INTRODUCTION TO MACHINE LEARNING

INTRODUCTION TO THE COURSE

Mingon Kang, PhD
Department of Computer Science @ UNLV

Self Introduction

- Sai Chandra Kosaraju
- Research interests:
  - Bioinformatics, Machine Learning, Data Mining, and Big Data Analytics
- Projects I am interested in:
  - Biomedical projects
  - Computer Vision projects
  - Developing Python package

Course Information

- Course Description
  - Explores various machine learning algorithms for regression, classification, clustering, and ensemble learning, including application of machine learning techniques to solve challenging problems in various fields.

Topics

- Data representation and visualization
- Supervised Learning
  - K-Nearest Neighbor (KNN)
  - Linear Models
  - Logistic Regression
  - Neural Networks
  - Convolutional Neural Networks
  - Support Vector Machine (SVM) and Kernels
  - Linear Discriminant Analysis (LDA)

Topics

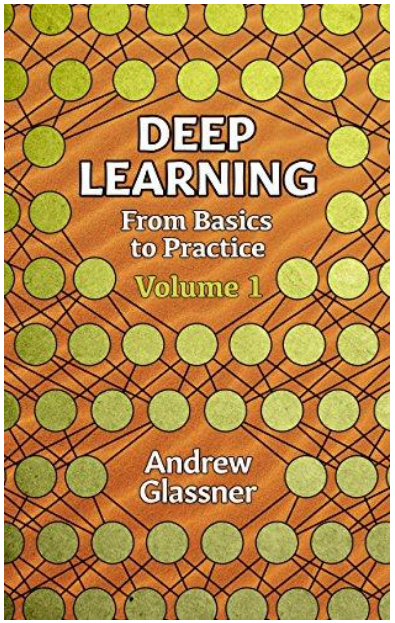
- Unsupervised Learning
  - Principal Component Analysis
  - K-means Clustering
- Ensemble Learning

Choice of Language

- There are many programming languages such as C/C++, JAVA.
- However, high-level script languages such as R, MATLAB, Python are highly recommended.
- Why?
  - Better for file I/O of textual data
  - Better to do matrix manipulation
  - Fast Prototyping
- We will use **Python** for this course.

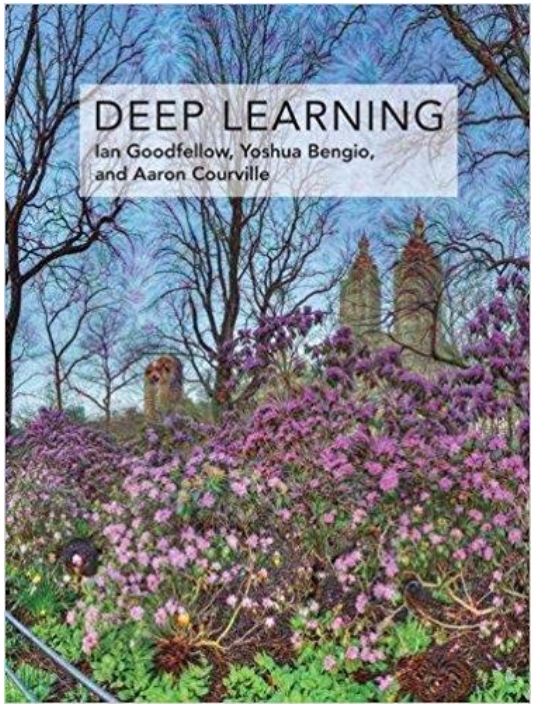
Reference

- Deep Learning, Vol. 1: From Basics to Practice by Andrew Glassner, 2018



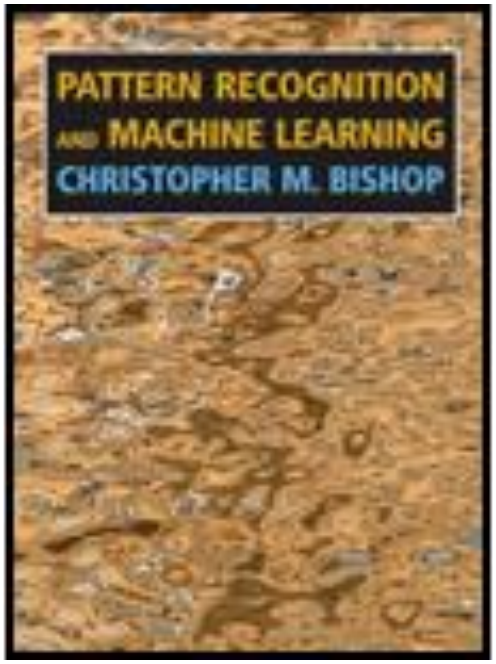
Reference

- Deep Learning, Ian Goodfellow, Yoshua Bengio and Aaron Courville, MIT press, 2016
  - Webpage: http://www.deeplearningbook.org



Reference

- Pattern Recognition and Machine Learning, Christopher M. Bishop, 6-edition, Springer-Verlag New York, 2006



Before beginning the course

- Let's discuss about the origins of Computer Science and philosophy

Philosophy

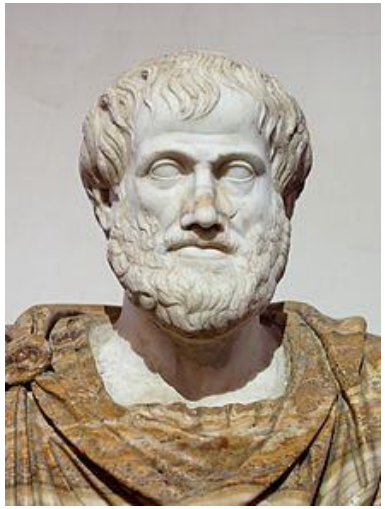
- Definition of the word
  - "The study of the fundamental nature of knowledge, reality, and existence, especially when considered as an academic discipline." Oxford Dictionary
- Literally means "love of wisdom" or "friend of wisdom"
- Logic
  - logically describe world (around 500 BC)
- Ancient Graeco-Roman philosophy
  - Socrates, Plato, Aristotle, and etc..

Philosophers

- Aristotle
- Gottfried Wilhelm Leibniz
- George Boole
- Bertrand Russell
- Alan Turing

Aristotle (384 – 322 BC)

- So many different roles
  - Physics, Biology, Music, Linguistics, Zoology, Economy, Politics
- How to understand the different world?
  - LOGIC

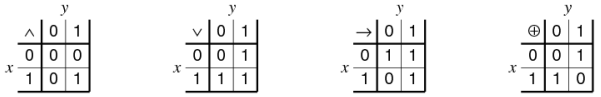


Gottfried Wilhelm Leibniz

- German philosopher (1646-1716)
- Known as one of the founding fathers of calculus
- Wanted to prove all phenomena using binary logic
  - Convert world to binary logic

George Boole

- English mathematician, philosopher, and logician (1815-1864)
- Author of "The Laws of Thought"
- Inventor of Boolean Logic



$\wedge$	0	1
0	0	0
1	0	1

$\vee$	0	1
0	0	1
1	1	1

$\rightarrow$	0	1
0	1	1
1	0	1

$\oplus$	0	1
0	0	1
1	1	0

Figure 1. Truth tables

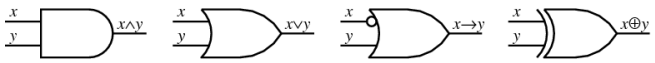


Figure 2. Logic gates

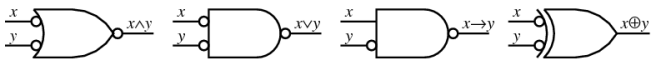
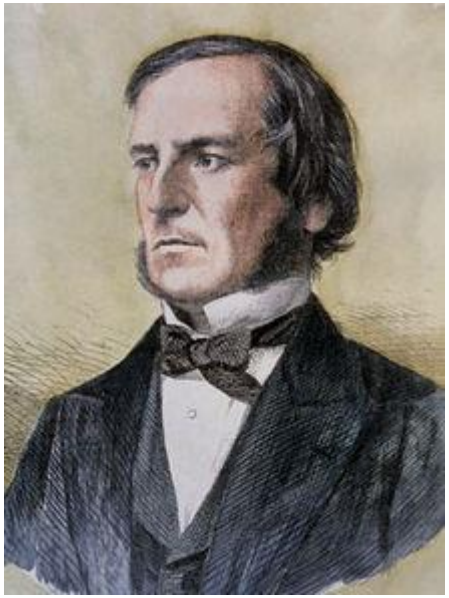


Figure 3. De Morgan equivalents

Figure 4. Venn diagrams

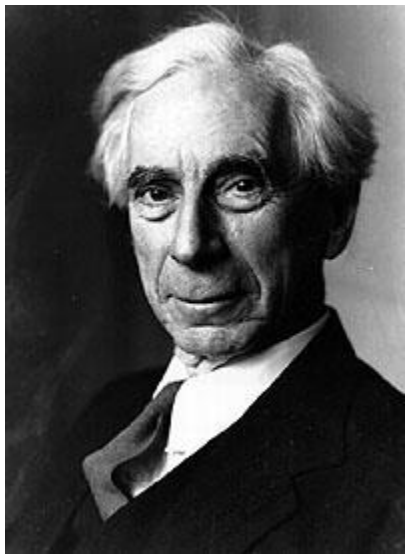
Note that Boolean logic can be used to implement binary arithmetic



Bertrand Russell

- British philosopher, logician, mathematician, historian, writer, social critic and political activist
- Wanted to make perfect mathematics from perfect logic
- Author of "*Principia Mathematica*", published in 1910, 1912, and 1913.

Total of 1994 pages!!



Principia Mathematica

$*54{\cdot}43. \quad \vdash :. \alpha, \beta \in 1 . \supset : \alpha \cap \beta = \Lambda . \equiv . \alpha \cup \beta \in 2$

Dem.

$\vdash . *54{\cdot}26 . \supset \vdash :. \alpha = \iota`x . \beta = \iota`y . \supset : \alpha \cup \beta \in 2 . \equiv . x \neq y .$

$[*51{\cdot}231] \qquad \equiv . \iota`x \cap \iota`y = \Lambda .$

$[*13{\cdot}12] \qquad \equiv . \alpha \cap \beta = \Lambda \qquad (1)$

$\vdash . (1) . *11{\cdot}11{\cdot}35 . \supset$

$\vdash :. (\exists x, y) . \alpha = \iota`x . \beta = \iota`y . \supset : \alpha \cup \beta \in 2 . \equiv . \alpha \cap \beta = \Lambda \qquad (2)$

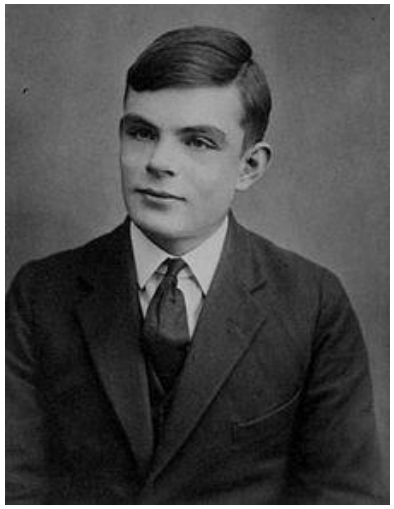
$\vdash . (2) . *11{\cdot}54 . *52{\cdot}1 . \supset \vdash . \text{Prop}$

From this proposition it will follow, when arithmetical addition has been defined, that $1 + 1 = 2$.

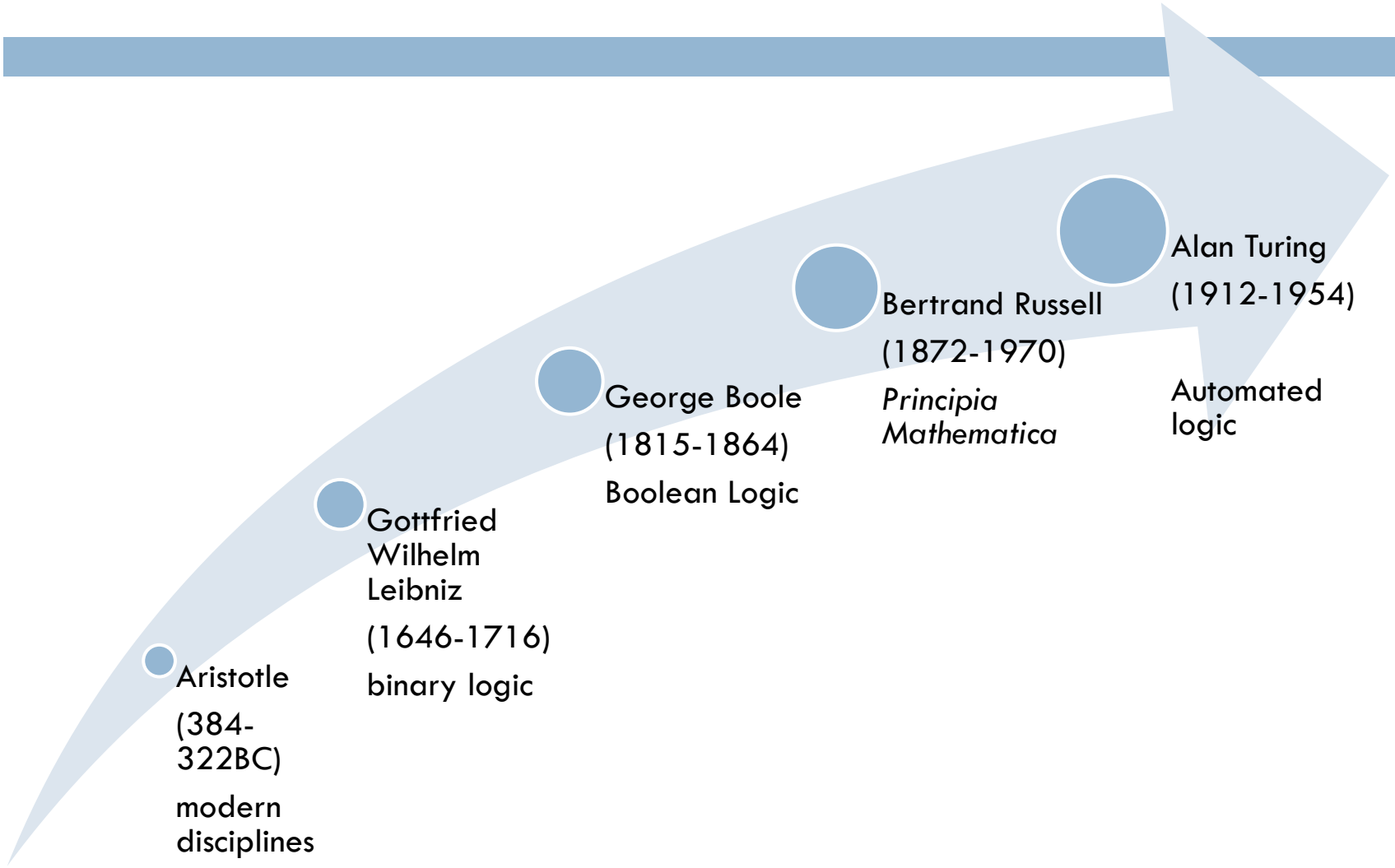
✷**54.43**: "From this proposition it will follow, when arithmetical addition has been defined, that 1+1=2." — Volume I, 1st edition, page 379

Alan Turing (1912-1954)

- Automatize logic.
  - If everything can be explained by logic, we may implement the logic automatically not manually.
  - Introduced Turing test: https://www.csee.umbc.edu/courses/471/papers/turing.pdf
- Turing Machine
  - A model of a general purpose computer



Summary



See http://www.datesandevents.org/events-timelines/07-computer-history-timeline.htm