

Lecture 0: Introduction

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EE210: Probability and Introductory Random Processes
KAIST EE

MONTH DAY, 2021

- Course logistics
- Why necessary to take the course of probability and random process?

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Instructor

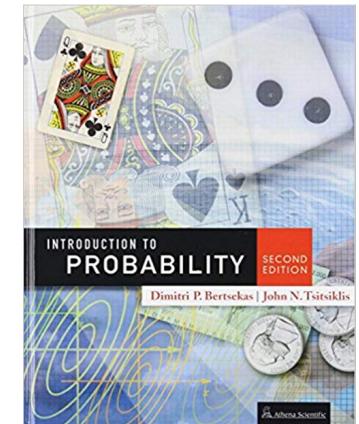
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- B
- C
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 - Please use KLMS for the questions about the lecture contents
 - This mailing list can be used for individual issues

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- <http://klms.kaist.ac.kr/>
- To download course materials
- To ask questions about everything
- To check your score on each homework/exam
- To see all the announcements about the class

- Introduction to Probability
(2nd edition)
 - MIT course textbook
 - Dimitri P. Bertsekas and John N. Tsitsiklis



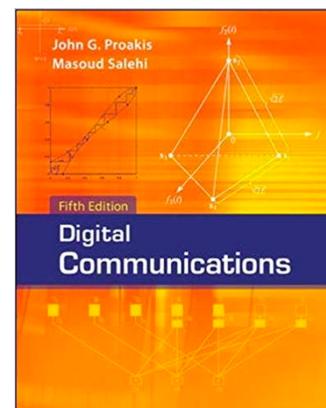
- Three Parts
 - Part I: Fundamentals of Probability
 - Part II: Inference and Limit Theorems
 - Part III: Random Processes
- On-line lectures at MIT and EdX
 - MIT: <http://bit.ly/2PkvYdr>
 - EdX: <http://bit.ly/3pHmZRd>
 - You can find older urls (2006, 2010, 2013) for this lecture, where there are many useful resources (recitation problems, homework problems, old exam problems, etc)
 - My lecture slides: based on theirs, but largely modified/reorganized/edited in many places for KAIST students

- In-class quiz (sometimes)
- Basically, weekly homework, but often bi-weekly
- 3 Exams (2 mid-terms and 1 final)
- Class participation
- Grading portions: A (X%), B (Y%), C(Z%), D(W%), F ...
- Online lectures due to COVID-19 may change how to grade.

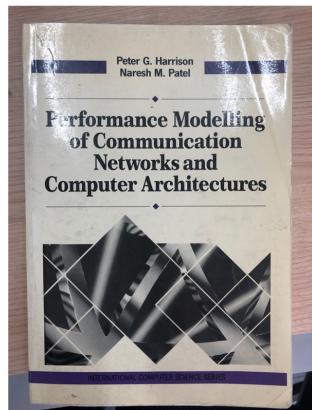
- Most should be via KLMS
 - Technical questions about lectures, homework, and etc
- Please DO NOT individually send emails to Prof. Yung Yi and TAs (or making calls or sending KakaoTalk msgs) about the technical questions (course contents, homework, etc)
 - All the questions need to be shared among the students.
 - TAs and Prof. Yung Yi will handle your questions as soon as possible.
 - But, you can send an email to Prof. Yung Yi for the things that need to be individually discussed.

Questions?

- Many things are "probabilistic"
- Assume that you are a designer of the following engineering systems. Good design?
 - a web server
 - a communication device like mobile phones
 - an AI-based image classifier
- From an engineering point of view,
 - System input
 - Algorithms in systems
 - Analysis of systems



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Preface

Chapter 1 Essentials of Probability Theory

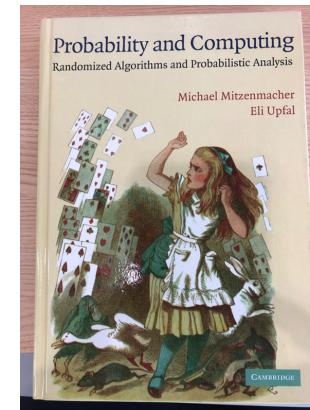
- 1.1 Sample space, events and probability
- 1.2 Conditional probability
- 1.3 Independence
- Exercises

Chapter 2 Random Variables and Distributions

- 2.1 Probability distribution functions
- 2.2 Discrete random variables
- 2.3 Continuous random variables
- 2.4 Joint random variables
- 2.5 Conditional distributions
- 2.6 Independence and sums
- Exercises

Chapter 3 Expected Values and Moments

- 3.1 Expectation
- 3.2 Generating functions and transforms
- 3.3 Asymptotic properties
- Exercises



Preface

1 Events and Probability

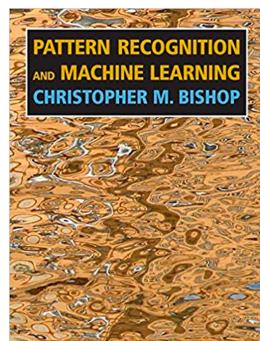
- 1.1 Application: Verifying Polynomial Identities
- 1.2 Axioms of Probability
- 1.3 Application: Verifying Matrix Multiplication
- 1.4 Application: A Randomized Min-Cut Algorithm
- 1.5 Exercises

2 Discrete Random Variables and Expectation

- 2.1 Random Variables and Expectation
- 2.1.1 Linearity of Expectations
- 2.1.2 Jensen's Inequality
- 2.2 The Bernoulli and Binomial Random Variables
- 2.3 Conditional Expectation
- 2.4 The Geometric Distribution
- 2.4.1 Example: Coupon Collector's Problem
- 2.5 Application: The Expected Run-Time of Quicksort
- 2.6 Exercises

3 Moments and Deviations

- 3.1 Markov's Inequality
- 3.2 Variance and Moments of a Random Variable
- 3.2.1 Example: Variance of a Binomial Random Variable
- 3.3 Chebychev's Inequality
- 3.3.1 Example: Coupon Collector's Problem
- 3.4 Application: A Randomized Algorithm for Computing the
- 3.4.1 The Algorithm
- 3.4.2 Analysis of the Algorithm
- 3.5 Exercises



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- Designer's perspective?
- In the year of 2021, suppose that unfortunately there is no theory of mathematically studying the *uncertainty* of some phenomena, events, etc.
- You have to design such a theory called "probability". How are you going to do it? Where are you going to start?
- You just have other basic mathematical theories such as set theory.
- You need to get used to the *English terms* on probability (e.g., sample space = 표본공간, probability density function = 확률밀도함수).
- We will take this exciting journey from the next lecture!

These days, every area in CS and EE is directly or indirectly related to machine learning!

Questions?

