UNSW Course Outline

TELE4642 Network Performance - 2024

Published on the 21 May 2024

General Course Information

Course Code : TELE4642
Year : 2024
Term : Term 2
Teaching Period : T2
Is a multi-term course? : No
Faculty : Faculty of Engineering
Academic Unit : School of Electrical Engineering & Telecommunications
Delivery Mode : In Person
Delivery Format : Standard
Delivery Location : Kensington
Campus : Sydney
Study Level : Postgraduate, Undergraduate
Units of Credit : 6

Useful Links

Handbook Class Timetable

Course Details & Outcomes

Course Description

This is an advanced course about modelling and managing the performance of communication networks such as the Internet. You will learn about formal methods and practical technologies to measure and improve the performance of computer networks.

This course aims to develop an understanding of methods and technologies for understanding and improving the performance of communication networks such as the Internet. It will introduce students to quantitative methods for loss and delay analysis in packet networks, using techniques from stochastic traffic modelling, Markov chains, and queueing theory. Additionally, it will expose students to frameworks for optimisation and orchestration of network performance, including emerging paradigms such as software-defined networking. The quantitative methods studied in this course will be applied to practical examples drawn from network architecture and design across various domains ranging from data centres and wide-area networks to home networks, mobile networks, and content-delivery networks.

Course Aims

This course provides you with engineering knowledge in the field of telecommunications, specifically emphasising the analysis of computer network system performance. By completing this course, you will achieve the following:

- Understand methods and technologies utilised in assessing and improving the performance of data networks like the Internet.
- Apply techniques from stochastic traffic modelling, Markov chains, and queueing theory to quantify loss and delay metrics within packet networks.
- Construct frameworks for optimising and orchestrating network performance, including emerging paradigms such as software-defined networking.

Course Learning Outcomes

Course Learning Outcomes
CLO1 : Identify the causes of poor performance (losses and delays) in computer networks
CLO2 : Quantify the performance of simple network systems by developing appropriate analytical models
CLO3 : Critique emerging technologies used by Internet Service Providers for offering Quality of Service (QoS) to Internet traffic
CLO4 : Construct and evaluate practical tools for performance evaluation

Course Learning Outcomes	Assessment Item
CLO1 : Identify the causes of poor performance (losses and delays) in computer networks	• Final Exam • Quizzes • Laboratory Practical Experiments • Project
CLO2 : Quantify the performance of simple network systems by developing appropriate analytical models	• Final Exam • Quizzes • Laboratory Practical Experiments • Project
CLO3 : Critique emerging technologies used by Internet Service Providers for offering Quality of Service (QoS) to Internet traffic	• Final Exam • Quizzes • Laboratory Practical Experiments • Project
CLO4 : Construct and evaluate practical tools for performance evaluation	• Final Exam • Quizzes • Laboratory Practical Experiments • Project

Learning and Teaching Technologies

Moodle - Learning Management System

Other Professional Outcomes

Engineers Australia (EA), Professional Engineer Stage 1 Competencies

The Course Learning Outcomes (CLOs) contribute to your development of the following EA competencies:

PE1: Knowledge and Skill Base:

PE1.1 Comprehensive, theory-based understanding of underpinning fundamentals: CLO 1, 2, 3, 4

PE1.2 Conceptual understanding of underpinning maths, analysis, statistics, computing: CLO 1, 2, 3, 4
PE1.3 In-depth understanding of specialist bodies of knowledge: CLO 1, 2, 3, 4
PE1.4 Discernment of knowledge development and research directions: n/a
PE1.5 Knowledge of engineering design practice: CLO 1, 2, 3, 4
PE1.6 Understanding of scope, principles, norms, accountabilities of sustainable engineering practice: n/a

PE2: Engineering Application Ability:
PE2.1 Application of established engineering methods to complex problem solving: CLO 1, 2, 3, 4
PE2.2 Fluent application of engineering techniques, tools and resources: CLO 1, 2, 3, 4
PE2.3 Application of systematic engineering synthesis and design processes: n/a
PE2.4 Application of systematic approaches to the conduct and management of engineering projects: n/a

PE3: Professional and Personal Attributes:
PE3.1 Ethical conduct and professional accountability: n/a
PE3.2 Effective oral and written communication (professional and lay domains): CLO 4
PE3.3 Creative, innovative and pro-active demeanour: CLO 4
PE3.4 Professional use and management of information: CLO 1, 2, 4
PE3.5 Orderly management of self, and professional conduct: n/a
PE3.6 Effective team membership and team leadership: CLO 4

Targeted Graduate Capabilities

Electrical Engineering and Telecommunications programs are designed to address the following targeted capabilities, which were developed by the school in conjunction with the requirements of professional and industry bodies:

- The ability to apply knowledge of basic science and fundamental technologies;
- The skills to communicate effectively, not only with engineers but also with the wider community;
- The capability to undertake challenging analysis and design problems and find optimal solutions;
- Expertise in decomposing a problem into its constituent parts, and in defining the scope of each part;
- Working knowledge of how to locate required information and use information resources to their maximum advantage;
- Proficiency in developing and implementing project plans, investigating alternative solutions,

and critically evaluating differing strategies;
- An understanding of the social, cultural and global responsibilities of the professional engineer; ability to work effectively as an individual or in a team;
- An understanding of professional and ethical responsibilities;
- The ability to engage in lifelong independent and reflective learning.

UNSW Graduate Capabilities

The course delivery methods and course content directly or indirectly address a number of core UNSW graduate capabilities, as follows:

- Developing scholars who have a deep understanding of their discipline through lectures and solutions to analytical problems in tutorials and assessed by assignments and written examinations.
- Developing rigorous analysis, critique, and reflection, and the ability to apply knowledge and skills to solving problems. These will be achieved by laboratory experiments and interactive checkpoint assessments and lab exams during the labs.
- Developing digital and information literacy and lifelong learning skills through assignment work.
- Developing independent, self-directed professionals who are enterprising, innovative, creative and responsive to change through challenging design and project tasks.

Additional Course Information

Credits

This is a 6 UoC course, and the expected workload is 15 hours per week throughout the 10-week term. It includes lectures and laboratories. Supervised labs are held 2 hours per week; however, you will be expected to work on the assignments and projects outside of designated lab hours.

Relationship to Other Courses

This is a 4th-year undergraduate elective course in the School of Electrical Engineering and Telecommunications.

Pre-requisites and Assumed Knowledge

The course **TELE3118** (Network Technologies) is a prerequisite for this course. Knowledge of data networking protocol architectures is assumed, since this course develops techniques for the design and performance analysis of such architectures. In addition, it is expected that the student is conversant with basic probability and statistics and comfortable with programming (preferably in C, Java, or Python).

Following Courses

The course is not a prerequisite for other courses in the school of faculty.

Workload

It is expected that you will spend at least 15 hours per week studying a 6 UoC course from Week 1 until the final assessment, including both online classes and independent, self-directed study. In periods where you need to complete assignments or prepare for examinations, the workload may be greater. Over-commitment has been a common source of failure for many students. You should take the required workload into account when planning how to balance study with employment and other activities.

Attendance

Regular and punctual attendance at all classes is expected. UNSW regulations state that if students attend less than 80% of scheduled classes they may be refused final assessment.

General Conduct and Behaviour

Consideration and respect for the needs of your fellow students and teaching staff is an expectation. Conduct which unduly disrupts or interferes with a class is not acceptable and students may be asked to leave the class.

Assessments

Assessment Structure

Assessment Item	Weight	Relevant Dates
Final Exam Assessment Format: Individual	40%	Start Date: Not Applicable Due Date: Not Applicable
Quizzes Assessment Format: Individual	30%	Start Date: Not Applicable Due Date: Not Applicable
Laboratory Practical Experiments Assessment Format: Group Short Extension: Yes (7 days)	20%	Start Date: Not Applicable Due Date: Not Applicable
Project Assessment Format: Group	10%	Start Date: Not Applicable Due Date: 02/08/2024 12:00 PM

Assessment Details

Final Exam

Assessment Overview

The 2-hour written final exam at the end of the term serves as the ultimate test of competency, encompassing all topics covered throughout the course. Marks will be allocated based on the accuracy of the responses provided.

Course Learning Outcomes

- CLO1 : Identify the causes of poor performance (losses and delays) in computer networks
- CLO2 : Quantify the performance of simple network systems by developing appropriate analytical models
- CLO3 : Critique emerging technologies used by Internet Service Providers for offering Quality of Service (QoS) to Internet traffic
- CLO4 : Construct and evaluate practical tools for performance evaluation

Assignment submission Turnitin type

This is not a Turnitin assignment

Quizzes

Assessment Overview

This course will include three one-hour in-class written quizzes distributed throughout the term. These quizzes are designed to assess your comprehension of the course material and provide valuable feedback on your progress. Each quiz is worth 10% of the final grade and will typically test your problem-solving skills. Marks will be assigned according to the correctness of the responses. Class-wide feedback will be verbally given during a later lecture session.

Course Learning Outcomes

- CLO1 : Identify the causes of poor performance (losses and delays) in computer networks
- CLO2 : Quantify the performance of simple network systems by developing appropriate analytical models
- CLO3 : Critique emerging technologies used by Internet Service Providers for offering Quality of Service (QoS) to Internet traffic
- CLO4 : Construct and evaluate practical tools for performance evaluation

Assessment information

This course will have three online timed written quizzes that will evaluate and provide feedback on your understanding of the material in this course. Quiz 1 will be held in week 3 (Wed 12 Jun), quiz 2 in week 7 (Wed 10 Jul), and quiz 3 in week 9 (Wed 24 Jul). Each quiz is worth 10% of the final grade, and each will typically test your problem-solving skills. Re-tests will not be granted in

the event that a student misses the test unless satisfactory written evidence is presented of adverse conditions that prevented the student from taking the test. In such a case, the course convenor may, at his sole discretion, conduct the re-test orally (instead of or in addition to a written component) individually with the student within two weeks of the original test date.

Assignment submission Turnitin type

This is not a Turnitin assignment

Laboratory Practical Experiments

Assessment Overview

The course includes lab assignments for which students are required to demonstrate their functional software, such as a simulator, a practical measurement tool, or a network application, in the lab environment. Students will work as a group of 2-3 students to develop their software by reading the handouts posted on the course web page. Lab assignments are equally weighted.

Although this is a group activity, the assessment will be conducted individually. Grading will be based on the correctness, functionality, and novelty of the design.

Course Learning Outcomes

- CLO1 : Identify the causes of poor performance (losses and delays) in computer networks
- CLO2 : Quantify the performance of simple network systems by developing appropriate analytical models
- CLO3 : Critique emerging technologies used by Internet Service Providers for offering Quality of Service (QoS) to Internet traffic
- CLO4 : Construct and evaluate practical tools for performance evaluation

Assignment submission Turnitin type

Not Applicable

Project

Assessment Overview

This project will be done in groups of up to 4 students and is designed to train you in conducting team research into a topic. Groups will choose from a given list of topics or propose their own in consultation with the course convenor. The chosen topic will be briefly presented to the class towards the end of the term. The final presentations will be conducted at the end of the term.

Although this is a group activity, the assessment will be conducted individually. Grading will be based on the technical quality of the presentation, working demo, handling questions, and the

submitted report.

Course Learning Outcomes

- CLO1 : Identify the causes of poor performance (losses and delays) in computer networks
- CLO2 : Quantify the performance of simple network systems by developing appropriate analytical models
- CLO3 : Critique emerging technologies used by Internet Service Providers for offering Quality of Service (QoS) to Internet traffic
- CLO4 : Construct and evaluate practical tools for performance evaluation

Assignment submission Turnitin type

Not Applicable

General Assessment Information

The assessment scheme in this course reflects the intention to assess your learning progress through the term. Ongoing assessment occurs through the lab checkpoints and quizzes.

Grading Basis

Standard

Course Schedule

Teaching Week/Module	Activity Type	Content
Week 1 : 27 May - 2 June	Lecture	Stochastic Processes, M/M/1 queueing model
	Laboratory	Lab 1: Queueing system simulation
Week 2 : 3 June - 9 June	Lecture	M/M/1 variants: finite storage, multiple servers, batch arrivals/departures
	Laboratory	Lab 1: Queueing system simulation
Week 3 : 10 June - 16 June	Lecture	Networks of queues
	Laboratory	Lab 2: SDN application
	Assessment	Quiz 1 (Wed 12 Jun)
Week 4 : 17 June - 23 June	Lecture	SDN concepts
	Laboratory	Lab 2: SDN application
Week 5 : 24 June - 30 June	Lecture	SDN platforms and control plane
	Laboratory	Lab 2: SDN application
Week 6 : 1 July - 7 July	Lecture	Flexibility Week - Revision discussions and activities
	Laboratory	Flexibility Week - Revision discussions and activities
Week 7 : 8 July - 14 July	Lecture	SDN use-cases
	Laboratory	Lab 3: Project
	Assessment	Quiz 2 (Wed 10 Jul)
Week 8 : 15 July - 21 July	Lecture	Discrete-Time Markov Chains (DTMC) concepts and application: Google Page Rank
	Laboratory	Lab 3: Project
Week 9 : 22 July - 28 July	Lecture	DTMC applications: Slotted Aloha and Randomised Routing
	Laboratory	Lab 3: Project
	Assessment	Quiz 3 (Wed 24 Jul)
Week 10 : 29 July - 4 August	Lecture	• QoS and traffic models • Review • Project presentations
	Laboratory	Lab 3: Project

Attendance Requirements

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

General Schedule Information

The course will be delivered in three modules:

(a) Wks 1-3: Continuous Markov Chain

(b) Wks 4-7: SDN Concepts and Platforms

(c) Wks 8-10: Discrete-Time Markov Chain

Course Resources

Prescribed Resources

There is no one prescribed textbook for this course. Material from the following books will be used and will be augmented with papers supplied via the course web page:

- Ivo Adan and Jacques Resing, "Queueing Theory", 2001, available online at no cost from the website http://www.win.tue.nl/~iadan/queueing.pdf
- Piet Van Mieghem, "Performance Analysis of Complex Networks and Systems", Cambridge University Press, 2006. This book is available in the bookshop. Some chapters of this book are available online free of charge at http://www.nas.ewi.tudelft.nl/people/Piet/bookPA.html
- Peter G. Harrison and Naresh M. Patel, "Performance Modelling of Communication Networks and Computer Architectures", Addison-Wesley, 1993.
- James F. Kurose and Keith W. Ross, "Computer Networking: A Top-Down Approach", Global Edition (7e), Pearson Higher Ed, 2016.
- Leonard Kleinrock, "Queueing Systems. Volume I: Theory", Wiley-Interscience, 1975.
- Papers and other reading material will be posted on the course web page https://subjects.ee.unsw.edu.au/tele4642/

Staff Details

Position	Name	Email	Location	Phone	Availability	Equitable Learning Services Contact	Primary Contact
Convenor	Hassan Habibi Gharakheili		Room 417, EE building (G17)	+61 (2) 9385 5176		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 Plagarism

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-specific Information

General Conduct and Behaviour

Consideration and respect for the needs of your fellow students and teaching staff is an expectation. Conduct which unduly disrupts or interferes with a class is not acceptable and students may be asked to leave the class.

Use of AI for assessments

Your work must be your own. If you use AI in the writing of your assessment, you must acknowledge this and your submission must be substantially your own work. More

information can be found on this website.

Workplace Health & Safety (WHS)

WHS for students and staff is of utmost priority. Most courses involve laboratory work. You must follow the rules about conduct in the laboratory. About COVID-19, advice can be found on this website.

School Contact Information

Consultations: Lecturer consultation times will be advised during the first lecture. You are welcome to email the tutor or laboratory demonstrator, who can answer your questions on this course and can also provide you with consultation times. ALL email enquiries should be made from your student email address with ELEC/TELExxxx in the subject line; otherwise they will not be answered.

Keeping Informed: Announcements may be made during classes, via email (to your student email address) and/or via online learning and teaching platforms – in this course, we will use Moodle https://moodle.telt.unsw.edu.au/login/index.php. Please note that you will be deemed to have received this information, so you should take careful note of all announcements.

Student Support Enquiries

For enrolment and progression enquiries please contact Student Services

Web

Electrical Engineering Homepage