

## ICOM 6506 (Sec. 050) Network Performance Analysis

**Time:** Monday, Wednesday, & Friday (LWM) 11:50 a.m. – 12:40 p.m. Spring 2007  
**Room:** S-203  
**Office Hours:** Monday (L) 1:00 – 4:00 p.m. or by appointment.

**Instructor:** Dr. Yi Qian  
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**Prerequisite:** Permission of the Director.

### Course Description:

Evaluating the performance of a computer system usually involves constructing an appropriate model of the system and then using the model to predict the system's behavior. Sometimes the model is analyzed using mathematical techniques; alternatively, the model may be simulated. Analytic models describe the system with a set of equations, and are often stochastic. Queuing Networks have been widely used to model and analyze the performance of complex systems involving service. Examples of such systems range from communication systems, computer networks and transaction models to models of production jobs and vehicular traffic. A study of such systems is necessary to evaluate their performance. Such studies are also required to locate bottlenecks; in such cases removing the bottleneck may allow significant improvement in the performance of the system.

### Course Objectives:

The course aims to provide analytical tools that serve as a basis for addressing several performance analysis and engineering problems while at the same time presenting the state-of-the-art in computer communication protocols.

- Create appropriate models of computer systems and computer networks.
- Use analytic and/or simulation methods to evaluate the performance of computer systems and computer networks
- Overview of current research topics and commercial development in wireline and wireless networks.

### Course Outlines: (Subject to Changes)

- Introduction to performance analysis on computer networks
- Probability Review
- Simulation Techniques
- Markov chains
- Queuing theory
  - Basic Queuing Theory – M/M/1, M/M/1/K queues
  - Basic Queuing Theory – M/M/m, M/M/m/B, M/M/m/m queues
  - Basic Queuing Theory – M/G/1 queues
  - Advanced Queuing Theory – M/G/1 queues with vacations and priorities
  - Advanced Queuing Theory – G/G/1 and G/G/m queues

- Advanced Queuing Theory – Discrete-time queues
- Queuing Networks – I
- Queuing Networks – II
- Queuing Networks - III
- Network traffic modeling
- Quality of Service
- Traffic engineering and MPLS
- Failure protection, mesh restoration and reliability analysis
- Final Project presentations

### **Textbook and References:**

- Textbook: High-speed Networks and Internets - performance and quality of service, 2e, William Stallings, Prentice Hall.
- Recommended reference books:
  - Dimitri Bertsekas and Robert Gallager, Data Networks, 2e, Prentice Hall, 1992.
  - Raj Jain, The Art of Computer Systems Performance Analysis, John Wiley & Sons, Inc., 1991.
  - E.D. Lazowska, J. Zahorjan, G.S.Graham, K.C. Sevcik, Computer System Analysis Using Queueing Network Models, available free on line: <http://www.cs.washington.edu/homes/lazowska/qsp>
  - Thomas G. Robertazzi, Computer Networks and Systems-queueing theory and performance evaluation, 3e, Springer.
  - Gunter Bolch, Stefan Greiner, Hermann de Meer, and Kishor S. Trivedi, Queueing Networks and Markov Chains, Modeling and Performance Evaluation with Computer Science Applications, John Wiley & Sons, Inc., 1998.
- Other materials: class notes (very important), WWW, current research papers, etc.

### **Projects:**

There will be one course project for this class.

The objectives of the project are:

- Familiarization with the basic functions of the network simulator software of your choice and use of such software to design a simple simulation model and analyze results.
- Extension of results of the M/M/... models studied in the course and application to a time division multiplexing scenario.

Network Simulator 2 is suggested as the simulation tool for this course. Please start to get familiar with ns2 as early as possible. Do not wait till the project is assigned. Please go to the following webpage to get information on ns2.

Main homepage: <http://www.isi.edu/nsnam/ns/>

Tutorial: <http://www.isi.edu/nsnam/ns/tutorial/index.html>

Manual: <http://www.isi.edu/nsnam/ns/ns-documentation.html>

**Grading:**

Homework 20%; Project 20%; Midterm Exam: 30%; Final Exam: 30%.