

# Stochastic Modeling of Computer and Communication Systems \*\*

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**Calendario:** 28 ore, Martedì e Giovedì ore 14.30 - 16.30. Prima lezione il 17 marzo 2009.  
Aula DEI/G (Piano 3, Dipartimento di Ingegneria dell'Informazione, Via Gradenigo 6/a).

**Prerequisiti:** Basics on Probability theory, Stochastic processes;

**Tipologia di esame:** Homework and Oral exam

**Aim:** This course aims to provide some of the mathematical techniques that are important for probabilistic performance analysis studies in computer- and communication systems. The focus is on Markov chains and queueing systems and their application in the performance analysis of communication protocols. The mathematical parts of the course aim to achieve a reasonable (for engineers) level of mathematical rigor.

**Topics:**

1. **Probability theory refresher**
2. **Discrete-time Markov chains**  
Definition and basic properties;  
Classification of states.  
Hitting Times, Stopping Times and Strong Markov  
Long-term behaviour of Markov chains, Steady-state solutions  
Protocol analysis examples
3. **Continuous-time Markov Chains**  
Matrix exponentials and Q-matrices  
Definition of CTMCs  
Classification of states, Hitting Probabilities  
Long-term behaviour, Steady-state  
Birth-Death and Pure-Birth processes  
Examples
4. **Renewal and Poisson processes**  
Definition of renewal processes  
Hidden and exposed terminal problems, solution considerations  
Residual Lifetimes  
Definition and equivalent characterizations of Poisson processes
5. **Queueing Theory**  
Introduction, Notation, Little's Law  
Markovian Systems  
M/G/1 systems  
Polling and priority systems

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\*\* Corso mutuato dalla *Scuola di Dottorato in "Ingegneria dell'Informazione"*

**References:**

Lecture Notes provided by the instructor: Andreas Willig, *Stochastic Performance Evaluation of Computer and Communication Systems - Markov Chains and Single-Station Queueing Systems* Telecommunication Networks Group Technical University of Berlin, Berlin DE, 2007