AI Technology in Your Daily Life

AI untuk Semua[1]

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[1] https://www.coursera.org/learn/ai-for-everyone/home/welcome

Outline

1. Introduction
2. Machine Learning
3. What is Data?
4. The Terminology of AI
5. What Machine Learning Can and Cannot Do
6. More examples of what ML can and cannot do
7. Non-technical explanation of deep learning
8. Survey of major AI application areas
9. MK Pilihan Jalur Komputasi Cerdas

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Introduction

Figure 1: Source: McKinsey Global Institute (Ng, 2019)

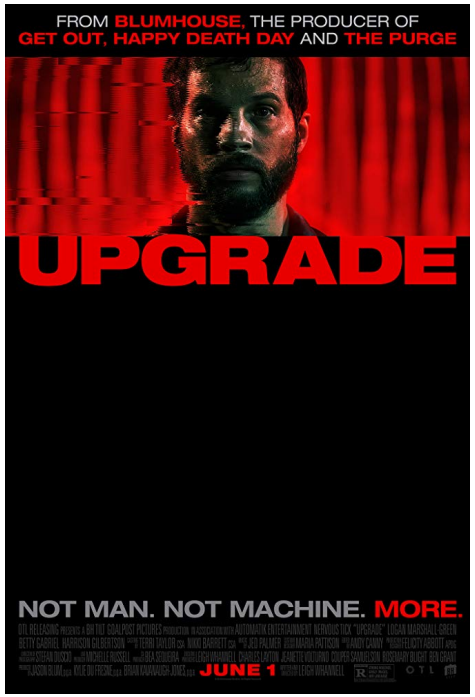
$\$13 \text{ trillion} = \$13 \times 10^{12} = \text{Rp}183 \times 10^{15}$.

Demystifying AI

Artificial Intelligence or **AI** can be divided into 2 as follows:

- **ANI** ⇒ Artificial Narrow Intelligence.
  Examples: smart speaker, self-driving car, web search, AI in farming and factories.

- **AGI** ⇒ Artificial General Intelligence.
  Examples: Do anything a human can do atau bahkan melebihi.



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Supervised Learning (1/2)

- One of the tools that drive the significant progress of AI is **Machine Learning**.
- A common type of of Machine Learning is a type of AI that learns from A to B or is often called ***Supervised Learning***.

$$\underset{\text{input}}{A} \longrightarrow \underset{\text{output}}{B}$$

Supervised Learning (2/2)

Input (*A*)		**Output (*B*)**	**Application**
email	$\longrightarrow$	spam? (0/1)	spam filtering
audio	$\longrightarrow$	text transcript	speech recognition
English	$\longrightarrow$	Indonesia	machine translation
ad, user info	$\longrightarrow$	click? (0/1)	online advertising
image, radar info	$\longrightarrow$	position of other cars	self-driving car
image of phone	$\longrightarrow$	defect? (0/1)	visual inspection

Why Now?

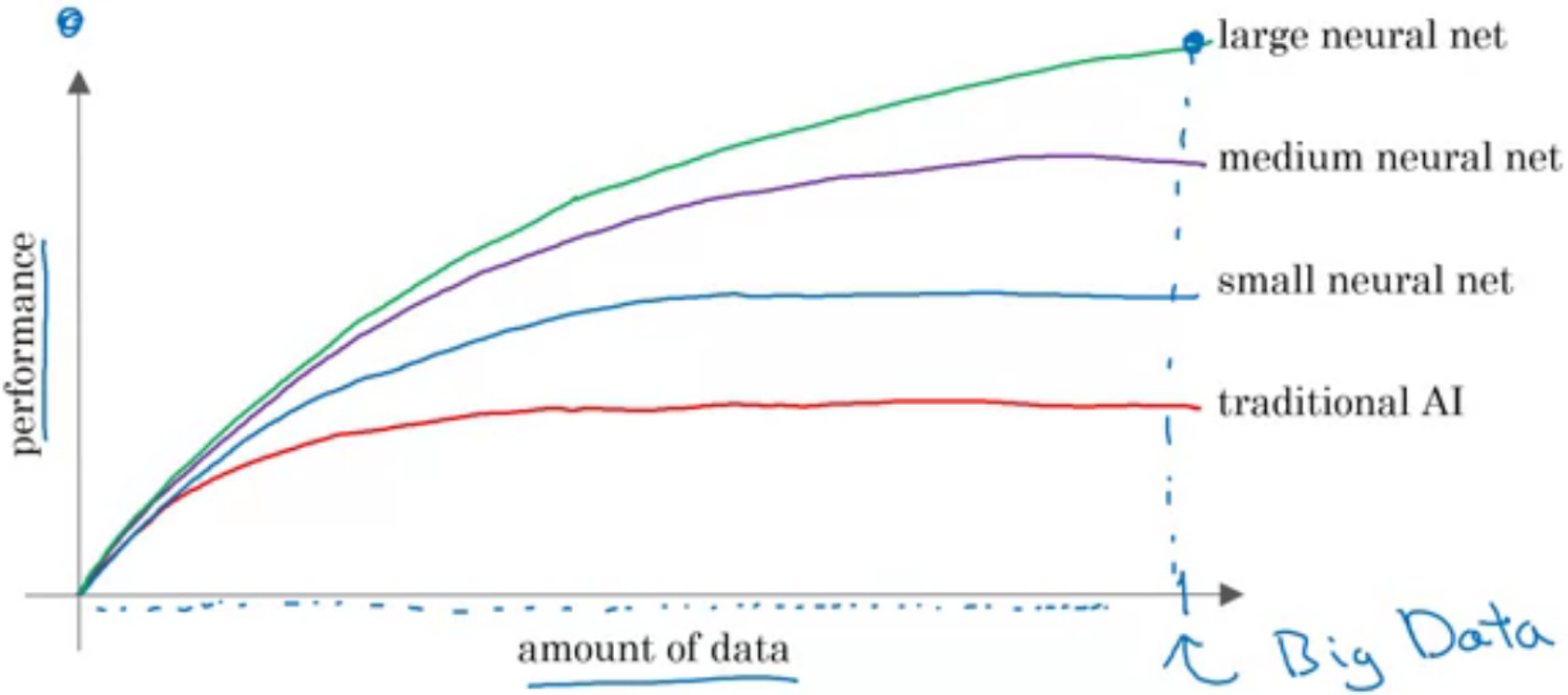

Figure 2: Large neural net + Big Data = High Performance (Ng, 2019)

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Example of a Table of Data (Dataset) (1/3)

size of house (square feet)		price (1000$)
523		115
645		150
708		210
1034		280
2290		355
2545		440

A B

$A \longrightarrow B$

Table 1: House prices dataset (Ng, 2019)

Example of a Table of Data (Dataset) (2/3)

size of house (square feet)	# of bedrooms	price (1000$)
523	1	115
645	1	150
708	2	210
1034	3	280
2290	4	355
2545	4	440

A B

$A \longrightarrow B$

Table 2: House prices dataset (Ng, 2019)

Example of a Table of Data (Dataset) (3/3)

image	label
	cat
	not cat
	cat
	not cat

A B

Table 3: Cat images dataset (Ng, 2019)

Acquiring data

- Manual labeling

cat

not cat

cat

not cat

- From observing behaviors

user ID	time	price ($)	purchased
4783	Jan 21 08:15.20	7.95	yes
3893	March 3 11:30.15	10.00	yes
8384	June 11 14:15.05	9.50	no
0931	Aug 2 20:30.55	12.90	yes

machine	temperature (°C)	pressure (psi)	machine fault
17987	60	7.65	N
34672	100	25.50	N
08542	140	75.50	Y
98536	165	125.00	Y

A B

- Download from websites / partnerships

Data is Messy

- Garbage in, garbage out
- Data problems: *incorrect labels* and *missing values*

size of house (square feet)	# of bedrooms	price (1000$)
523	1	115
645	1	0.001
708	unknown	210
1034	3	unknown
unknown	4	355
2545	unknown	440

- Multiple types of data
  images, *audio*, *text* $\Rightarrow$ **unstructured data**

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Machine Learning vs. Data Science (1/2)

size of house (square feet)	# of bedrooms	# of bathrooms	newly renovated	price (1000$)
523	1	2	N	115
645	1	3	N	150
708	2	1	N	210
1034	3	3	Y	280
2290	4	4	N	355
2545	4	5	Y	440

A B

Figure 3: Home prices (Ng, 2019)

According to *Machine Learning*:

$A \longrightarrow B$: Running AI system (e.g., websites / mobile app)

According to *Data Science*:

Homes with 3 bedrooms are more expensive than homes with 2 bedrooms of a similar size.

Newly renovated homes have a 15% premium.

Machine Learning vs. Data Science (2/2)

Machine Learning

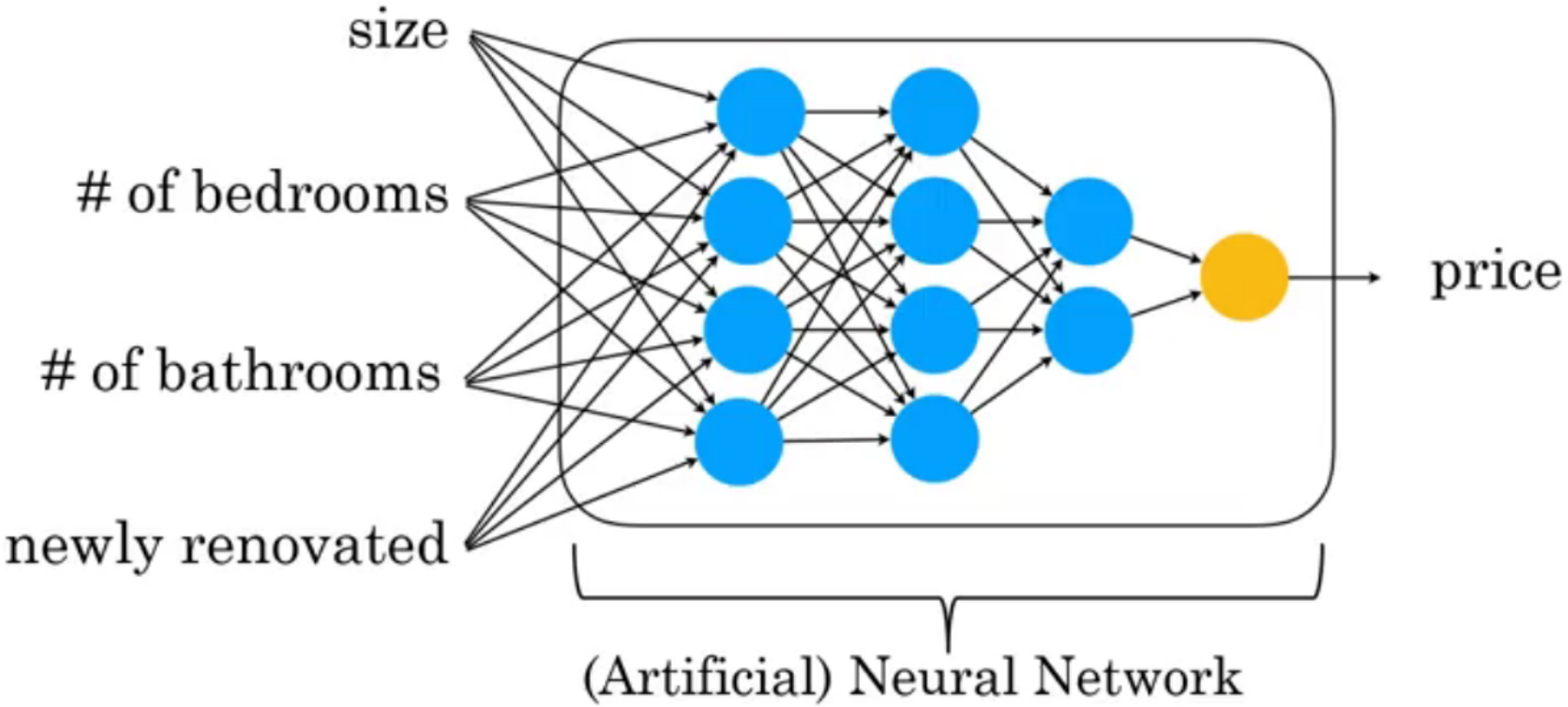
"Field of study that gives computers the ability to learn without being explicitly programmed."
$\longrightarrow$ software
-Arthur Samuel (1959)

Data Science

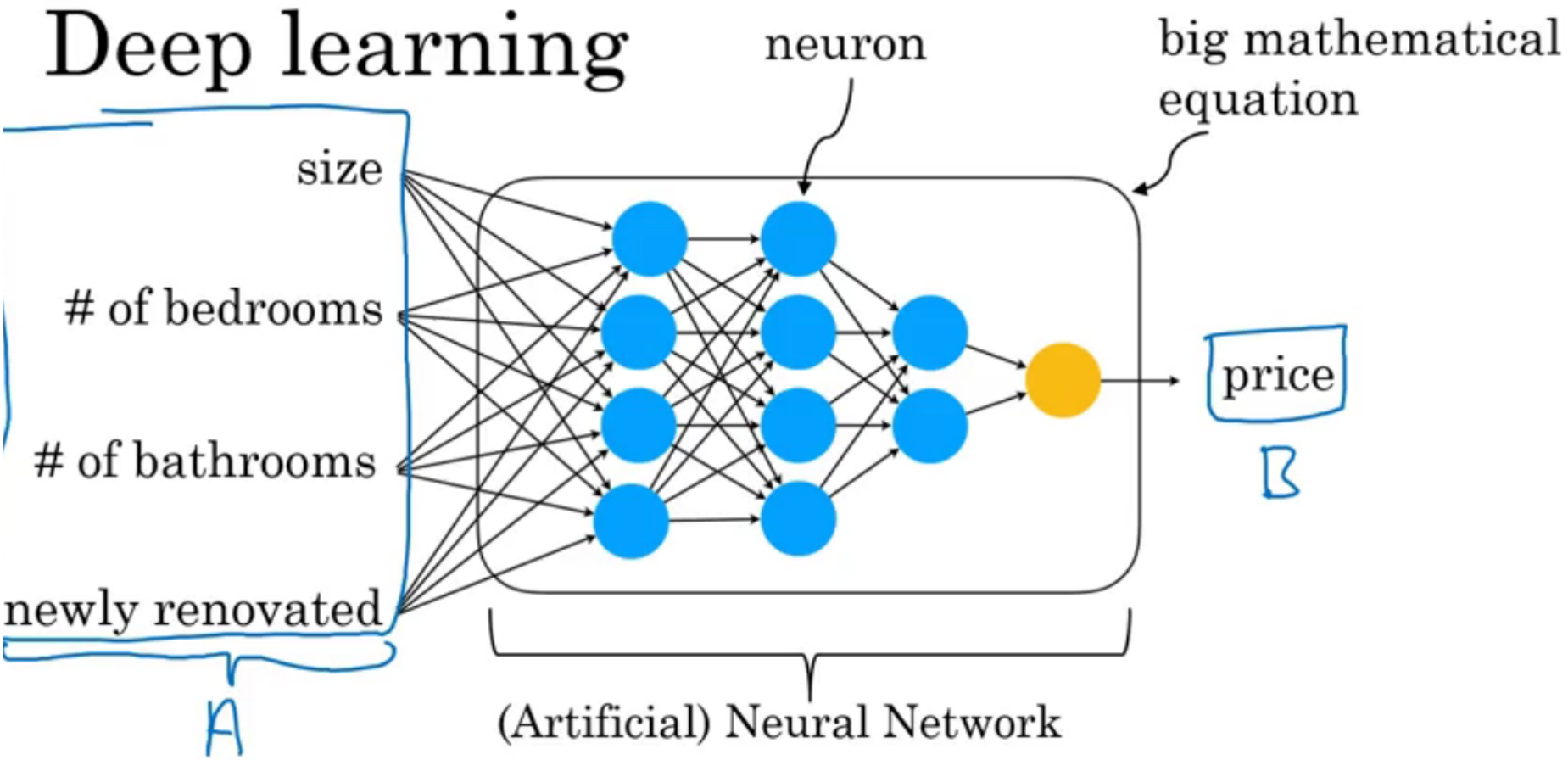
Science of extracting knowledge and insights from data.

$\longrightarrow$ slide deck

Deep Learning (1/2)



Deep Learning (2/2)



AI has many tools (1/2)

- Machine learning and data science
- Deep learning / neural network
- Other buzzwords: Unsupervised learning, reinforcement learning, graphical models, planning, knowledge graph, ...

AI has many tools (2/2)

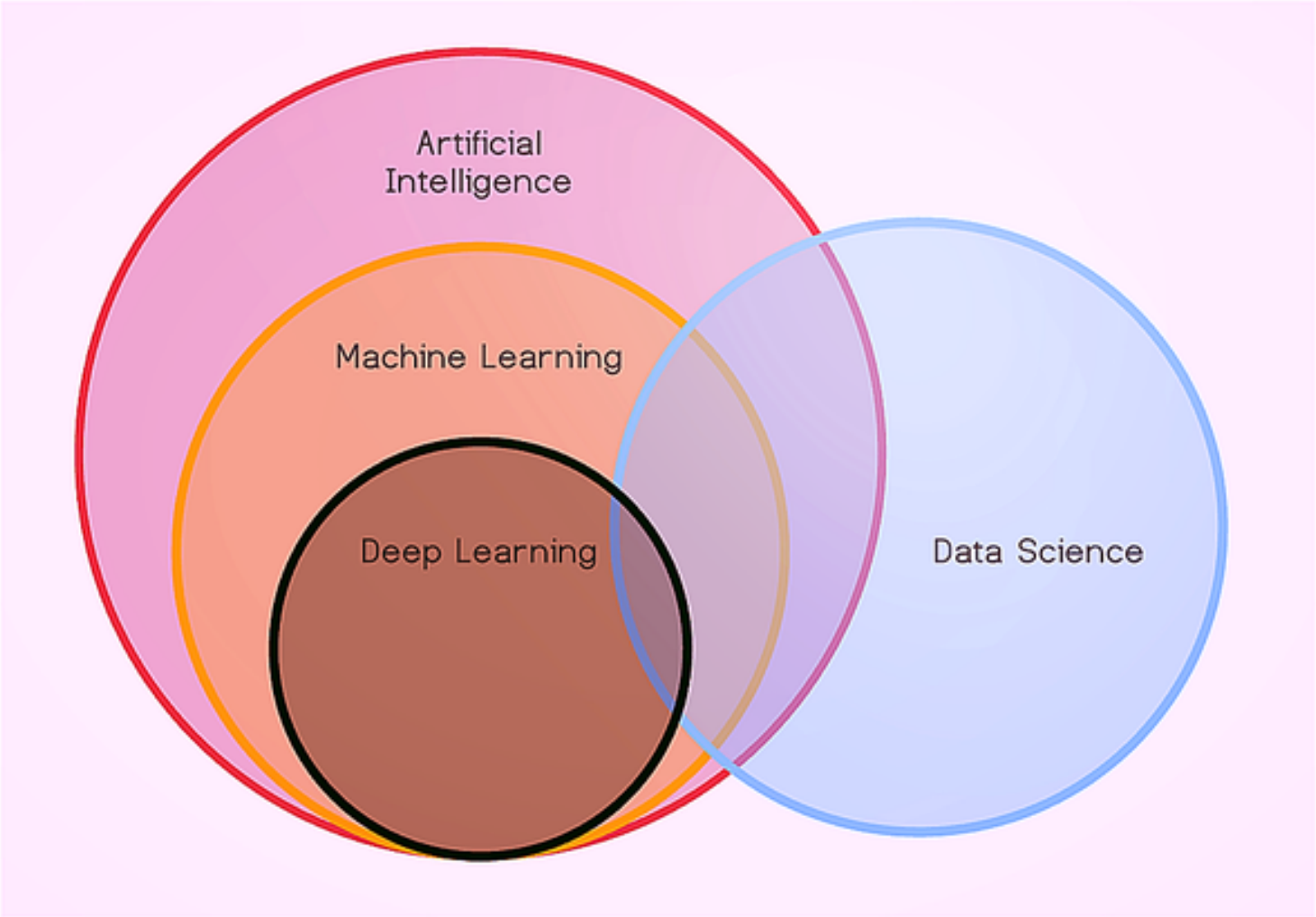


Figure 4: Relationship among AI, ML, DL, and DS (Kharkovyba, 2019)

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Supervised Learning

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audio	text transcripts	speech recognition
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ad, user info	click? (0/1)	online advertising
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image of phone	defect? (0/1)	visual inspection

Anything you can do with 1 second of thought, we can probably now or soon automate.

What machine learning today can and cannot do

The toy arrived two days late, so I wasn't able to give it to my niece for her birthday.
Can I return it?

$\longrightarrow$ "*Refund request*"
Input text $\longrightarrow$ Refund/Shipping/Other
$A \longrightarrow B$

$\longrightarrow$ "*Oh, sorry to hear that. I hope your niece had a good birthday. Yes, we can help with ...*"

What happens if you try?

Input (A)	$\longrightarrow$	**Output (B)**
User email		2-3 paragraph response

1000 examples

"My box was damaged"	$\longrightarrow$	Thank you for your email.
"Where do I write a review?"	$\longrightarrow$	Thank you for your email.
"What's the return policy"	$\longrightarrow$	Thank you for your email.
"When is my box arriving?"	$\longrightarrow$	Thank yes now your....

What makes an ML problem easier

1. Learning a "simple" concept

$$\leq 1 \text{ sec}$$

2. Lots of data available

$$\underset{\text{input}}{A} \longrightarrow \underset{\text{output}}{B}$$

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Self-driving car

Can do

A ⟶ B

Cannot do

stop

hitchhiker

bike turn left signal

A ⟶ B

1. Data
2. Need high accuracy

X-ray diagnosis

Can do	**Cannot do**
Diagnose pneumonia from ∼10,000 labeled images	Diagnose pneumonia from 10 images of medical textbook chapter explaining pneumonia

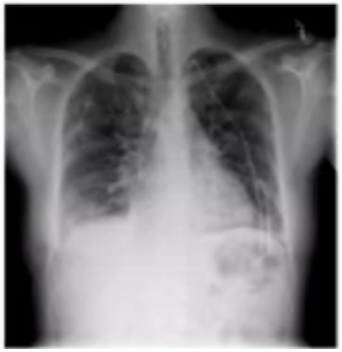
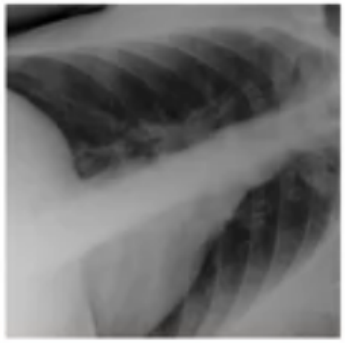
Strengths and weaknesses of machine learning

ML tends to work well when:

1. Learning a "simple" concept
2. There are lots of data available

ML tends to work poorly when:

1. Learning complex concepts from small amounts of data
2. It is asked to perform on new types of data

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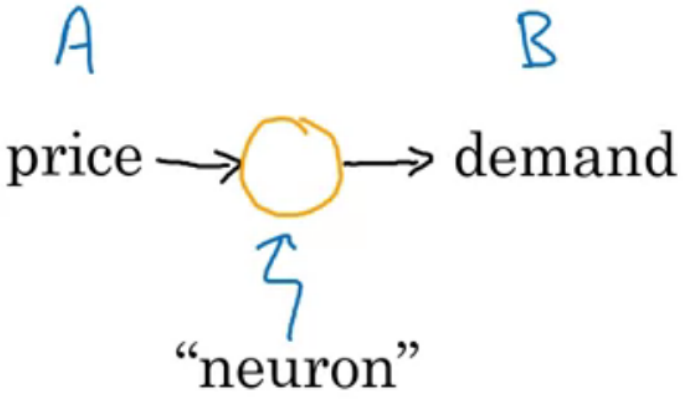
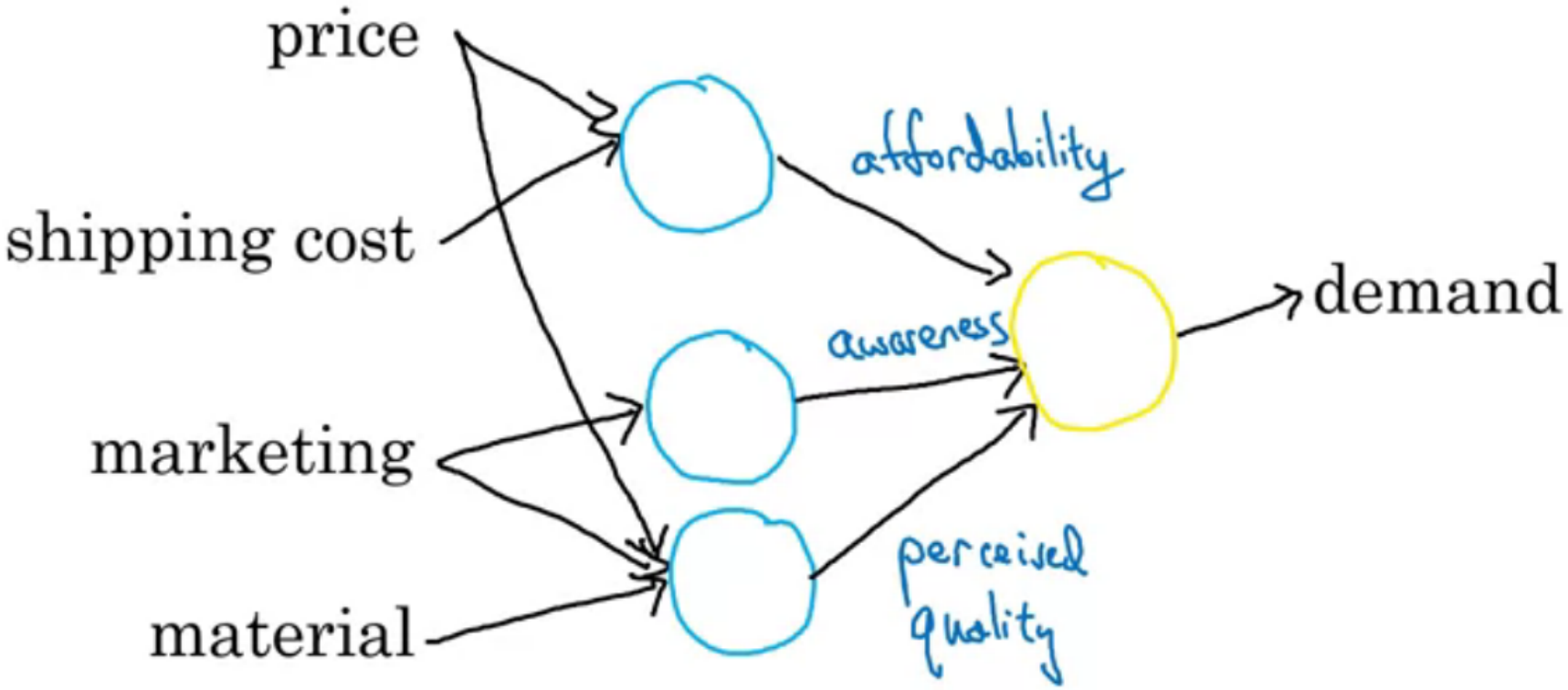
Demand prediction (1/2)

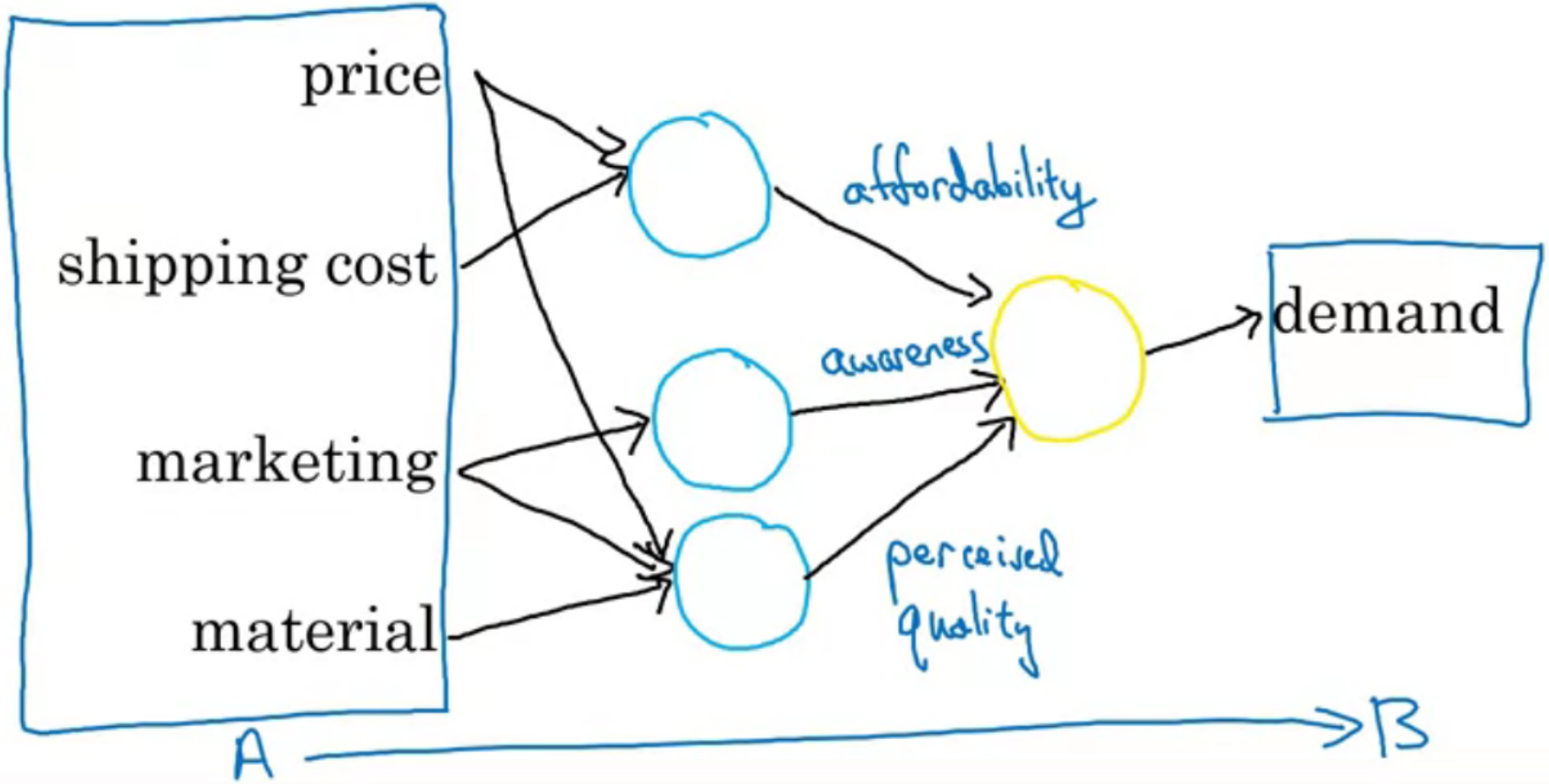
Demand prediction (2/2)



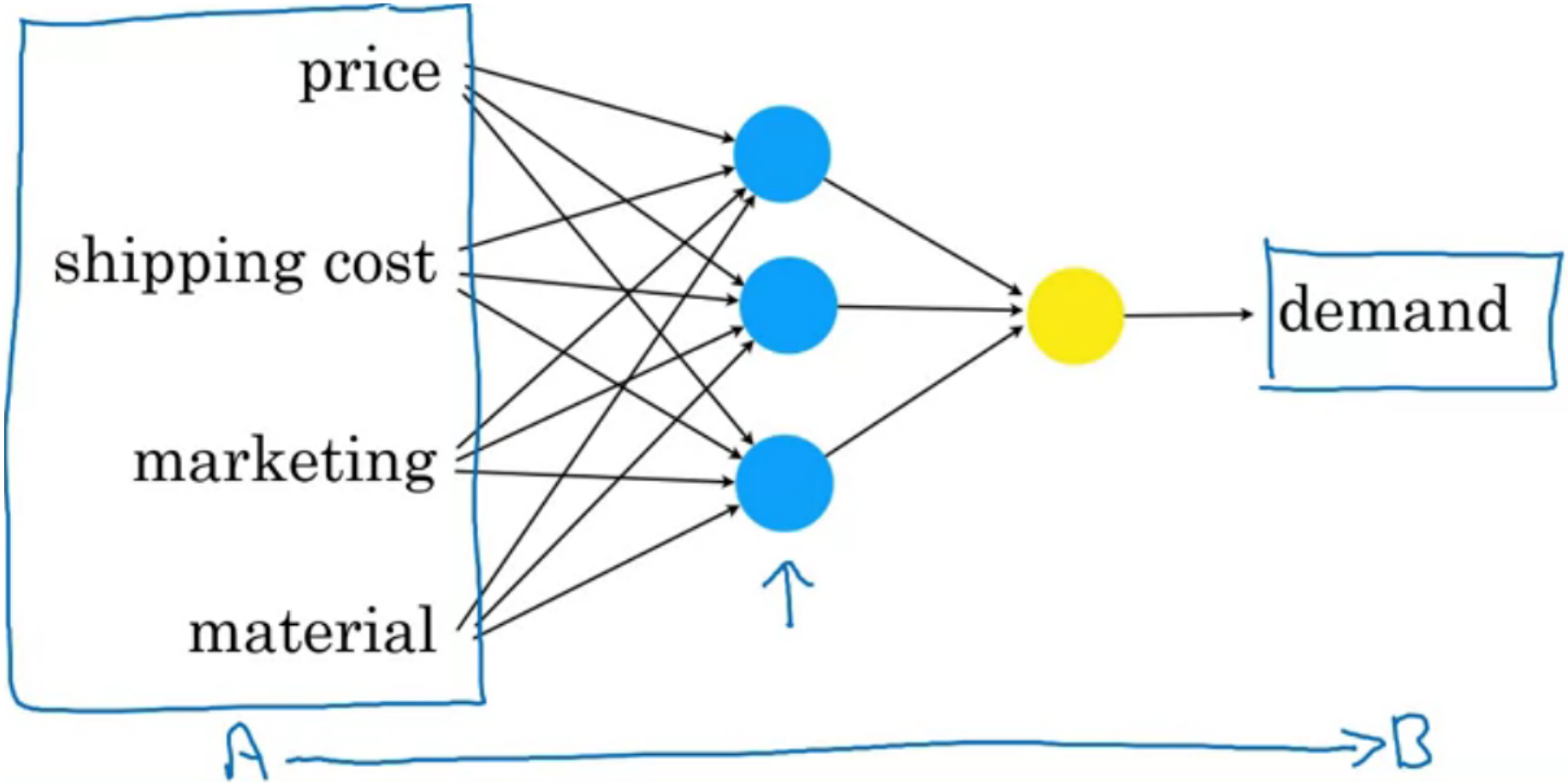
Demand prediction: a little bit more complex (1/3)



Demand prediction: a little bit more complex (2/3)

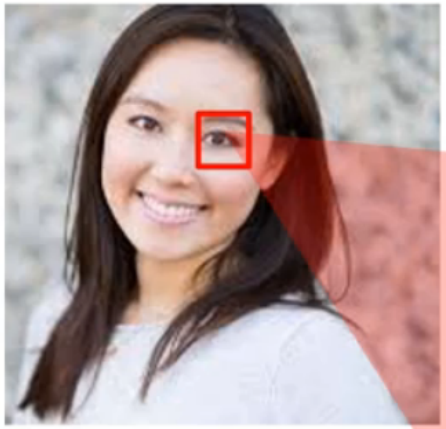


Demand prediction: a little bit more complex (3/3)



NN Application: Face recognition (1/3)

We want to build a system that recognizes people from pictures.



30	32	22	12	10	10	12	33	35	30
12	11	12	234	170	176	13	15	12	12
234	222	220	230	200	222	230	234	56	78
190	220	186	112	110	110	112	180	30	32
49	250	250	250	4	2	254	200	44	6
55	250	250	250	3	1	250	245	25	3
189	195	199	150	110	110	182	190	199	55
200	202	218	222	203	200	200	208	215	222
219	215	220	220	222	214	215	210	220	220
220	220	220	220	221	220	221	220	220	222

Figure 5: What a computer sees from an image (assume the picture is grayscale) (Ng, 2019)

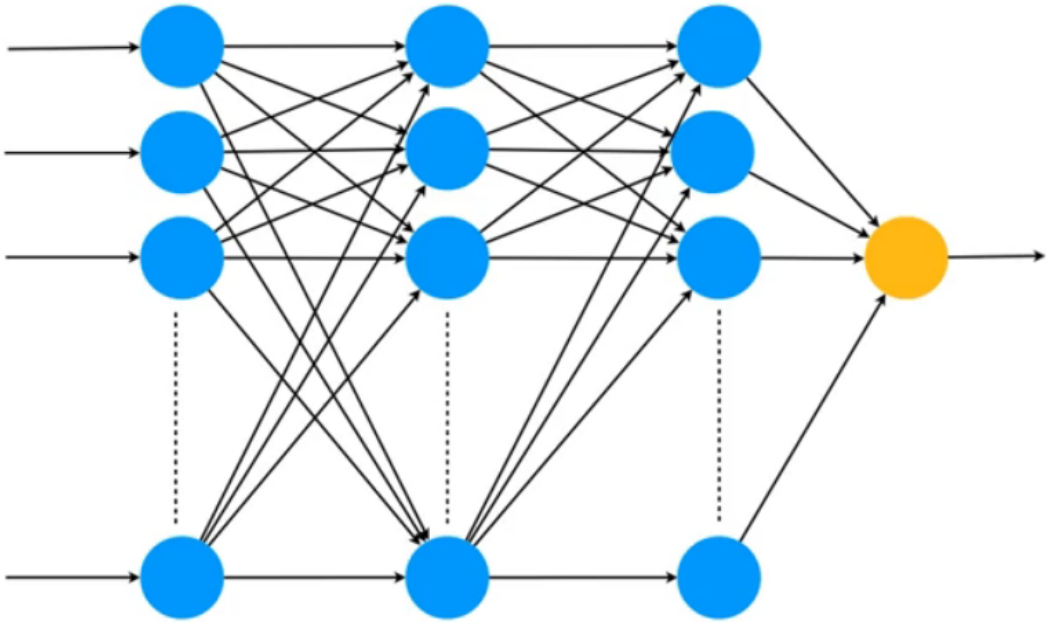
NN Application: Face recognition (2/3)

1000

1000

1,000,000

3,000,000



NN Application: Face recognition (3/3)

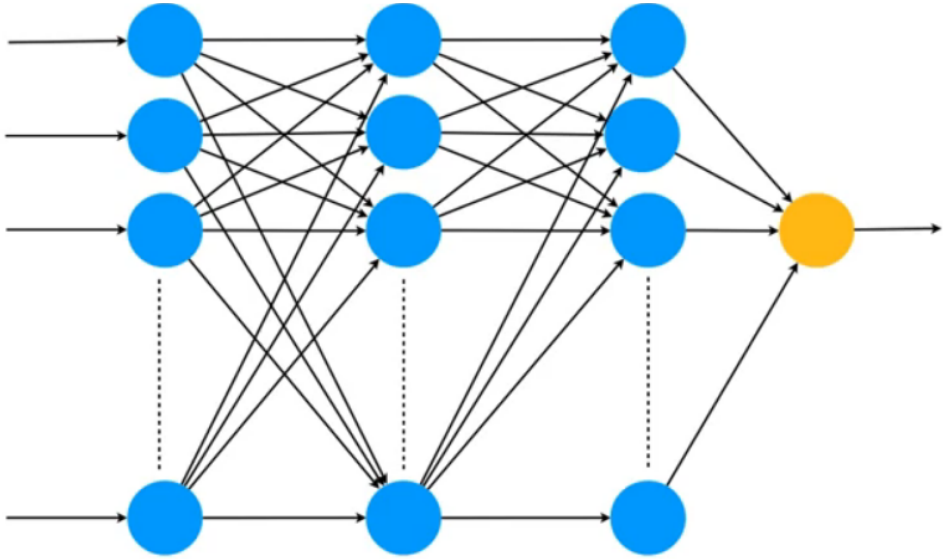
1000

1000

A

1,000,000

3,000,000



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Computer Vision (1/3)

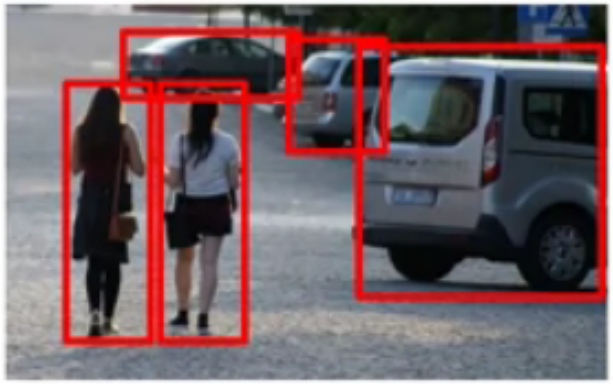
- Image classification/Object recognition

cat

  - Face recognition

Computer Vision (2/3)

- Object detection



Computer Vision (3/3)

- Image Segmentation

- Tracking

Natural Language Processing (1/7)

- Text Classification

  Email $\longrightarrow$ Spam/Non-Spam
  Product description $\longrightarrow$ Product category

  - Sentiment recognition

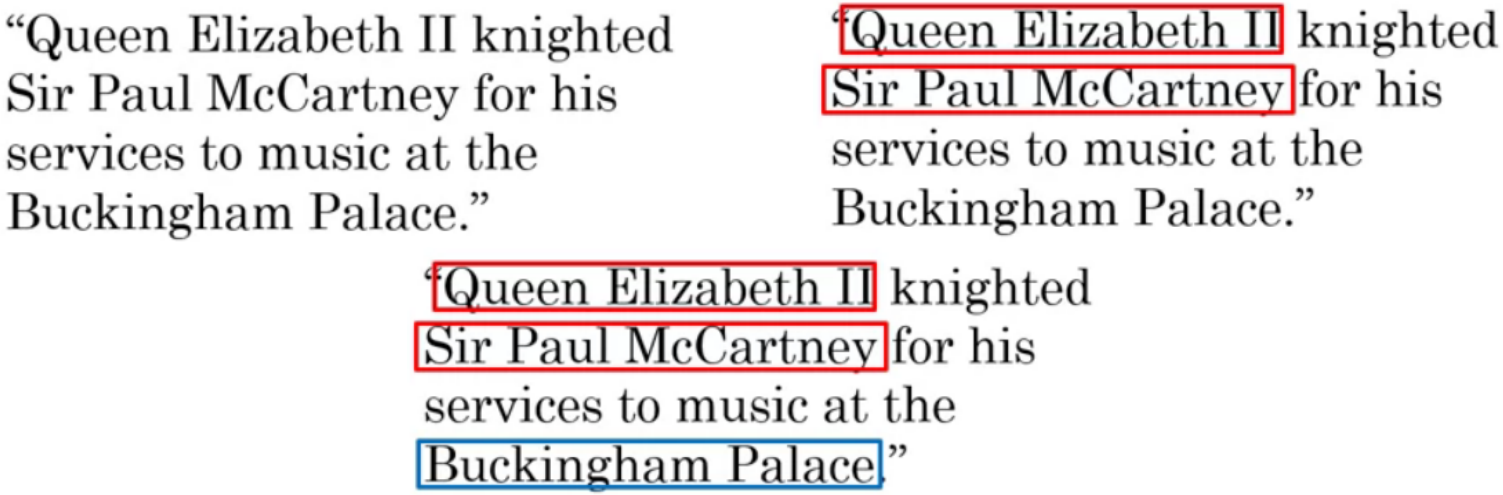
    "The food was good" $\longrightarrow$ ★★★★

    "Service was horrible" $\longrightarrow$ ★

- Information retrieval
  - E.g., web search

Natural Language Processing (2/7)

- Name entity recognition



- Machine translation
  "AI adalah listrik baru" $\Longrightarrow$ "AI is new electricity"

Natural Language Processing (3/7)

- Others: parsing, part-of-speech tagging

The cat on the mat

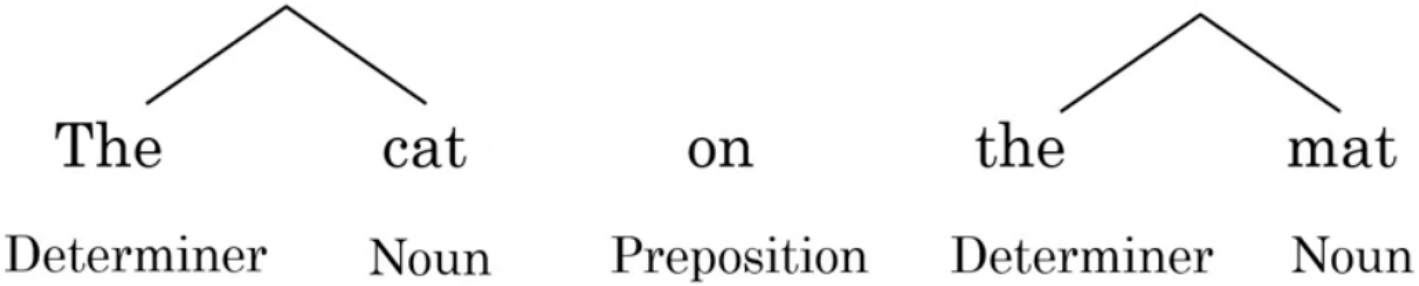
Natural Language Processing (4/7)

- Others: parsing, part-of-speech tagging

The	cat	on	the	mat
Determiner	Noun	Preposition	Determiner	Noun

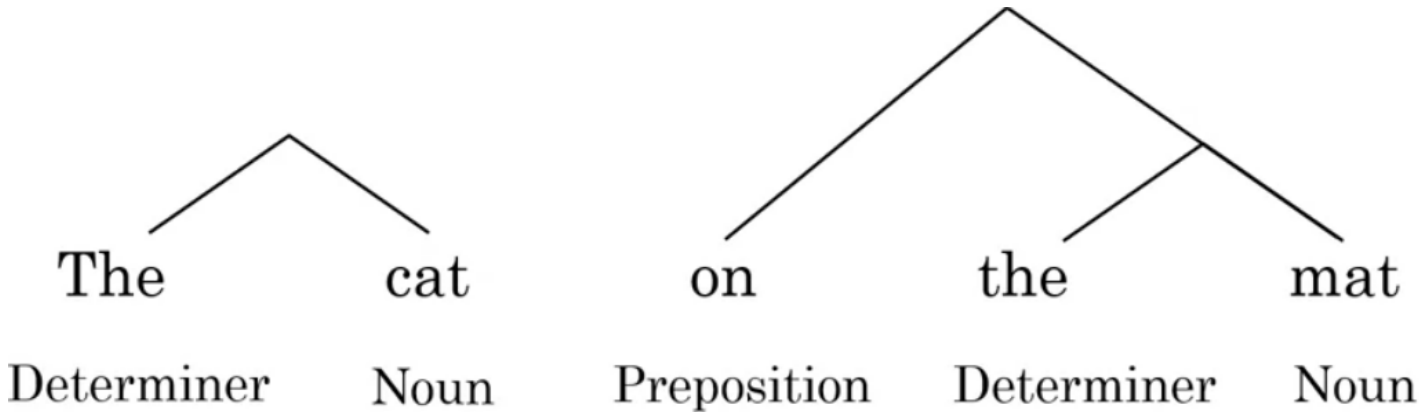
Natural Language Processing (5/7)

- Others: parsing, part-of-speech tagging



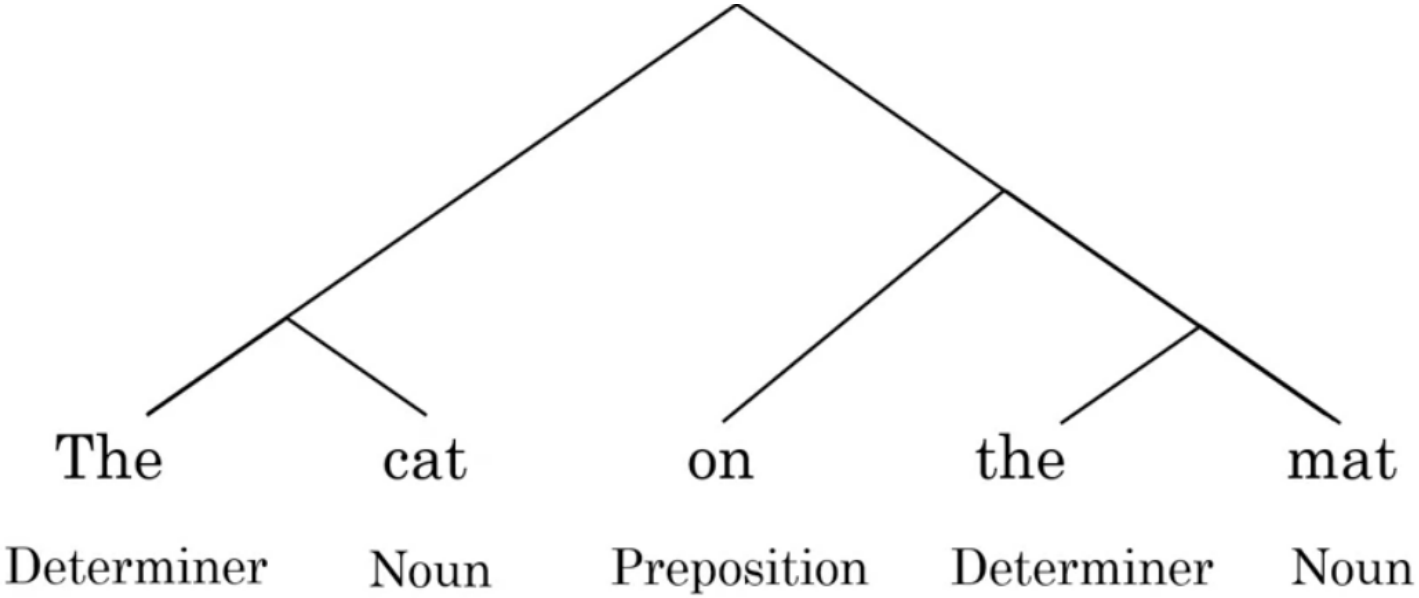
Natural Language Processing (6/7)

- Others: parsing, part-of-speech tagging



Natural Language Processing (7/7)

- Others: parsing, part-of-speech tagging



Speech (1/2)

- Speech recognition (speech-to-text)

Amazon
Echo / Alexa

Google
Home

Apple
Siri

Baidu
DuerOS

- Trigger word/wakeword detection
  Audio $\longrightarrow$ "Hey device"? (0/1)

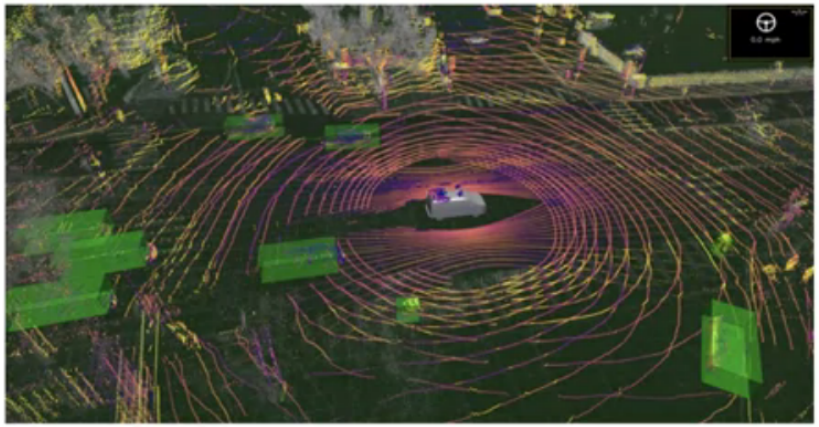
Speech (2/2)

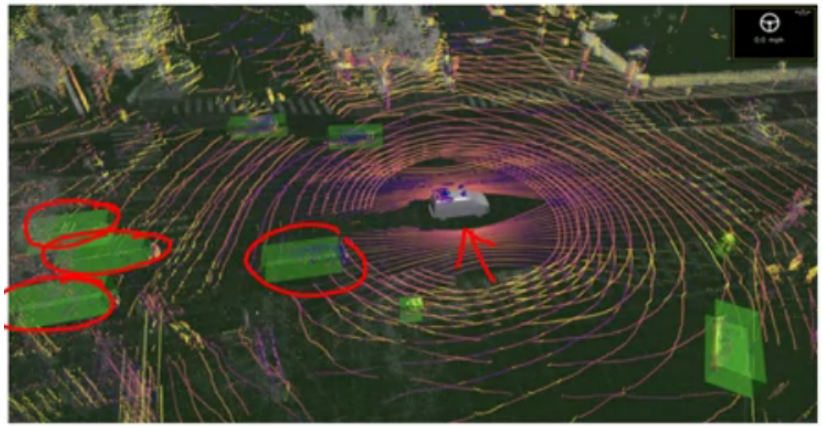
- Speaker ID
- Speech synthesis (text-to-speech, TTS)

  `The quick brown fox jumps over the lazy dog.`

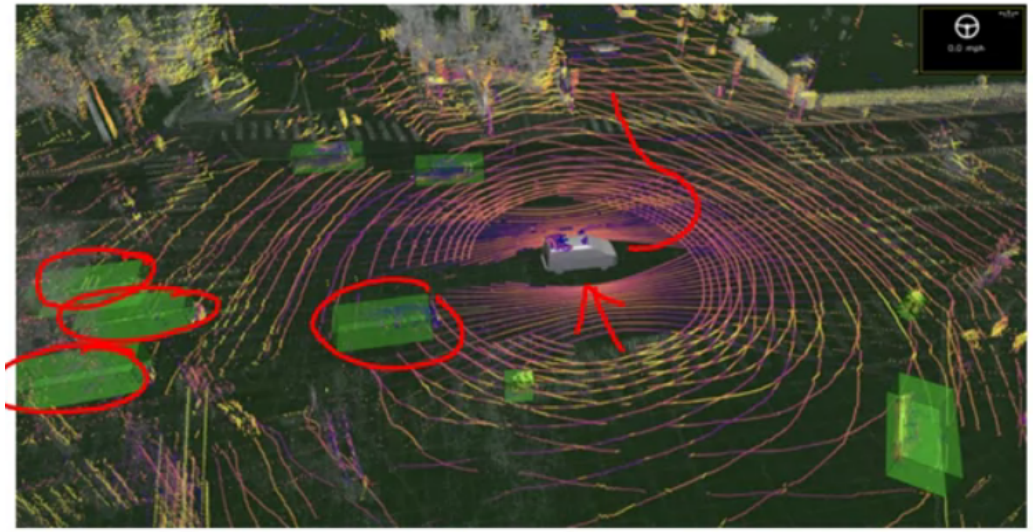
Robotics

- Perception: figuring out what's in the world around you.





- Motion planning: finding a path for the robot to follow.



- Control: sending commands to the motors to follow a path

General machine learning

- Unstructured data (images, audio, text)

image

audio

AIは、新たな電気だ
AI is the new electricity

text

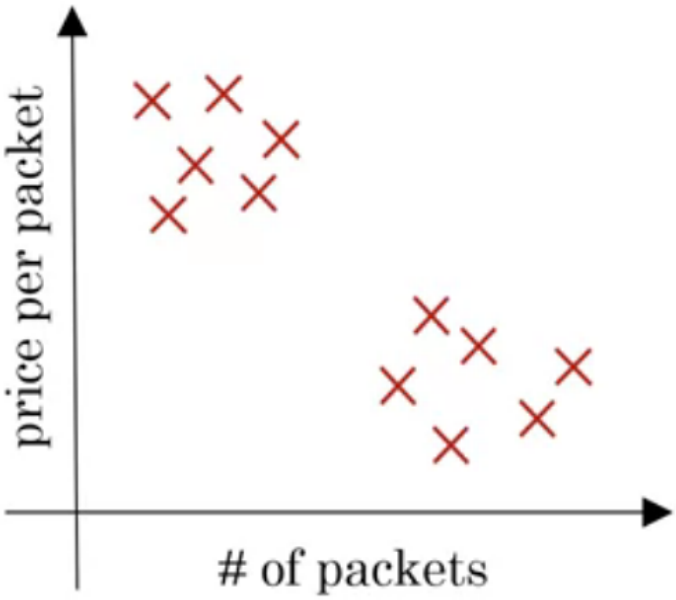
- Structured data

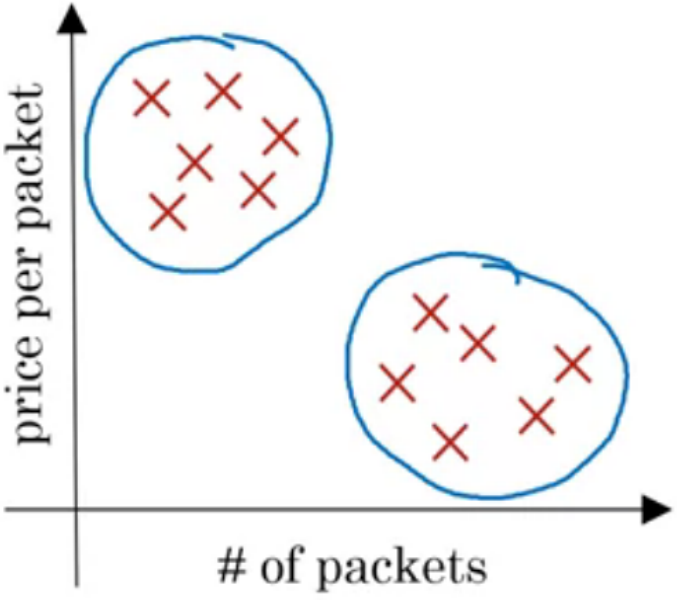
House size (square feet)	# of bedrooms	Price (1000$)
523	1	100
645	1	150
708	2	200

Clay batch #	Supplier	Mixing time (minutes)
001	ClayCo	35
034	GooClay	22
109	BrownStuff	28

Unsupervised learning (1/2)

Clustering potato chip sales





Unsupervised learning (2/2)

Unsupervised learning:

Given data (without any specific desired output labels), find something interesting about the data.

Another example of unsupervised learning:

Finding cats from unlabeled YouTube videos

Transfer learning

Car detection

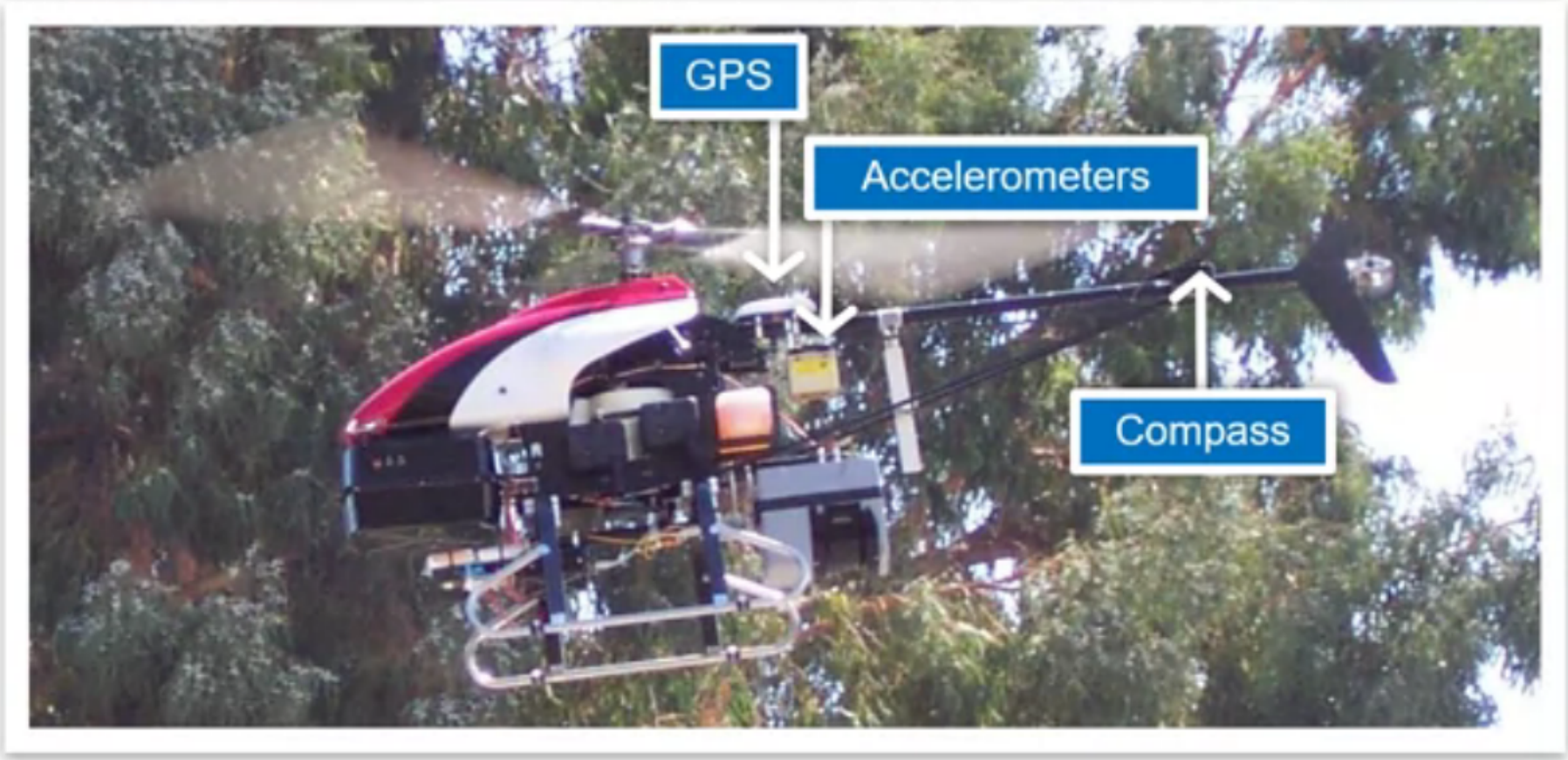
100,000 images

Golf cart detection

100 images

Learn from task A, and use knowledge to help on task B

Reinforcement learning (1/2)



Use a "reward" signal to tell the AI when it is doing well or poorly. It automatically learns to maximize its rewards.

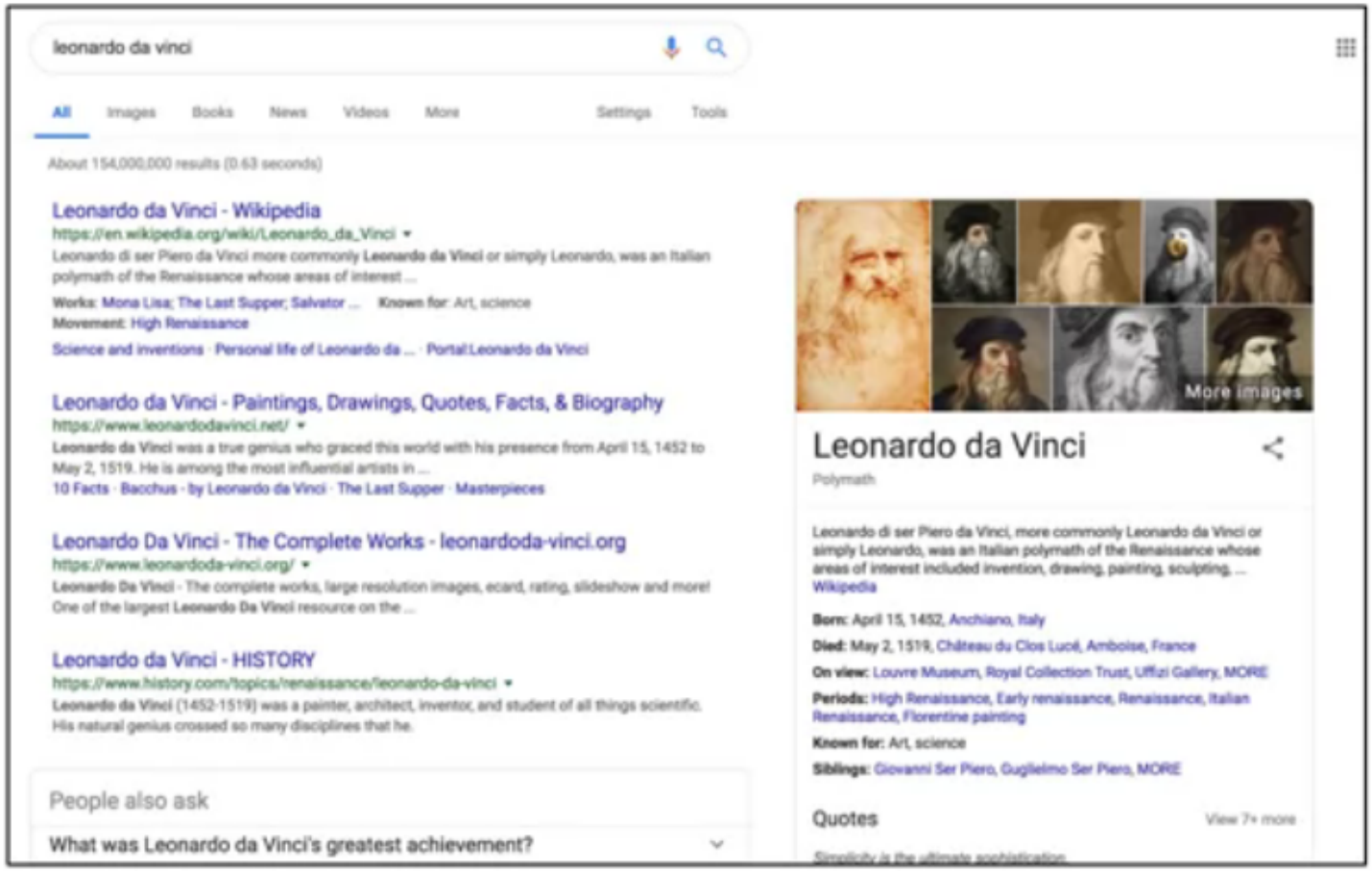
Reinforcement learning (2/2)

Use a "reward" signal to tell the AI when it is doing well or poorly. It automatically learns to maximize its rewards.

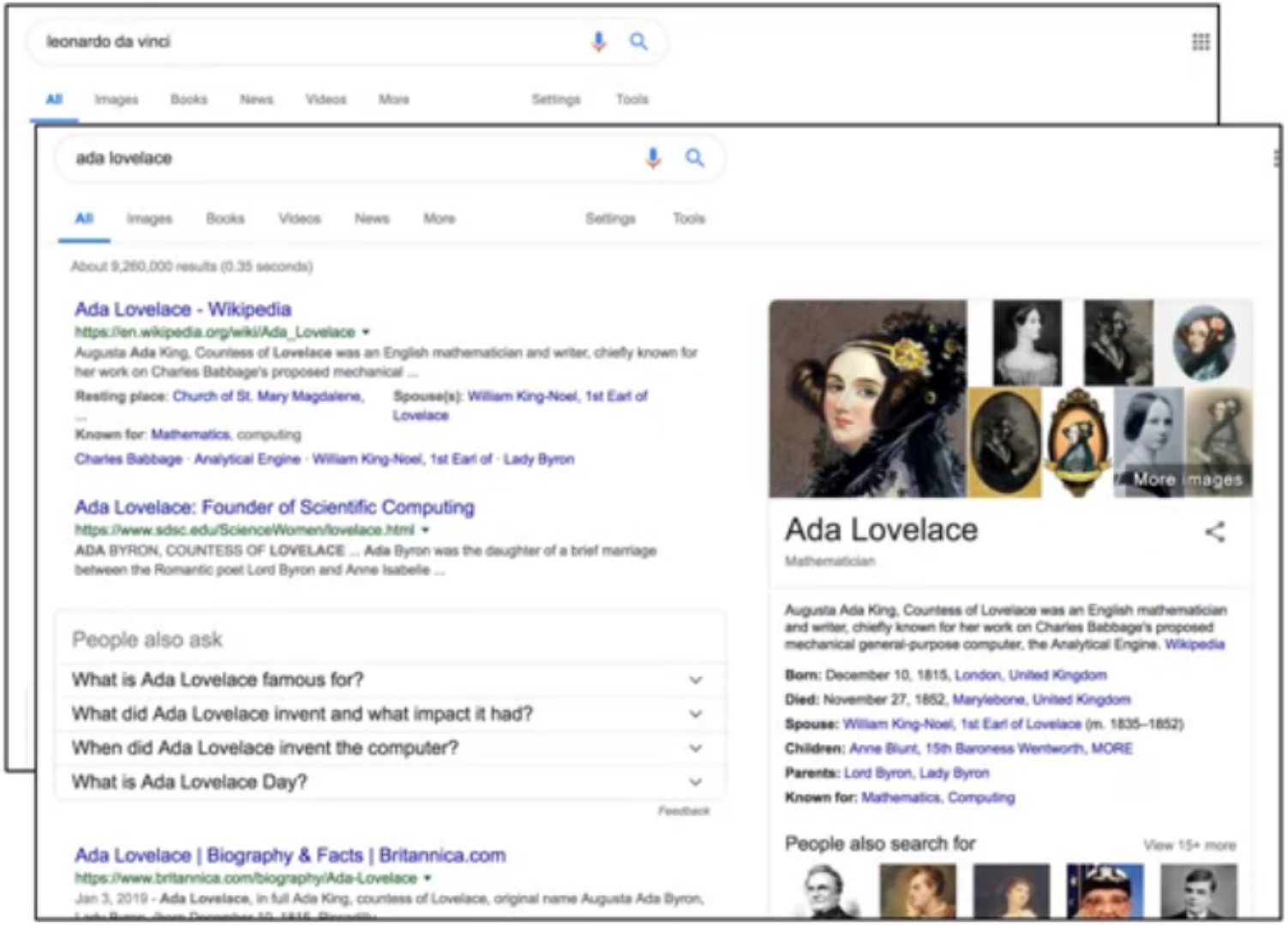
GANs (Generative Adversarial Network)

Synthesize new images from scratch (Karras et al., 2017)

Knowledge Graph (1/4)



Knowledge Graph (2/4)



Knowledge Graph (3/4)

Ada Lovelace	
Born	Dec 10, 1815
Died	Nov 27, 1852
Bio	English mathematician and writer...

Knowledge Graph (4/4)

Northern Rooster Hotel	
Address	45 Rooster St, LA
Phone	(650) 555-3992
Wifi	yes
Pool	no

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Mata Kuliah Pilihan

Kode	Nama MK	SKS	Prasyarat
IN056	Teknik Kompilasi	3+1	IN035 MatDis
IN068	Competitive Programming	3+1	-
IN075	Sistem Pakar	3	-
IN086	Temu Pengetahuan	3+1	-
IN074	Pembelajaran Mesin	3+1	IN060 PKB
IN084	Pengantar Temu Balik Informasi	3+1	-
IN085	Pemrosesan Bahasa Alami	3	-
IN039	Topik Lanjut Komputasi Cerdas	3+1	-

Daftar Pustaka I

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