General Information

Instructor
Prof. Marwan Krunz
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Office Hours
Mondays 1:30–2:30pm and Fridays 10–11am. If both hours conflict with your classes or if you have an emergency, email or call the instructor to set up an appointment.

Class Material
There is no designated textbook for this class. The material will be based on lecture notes, selected chapters from books, and handouts. Some of the class material will need to be purchased from Fast Copy in the Student Union. The rest will be sent by email, posted on the class page (D2L), or distributed during the class.

References


Prerequisite
ECE 503 or an equivalent course in probability theory and random processes.
Grading

- 25% Homework Assignments
- 10% Quizzes and Class Participation
- 20% Midterm-I (tentatively on Monday, Feb. 17)
- 20% Midterm-II (tentatively on Monday, March 23)
- 25% Final Exam (Tuesday, May 12, 3:30–5:30pm)

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

Course Objectives

Computer systems and networks 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 network systems, switches, routers, etc. The underlying principles of computer systems analysis and evaluation are based on probability, queueing theory, and optimization. Mathematical analysis will be augmented, when possible, with simulations.

Discrete-Event Simulation Using Csim

Although simulation is not the main focus of this course, for some homework assignments you may 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. Csim will be reviewed in class, 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 it is covered in class. Csim’s User’s Guide is available on electronic reserve and also online at http://www.mesquite.com/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. The minimum penalty for cheating on exams and quizzes is an E grade. **Group efforts are not permitted.** You are free to use reference books to help you with assignments, but make sure to 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 incomplete will be given).

**Covered Topics (tentative)**

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

- Preliminaries: Review of basic concepts in random processes, common distributions, max/min theorems, transform methods, random sums, useful inequalities, etc.

- Elementary queueing theory (birth-death models).

- Advanced queueing theory: Review of Markov 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 systems.

- Fluid analysis of bursty packet networks.

- Effective bandwidth theory.

- Bounds and approximations.

- Operational laws.

- Teletraffic modeling and characterization:
  - Quality of service (QoS) metrics
  - Poisson-based and renewal traffic models
  - Advanced traffic models: Markov-modulated processes, self-similarity and long-range dependence, etc.
  - Models for multimedia traffic.

- Workload characterization techniques (time permitting).

- Mean value analysis (time permitting).

- Analysis of wireless communications systems.

- Statistical techniques: Variance reduction, linear and nonlinear regression, art of data representation (time permitting).

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