Advances in Artificial Intelligence: Diverse and Collaborative Learning

Session co-chairs:

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Huge progress and success in recent **AI** based on **deep learning**

AlphaGo (Silver et al., 2016)

- ✓ Representation learning
- ✓ Monte Carlo tree search

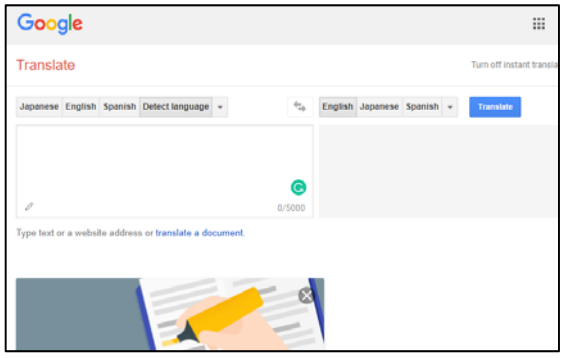
Self-driving car (Google and so on)

- ✓ Pedestrian detection
- ✓ Semantic segmentation

Google Home

- ✓ Speech recognition & synthesis

https://www.engadget.com/2018/06/12/google-home-handles-three-requests-at-once/



Google Translate

- ✓ Neural machine translation

https://translate.google.com/

http://venturebeat.com/2011/02/15/ibm-watson-jeopardy-2/, http://weekly.ascii.jp/elem/000/000/207/207410/

Shogi/ Japanese chess

IBM Watoson

Deep learning era

Wining in ILSVRC（2012）
Google's cat（2012）
M&A of DeepMind（2013）
FB/Baidu's AI lab.（2013）
Alpha Go（2016）
Google Home (2017)

Application to robots and cars

Self-driving Vehicle
Pepper

Machine learning

Web, Big data

Statistical
Natural language processing

Application to
Search engine

Medical diagnosis

Task ontology

MYCIN
DENDRAL

Expert system

Ontology

Watoson(2011)

LOD（Linked Open Data)

Winter of AI....

Eliza

Dialog system

Siri(2012)

Calo project

bot

Search
Game, puzzle

Planning
STRIPS

Chess（1997)
Deep Blue

Shogi(2012-)

Go

1956 1970 1980 1995 2010 2015

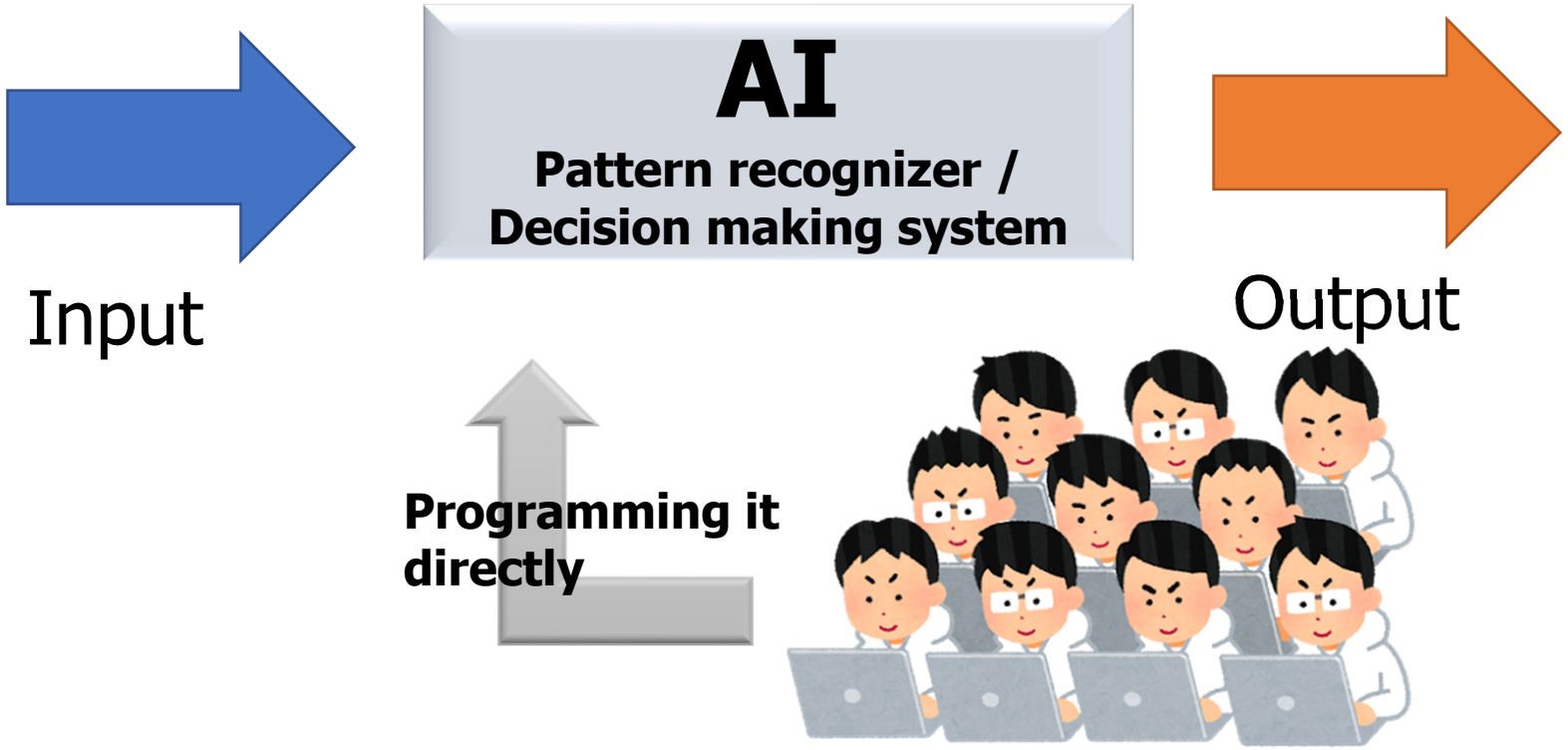
The 1st AI boom
(Search, Induction)

The 2nd AI boom
(Knowledge engineering)

The 3rd AI boom
(Machine learning, DL)

Rule-based AI

- Representative of the 2nd AI boom (1970s-)



Progress in **Machine Learning**

- Progress in 1990s and 2000s

AI

Pattern recognizer/
Decision making system

Feature extractor

ML

Labeled Data For training

Input

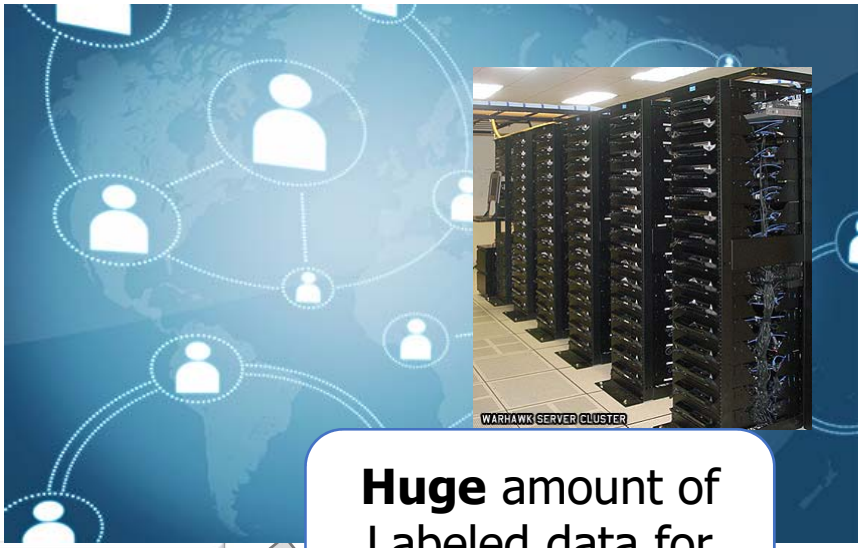
Output

Developed By human researchers

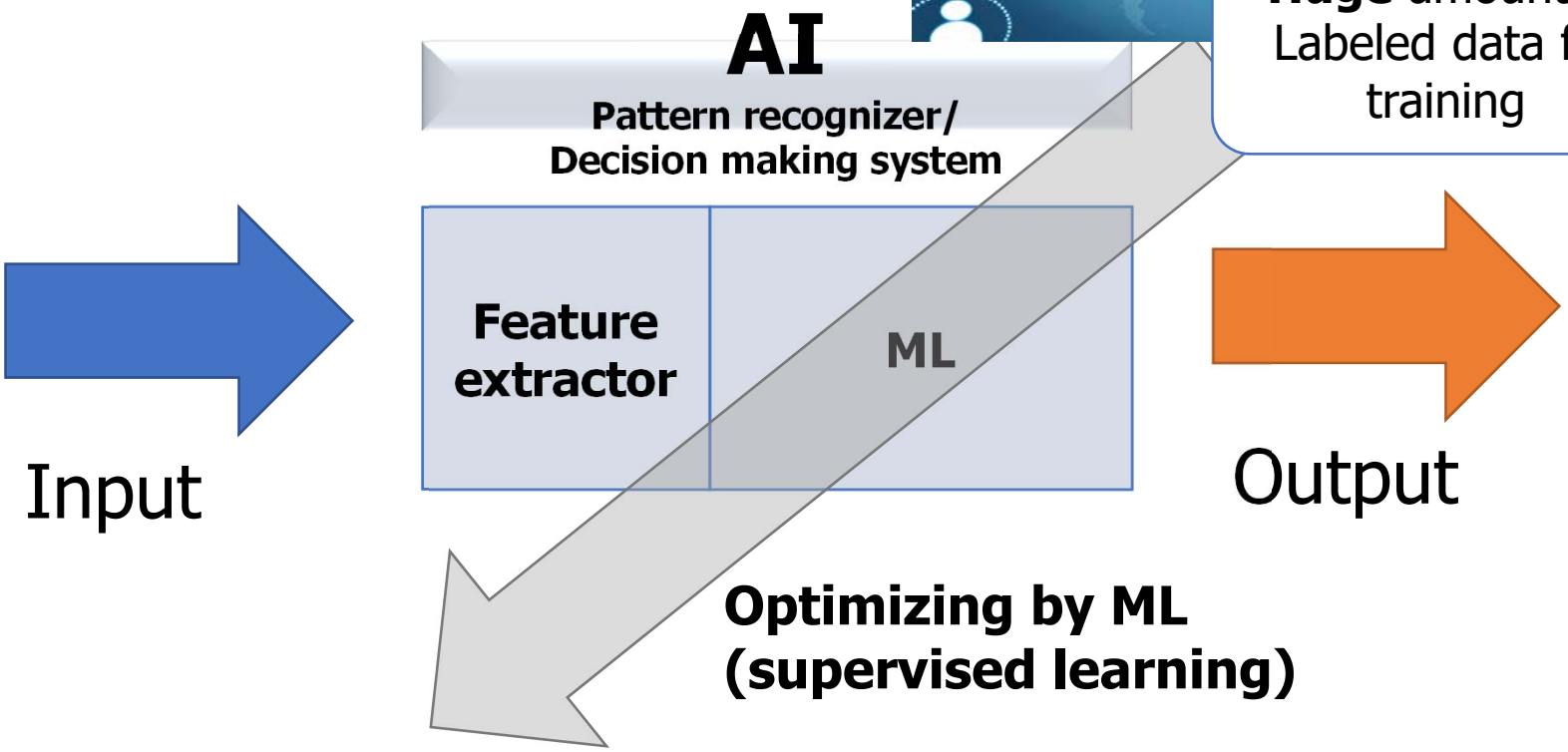
Optimizing by ML (supervised learning)

Deep learning

- The 3rd AI boom since around 2013



Huge amount of Labeled data for training



End-to-End learning

Encoder-decoder architecture

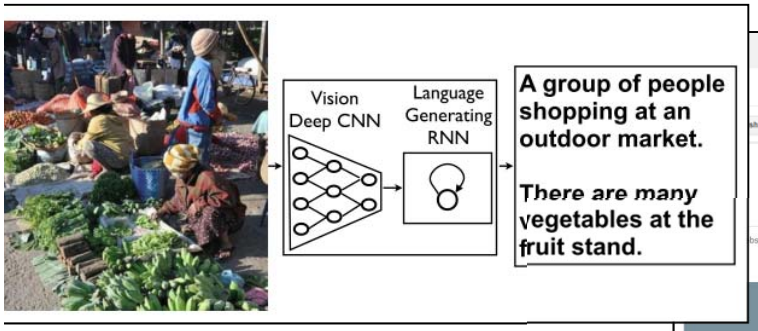
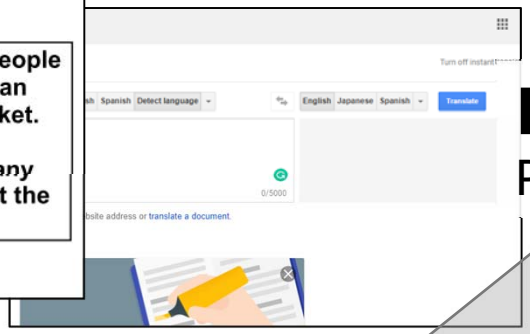


Image captioning

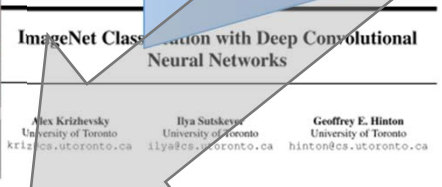


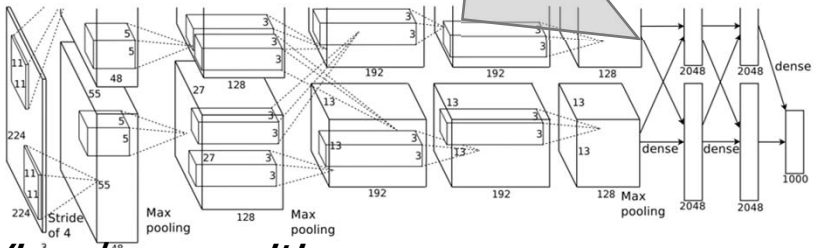
Machine translation

Labeled data/
Perfect simulation environment

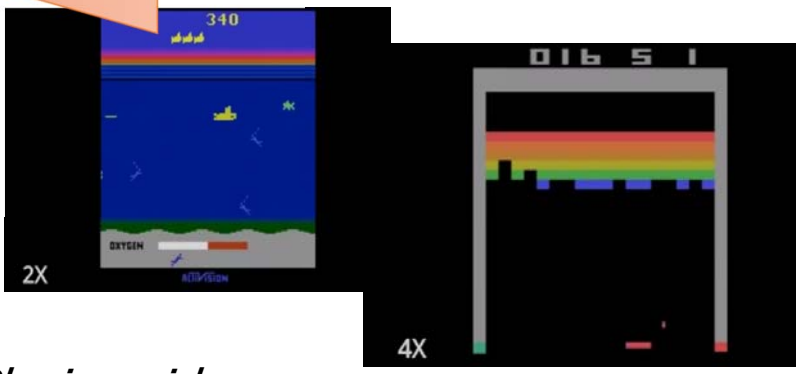
Labeled data matters!

Input → Encoder NN → Decoder NN → Output





Visual recognition



Playing video games

Labeled data make a machine **intelligent**!?

Deep learning solved everything?

Dialogue with AI researcher!

(Cynical but somehow typical)

Non-AI Guy

N: Hey! I want to use AI for my business to solve our problem. Can you give me some advice?

A: Okay. Do you have (labeled) data?

AI Guy

N: We have some. But, it's not enough, and other data has not been organized well.

A: Is it easy for you to prepare a large amount of labeled data?

N: No. I may be able to try. But, it will take a long time. We have several problems to do that.

A: Hmm. If you don't have enough data, I cannot help you. If you solve the problems and prepare a large amount of (labeled) data, please visit me again.

<u>Then, the non-AI person gave up adapting AI/ML-based methods.</u>

Reality
in practical application of AI

- ✓We **don't have** a large amount of **labeled data** for our target domain.
- ✓We often have massive **unlabeled data** obtained from web sites, social networks, sensor networks, and POS data.
- ✓Our target domain is often not a static dataset, but often a **dynamic physical system**, e.g., industrial plants, robots, and networked IoT devices observing human activities.

Practical challenge in AI

- Let's use a small labeled dataset and a large amount of unlabeled data. (Semi-supervised learning)

Anomaly mining

- Let's make use of constraints o physical systems

Physical system analytics

How can we tackle with the "data sparsity" problems to solve real-world problems?

Relational data analysis

- Let's carefully model the observed unlabeled data (Unsupervised learning)

Robot control

- Let's make a robot collect data

Speakers

US-side

1. Leman Akoglu
(Carnegie Mellon University)

"Anomaly Mining: Beyond Detection"

2. Ion Matei
(Palo Alto Research Center)

"Learning Algorithms for Physical Systems: Challenges and Solutions"

Perception
Big data

Action
Physical systems

JP-side

3. Takamitsu Matsubara
(Nara Institute of Science and Technology)

4. Iku Ohama
(Panasonic)

"Statistical Models for Discovering Knowledge from Relational Data"

"Sample-Efficient Reinforcement Learning for Real-World Robot Control"

Advances in Artificial Intelligence: Diverse and Collaborative Learning

- 1st session (chair: Tadahiro Taniguchi)
  1. Anomaly Mining: Beyond Detection
     Leman Akoglu, Carnegie Mellon University
  2. Learning Algorithms for Physical Systems: Challenges and Solutions
     Ion Matei, Palo Alto Research Center

- 2nd session (chair: Ion Matei)
  3. Sample-Efficient Reinforcement Learning for Real-World Robot Control
     Takamitsu Matsubara, Nara Institute of Science and Technology

  4. Statistical Models for Discovering Knowledge from Relational Data
     Iku Ohama, Panasonic

Enjoy the talk and the discussion of Advanced AI session!