STATS217: Introduction to Stochastic Processes

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Teaching Assistants: tba

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Joonhyuk Lee.
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Sections: Wed 1:30 - 2:20 PM (at CoDA B40).

Schedule & Location:
Tu and Th 9:00 AM - 10:15 AM at NVIDIA Auditorium

Textbook:
Stochastic Processes
Sheldon M. Ross
Wiley, 1996 (2nd Edition)

Further texts:
(not required)

An Introduction to Stochastic Modeling
M.A. Pinsky and S. Karlin
Academic Press, 2011 (4th Edition)

Introduction to Stochastic Processes
P.G. Hoel, S.C. Port and C.J. Stone
Waveland Press, 1987 (originally Houghton-Mifflin, 1972)

Prerequisites

Prerequisites: (recommended) STATS 117, MATH 51, MATH 104, or equivalent. See https://statistics.stanford.edu/course-equiv for equivalent courses in other departments that satisfy these prerequisites.

Course description

By the end of the course, students should be able to

- describe and understand discrete-time Markov chains in terms of their transition matrices,
- compute n-step transition probabilities of such chains and to classify its states,

- use suitable criteria in order to decide whether a Markov chain is recurrent or transient,
- find the stationary distribution if it exists,
- compute absorption probabilities in simple examples,
- check reversibility and understand the meaning of detailed balance,
- understand the fundamental limit theorems of Markov chains and ergodicity,
- know the various ways of defining homogeneous and nonhomogeneous Poisson processes,
- know their basic properties under certain operations (superposition, thinning, time scaling),
- describe and understand continuous-time Markov chains and their infinitesimal generator (the Q-matrix),
- know its additional features when opposed to discrete-time Markov chains,
- use reversibility of such chains to study some basic queuing examples like tandem queues.

Homework and TA-Section:

There will be 7 homework assignments, given out each Thursday and due a week later (after class). Cooperation among students and consulting with the instructor and TA's are encouraged.

Exams:

There will be a mid-term and a final comprehensive exam. The mid-term will be given in class half-way through the quarter on Thursday July 17. Following the Stanford calendar, the final exam will be given on Friday, August 15, 8:30 - 11:30 AM.

Grading: (approximately)

Homework: 30% *Mid-term Exam:* 30% *Final Exam:* 40%

Topics

- Course introduction and probability review
- Definition of discrete-time Markov chains and examples
- Transition matrix, classification of states
- Stationary distribution and ergodic theorems
- Absorption problems (gambler's ruin, branching processes)
- Reversibility and detailed balance equations
- Introduction of homogeneous and nonhomogeneous Poisson processes
- Applications and properties of Poisson processes
- Definition of continuous-time Markov chains and examples
- Definition and interpretation (clock mechanism) of the Q-matrix
- Stationary distribution and ergodic theorems
- Reversibility and detailed balance equations
- Applications of continuous-time Markov chains in queuing