

EC541 Computer Communication Networks Syllabus

Description: This is a graduate-level course on performance analysis of communication networks. The objective of the course is to introduce popular mathematical models of computer communications and analytic techniques to quantify critical performance issues. The emphasis is on recent developments that apply to modern communication networks. The course also features programming assignments in Python, involving the use of popular data science libraries.

Topics: We expect to cover the following topics in the class:

- Introduction to Python, NumPy, SciPy, and Matplotlib
- Review of fundamental concepts in computer networking
- Queueing and delay models in communication networks
- Little Theorem
- Probability refresher
- The Poisson process and its properties
- The M/M/1 queueing model
- Multi-server queues
- State-diagrams and Markov chains
- Applications of Markov chains and queueing models
- Random walks on graphs
- Google's PageRank algorithm
- The gambler's ruin problem
- Bitcoin and double spending attack analysis
- The paradox of residual life
- The M/G/1 queueing model
- Priority queueing systems
- Network simulation with SimPy
- Confidence intervals
- Jackson networks
- Closed queueing networks
- Reversibility and Burke's theorem

Recommended text: D. Bertsekas and R.G. Gallager, Data Networks, 2nd Ed., Prentice-Hall, 1992. Available on-line at <http://web.mit.edu/dimitrib/www/datanets.html>

Other references:

- M. Harchol-Balter, Performance Modeling and Design of Computer Systems: Queueing Theory in Action, 2013
- L. Kleinrock, Queueing systems Vol. 1, Wiley, 1975
- M. Schwartz, Broadband integrated networks, Prentice-Hall, 1996
- C.S. Chang, Performance guarantees in communication networks, Springer, 2000.
- A. Kumar, D. Manjunath, J. Kuri, Communication networking: An Analytical Approach, Elsevier, 2004.