



TELE4642

Network Performance

Session 1, 2009

SCHOOL OF ELECTRICAL ENGINEERING
AND TELECOMMUNICATIONS

Course staff

- Course convener and lecturer: Dr. Vijay Sivaraman
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Consultations

- Tuesdays 2pm—3pm
- Students are strongly encouraged to use the open consultation hour rather than contact by email.

Course details

- This course is 6 units of credit.
- This course involves lectures and laboratories.
- Lecture times: Tue 12-2pm in OMB150 and Thu 12-1pm in ASBus220
- Supervised labs (1 hour per week) will commence in week 3. However, you will be expected to work on the assignments and projects outside of designated lab hours using the undergraduate computer labs in the EE building.

Course aims

This course aims to develop an understanding of the tools 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. The quantitative methods will be applied to practical examples from communication protocol design, Internet switch architectures, Internet search algorithms, etc., and augmented with emerging qualitative techniques for providing quality of service in data networks.

Pre-requisites and relation to other courses

The course TELE3118 “Network Technologies” is a pre-requisite 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).

Student learning outcomes

Upon successful completion of this course, you will be able to:

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

The course delivery methods and course content address a number of core UNSW graduate attributes; these include:

- The skills involved in scholarly enquiry: This course develops and appreciation of and the ability to indulge in research. It helps develop an attitude towards rigorous application of methods and technology.
- The capacity for analytical and critical thinking and for creative problem solving: This course develops the ability to analyse and criticise, indulge in design, and solve problems outside the limits of principles and examples used in teaching.
- The ability to indulge in independent and reflective thinking.
- An in-depth engagement with the disciplinary knowledge and its interdisciplinary context.
- The capacity for enterprise, initiative, and creativity.
- The skills required for collaborative and multi-disciplinary work.
- The skills for effective communication.

The rationale behind the approach to learning and teaching

- The theoretical content of this course is best learnt by continuous critical thinking, extensive discussion, and practical problem solving. The lectures will be a forum for expounding the theoretical content: an attempt will be made to combine rigour in approach (required for students to get trained in the scientific process) with intuitive feel (that provides the guiding direction). Students are very strongly encouraged to not miss classes, and to participate actively in class discussion.
- The Thursday lectures will often be converted to tutorials, and devoted to problem solving. This will not only consolidate and apply the theory learnt in the lectures, but also provide an opportunity for reflection, critical thinking, and discussion.
- The laboratory assignments will stress the applicability and importance of the course material to the real-world. The first two programming exercises will require you to do independent thinking and experimentation in your own time. The final project will require students to work in groups to undertake a larger problem, and they will communicate their approach and results via oral presentation, demonstration, and a written report.

Teaching strategies

- Lectures – to give the basic material, discuss the intuition behind the mathematics, and learn to incorporate rigour in the solution process.
- Tutorials (though not formally scheduled, many of the Thursday lectures will be run as tutorials) – to learn problem-solving techniques, employ critical thinking, and reflect and discuss alternative techniques.
- Labs – laboratory assignments will provide hands-on experience of network performance, and an opportunity for constructing and evaluating practical tools.

- Project – will use group-work as a means of exploring a research problem in greater depth, and provide you with the opportunity to demonstrate and communicate your approach and solution.
- Quizzes and mid-session test – will provide feedback on your progress in problem-solving.
- Final examination – final test of competency.

Assessment

- Labs/Assignments [30%]:
 - Assignment 1 [5%]: This assignment will require you to develop a simple and practical tool that measures and reports performance in a real network. You will demonstrate your functioning tool by week 5.
 - Assignment 2 [10%]: This assignment will involve design and development of simulation software, to be performed in your own time, and demonstrated in lab session by week 8. Grading will be based on correctness, functionality, and novelty of design.
 - Project [15%]: 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 in week 9. The final presentations will be done in week 12, and a final report is due by week 12.

Note that all submitted assignments must have the School Assignment sheet as the first page. These sheets are available from the School Office, or may be downloaded from the School web page. Also note that late submissions will generally attract a penalty for each day that the assignment is late.

- Quizzes and mid-session tests [30%]: This course will have two in-class written quizzes and a mid-session test that will evaluate and provide feedback on your understanding of the material in this course. Quiz 1 will be held in week 4 (Thu 02 Apr), the mid-session test in week 6 (Tue 21 Apr), and quiz 2 in week 10 (Thu 21 May). Each quiz is worth 5% of the final grade, the mid-session test 20%, 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.
- Final exam [40%]: This three-hour final exam scheduled by the University will test your overall competency in the course.

Course schedule

Week	Topic
1	Introduction, Review of Probability Theory
2	Poisson process
3-5	M/M/1 queueing model, variants, networks of queues
7	Traffic models, QoS
8-10	Discrete Time Markov Chains
11	Miscellaneous topics
12	Student Presentations

Textbooks and Resources for students

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", available on-line at no cost from the web-site <http://www.cs.duke.edu/~fishhai/misc/queue.pdf>
- Piet Van Mieghem, "Performance Analysis of Communication Networks and Systems", Cambridge University Press, 2006. This book is available in the bookshop. Several chapters of this book are available on-line at no cost from the web-site <http://www.nas.ewi.tudelft.nl/people/Piet/books.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", 4th Edition, Addison-Wesley, 2007.
- 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/>
- Students seeking resources can also obtain assistance from the UNSW Library; please see info.library.unsw.edu.au/web/services/services.html

Academic honesty and plagiarism

What is Plagiarism?

Plagiarism is the presentation of the thoughts or work of another as one's own.*

Examples include:

- direct duplication of the thoughts or work of another, including by copying material, ideas or concepts from a book, article, report or other written document (whether published or unpublished), composition, artwork, design, drawing, circuitry, computer program or software, web site, Internet, other electronic resource, or another person's assignment without appropriate acknowledgement;
- paraphrasing another person's work with very minor changes keeping the meaning, form and/or progression of ideas of the original;
- piecing together sections of the work of others into a new whole;
- presenting an assessment item as independent work when it has been produced in whole or part in collusion with other people, for example, another student or a tutor; and
- claiming credit for a proportion a work contributed to a group assessment item that is greater than that actually contributed.†

For the purposes of this policy, submitting an assessment item that has already been submitted for academic credit elsewhere may be considered plagiarism.

Knowingly permitting your work to be copied by another student may also be considered to be plagiarism.

Note that an assessment item produced in oral, not written, form, or involving live presentation, may similarly contain plagiarised material.

The inclusion of the thoughts or work of another with attribution appropriate to the academic discipline does *not* amount to plagiarism.

The Learning Centre website is main repository for resources for staff and students on plagiarism and academic honesty. These resources can be located via:

www.lc.unsw.edu.au/plagiarism

The Learning Centre also provides substantial educational written materials, workshops, and tutorials to aid students, for example, in:

- correct referencing practices;
- paraphrasing, summarising, essay writing, and time management;
- appropriate use of, and attribution for, a range of materials including text, images, formulae and concepts.

Individual assistance is available on request from The Learning Centre.

Students 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 items.

* Based on that proposed to the University of Newcastle by the St James Ethics Centre. Used with kind permission from the University of Newcastle

† Adapted with kind permission from the University of Melbourne.

Course evaluation and development

- Students are strongly encouraged to provide feedback on the course during lectures and labs, including suggestions for improving the course content, organisation, delivery, and assessment. Such feedback will be considered carefully with a view to acting on it constructively wherever possible.
- Towards the end of the course formal feedback will be gathered using the Course and Teaching Evaluation and Improvement (CATEI) Process.

Other matters

- Expectations and responsibilities of students: Students are expected to attend lectures and lab sessions, since the material in this course is best absorbed by discussion and by watching the process of reasoning as performed by an experienced person. Group study and problem-discussion is also highly encouraged.
- Special consideration for missed in-class tests requires provision of satisfactory written evidence within a week of the illness or misadventure; the re-test may be conducted orally by the course convenor within two weeks of the date of the missed test. Special consideration for final examination will have to go through the normal University procedures.
- Information on Occupational Health and Safety policies and expectations are available at: www.riskman.unsw.edu.au/ohs/ohs.shtml
- Equity and diversity: Students who have a disability that requires some adjustment in their learning and teaching environment are encouraged to discuss their study needs with the course convenor prior to, or at the commencement of the course, or with the Equity Officer (Disability) in the Equity and Diversity Unit (9385 4734). Information for students with disabilities is available at:

www.equity.unsw.edu.au/disabil.html

Issues to be discussed may include access to materials, signers or note-takers, the provision of services and additional examination and assessment arrangements. Early notification is essential to enable any necessary adjustments to be made. Information on designing courses and course outlines that take into account the needs of students with disabilities can be found at:

www.secretariat.unsw.edu.au/acboardcom/minutes/coe/disabilityguidelines.pdf