



UNSW Course Outline

COMP9312 Data Analytics for Graphs - 2024

Published on the 23 May 2024

General Course Information

Course Code : COMP9312

Year : 2024

Term : Term 2

Teaching Period : T2

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

Graphs are ubiquitous and are widely used to capture relationships between different entities in real-world applications. However, compared with traditional sequential data (e.g. text and audio), the unstructured property and the sparsity make processing big graphs very challenging. The

course will introduce a series of data structures and algorithms for graph processing in terms of database (i.e., big data) and deep learning. Fundamental methods and the state-of-the-art research works will be integrated. The course will serve as a launching pad for those interested in graph analytics, big data processing and graph neural networks.

Data structures and algorithms are the building blocks of many complex systems and software. Certain fundamental graph algorithms such as Dijkstra's algorithm and depth-first search have been covered by many text books and compulsory courses. They may be discussed in terms of pseudocode and time complexity. This course will start from studying how to efficiently implement the fundamental algorithms in big graphs. Then, the course explores more challenging and more complex algorithms step-by-step. When dealing with big graphs, we may consider various scenarios such as external memory solutions, distributed solutions, multi-core solutions, etc.

The course also puts some attention to graph neural networks, which is a hotspot in the area of AI and deep learning. The course will not study theoretical details about machine learning and deep learning but just introduce several representative graph neural networks. The students will play with basic graph learning tasks and understand learning-based techniques for graph problems such as link prediction and node classification.

Course Aims

The course aims to reinforce students' understanding of important graph algorithms and data structures, as well as building their capabilities in designing algorithms for big data processing. In particular, the course will improve students' ability to analyze time complexity, identify potential optimisations, and work on real problems. At the end of this course, you should be in a position where you could write efficient code to solve a complex graph problem. Some of you might even be at the stage where you could do research in the area of big graph processing and graph-based interdisciplinary problems.

Course Learning Outcomes

| Course Learning Outcomes |
|---|
| CL01 : Evaluate data structures to store and represent graphs |
| CL02 : Analyze fundamental graph traversal techniques |
| CL03 : Analyze cohesive subgraph models and their representative computation algorithms |
| CL04 : Understand basic machine learning methods |
| CL05 : Apply techniques for graph neural networks |

| Course Learning Outcomes | Assessment Item |
|---|---|
| CLO1 : Evaluate data structures to store and represent graphs | <ul style="list-style-type: none"> • Assignment 1 • Project 1 • Final Exam |
| CLO2 : Analyze fundamental graph traversal techniques | <ul style="list-style-type: none"> • Assignment 1 • Project 1 • Final Exam |
| CLO3 : Analyze cohesive subgraph models and their representative computation algorithms | <ul style="list-style-type: none"> • Project 1 • Final Exam |
| CLO4 : Understand basic machine learning methods | <ul style="list-style-type: none"> • Assignment 2 • Final Exam |
| CLO5 : Apply techniques for graph neural networks | <ul style="list-style-type: none"> • Assignment 2 • Final Exam |

Learning and Teaching Technologies

Moodle - Learning Management System

Assessments

Assessment Structure

| Assessment Item | Weight | Relevant Dates |
|---|--------|--|
| Assignment 1 Assessment Format: Individual | 15% | Start Date: Week 2 Due Date: Week 4: 17 June - 23 June |
| Project 1 Assessment Format: Individual | 25% | Start Date: Week 5 Due Date: Week 8: 15 July - 21 July |
| Assignment 2 Assessment Format: Individual | 10% | Start Date: Week 9 Due Date: Week 10: 29 July - 04 August |
| Final Exam Assessment Format: Individual | 50% | Due Date: During Exam Period |

Assessment Details

Assignment 1

Assessment Overview

You are expected to prepare a document to answer 6–10 written questions in 2 weeks. The questions include analysing the time complexity of given code, presenting the intermediate process of certain algorithms, and designing solutions for small real problems.

The assessment paper will be provided via Webcms with notification emails. You are expected to submit solutions on Moodle. Marking will be against specific criteria in a marking guide. Results and formal feedback on your assessment task will be provided within two weeks of the relevant submission date through Moodle.

Course Learning Outcomes

- CL01 : Evaluate data structures to store and represent graphs
- CL02 : Analyze fundamental graph traversal techniques

Project 1

Assessment Overview

You are expected to design solutions for 2 or 3 real graph problems in 4 weeks. For each problem, you need to provide a Python implementation of your solution with an additional documentation to describe your idea and analyse your algorithm (e.g., time complexity and index space complexity).

The assessment paper will be provided via Webcms with notification emails. You are expected to submit solutions on Moodle. Marking will be against specific criteria in a marking guide. Results and formal feedback on your assessment task will be provided within two weeks of the relevant submission date through Moodle.

Course Learning Outcomes

- CL01 : Evaluate data structures to store and represent graphs
- CL02 : Analyze fundamental graph traversal techniques
- CL03 : Analyze cohesive subgraph models and their representative computation algorithms

Assignment 2

Assessment Overview

You are expected to prepare a document to answer 5–8 written questions in two weeks. The questions include presenting the intermediate process of certain algorithms and justifying claims about certain graph concepts.

The assessment paper will be provided via Webcms with notification emails. You are expected to submit solutions on Moodle. Marking will be against specific criteria in a marking guide. Results and formal feedback on your assessment task will be provided within two weeks of the relevant submission date through Moodle.

Course Learning Outcomes

- CL04 : Understand basic machine learning methods
- CL05 : Apply techniques for graph neural networks

Final Exam

Assessment Overview

The final exam contains 8–10 questions. The questions are of various types, such as designing solutions for real problems and analyzing time complexity.

The exam will be held in the UNSW exam period.

Course Learning Outcomes

- CL01 : Evaluate data structures to store and represent graphs
- CL02 : Analyze fundamental graph traversal techniques
- CL03 : Analyze cohesive subgraph models and their representative computation algorithms
- CL04 : Understand basic machine learning methods
- CL05 : Apply techniques for graph neural networks

General Assessment Information

Grading Basis

Standard

Course Schedule

| Teaching Week/Module | Activity Type | Content |
|------------------------------|---------------|--|
| Week 1 : 27 May - 2 June | Lecture | Course Introduction & Graph Storage |
| Week 2 : 3 June - 9 June | Lecture | Graph Storage & Graph Traversal |
| Week 3 : 10 June - 16 June | Lecture | Graph Traversal |
| Week 4 : 17 June - 23 June | Lecture | Graph Traversal & Reachability |
| Week 5 : 24 June - 30 June | Lecture | Shortest Distance & Path |
| Week 7 : 8 July - 14 July | Lecture | Subgraph Query Processing |
| Week 8 : 15 July - 21 July | Lecture | Distributed Graph Systems & Deep Learning Basics |
| Week 9 : 22 July - 28 July | Lecture | Node Embedding & Graph Neural Networks |
| Week 10 : 29 July - 4 August | Lecture | Graph Neural Networks & Graph Database |

Attendance Requirements

Please note that lecture recordings are not available for this course. Students are strongly encouraged to attend all classes and contact the Course Authority to make alternative arrangements for classes missed.

Course Resources

Prescribed Resources

Lectures

Reference Python Codes

Tutorials

Private Help Sessions

Recommended Resources

Textbook: Introduction to Algorithms by Cormen Thomas H

Course Evaluation and Development

In past feedback, some students mentioned that the algorithm for reachability query processing is not clear enough. In this term, we have revised the slides by adding more examples.

Staff Details

| Position | Name | Email | Location | Phone | Availability | Equitable Learning Services Contact | Primary Contact |
|----------|----------|-------|----------|-------|--------------|-------------------------------------|-----------------|
| | Dong Wen | | | | | Yes | 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 policies. 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. 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 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

- 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

- 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.