

Data Networks

Syllabus

Instructor	Office	email	Telephone
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Lectures Slot 12 (Mon. 12:30 – 1:20 , Wed. 11:30 – 12:20, Thurs. 1:30 – 2:20)

Location Jeffery 222

Required Text *Data Networks, 2nd Ed.* by Dimitri Bertsekas and Robert Gallager, Prentice Hall, 1992.

Web Page <http://www.mast.queensu.ca/~math484/>. Consult the web page regularly to download assignments and view announcements.

Office Hours Wednesdays 12:30 – 2:00 or by appointment.

Purpose and Course Description

Purpose: The purpose of this course is to introduce you to issues and techniques in the performance analysis of data networks. The primary goal of performance analysis in the design stage is to predict, without actual deployment, the relative performance of different schemes to move information through a network. Typical performance measures are loss, throughput, delay, fairness, and efficiency, which usually have to be traded off against each other.

Data networks continue to evolve at a rapid pace. Telephone communication networks, the Internet, wireless and cable networks are all competing or merging to provide ubiquitous, transparent, and comprehensive service including email, file transfer, web browsing, e-commerce, streaming audio and video, broadcast video, video on demand, video telephony, as well as traditional voice communications and future services.

The driving forces behind this evolution are consumer demand for services and technological advances (e.g. fibre optics, microchip advances, high speed electronics), though current technology is currently outpacing demand. With the technological advances on the hardware side new protocols are required, implemented in both software and hardware, to form the “brains” of this infrastructure. The collection of protocols which specify the rules for moving information is sometimes called the network architecture. It is NOT one of the purposes of this course to give a comprehensive overview of these protocols. Just becoming familiar with existing protocols can occupy the greater part of a course (eg. ELEC 471, ELEC 478, ELEC 878, CISC 435, CISC 837). However, this

is also not one of the primary purposes of this course, although as we apply techniques for performance analysis, we will familiarize ourselves with *some* protocols.

Description: This course is intended for 4th year undergraduate students in Mathematics and Engineering and Mathematics, and first or second year graduate students in Electrical Engineering, Mathematics and Engineering, Computer Science, and Mathematics. Knowledge of networking protocols is not assumed, and will be introduced as needed. The lectures are the same for all students but the work load will differ for graduate and undergraduate students. We will cover the material in chapters 3 and 4 of the *Data Networks* book and, tentatively, parts of chapters 5 and 6, while referring back to parts of chapters 1 and 2 as needed. Moreover, performance analyses from other sources, including research papers, may be incorporated into the lectures.

Prerequisite STAT455/855 or permission of the instructor.

Required Work and Grading Criteria

Type of Work	484	884
4 or 5 assignments	30%	30%
midterm	15%	15%
final exam or project	55%	0%
project	0%	55%

The project will involve either (a) performance analysis of a system involving analysis or simulation or both, which sheds light on the strengths and weaknesses of a given protocol or setup, or (b) re-analysis of a performance analysis from a research paper. The project will be evaluated on the basis of a written report and a short class presentation. Math 484 students have the option of doing the project or writing a final exam. The midterm will be scheduled by mutual agreement in class and will be a one hour, in-class, closed book exam.

If you miss an exam, I will give you a makeup if you have a debilitating medical reason *documented by the University*.

Supplementary Texts

Performance Analysis:

1. *Queueing Systems Volume II: Computer Applications* by Leonard Kleinrock, Wiley, 1976.
2. *Multiservice Loss Models for Broadband Telecommunication Networks* by Keith W. Ross, Springer, 1995.
3. *Metropolitan Area Networks*, by Marco Conti, Enrico Gregori, and Luciano Lenzini, Springer, 1997.
4. *Modeling and Analysis of Computer Communications Networks* by Jeremiah F. Hayes, Plenum Press, 1984.
5. *Computer Networks and Systems, Queueing Theory and Performance Evaluation, 2nd Ed.* by Thomas G. Robertazzi, Springer-Verlag, 1994.

6. *Performance of Computer Communication Systems, A Model-Based Approach* by Boudewijn R. Haverkort, Wiley, 1998.
7. *ATM Network Performance, 2nd Ed.* by George Kesidis, Kluwer, 1999.
8. *Performance Evaluation of Communication Networks* by Gary N. Higginbottom, Artech House, 1998.

Queueing:

1. *Queueing Systems Volume I: Theory* by Leonard Kleinrock, Wiley, 1975.
2. *Fundamentals of Queueing Theory, 3rd Ed.* by Donald Gross and Carl M. Harris, Wiley, 1998.
3. *Discrete Stochastic Processes* by Robert Gallager, Kluwer.

Data and Communication Networks:

1. *Computer Networks, 4th Ed.* by Andrew S. Tannenbaum, Prentice Hall, 2002.
2. *Data and Computer Communications, 6th Ed.* by William Stallings, Prentice Hall, 1999.