Deep Learning for Business

Basics of Deep Learning
Neural Networks

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Deep Learning for Business

Basics of Deep Learning Neural Networks

What is Deep Learning & Machine Learning?

Deep Learning & Machine Learning

AI (Artificial Intelligence)

- **Technology that enables a machine to make an intelligent decision or action**

- **AI technology enables an intelligent agent (HW, SW, Robot, App.) to cognitively perceive its environment and correspondingly attempt to maximize its probability of success of a target action**

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ML (Machine Learning)

- **Capability enabled to a computer to learn without being explicitly programmed**

- **Functionality to learn and make predictions from data**

- **Evolved from pattern recognition and computational learning theory in AI**

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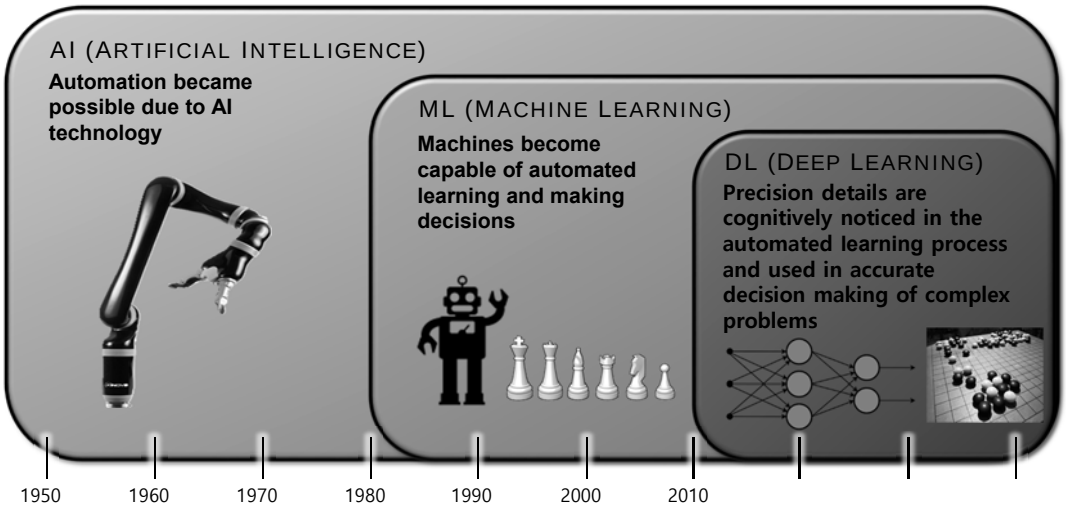
DL (Deep Learning)

- **ML technique that uses multiple internal layers (hidden layers) of nonlinear processing units (neurons) to conduct supervised or unsupervised learning from data**
- **DL is commonly implemented using a NN (Neural Network)**

Relation between AI, ML, and DL



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Author: Donarreiskoffer
https://commons.wikimedia.org/wiki/File%3AGo_board.jpg

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Examples of Human vs. AI

- 1996~1997 IBM's Deep Blue beats world top ranked Chess players
  - Estimated 11.4 GFLOPS

Computer Chess Rating Lists (CCRL)

World Chess Federation (FIDE) Ratings

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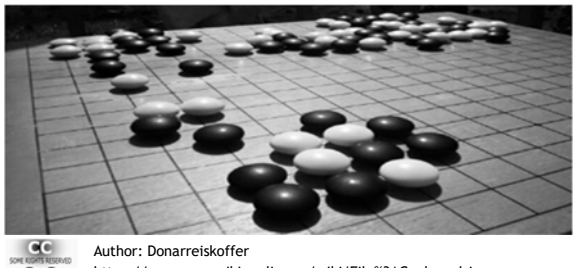
Examples of Human vs. AI

- 2015~2017 Google's DeepMind AlphaGo beats world top ranking Go players

TPU (Tensor Processing Unit) 2nd Generation

11.5 PFLOPS = 11.5×10^{15} FLOPS



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CPU (Central Processing Unit)

- CPU executes instructions of a PC, Smartphone, etc.

- Designed to support all process types

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GPU (Graphics Processing Unit)

- GPU is a custom made CPU that is operation specified for high speed and low power operations

- Embedded in PC and Smartphone Video Cards, Motherboards, and inside CPUs

Computer Performance Units

- FLOPS (FLoating-Point Operations Per Second)
  - Floating-point computation based performance measure
  - GFLOPS (Giga=Billions=10^9 FLOPS) commonly used

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Computer Performance Units

- IPS (Instructions per Second)
  - Integer number of operations based performance measure
  - MIPS (Millions=10^6 of IPS) commonly used

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Human

- Approximately 0.01 FLOPS = $\frac{1}{100}$ FLOPS
  - 0.01 FLOPS = 100 s for one Floating-Point calculation
  - Example: 1.2345 + 0.6789 = **1.9134**
- 2.5×10^{15} = 2.5 PB of memory running on 20 W of power

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Human's Brain

- 100 Billion (10^{11}) neurons
- 10,000 (10^{4}) connections per neuron
- 1 Quadrillion (10^{15}) synaptic connections

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FLOPS Comparison (Approximations)

- Human
  - 0.01 FLOPS
- Modern Smartphones or PCs
  - 10~300 GFLOPS (10^9 FLOPS)
- Google's DeepMind AlphaGo Master
  - TPU 2G 11.5 PFLOPS = 11.5×10^{15} FLOPS

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How is Intelligence extracted from Data?

- Among the possible ways we will focus on
  - **ML (Machine Learning)**
  - **DL (Deep Learning)**

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What is this Intelligence used for?

- Natural language processing
- Computer vision
- Speech recognition
- Robotics motion and manipulation
- Computational creativity
- etc.

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DL & ML uses many AI Technologies

- AI Technologies Types
  - **ANN** (Artificial Neural Network)
    - **NN** (Neural Network)
  - Evolutionary Algorithms
  - Genetic Programming
  - Swarm Intelligence
  - etc.

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DL & ML uses many AI Technologies

- AI Tools used to make Optimal decisions (or Faster Suboptimal decisions)
  - Optimization Theory
  - Game Theory
  - Fuzzy Logic
  - Simulated Annealing
  - Monte Carlo experiments & simulation
  - Complex Theory, etc.

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DL & ML Technology

- We will study on how intelligence is obtained from data using
  - **Neuron, Perceptron**
  - **NN (Neural Network)**
  - **CNN (Convolutional Neural Network)**
  - **RNN (Recurrent Neural Network)**

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References

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Image sources

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