

Lecture 0: Introduction

Yi, Yung (이용)

EE210: Probability and Introductory Random Processes
KAIST EE

August 22, 2022

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Outline

- Course logistics
- Why this course?

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- Yi, Yung (이용)
- Office: N1, 810
- Homepage: <https://yung-web.github.io/home/>
- E-mail: yiyung@kaist.edu
- Computer Division
- In KAIST EE since 2008

How to Run This Course

- non-real-time online ($\leq 50\%$) + real-time offline/online ($\geq 50\%$)
- All lecture videos have already been pre-recorded. Available in [YouTube](#).
- non-real-time online: Just watch anytime and anywhere you like.
- realtime offline/online: Watch lecture videos in the classroom or in the zoom, with asking and answering questions.
- No attendance check!

Accessing Lecture Videos and Slides



- Method 1:
<https://yung-web.github.io/home/courses/probability.html>
- Method 2: (a) Type **Yung Yi** in the google, (b) visit his [GitHub homepage](#), (c) find the links on [Course](#).

The screenshot shows a Google search results page for the query "yung yi". The first result is a link to "Yung Yi - GitHub Pages" which is highlighted with a red box. Below it, there's a snippet of text from the GitHub page: "Short Bio: Yung Yi received his B.S. and the M.S. in the School of Computer Science and Engineering from Seoul National University in 1997 and 1999, respectively, and his Ph.D. in the Department of Electrical and Computer Engineering at the University of Texas at Austin in 2006. From 2006 to 2008, he was a post-doctoral research associate in the Department of Electrical Engineering at KAIST, South Korea. His current research interests include machine learning, design and analysis of wired/wireless networking systems. He was the recipient of two best paper awards at SECON 2013 and ACM MobiHoc 2013. He was the co-recipient of IEEE William R. Bennett Award, 2016." To the right of the snippet is a small profile picture of Yung Yi.



Short Bio: Yung Yi received his B.S. and the M.S. in the School of Computer Science and Engineering from Seoul National University in 1997 and 1999, respectively, and his Ph.D. in the Department of Electrical and Computer Engineering at the University of Texas at Austin in 2006. From 2006 to 2008, he was a post-doctoral research associate in the Department of Electrical Engineering at KAIST, South Korea. His current research interests include machine learning, design and analysis of wired/wireless networking systems. He was the recipient of two best paper awards at SECON 2013 and ACM MobiHoc 2013. He was the co-recipient of IEEE William R. Bennett Award, 2016.

LANADA (Laboratory of Network Architecture, Design, and Analysis)
LANADA is a research group which I currently lead. Currently, we do not hire new graduate students.

Students advised (PhD)

1. Jinsung Lee, 2012, Postdoc at U. of Colorado
2. Jihyeong Lee, 2014, Sony Ericsson, Sweden
3. Joohyun Lee, 2014, Hanyang Univ.
4. Hanjin Park, 2015, National Security Research Institute
5. Donghyun Kim, 2016, Naver
6. Sochwan Lee, 2016, ETRI
7. Jihyeong Lee, 2016, SK Telecom
8. Hyeyoung Jeon, 2016, Donguk Univ.
9. Jungseul Oh, 2017, POSTECH
10. Hyojeong Lee, 2017, Samsung

Education

- Ph.D. Dept. of Electrical and Computer Engineering, University of Texas at Austin, 2006 - Current
- M.S. Dept. of Computer Science and Engineering, Seoul National University, 1999
- B.S. Dept. of Computer Science and Engineering, Seoul National University, 1997

Position

- KAIST Chair Professor (KAIST 기방재단교수), Dept. of Electrical Engineering, KAIST, 2007 - Current
- Full Professor, Dept. of Electrical Engineering, KAIST, 2018.2 - Current
- Associate Professor, Dept. of Electrical Engineering, KAIST, 2011.8 - 2018.2
- Assistant Professor, Dept. of Electrical Engineering, KAIST, 2008.8 - 2011.8
- Postdoctoral Research Associate, Dept. of Electrical Engineering Princeton University, 2006.8 - 2008.8

Courses

- Probability and Introductory Random Process (video included), Undergraduate
- Data Structures for Electrical Engineers, Undergraduate
- Mathematics for Machine Learning, Undergraduate
- Computer Network, Undergraduate
- Complex Network Analysis: Epidemics and Rumours (video included), Graduate

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2020 Spring

August 22, 2022

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Using KLMS

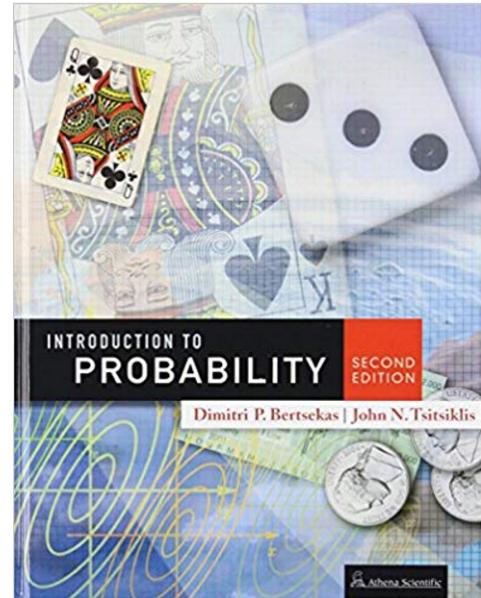


- All notifications and announcements (also sent to you via email)
- Questions about course contents
 - Only through posting in KLMS (so should be in English)
 - NOT individual emails to the lecturer or the TAs
- Homework upload
- Score upload and all the grade-related things

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- Introduction to Probability
(2nd edition)
 - MIT course textbook
 - Dimitri P. Bertsekas and John N. Tsitsiklis
- You can order it from Yes24, Aladin, Kyobo
 - Yes24: <http://www.yes24.com/Product/Goods/3995311>
 - Aladin: <https://www.aladin.co.kr/shop/wproduct.aspx?ItemId=12945615>
 - Kyobo: <http://www.kyobobook.co.kr/product/detailViewEng.laf?ejkGb=ENG&mallGb=ENG&barcode=9781886529380&orderClick=LAG&Kc=>



- <http://athenasc.com/probbook.html>
- Problem solutions
- Links to the MIT courses
- You can find the urls (2006, 2010, 2013) for the MIT lectures based on the same textbook, where there are many useful resources (recitation problems, homework problems, old exam problems, etc)
- Some of my lecture slides are based on theirs, but my slides are largely modified/reorganized/edited in many places for our purpose.

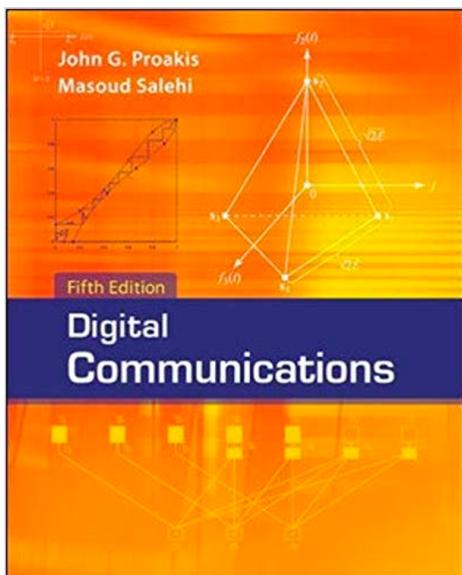
1. Probabilistic model (1/2 week)
2. Conditioning and Independence (1/2 week)
3. Random Variable, Part I (Discrete Random Variable) (1.5 week)
4. Random Variable, Part II (Continuous Random Variable) (1.5 week)
5. Random Variable, Part III (Advanced Topic on Random Variable) (1.5 week)
6. Limit of Scaled Sum of Random Variables: Central Limit Theorem and Weak Law of Large Numbers (1.5 week)
7. Random Process: Bernoulli and Poisson Processes (2 week)
8. Random Process: Markov Chain (2 week)
9. Introduction to Statistical Inference (2 week)

- 2 Exams (mid-term and final)
- Homeworks
 - All problems are from exercise problems in the textbook.
 - We do NOT check whether you copy your solution from the problem solutions or not.
- 9 Homeworks for each of 9 chapters.

- Read **ALL** the emails and sms from KLMS.
- OK not to be present in the classroom? Yes
- OK that my homework solutions is sams as those in the solutions book? Yes
- Can I ask for a personal meeting to ask quetions or get other general advices? Yes. Send me an email.

Questions?

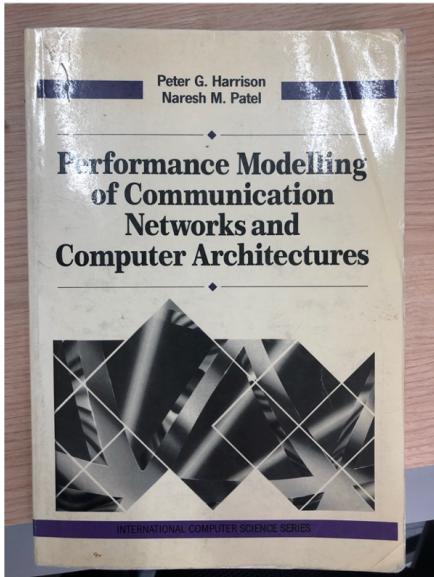
- Many things are "probabilistic"
- Assume that you are a designer of the following engineering systems. Good design?
 - a web server
 - a communication device like mobile phones
 - an AI-based image classifier
- From an engineering point of view,
 - System input
 - Algorithms in systems
 - Analysis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



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Textbook: Computer Networking

KAIST EE



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

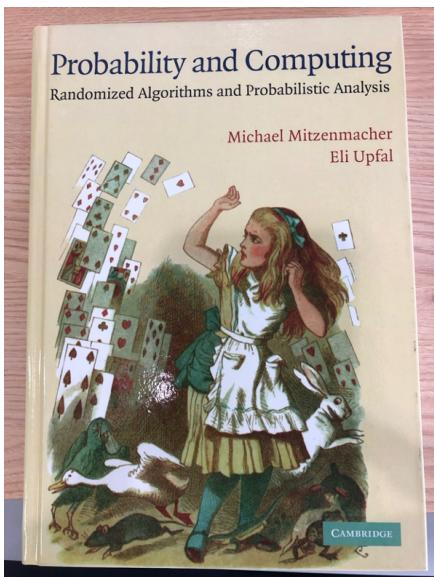
Chapter 3 Expected Values and Moments

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

Exercises

Textbook: Algorithm and Computing

KAIST EE



Preface

1 Events and Probability

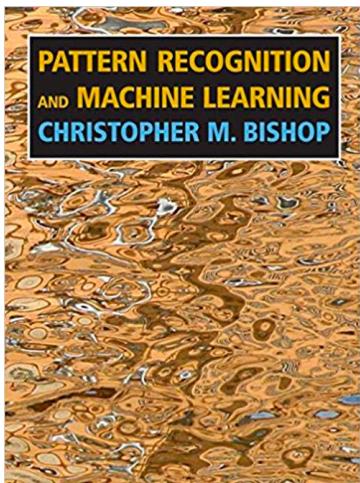
- 1.1 Application: Verifying Polynomial Identities
- 1.2 Axioms of Probability
- 1.3 Application: Verifying Matrix Multiplication
- 1.4 Application: A Randomized Min-Cut Algorithm
- 1.5 Exercises

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 34.1 The Algorithm
- 3.4.2 Analysis of the Algorithm
- 3.5 Exercises



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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?



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