Lecture 0: Introduction

Yi, Yung (이융)

EE210: Probability and Introductory Random Processes
KAIST EE

MONTH DAY, 2021

Outline

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

Instructor

- Yi, Yung (이융)
- Office: N1, 810
- `http://lanada.kaist.ac.kr`, `yiyung@kaist.edu`
- Computer Division
- A professor in KAIST EE since 2008
- Office hours: TBA

TAs

- A
- B
- C

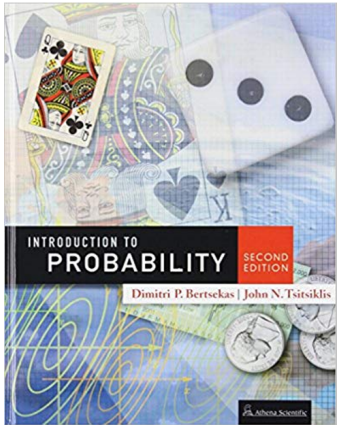
- Mailing list: `ee210@lanada.kaist.ac.kr`
  - Please use KLMS for the questions about the lecture contents
  - This mailing list can be used for individual issues

Course Homepage

- 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

Textbook

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



Contents and Web Resources

- 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

Grading

- 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.

How to Communicate

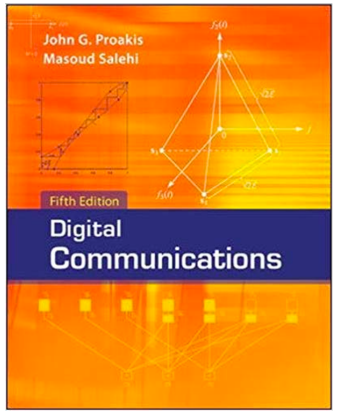
- Most should be via KLMS
  - Technical questions about lectures, homework, and etc
- Please DO NOT individually send emails to Prof. Yung Yi and TAs (or making calls or sending KakaoTalk msgs) about the technical questions (course contents, homework, etc)
  - All the questions need to be shared among 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?

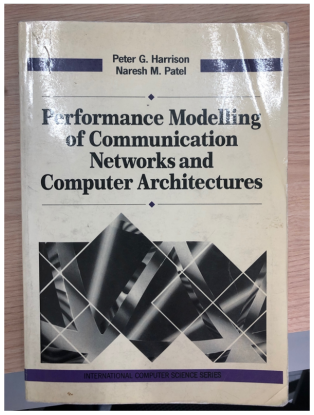
Why Probability?

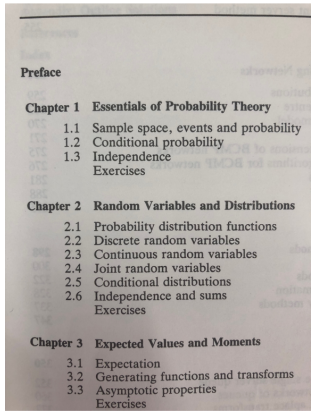
- Many things are "probabilistic"
- Assume that you are a designer of the following engineering systems. Good design?
  - a web server
  - a communication device like mobile phones
  - an AI-based image classifier
- From an engineering point of view,
  - System input
  - Algorithms in systems
  - Analysis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

Textbook: Digital Communication



Textbook: Computer Networking





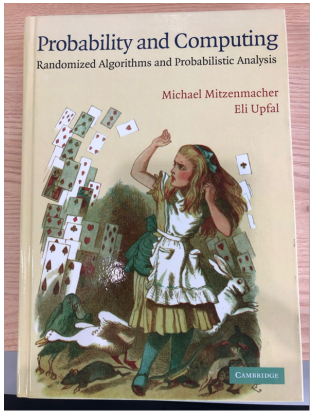
Preface

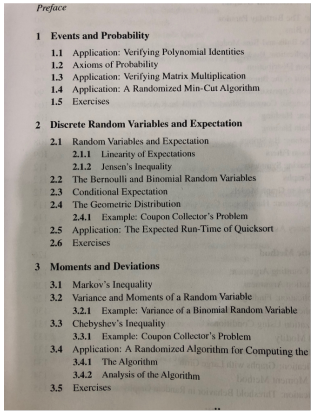
Chapter 1 Essentials of Probability Theory
1.1 Sample space, events and probability
1.2 Conditional probability
1.3 Independence
Exercises

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

Textbook: Algorithm and Computing





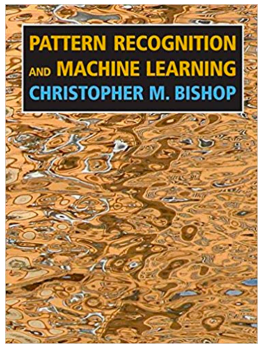
Preface

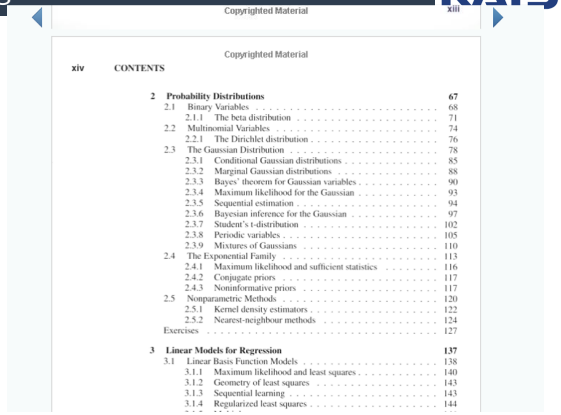
1 Events and Probability
1.1 Application: Verifying Polynomial Identities
1.2 Axioms of Probability
1.3 Application: Verifying Matrix Multiplication
1.4 Application: A Randomized Min-Cut Algorithm
1.5 Exercises

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 Chebyshev'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

Textbook: Machine Learning





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

How to take this course? A designer's perspective

- 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!

Questions?