

## **ECE1528S (Spring 2012): Special Topics on Data Communications -- Stochastic Networks**

An introduction to analysis, control, and optimization in communication networks using stochastic models. We cover both classical queueing networks and recent advances in stochastic network modeling and optimization. Topics include Jackson and Whittle networks, reversible network processes, Palm probabilities, space-time Poisson models, stochastic geometry, network utility maximization, Lyapunov stability, and stochastic network optimization. Pre-requisite: ECE1500/ECE537 or equivalent with continuous-time Markov chains.

### *Instructor:*

Ben Liang (<http://www.comm.utoronto.ca/~liang>)

### *Lectures:*

Tuesdays 3 – 4:30 pm, BA2185; Thursdays 3 – 4:30 pm, BA4164.

### *Approximate Schedule:*

- Week 1: Background and preliminaries
- Week 2: Jackson and Whittle networks
- Week 3: Throughput and sojourn, reversibility
- Week 4: Reversible network processes
- Week 5: Jackson and Whittle network flows
- Week 6: Palm probability for Markov chains
- Week 7: Palm probability for stationary processes
- Week 8: Space-time Poisson models
- Week 9: Stochastic geometry
- Week 10: Network utility maximization
- Week 11: Stochastic network control and optimization
- Week 12: Survey presentation

### *Grading:*

Homework assignment (50%) and one survey report (50%).

### *Main References:*

- R. Serfozo, *Introduction to Stochastic Networks*, Springer, 1999
- F. Kelly, *Reversibility and Stochastic Networks*, Wiley, 1979
- F. Baccelli and B. Blaszczyszyn, “Stochastic Geometry and Wireless Networks Volume I: Theory,” *Foundations and Trends in Networking*, vol. 3, no. 3-4, pp. 249 – 449
- F. Baccelli and B. Blaszczyszyn, “Stochastic Geometry and Wireless Networks Volume II: Applications,” *Foundations and Trends in Networking*, vol. 4, no. 1-2, pp. 1 – 312
- R. Srikant, *The Mathematics of Internet Congestion Control*, Birkhauser, 2003 (S.Shakkottai and R. Srikant, “Network optimization and control,” *Foundations and Trends in Networking*, vol. 2, no. 3, 2007, pp. 271 – 379)
- M. J. Neely, *Stochastic Network Optimization with Application to Communication and Queueing Systems*, Morgan & Claypool, 2010 (L. Georgiadis, M. J. Neely, and L. Tassiulas, “Resource allocation and cross-layer control in wireless networks,” *Foundations and Trends in Networking*, vol. 1, no. 1, 2006, pp. 1 – 144)