Course Outline

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Course Details

Course Code	COMP3331
Course Title	Computer Networks and Applications
Units of Credit	6
Course Website	http://cse.unsw.edu.au/~cs3331 (http://cse.unsw.edu.au/~cs3331)
Handbook Entry	http://www.handbook.unsw.edu.au/undergraduate/courses/current/COMP3331.html (http://www.handbook.unsw.edu.au/undergraduate/courses/current/COMP3331.html)

Course Summary

This course is an introductory course on computer networks, aimed at students with a background in computer science / electrical engineering. We will focus on common paradigms and protocols used in present data communication. Through lectures, in-class activities, labs and assignments, you will learn the theory and application of (1) medium access control, congestion control, flow control, and reliable transmission, (2) addressing and naming, (3) routing and switching, (4) widely used protocols such as Ethernet, IP, TCP, UDP, HTTP, etc. (5) security threats and common defensive techniques, and (6) special purpose networks such as content delivery networks, peer-to-peer networks and wireless networks. This is a combined undergraduate and postgraduate course. The written exams for the postgraduate students will contain some questions, which are different from the undergraduate exam, and will more challenging.

Course Timetable

There will be 3 hours of lectures every week: (i) 2-hour lecture on Monday 16:00 - 18:00 in Ritchie Theatre and (ii) 1-hour lecture on Wednesday 14:00 - 15:00 in Rex Vowels Theatre. There will be 2-hour labs during 9 weeks (starting in Week 2). The detailed lab schedule will be posted on lab exercises page. The detailed course timetable is available here (/COMP3331/16s2/timetable) .

Course Aims

To provide an in-depth introduction to a wide range of topics in the field of computer networks including the Internet. To get a hands-on understanding of the working on network protocols. To gain expertise in network programming, designing and implementing network protocols, evaluating network performance and problem-solving skills. To build the necessary foundational knowledge required in subsequent networking courses (COMP4335-4337, COMP9332-9337).

Student Learning Outcomes

After completing this course, students will:

- have a working knowledge of computer networks, and will be able to demonstrate their knowledge both by describing aspects of the topics and by solving problems related to the topics
- have a solid understanding of the current architecture of the Internet and the entities involved in its operations
- be able to identify soundness or potential flaws in proposed protocols
- be equipped with the necessary skills to design networked applications and protocols
- implement and write protocols and applications in C, Java or Python
- analyse and evaluate the performance of computer networks
- be able to capture and analyse network traffic
- be able to understand and explain security and ethical issues in computer networking

This course contributes to the development of the following graduate capabilities:

Graduate Capability	**Acquired in**
scholarship: understanding of their discipline in its interdisciplinary context	lectures, labs, assignments
scholarship: capable of independent and collaborative enquiry	labs, assignments
scholarship: rigorous in their analysis, critique, and reflection	lectures, labs, exams, sample problems
scholarship: able to apply their knowledge and skills to solving problems	labs, assignments, exams, sample problems
scholarship: capable of effective communication	labs, assignments, lectures, exams
scholarship: information literate	all aspects of the course
scholarship: digitally literate	all aspects of the course
leadership: collaborative team workers	labs, assignments
professionalism: capable of independent, self-directed practice	all aspects of the course
professionalism: capable of lifelong learning	all aspects of the course
professionalism: capable of operating within an agreed Code of Practice	labs, assignments
global citizens: culturally aware and capable of respecting diversity and acting in socially just/responsible ways	labs, course forums

Assumed Knowledge

Before commencing this course, students should:

- have a good understanding of data structures and algorithms, basic probability theory.
- be able to write working programs in C, Java or Python. The course will include programming assignments and labs.

These skills are assumed to have been acquired in the courses: COMP1921 or COMP1927 or MTRN3530 (for undergraduates) and COMP9024 (for postgraduates)

Teaching Rationale

This course takes a top-down approach to teaching computer networks. The rationale behind this is that most students have first-hand experience using applications running over the Internet. This allows them to relate to each layer of protocol stack as we travel down the layers. Once they are committed, they participate in appropriate cognitive aspects such as learning the details with a focus to understand them. Students get mentally prepared to answer questions where very often there is no single answer or the answers can be unexpected. This results in deep learning and gives students a sense of accomplishment and confidence.

Learning will be largely facilitated through the delivery of lectures. The hands-on laboratories will provide an opportunity to gain deeper understanding of the concepts discussed in the lectures. The sample problems, homework problem set and tutorials will help in the development of problem-solving skills and in preparing for the exams. The programming assignments are mainly geared to allow students to gain familiarity with basic network programming and designing network protocols.

Teaching Strategies

- Lectures: introduce theory and concept and demonstrate how they apply in practice
- Lab Work: reinforce concepts taught in lectures by conducting hands-on experiments and analyse network performance
- Assignments: allow students to design and implement network protocols and evaluate network performance
- Sample Problems: allow students to solve problems based on content from lectures, develop problem-solving skills, assist with exam preparation
- Consultations and Course Forum: allow students an opportunity to ask questions and seek help.

Assessment

There will be four assessment components as listed below:

Component	**Weight**

Lab Exercises	20%
Programming Assignments	25%
Mid-semester Exam	20%
Final Exam	35%

To pass the course a student MUST receive at least 40% marks in the final exam. The following formula outlines precisely how the final mark will be computed:

```
lab = marks for lab exercises (scaled to 20)
assign = marks for the two programming assignments (scaled to 25)
midExam = mark for the mid-semester exam (out of 20 marks)
finalExam = mark for the final exam (out of 35 marks)
mark = lab + assign + midExam + finalExam
grade = HD|DN|CR|PS if mark >= 50 && finalExam >= 14
      = FL          if mark < 50 || finalExam < 14
```

Academic Honesty and Plagiarism

Plagiarism is defined as (https://student.unsw.edu.au/what-plagiarism) *using the words or ideas of others and presenting them as your own* . UNSW and CSE treat plagiarism as academic misconduct, which means that it carries penalties as severe as being excluded from further study at UNSW. There are several on-line sources to help you understand what plagiarism is and how it is dealt with at UNSW:

- Learning Centre: Plagiarism and Academic Integrity (http://www.lc.unsw.edu.au/plagiarism/index.html)
- MyUNSW: Plagiarism (https://student.unsw.edu.au/plagiarism) and Academic Misconduct (https://www.gs.unsw.edu.au/policy/documents/studentmisconductprocedures.pdf)
- CSE: Addendum to UNSW Plagiarism Guidelines (http://www.cse.unsw.edu.au/~chak/plagiarism/plagiarism.html)
- CSE: Yellow Form (http://www.cse.unsw.edu.au/people/studentoffice/policies/yellowform.html) (whose terms you have agreed to)

Make sure that you read and understand these. Ignorance is not accepted as an excuse for plagiarism.

Course Schedule

The following table lists the tentative weekly schedule. Students will be informed of any changes during the lecture and by announcements on the notices page.

Week	Lecture Dates	Lecture Topics	Labs	Assessment Tasks
1	25 & 27 July	Course Logistics Introduction: • What is a network made of? • How is it shared? • How is it organised? • How does communication happen?	No Lab	
2	1 & 3 August	Introduction: • How do we evaluate a network? • How did the Internet come about? Application Layer: • Client-server and P2P architectures • The Web & HTTP • E-mail	Lab 1	
3	8 & 10 August	Application Layer: • Domain Name Service (DNS) • Content Distribution Networks • Socket Programming	Lab 2	Assignment 1 Released
4	15 & 17 August	Application Layer: • Peer-to-Peer Networks and DHT Transport Layer: • Transport services • Multiplexing & Demultiplexing • UDP	Lab 3	
5	22 & 24 August	Transport Layer: • Principles of reliable data delivery • TCP	Tutorial 1 for Exam Prep	
6	29 & 31 August	Transport Layer: • Congestion control • Fairness	No LAB	**Mid-semester Exam on 29th August**
7	5 & 7 September	Network Layer: • Network services • Datagram vs Virtual Circuits • IP • Addressing	Lab 4	
8	12 & 14 September	Network Layer: • Router internals • Routing algorithms Link Layer: • Services • Error detection	Lab 5	Assignment 1 Due Assignment 2 Released
9	19 & 21 September	Link Layer: • medium access control • link layer addressing • Ethernet switches Wireless and Mobile Networks • Wireless characteristics • CDMA	Lab 6	
		Mid-semester Break		
10	5 October 3 October is public holiday	Wireless and Mobile • 802.11 • Network mobility Network Security • Basic Cryptography	Remedial Marking for Assignment 1 (optional)	
11	10 & 12 October	Network Security • Message integrity & Digital signatures • Authentication • Secure E-mail • Firewalls • SSL	Lab 7	
12	17 & 19 October	Optional (one of the following): • Multimedia Networking • SDN, Virtualisation • Internet of Things	Tutorial 2 for Exam Prep	

		Problem Solving and Revision	
13	24 October	Remedial Lecture if necessary	Assignment 2 Due
Exam Period	4th November - 22nd November	Exam Period	**Final Exam**

Resources for Students

Course Textbook:

- Computer Networking - A Top-Down Approach Featuring the Internet, J. Kurose and K. Ross, Addition Wesley , Sixth Edition, 2012.

Reference Texts:

- Unix Network Programming Volume 1 - Networking APIs: Sockets and XTI, W. Richard Stevens, Prentice Hall, Second Edition, 1998.
- Java Network Programming, E. R. Harold, O'Reilly, Third Edition, 2004.
- Learning Python, Mark Lutz, O'Reilly, Fifth Edition, 2013.
- Computer Networks: A Systems Approach, Larry Peterson and Bruce Davie, Morgan Kaufmann, Fifth Edition, 2011.
- Introduction to Computer Networks and Cybersecurity, John Wu and J. David Irwin, CRC Press, 2013.
- Computer Networks, Andrew Tanenbaum and David Wetherall, Fifth Edition, Pearson, 2010.

Links to additional reading material will be available on the lecture notes page.

Software:

For the labs, we will be using several Unix-based network utility programs. The purpose of these programs and information on how to use them will be provided in the lab handouts. We will also use a packet sniffing tool called Wireshark , which has been widely deployed on CSE machines. In addition, we will also use ns-2 (http://www.isi.edu/nsnam/ns/) , a widely used network simulator for a few labs. Ns-2 is installed on the CSE lab machines. The simulator is written in C++. However, it uses OTcl (https://en.wikipedia.org/wiki/OTcl) as its command and configuration interface. In the lab exercises, we will use scripts written in OTcl. We will provide the OTcl scripts for the lab exercises . You will expected to run the scripts, make some minor changes in the scripts, and analyse certain performance metrics. You will not be required to write C++ code. Detailed resources for all tools used will be made available on the lab exercises page.

Programming assignments are expected to be developed in C, Java or Python. Students are assumed to have sufficient expertise in one of these programming languages. Links to network programming in C, Java and Python will be available under the assignments link of the course webpage. Sample code demonstrating a simple client/server application will also be supplied as a starting point for students.

Course Evaluation and Development

In the previous offering of this courses, we had introduced a new set of labs using a network emulator called Mininet which provides the ability to simulate large network topologies and observe protocol behaviour and evaluate network performance using these topologies. Unfortunately, several students had problems getting Mininet to run. Moreover, the lab exercises provided to be difficult to configure and run. As a result, we have scraped the Mininet labs in this semester and introduced a new set of labs which we believe will be easy to run and still very instructive.

Supplementary Examination/Re-assessment

You can view the CSE Supplementary exam/Special consideration policy at the following link: https://www.cse.unsw.edu.au/about-us/organisational-structure/student-services/policies/yellow-form/index.html#dates (https://www.cse.unsw.edu.au/about-us/organisational-structure/student-services/policies/yellow-form/index.html#dates)

Re-Assessment Policy: Due care is taken to mark all assessment components fairly and appropriately. Therefore, it is unlikely that marks will be changed after a re-assessment. You should contact the LiC to discuss this further. However, students who still feel that the mark they received does not reflect their performance have the right to apply for re-assessment. Students MUST apply for re-assessment via Student Central within 15 days after notification of results of assessment. Please note that re-assessment or re-marking of a piece of work may result in marks to go up or down. Further details can be found from UNSW student guide at following site: https://student.unsw.edu.au/results (https://student.unsw.edu.au/results)

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