork skills
- Digital literacies

Content

- Introduction
  - Basic concepts and data type construction in C++
  - Sets, arrays, indexer, and iterators
  - Asymptotic algorithm analysis
- Fundamental Data Structures
  - Dynamic arrays
  - Single-linked lists
- Data Types and Abstraction
  - Abstract data types
  - Design patterns
  - Pointers
  - Memory management
- Basic Container Types
  - Stacks
  - Queues
  - Ordered lists
  - Hash tables
- Hierarchical Data Types
  - Trees
  - Graphs
  - Tree traversals
- Algorithmic Patterns and Problem Solvers
  - Basics
  - Performance analysis
  - Greedy algorithms
  - Backtracking

- Divide-and-Conquer

PART B: Your Unit in more detail

Unit Improvements

Feedback provided by previous students through the Student Survey has resulted in improvements that have been made to this unit. Recent improvements include:

- The contents and assessment material is being continuously revised to incorporate selected features of the latest C++ standard into the unit. Presently, C++17 is now supported by all mainstream C++ compilers and C++ standard libraries. Hence, COS30008 uses C++17 a reference standard.

Unit Teaching Staff

Name	Role	Email	Consultation Times
Dr Phan Thanh Tra	Unit Convenor and Lecturer	thanhtraphan@swin.edu.au	Appointment by email

Resources and Reference Material

- Stanley B. Lippman, Josée Lajoie, and Barbara E. Moo: C++ Primer. 5th Edition.
- Jeffrey S. Childs: C++ Classes and Data Structures.
- Kurt Mehlhorn and Peter Sanders: Algorithms and Data Structures – The Basic Toolbox
- Kenneth H. Rosen: Discrete Mathematics and Its Applications.
- Scott Meyers: Effective Modern C++
- Anthony Williams: C++ Concurrency in Action
- Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein: Introduction to Algorithms. 3rd Edition.
- Nicolai M. Josuttis: The C++ Standard Library - A Tutorial and Reference.
- Erich Gamma, Richard Helm, Ralph Johnson, and John Vlissides, Design Patterns.
- Frank Buschmann, Regine Meunier, Hans Rohnert, Peter Sommerlad, and Michael Stal, Pattern-Oriented Software Architecture: A System of Patterns.
- Kenneth A. Berman and Jerome L. Paul: Algorithms: Sequential, Parallel, and Distributed.
- Russ Miller and Laurence Boxer: Algorithms Sequential and Parallel - A Unified Approach. 2nd Edition.
- Gary J. Bronson: Program Development and Design Using C++, 3rd Edition.

Additional references will be given occasionally during the semester.

Canvas Site for this Unit of Study

Important information concerning this unit of study is placed on the Swinburne course management system (Canvas), accessible via https://swinburne.instructure.com/ Canvas is updated regularly with important unit information and communications. It is your responsibility to access

- the Canvas site for your unit of study,
- the Announcements section on Canvas, and
- any emails sent by the teaching staff to your student email address via Canvas.

If you access your email through a provider other than Swinburne, it is your responsibility to ensure that your Swinburne email is redirected to your private email address.

Assessment

There will be regularly scheduled problem sets and programming assignments to help you learn the material and to allow us to evaluate your progress.

a) Assessment Overview

Problem sets will be handed out roughly every week or two. Most assignments will require laboratory work. You should expect to work on a problem set between two and four hours. If you have trouble finding a solution, ask for help! All assignments are fair and reasonable. No problem set will require more than six hours. Handouts for all problem sets will be made available online.

Assessment Task	Individual/ Group Task	Related Learning Objective(s)	Weighting	Due Date
4	Individual	1-6	25%	As specified on the assignment handouts
Midterm assessment (2h)	Individual	1-5	25%	Week 8 (tentatively)
Final Examination (2h)	Individual	1-5	50%	Exam period

Your grade is independent of anyone else's grade in this class. That is, we do not grade on a curve, and everyone can get an HD. Our purpose in grading is to uphold a standard of quality and to give you feedback: it is not to rank students.

The final grade is calculated as follows:

Final grade:	25% homework grade
	25% mid-term assessment grade
	50% final exam grade

All problem sets are equally weighted. In general, every problem set is worth a different number of points. The maximum number of points equals 100%. You receive one grade for all problem sets, which calculated as follows:

Homework grade = sum of all homework's / number of homework's

Example:

- Problem set 1: 50 out of 75 = 67%
- Problem set 2: 67 out of 80 = 84%
- Problem set 3: 89 out of 90 = 99%

Grade: 67% + 84% + 99% / 3 = 83%

Occasionally, you may earn some extra marks for a problem set, if this problem set is particular challenging. Therefore, the final homework grade may be greater that 100%. Extra marks can help you to improve your final grade. However, your aggregated final mark cannot exceed 100.

b) Minimum requirements to pass this Unit

There will be one mid-term test and a final exam. The final grade for the course will be weighted towards exams.

To pass this unit, you must:

- achieve an overall mark for the unit of 50% or more, and
- achieve at least 40% in the final exam

Students who do not achieve at least 40% for the final exam, will receive a maximum of 44% as the total mark for the unit and will not be eligible for a conceded pass.

Failure to submit assignment work may lead to disqualification from special examinations.

c) Final Assessment Period

If the unit you are enrolled in has a final assessment (including invigilated exams), you will be expected to be available for the entire final assessment period including any Special Exam period.

If the unit you are enrolled in has an official examination, you will be expected to be available for the entire examination period including any Special Exam period.

The final examination is open book and will be conducted online.

d) Submission Requirements

Homework problems are due **electronically** at the date and time specified on the handouts. For submission, COS30008 uses Canvas and the submission window is timed. In general, problem sets are due **at the start of the lecture**. If you have problems with a particular assignment, talk to the instructor before the deadline. No submissions will be accepted after the lecture, unless there are unforeseen circumstances outside the control of students.

Every problem set will have its own cover sheet to be used when submitting your assignment. **Please provide your name, student id, and tutorial session where indicated on the assignment cover sheet.**

Students must retain all assessed material that contributes to the final result up until such time as the final results are published.

e) Extensions and Late Submission

Extensions will only be granted in exceptional circumstances on medical or compassionate grounds. Extensions must be applied for in advance of the assignment's due date (Doctors certificate must be provided).

Absolutely no marks for late homework will be given at any time, unless otherwise negotiated in advance with the subject convener!

Late assignment submissions will not be marked.

f) Referencing

To avoid breaching academic integrity, you are required to provide references whenever you include information from other sources in your work and acknowledge when you have used Artificial Intelligence (AI) tools (such as ChatGPT).

Further details regarding plagiarism are available in Section C of this document.

You need to acknowledge the origin and authorship of any code not written by you.

Helpful information on referencing can be found at http://www.swinburne.edu.au/library/referencing/

g) Groupwork Guidelines

There are no group assessment tasks in this unit.

You can work in groups to tackle problem sets. **However, your contribution to the solution must be original and not just echo group consensus.**

PART C: FURTHER INFORMATION

For further information on any of the below topics, refer to Swinburne's Current Students web page http://www.swinburne.edu.au/student/.

Student behaviour and wellbeing

All students are expected to: act with integrity, honesty and fairness; be inclusive, ethical and respectful of others; and appropriately use University resources, information, equipment and facilities. All students are expected to contribute to creating a work and study environment that is safe and free from bullying, violence, discrimination, sexual harassment, vilification and other forms of unacceptable behaviour.

The Student Charter describes what students can reasonably expect from Swinburne in order to enjoy a quality learning experience. The Charter also sets out what is expected of students with regards to your studies and the way you conduct yourself towards other people and property.

You are expected to familiarise yourself with University regulations and policies and are obliged to abide by these, including the Student Academic Misconduct Regulations, Student General Misconduct Regulations and the People, Culture and Integrity Policy. Any student found to be in breach of these may be subject to disciplinary processes.

Examples of expected behaviours are:

- conducting yourself in teaching areas in a manner that is professional and not disruptive to others
- following specific safety procedures in Swinburne laboratories, such as wearing appropriate footwear and safety equipment, not acting in a manner which is dangerous or disruptive (e.g. playing computer games), and not bringing in food or drink
- following emergency and evacuation procedures and following instructions given by staff/wardens in an emergency response

Canvas

You should regularly log on to the Swinburne learning management system, Canvas. You can access Canvas via the Student login webpage or https://swinburne.instructure.com/ Canvas is updated regularly with important unit information and communications.

Communication

All communication will be via your Swinburne email address. If you access your email through a provider other than Swinburne, then it is your responsibility to ensure that your Swinburne email is redirected to your private email address.

Academic Integrity

Academic integrity is about taking responsibility for your learning and submitting work that is honestly your own. It means acknowledging the ideas, contributions and work of others; referencing your sources and acknowledging the use of artificial intelligence tools (such as ChatGPT, DALLE, Midjourney); contributing fairly to group work; and completing tasks, tests and exams without cheating. Artificial intelligence tools should only be used where approved by the Unit Convenor.

Swinburne University uses the Turnitin system, which helps to identify inadequate citations, poor paraphrasing and unoriginal work in assignments that are submitted via Canvas. Your Unit Convenor will provide further details.

Plagiarising, cheating and seeking an unfair advantage in a test, exam or assessment task are all breaches of academic integrity and treated as academic misconduct. Examples of breaches of academic integrity include:

- using the whole or part of computer program written by another person as your own without appropriate acknowledgement
- copying the whole or part of somebody else's work in an assessment, including material from a published work, a website or database, a set of lecture notes, current or past student's work, or any other person's work
- using output from artificial intelligence tools (e.g. ChatGPT) in whole or part without acknowledgement and/or without the approval of the Unit Convenor
- poorly paraphrasing somebody else's work
- using a musical composition or audio, visual, graphic and photographic work created by another without acknowledgment
- using objects, artefacts, costumes or models created by another person and presenting them as your own
- submitting assessments that have been developed by another person or service (paid or unpaid), referred to as contract cheating
- presenting or submitting assignments or other work in conjunction with another person or group of people when that work should be your own independent work.
- enabling others to cheat, including letting another student copy your work or by giving access to a draft or completed assignment.

The penalties for academic misconduct can be severe, ranging from a zero grade for an assessment task through to exclusion from Swinburne.

For further details, see https://www.swinburne.edu.au/student-login/academic-integrity/

Student support

Swinburne offers a range of services and resources to help you complete your studies successfully. Your Unit Convenor or studentHQ can provide information about the study support and other services available for Swinburne students. See https://www.swinburne.edu.au/life-at-swinburne/student-support-services/ for further information.

Special consideration

If your studies have been adversely affected due to serious and unavoidable circumstances outside of your control (e.g. severe illness or unavoidable obligation), you may be able to apply for special consideration (SPC).

Applications for Special Consideration are submitted via the SPC online tool normally no later than 5.00pm on the third working day after the submission/sitting date for the relevant assessment component. See https://www.swinburne.edu.au/life-at-swinburne/student-support-services/special-consideration-assistance/

Accessibility needs

Sometimes students with a disability, a mental health or medical condition or significant carer responsibilities require reasonable adjustments to fully access and participate in education. Swinburne's AccessAbility Services can develop an 'Education Access Plan' that includes the services and reasonable adjustments that you need. The plan makes recommendations to University teaching and examination staff.

It is recommended that you register with AccessAbility Services within one week after the commencement of your unit to allow the University to make reasonable adjustments.

Review of marks

An independent marker reviews all fail grades for major assessment tasks. In addition, a review of assessment is undertaken if your final result is between 45 and 49 or within 2 marks of any grade threshold.

You can ask the Unit Convenor to check the result for an assessment item or your final result. Your request must be made in writing within 10 working days of receiving the result. The Unit Convenor

can discuss the marking criteria with you and check the aggregate marks of assessment components to identify if an error has been made. This is known as local resolution.

If you are dissatisfied with the outcome of the local resolution, you can lodge a formal complaint.

Feedback, complaints and suggestions

In the first instance, discuss any issues with your Unit Convenor. If your concerns are not resolved or you would prefer not to deal with your Unit Convenor, then you can complete a feedback form.

See https://www.swinburne.edu.au/corporate/feedback/

Advocacy

Should you require assistance with any academic issues, University statutes, regulations, policies, and. procedures, you are advised to seek advice from Student HQ or Academic Department.