Performance Evaluation

AA 2006/2007

Program and Goals

The course aims at building the theoretical foundations for complex systems performance analysis. Particular attention will be given to computer science and networking systems. The course is fundamental and elementary in its methodology, thus its concepts are applicable to many complex systems, including biology and biochemistry. Exercises and examples are concentrated on computer science, networking and distributed systems, but everyday life exemplifications are used for the sake of clarity, and some examples from other disciplines are given for completeness. The course goal is allowing students that follow it to tackle the modeling of complex systems with stochastic and random components and solve the resulting model analytically whenever possible. From a mathematical point of view, the course is focused on the analysis and manipulation of stochastic processes, and particularly of Markov chains, and related high-level modeling tools, like queues and queuing networks.

A good knowledge (equivalent to 12 credits) of probability theory, random variables, combinatorial and transformations is required. A good example of the basic knowledge we build upon is the course “Calcolo delle probabilità e statistica” held in the “Laurea triennale” of this University by Prof. Bonaccorsi.

Contents

- Introduction to the art of modeling:
  - Why do we need Performance models;
  - Why do we need and use stochastic models;
  - What is a stochastic model;
  - What are the information about "life" we can have from a stochastic model.
- Recap on Markov Chains (discrete and continuous time).
- The concept of reward and weighted averages as performance measures.
    - Exercises
- Recap on transformation methods and their relation to the moment generating function of RVs.
- Single server queues:
  - M/M/1, M/M/OO, M/M/m;
  - M/M/k and finite capacity queues;
  - Different serving disciplines: Processor Sharing;
  - Erlang and Hyperexponential distributions;
  - Approximation of General distributions;
  - The M/G/1 queue;
  - Other types of queues: G/G/1, GEOM/GEOM/1, MMAP/M/1, etc.
    - Exercises

- Priority queueing and server vacancies.
  - Classes of customers;
- Queueing Networks:
  - Tandem queues and Jakson theorem;
  - Gordon/Newell and BCMP theorems
- Additional topics:
  - The “art” of modeling;
  - Renewal processes and their role in models.