(bcam) basque center for applied mathematics

Mathematical Modeling of Communication Networks

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Date: 18–22 January 2010

Objective: Learn to analyze and evaluate the performance of computer systems using stochastic models.

Application: Modeling of computer systems.

Abstract:
When designing a new computer architecture, network protocol, distributed system, etc. it is essential to be able to quantify the performance impacts of design choices along the way. For example, should we invest in more buffer space or a faster processor? One fast disk or multiple slower disks? How should requests be scheduled? What migration policy will work best? Ideally, one would like to make these choices before investing the time and money to build a system. This course will teach how to answer this type of "what if" question by introducing students to analytic performance modeling, the tools necessary for rigorous system design.

The course will focus on the mathematical tools, so it should be interesting and accessing both for Computer Science students and for students in Electrical Engineering, Applied Mathematics, Economics, and Operations Research.

Program:

1. Probability Theory
2. Random Variable
3. Discrete Time Markov Chains
4. Continuous Time Markov Chains
5. Queueing Theory
6. Event-based Simulations (confidence intervals and regressions models)
7. Scheduling Theory

References:

[1] E. Gelenbe and I. Mitrani. *Analysis and Synthesis of Computer Systems*. Academic Press, 1980.

[2] D. P. Heyman and M. J. Sobel. *Stochastic Models in operations research, Volume I: Stochastic Processes and operating characteristics*. McGraw-Hill, 1982.

[3] L. Kleinrock. *Queueing Systems, vol. 1*. John Wiley and Sons, 1976.

[4] R. W. Wolff. *Stochastic Modeling and the theory of Queues*. Prentice-Hall, 1989.