

# Introduction to probability

## 0. Introduction

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Consulting hours: Friday 15:10-16:40 or other day arranged by email

# Evaluation

Stress on **understanding** the subject, not memorization!

Assuming that the evaluation will be carried on-line:

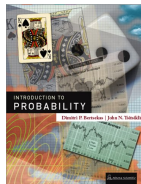
- Both classes and lectures are evaluated with the same grade
- The grading based on **two tests**, each covering around 7 lectures (the first test arranged in midterm)
- Each test is planned to be 75-90 minutes long, and will consist of automatically checked questions (fill-in questions, multiple- or single-choice questions, etc.)

Lectures are not compulsory to attend ...

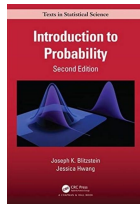
... But beware: this course is **difficult**!

# Literature

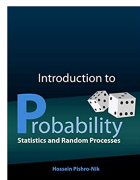
D. Bertsekas, J. Tsitsiklis  
**Introduction To Probability**  
Athena Scientific, 2002



J. K. Blitzstein, J. Hwang  
**Introduction to probability**  
CRC Press  
Available [online](#)



H. Pishro-Nik  
**Introduction to Probability, Statistics,  
and Random Processes**  
Kappa Research, LLC  
Available [online](#)

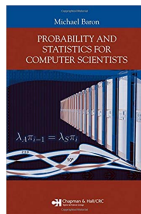


# Literature

M. Baron:

Probability and Statistics for Computer Scientists

Chapman & Hall



J. Jakubowski, R. Sztencel

Rachunek prawdopodobieństwa dla prawie każdego

SCRIPT, 2006

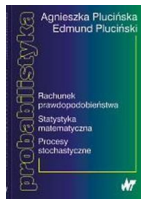
(hard to find, not available in the library)



A. Plucińska, E. Pluciński

Probabilistyka: rachunek prawdopodobieństwa,  
statystyka matematyczna, procesy stochastyczne

WNT, 2000



# Literature

M. Mitzenmacher, E. Upfal

Metody probabilistyczne i obliczenia

WNT, 2009



W. Feller

Wstęp do rachunku prawdopodobieństwa.

Część 1

PWN, 2017



W. Krysicki, J. Bartos i in.

Rachunek prawdopodobieństwa i statystyka matematyczna w zadaniach

PWN, 2010



# Courses

Courses on probability calculus available *online*  
(some of which I used to prepare mine):

- [Introduction to Probability](#)  
MIT
- [Probability for Computer Scientists](#)  
Stanford University
- [Introduction to Probability and Statistics](#)  
Carnegie Mellon University
- [Introduction to Probability](#)  
edX course
- (Polish) J. Potoniec: [Rachunek prawdopodobieństwa i statystyka](#)  
For external students at PUT
- (Polish) K. Rybarczyk-Krzywdzińska: [Rachunek prawdopodobieństwa](#)  
UAM, Poznan

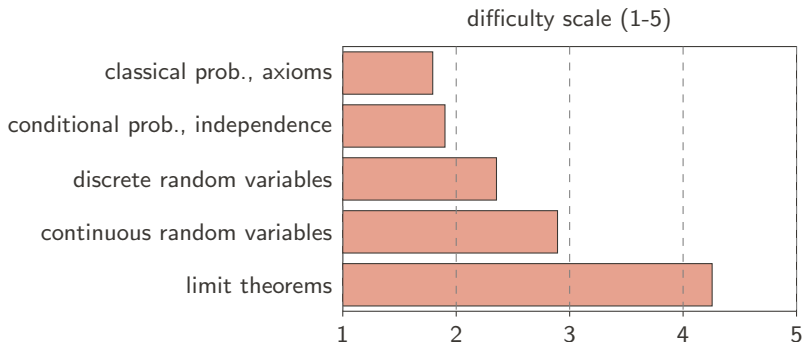
# Course syllabus

1. Classical and geometric probability, probability axioms [2 lectures]
2. Conditional probability and independence [2 lectures]
3. Discrete random variables [3-4 lectures]
4. Continuous random variables [2-3 lectures]
5. Limit theorems [2 lectures]
6. Stochastic processes and Markov chains [1-2 lectures]



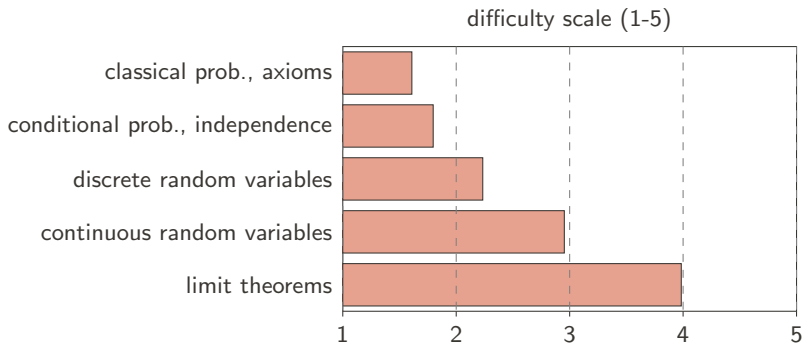
# Difficulty assessment

Based on the survey among 121 students 2017/2018



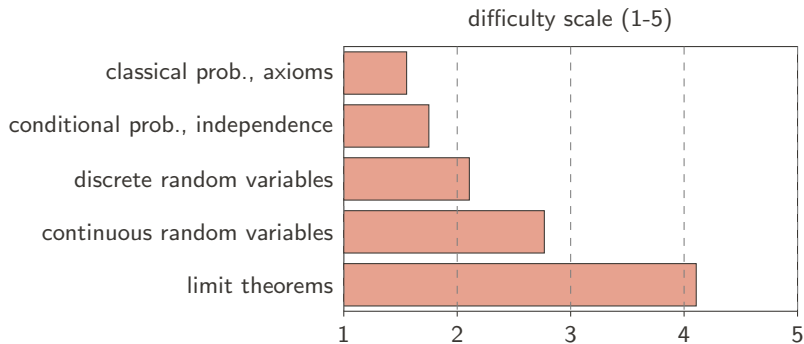
# Difficulty assessment

Based on the survey among 64 students 2018/2019



# Difficulty assessment

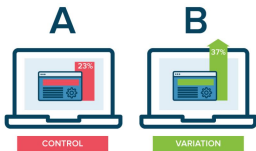
Based on the survey among 57 students 2019/2020



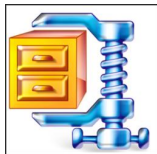
# Applications of probability

*Probability is the very guide of life*

Joseph Butler (1692-1752)



A/B tests



data compression



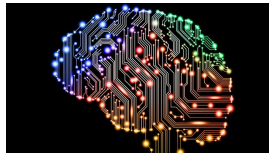
cryptography



computer networks



risk assessment

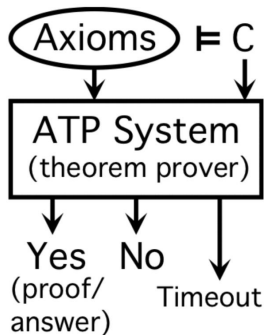


AI & machine learning

# Artificial intelligence

The research in AI was initially based on logic, symbolic computation, formal languages and linguistics ...

... It led to a failure in solving the basic problems in the field (natural language processing, speech recognition, pattern recognition, etc.) and to a long stagnation known as *AI winter*.



## Machine translation in 1966

*the spirit is willing but the flesh is weak*

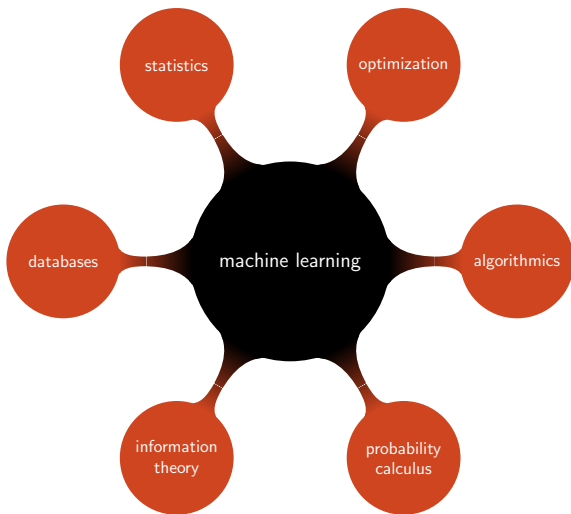


(Russian  $\rightarrow$  English)



*the vodka is good but the meat is rotten*

# Machine learning – revolution in AI



Machine learning is based on probability and statistics

Concerns algorithms which **learn** from data

# Successes of machine learning

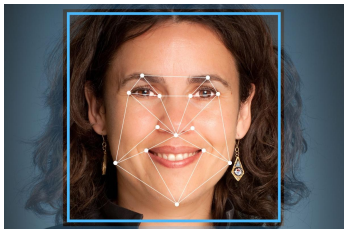
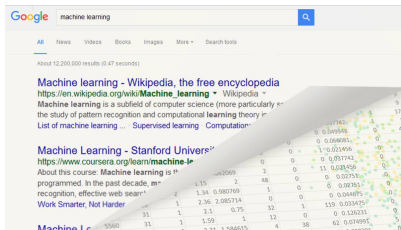


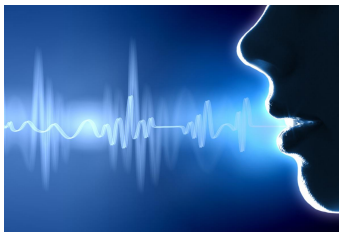
Image recognition



Information retrieval



Automatic translation



Speech recognition



## The Top Skills of 2016 on LinkedIn Global

- 1 Cloud and Distributed Computing
- 2 Statistical Analysis and Data Mining
- 3 Web Architecture and Development Framework
- 4 Middleware and Integration Software
- 5 User Interface Design
- 6 Network and Information Security
- 7 Mobile Development
- 8 Data Presentation
- 9 SEO/SEM Marketing
- 10 Storage Systems and Management

## The top 5 hard skills companies need most in 2019

Based on research from LinkedIn Learning

1. Cloud Computing
2. Artificial Intelligence
3. Analytical Reasoning
4. People Management
5. UX Design

Source: LinkedIn

*The sexy job in the next 10 years will  
be statisticians*

Hal Varian, Chief Economist at Google (2009)