ECE 577 — Spring 2006
Computer System and Network Evaluation
TR 9:30-10:45am, Harvill 105

http://www.ece.arizona.edu/~krunz/Classes/ECE577/

General Information

Instructor
Prof. Marwan M. Krunz
ECE Building, Room 320H
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Office Hours Tuesday 11am – 12pm and Thursday 4pm – 5pm. If both hours conflict with your classes or if you have an emergency, then you can make an appointment to see me.

Class Material There is no required textbook for this class. The material will be based on lecture notes and handouts, which will either be provided in class or made available for purchase through the Copy Center (Harvill, Rm. 137).

References

- Kishor S. Trivedi, *Probability and Statistics with Reliability, Queueing and Computer Science Applications.* John Wiley & Sons Inc., 2002.
- Raj Jain, *The Art of Computer Systems Performance Analysis.* John Wiley & Sons, Inc., 1991.
- L. Kleinrock, *Queueing Systems – Volume I: Theory* and *Volume II: Computer Applications*, Wiley & Sons, 1975/1976.
- Research papers (will be announced in class).

Prerequisite ECE 503 or an equivalent course in probability theory and random processes (check with me if you are not sure of the suitability of your background).

Grading

25%	Homework Assignments
10%	Quizzes and Class Participation
20%	Midterm-I (tentatively on Thursday Feb. 23)
20%	Midterm-II (tentatively on Tuesday April 11)
25%	Final Exam (Tuesday, May 9, 8-10am)

Some assignments will involve numerical computations. I strongly recommend that you use Csim, Matlab, or C for your programming needs.

Course Objectives

Computer systems play a vital role in our lives. The ability to predict the performance of these systems and optimally design their parameters is an area of significant interest to computer engineers and scientists. This course will provide the theoretical foundation for computer systems analysis and evaluation. With such foundation, students will learn how to model and evaluate memory systems, CPUs, network systems, switches, routers, etc. The underlying principles of computer systems analysis and evaluation are based on stochastic theory, statistics, and queueing theory. Several operational laws that are used in analyzing large computer systems will also be discussed. Mathematical analysis will be augmented, when possible, with simulations.

Discrete-Event Simulation Using Csim

Although simulations is not the main focus of this course, in some homework assignments you will be asked to write simulation code and run experiments using the Csim language. The purpose of these simulations is to study the performance of certain complicated systems that are hard to analyze or to compare the simulation results with analysis. I will spend 1-2 weeks reviewing Csim, but that will not be enough to cover all of its aspects. Therefore, YOU SHOULD START LEARNING CSIM ON YOUR OWN AS SOON AS POSSIBLE, AND BEFORE I COVER IT IN CLASS. Csim's *User's Guide* is available on electronic reserve and also online at `http://www.mesquite/com/` (under 'Documentation').

General Course Policies

- Academic Integrity: The University's Code of Academic Integrity (Section 2.1a) states that students shall not "represent the work of others as their own." This policy will be applied to all work submitted for a grade: exams, quizzes, homework, computer work, and writing assignments. Any student submitting homework solutions or computer project reports with part(s) copied from solutions provided by any instructor(s) in previous semesters, or from the text solutions manual, or from students who took the course in previous semesters, will automatically receive zero credit for ALL homework/computer work for the entire semester. In other words, all work must be original. The minimum penalty for cheating on exams and quizzes is an E grade. Group efforts are not permitted and will be considered academic dishonesty.

  You are free to use reference books to help you with assignments, but make sure that you cite any used reference.

- No late homework will be accepted.

- Make-up exams will be given only in emergency, which must be supported by written documentation (e.g., doctor's letter).

- All work must be completed during the semester (i.e, no incompletes will be given).

Covered Topics (tentative)

The theory presented in this course will be based on the following topics:

- Preliminaries: Notation, review of basic concepts in random processes, important theorems, transform methods, random sums, distribution of failure times, reliability analysis, etc.
- Traffic characterization:
  - Elementary traffic models
  - Advanced traffic models: Markov models, fluid models, modulated processes, self-similarity and long-range dependence, etc.
  - Models for multimedia traffic.
- Elementary queueing theory.
- Advanced queueing theory: M/G/1 queue, G/M/1 queue, G/G/1 queue.
- Heavy-traffic approximation.
- Networks of queues: Jackson's networks, open and closed-loop networks.
- Analysis of priority scheduling and queueing systems.
- Fluid analysis.
- Effective bandwidth theory.
- Bounds and approximations.
- Operational laws.
- Workload characterization techniques.
- Mean value analysis (MVA).
- Analysis of web caching and prefetching systems.
- Statistical techniques: Confidence intervals, analysis of variance, linear and nonlinear regression, etc.
- Art of data analysis and representation.
- Other topics (if time permits).

The above topics will be discussed in the context of computer applications (network protocols, memory systems, capacity analysis, etc.). Examples of related applications will be presented throughout the course.