College of Engineering, Boston University **Spring 2025**

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 analytical 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:

Foundations:

1) Review of fundamental concepts in computer networking
2) Introduction to Python, NumPy, SciPy, and Matplotlib
3) Queueing and delay models in communication networks
4) Little Theorem
5) Probability refresher
6) The exponential distribution
7) The Poisson process and its properties

Core:

1) The M/M/1 queueing model
2) Multi-server queues
3) State-diagrams and Markov chains
4) Applications of Markov chains and queuing models
5) Random walks on graphs
6) Google's PageRank algorithm
7) The gambler's ruin problem
8) The paradox of residual life
9) The M/G/1 queueing model
10) Priority queueing systems
11) Network simulation with SimPy
12) Confidence intervals
13) Blockchain applications

Advanced (time permitting):

1) Jackson queueing networks
2) Markov Decision Processes (MDPs)
3) Queueing games

References:

- M. Harchol-Balter, Introduction to Probability for Computing, 2024. Available on-line at https://www.cs.cmu.edu/~harchol/Probability/book.html.
- 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.
- M. Harchol-Balter, Performance Modeling and Design of Computer Systems: Queueing Theory in Action, 2013.