CIE 5133 機器學習與深度學習導論
線上課程

開始之前 (09.22.2021)

- 請將你的麥克風靜音
- 請找個安全、舒適的空間
- 聽講時有任何問題請到 slido #073374 留言
- 我們會透過 Zoom, slido, 討論區，臉書社群來強化無法面對面所造成的互動不足，同學們有任何建議也請讓我們知道。
- Stay Home! Happy Learning!!

加簽？旁聽？

1. 目前已經已順利選上本課程的同學 100 人。
2. 目前已初選登記，但需加簽的同學 89 人：我們會將個人的加簽授權碼陸續寄給你，請留意。
3. 還沒登記的同學：請至 NTU Cool 登記，如果人數不要太離譜，我會儘可能加簽。
4. 歡迎旁聽，請寄 email 給我 (dchen@ntu.edu.tw) 或大助教 (harry@caeca.net) 。

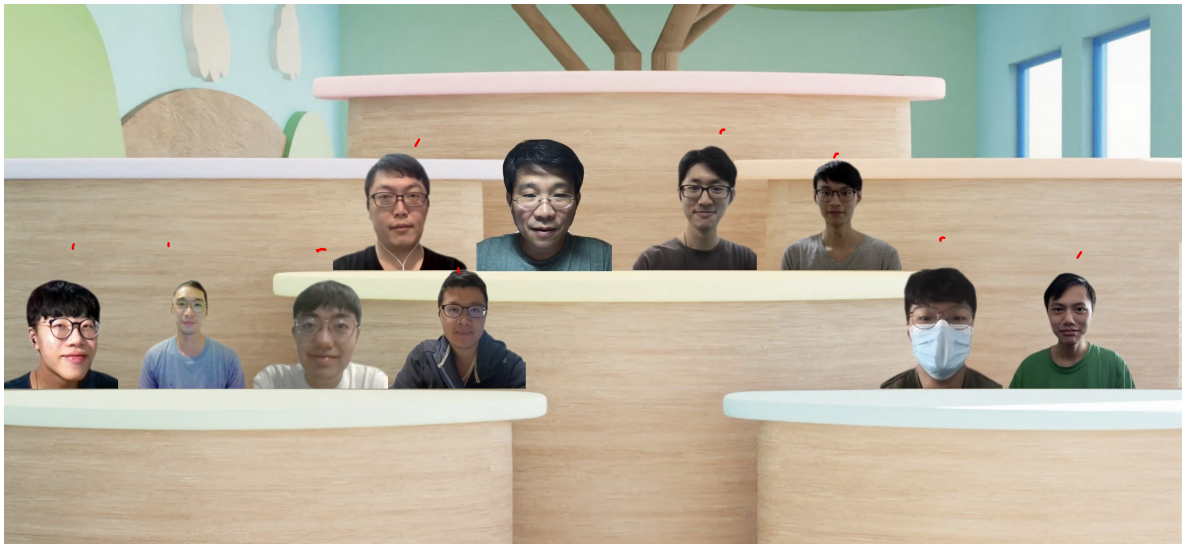
Question? Zoom 回應舉手、Zoom 聊天留言、slido #073374 留言

CIE 5133 機器學習與深度學習導論

- Welcome!
- Instructor: Prof. Chuin-Shan David Chen (陳俊杉)
- What will we do for this course? (**see syllabus**).

↘務必加入

Course FaceBook



Fun time: who is not your TA?

(1) 黃政維
(2) 張鈞程
(3) 黃琮煒
(4) 宋嘉誠
(5) 王鈞平

85%

https://www.sli.do/
#073374

(5)

This is a task that computer will do better than us.

In this introduction …

1. Why Engineering? Why Artificial Intelligence (AI)? Why AI + Engineering?
2. Machine Learning and Supervised Learning
3. Deep Learning and Computer Vision
4. In addition to this course …

- Supervised learning
- Unsupervised "
- Reinforcement "

1. Why Engineering? Why AI? Why AI + Engineering?

Fun time: let's put 10 seconds on the clock and name the appliance in your home that would be the hardest to live without.

?

?

End

Refrigerator!

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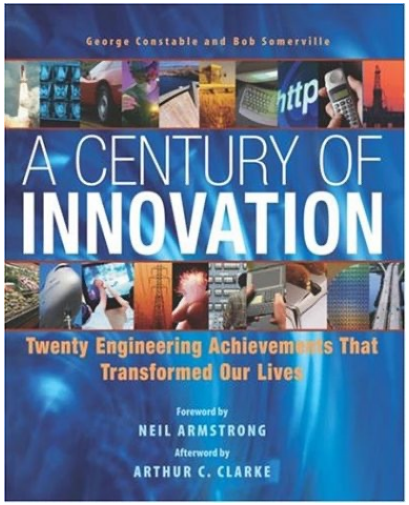
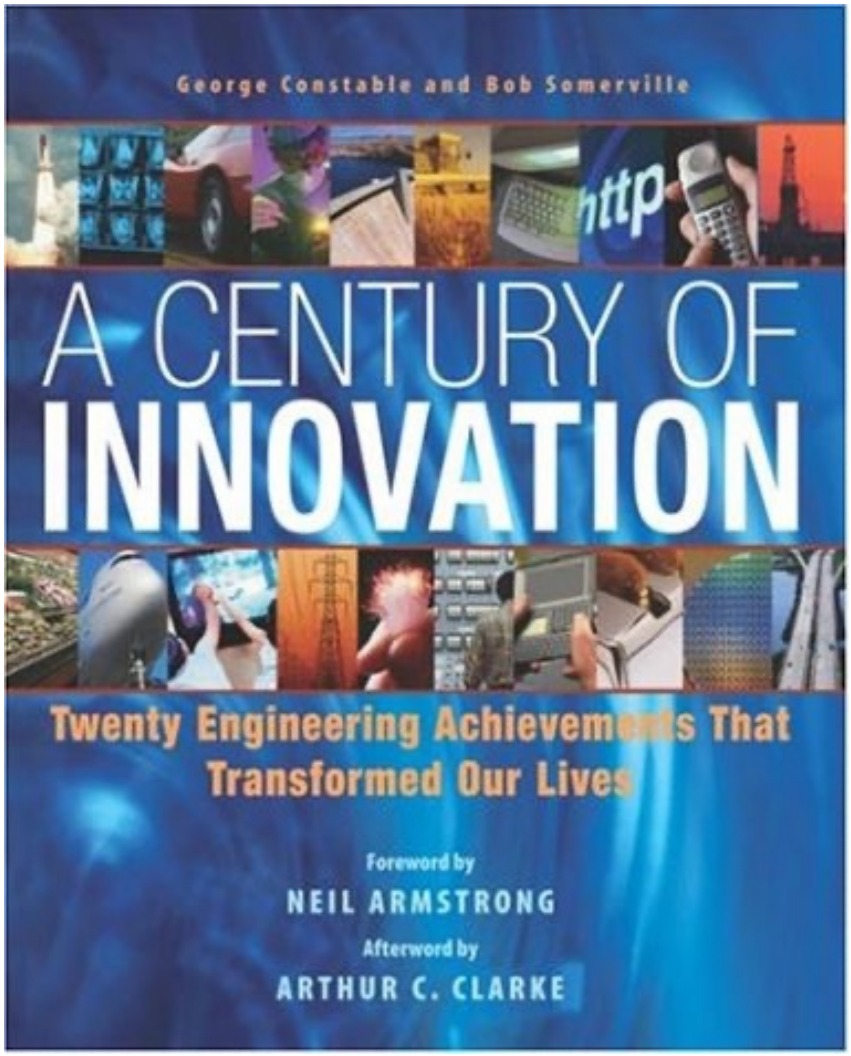
C-S David Chen, Department of Civil Engineering, National Taiwan University

A Century of **Innovation**: Twenty Engineering Achievements That Transform Our Lives (1901 – 2000)



- **Electrification**
- **Automobile**
- **Airplane**
- **Water Supply and Distribution**
- **Electronics**
- Radio and Television
- Agricultural Mechanization
- Computers
- Telephony
- **Air Conditioning & Refrigeration**
- Highways
- Spacecraft
- Internet
- Imaging
- Household Appliances
- Health Technologies
- Petroleum and Petrochemical Technologies
- Lasers and Fiber Optics
- Nuclear Technologies
- High-Performance Materials

George Constable, et al. 2003. *A Century of Innovation: Twenty Engineering Achievements that Transformed our Lives*. Washington, DC: Joseph Henry Press. https://doi.org/10.17226/10726.



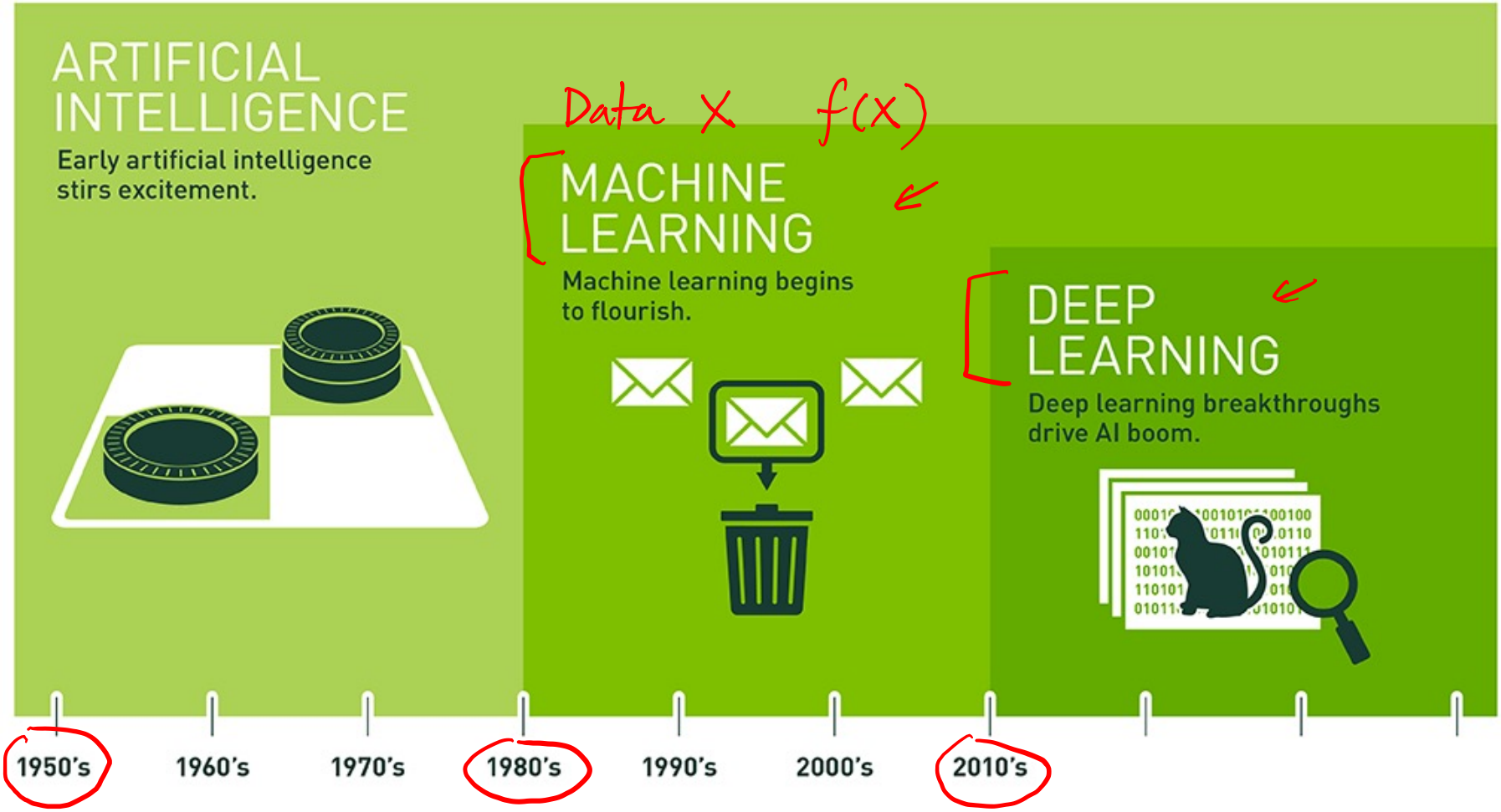
Topping the list is electrification. More than half of the "Top 20" would not have been possible without it. Abundant and available electric power helped spur America's economic development and distributed benefits widely, from cities to farms. This achievement clearly shines as an example of how engineering has changed the world.

George Constable, et al. 2003. *A Century of Innovation: Twenty Engineering Achievements that Transformed our Lives*. Washington, DC: Joseph Henry Press. https://doi.org/10.17226/10726.

"Just as electricity transformed almost everything 100 years ago, today I actually have a hard time thinking of an industry that I don't think AI will transform in the next several years."

— Andrew Ng

Artificial Intelligence
Machine Learning & Deep Learning



Since an early flush of optimism in the 1950s, smaller subsets of artificial intelligence – first machine learning, then deep learning, a subset of machine learning – have created ever larger disruptions.

Source: https://blogs.nvidia.com/blog/2016/07/29/whats-difference-artificial-intelligence-machine-learning-deep-learning-ai/

What Machine Learning Can Do

A simple way to think about supervised learning.

$B = f(A)$

INPUT A	RESPONSE B	APPLICATION
Picture	Are there human faces? (0 or 1)	Photo tagging
Loan application	Will they repay the loan? (0 or 1)	Loan approvals
Ad plus user information	Will user click on ad? (0 or 1)	Targeted online ads
Audio clip	Transcript of audio clip	Speech recognition
English sentence	French sentence	Language translation
Sensors from hard disk, plane engine, etc.	Is it about to fail?	Preventive maintenance
Car camera and other sensors	Position of other cars	Self-driving cars

- Being able to input A and output B has transformed many industries.
- These A→B systems have been improving rapidly, and the best ones today are built with a technology called deep neural networks. DNN
- Many impacts from A→B centers on **fast and accurate prediction**.

Andrew Ng, What Artificial Intelligence Can and Can't Do Right Now, Harvard Business Review, November 2016.

Tesla released what Autopilot's neural net can see (2020.01.31)

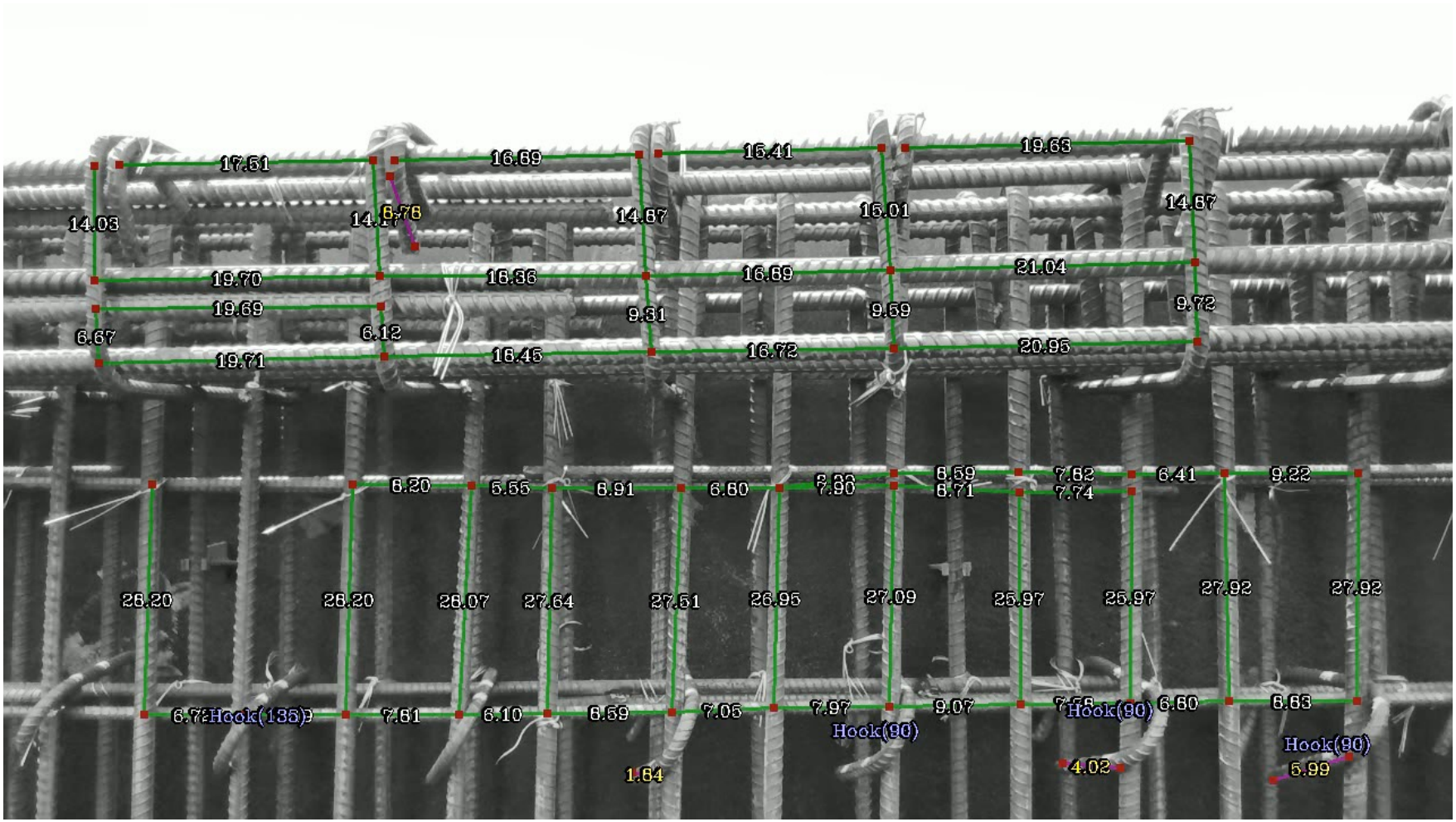
train] → 花時間

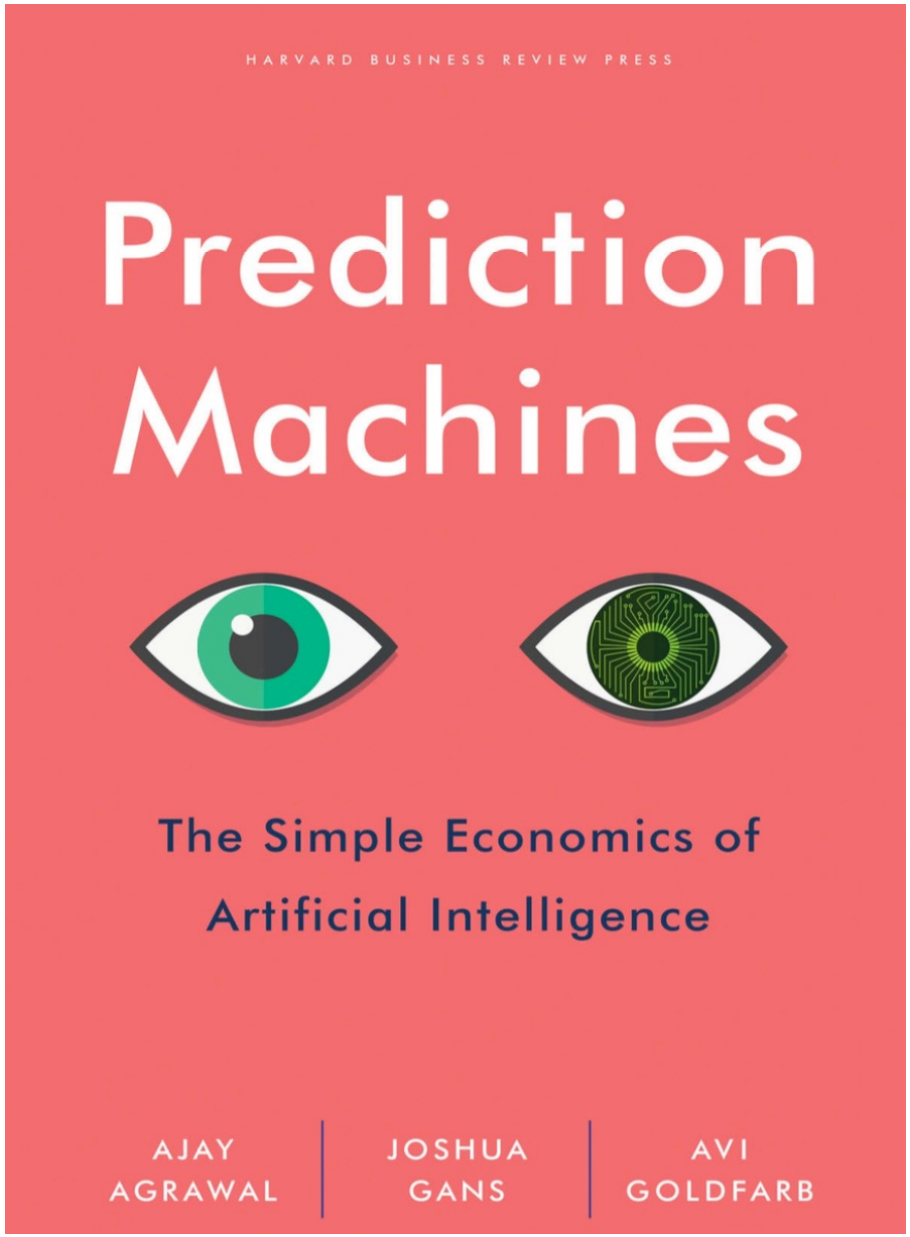
apply → real time

Apply cutting-edge research to train **deep neural networks** on problems ranging from perception to control. Our per-camera networks analyze raw images to perform **semantic segmentation**, **object detection** and **monocular depth estimation**. Our birds-eye-view networks take video from all cameras to output the **road layout**, **static infrastructure** and **3D objects** directly in the top-down view.

Our networks learn from the most complicated and diverse scenarios in the world, iteratively sourced from our fleet of nearly 1M vehicles in real time. A full build of Autopilot neural networks involves 48 networks that take 70,000 GPU hours to train 🔥. Together, they **output 1,000 distinct tensors (predictions)** at each timestep.

https://www.tesla.com/autopilotAI

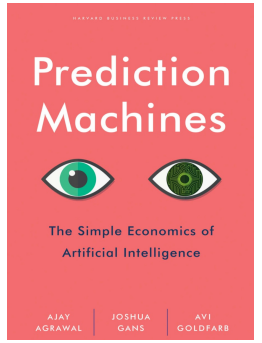

17.51
16.69
15.41
19.63
14.03
14.67
6.78
14.87
15.01
14.67
19.70
16.56
16.69
21.04
19.69
9.31
9.59
9.72
6.67
6.12
19.71
16.45
16.72
20.95
6.20
5.55
8.91
6.60
7.90
6.71
6.59
7.82
7.74
6.41
9.22
28.20
28.20
28.07
27.64
27.51
26.95
27.09
25.97
25.97
27.92
27.92
6.72
Hook(135)
7.61
6.10
6.59
7.05
7.97
Hook(90)
9.07
Hook(90)
6.60
6.83
Hook(90)
1.64
4.02
5.99



- What is it that AI does that's unique? **Prediction**.
- The process of filling in missing information is called prediction.
- Prediction is the central input into decision making.
- Artificial intelligence can be understood as a drop in the cost of prediction.

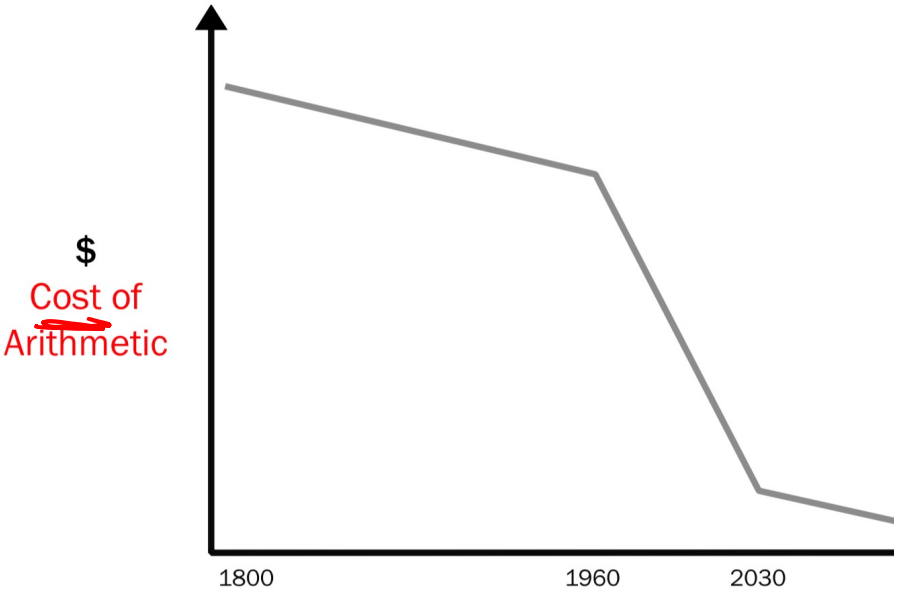
Agrawal, Ajay, Joshua Gans, and Avi Goldfarb, "Prediction Machines: The Simple Economics of Artificial Intelligence," Harvard Business Review Press, 2018.

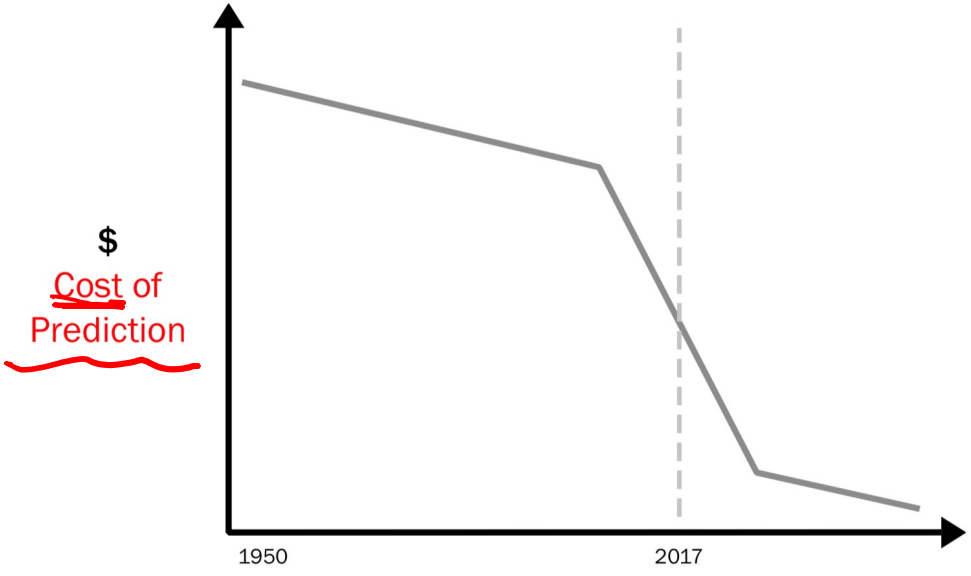
- Current wave of advances in AI doesn't actually bring us intelligence but instead a critical component of intelligence: **prediction**.



Semiconductor

AI ML



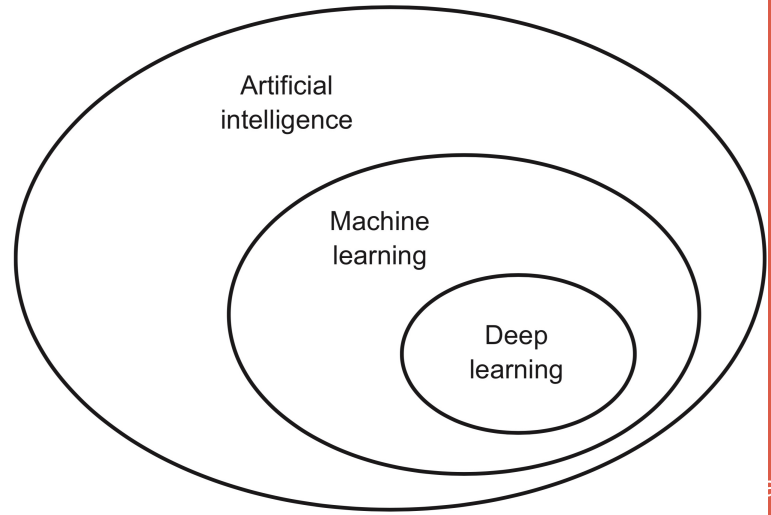


Agrawal, Ajay, Joshua Gans, and Avi Goldfarb, "Prediction Machines: The Simple Economics of Artificial Intelligence," Harvard Business Review Press, 2018.

Fun time: which answer is correct?

(1) Machine learning is a subfield of artificial intelligence
(2) Deep learning is a subfield of artificial intelligence
(3) Deep learning is a subfield of machine learning
(4) All of the above
(5) None of the above

(4)



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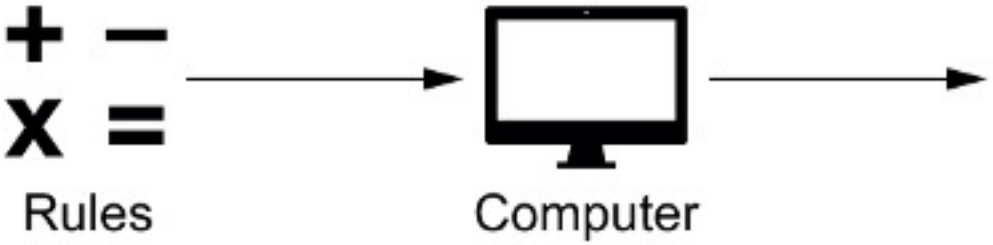
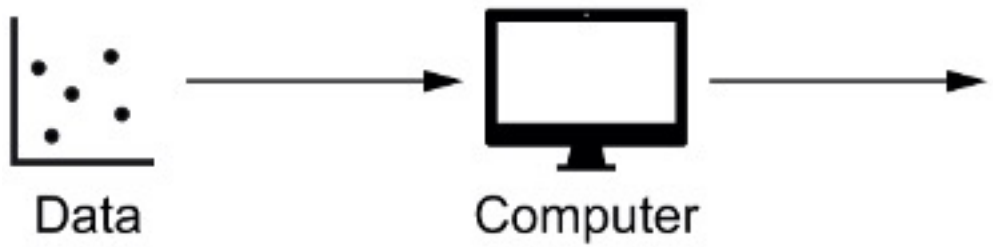
2. Machine Learning and Supervised Learning

C-S David Chen, Department of Civil Engineering, National Taiwan University

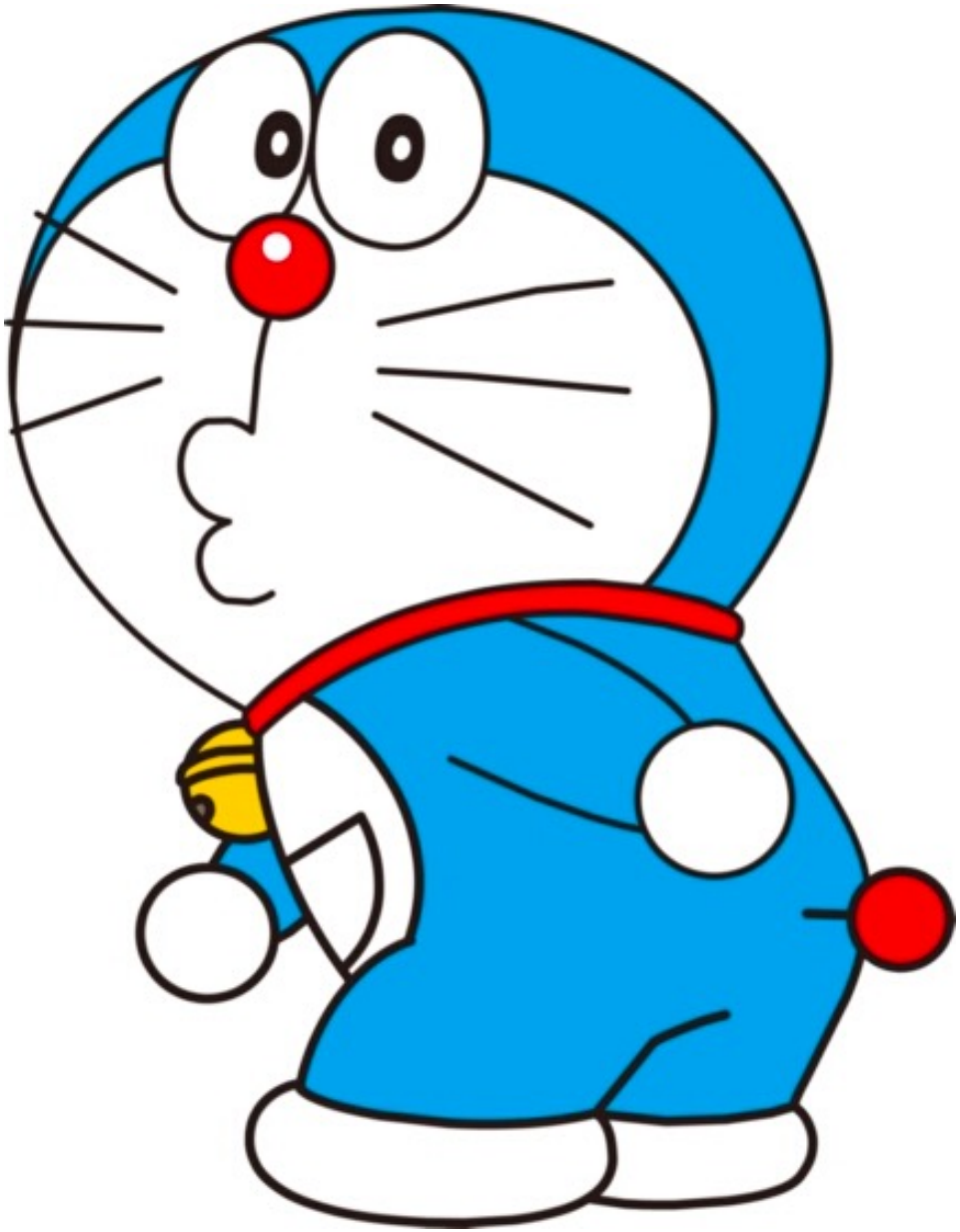
Traditional Programming



Machine Learning



Valigi and Mauro (2020), Zero to AI, Manning Publications.




WARRIORS
貓戰士

Machine Learning (**Supervised Learning**)

$\hat{x} \rightarrow \hat{y}$

x Data

y Answers (Labeled)

$y = f(x)$

Machine Learning

(Model, Implicit Rule)

Answers $\hat{y}$

(e.g., Cat or Dog)

Fun time: consider the task of automated spam detection email, what is the label?

(1) email sender
(2) email server
(3) email subject
(4) strange words or phrases ("Viagra", "Nigerian prince" etc.)
(5) spam or not spam

https://www.sli.do/
#073374

(5) (y and the others could be features ***x***)

Supervised Learning: simple x→y to enable many applications

INPUT x		RESPONSE y
Picture	Photo tagging	Are there human faces? (0 or 1)
Loan application	Loan approvals	Will they repay the loan? (0 or 1)
Ad plus user information	Targeted online ads	l user click on ad? (0 or 1)
Audio clip	Speech recognition	nscript of audio clip
English sentence	Language translation	ch sentence
Sensors from hard disk, pla	Preventive maintenance	ut to fail?
Car camera and other sens	Self-driving cars	Position of other cars

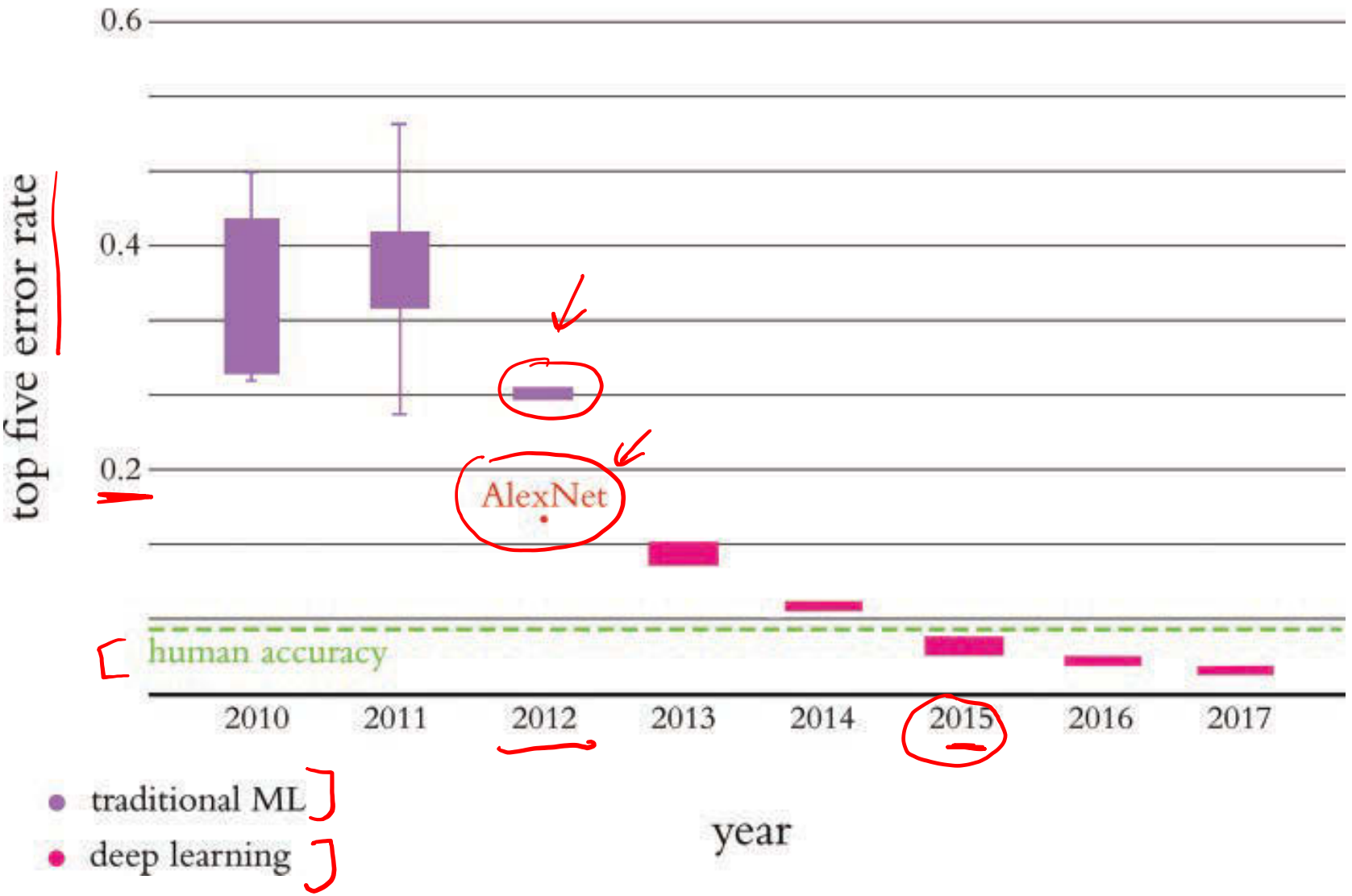
Andrew Ng, What Artificial Intelligence Can and Can't Do Right Now, Harvard Business Review, November 2016.

3. Deep Learning and Computer Vision

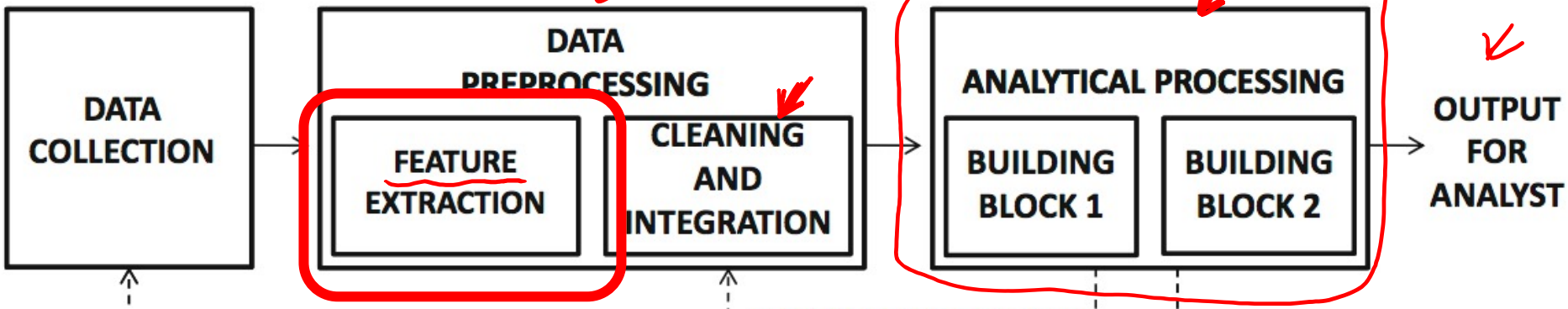
C-S David Chen, Department of Civil Engineering, National Taiwan University

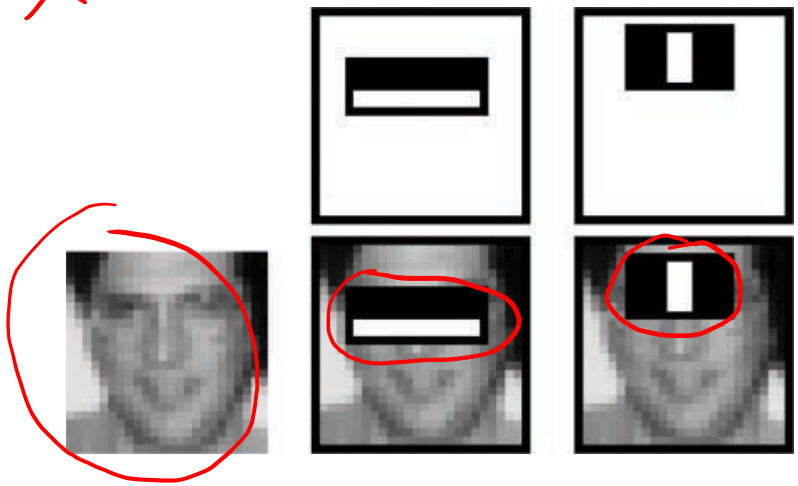
沈向洋：以 Deep Learning 為核心的 Computer Vision，**十年內**將全面取代人眼 (2019.10.31 【與AI大師沈向洋博士對話】)

ILSVRC (the ImageNet Large Scale Visual Recognition Challenge)

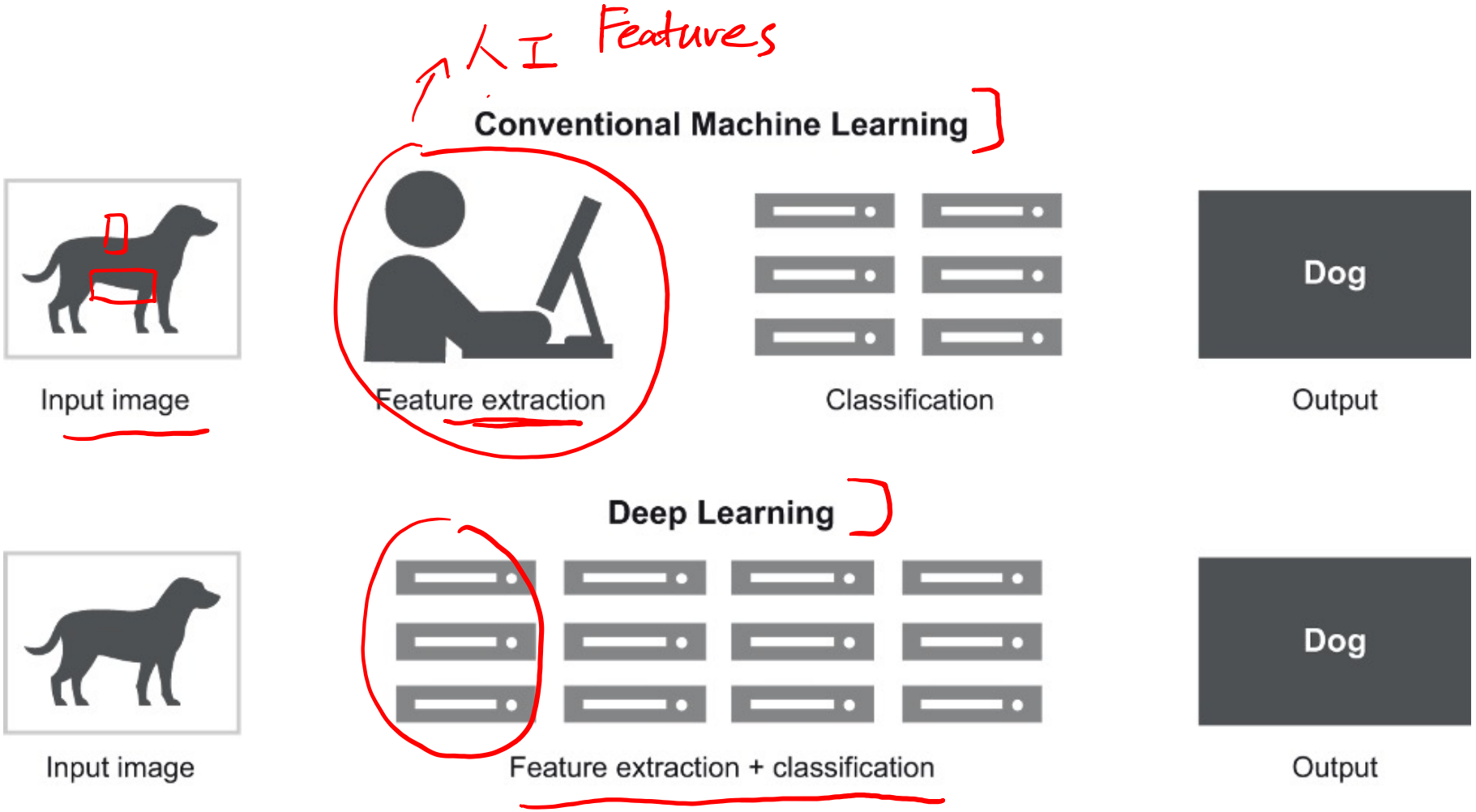


機器學習與資料處理的主要流程

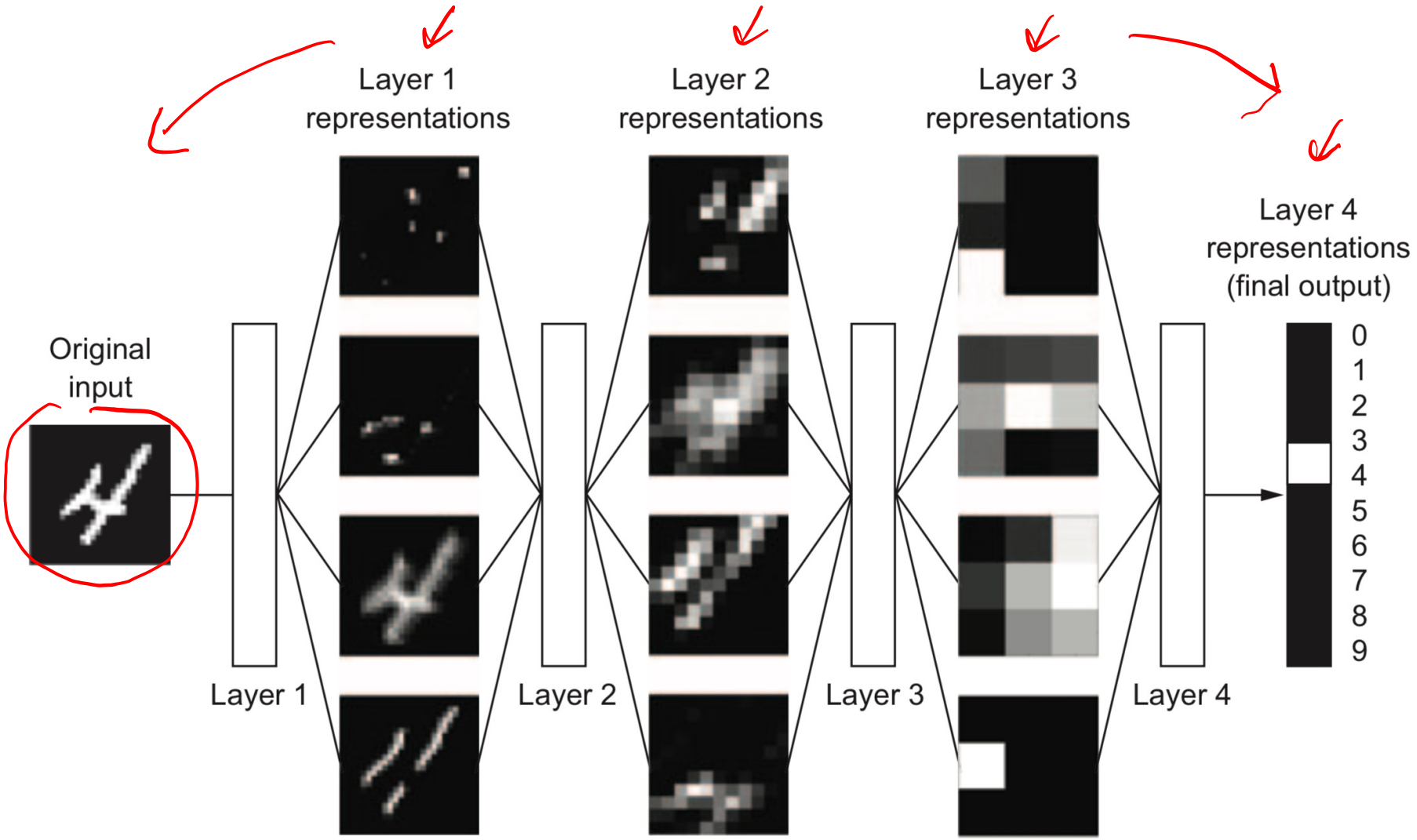




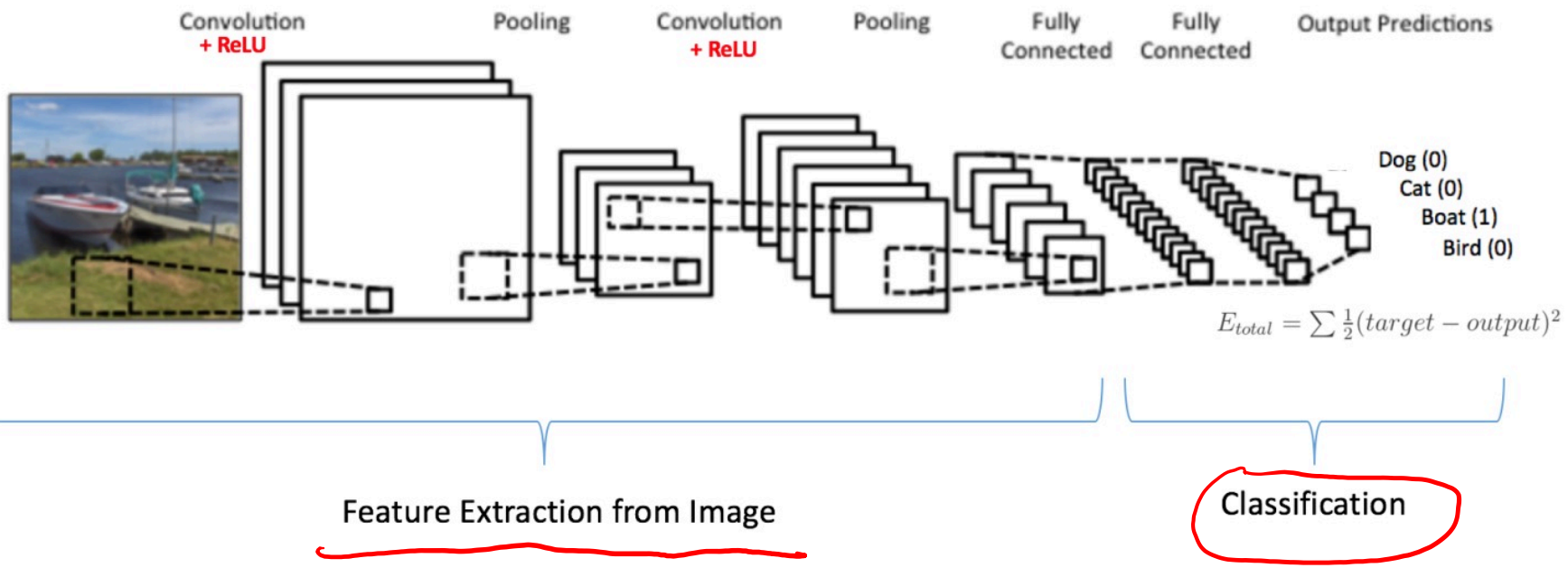
- Engineered features leveraged by Viola and Jones (2001) to detect faces reliably.
- Their efficient algorithm found its way into Fujifilm cameras, facilitating real-time auto-focus.


Features
Conventional Machine Learning
Input image
Feature extraction
Classification
Dog
Output
Deep Learning
Input image
Feature extraction + classification
Dog
Output

Deep Learning: Find the Features by Neural Network Layers

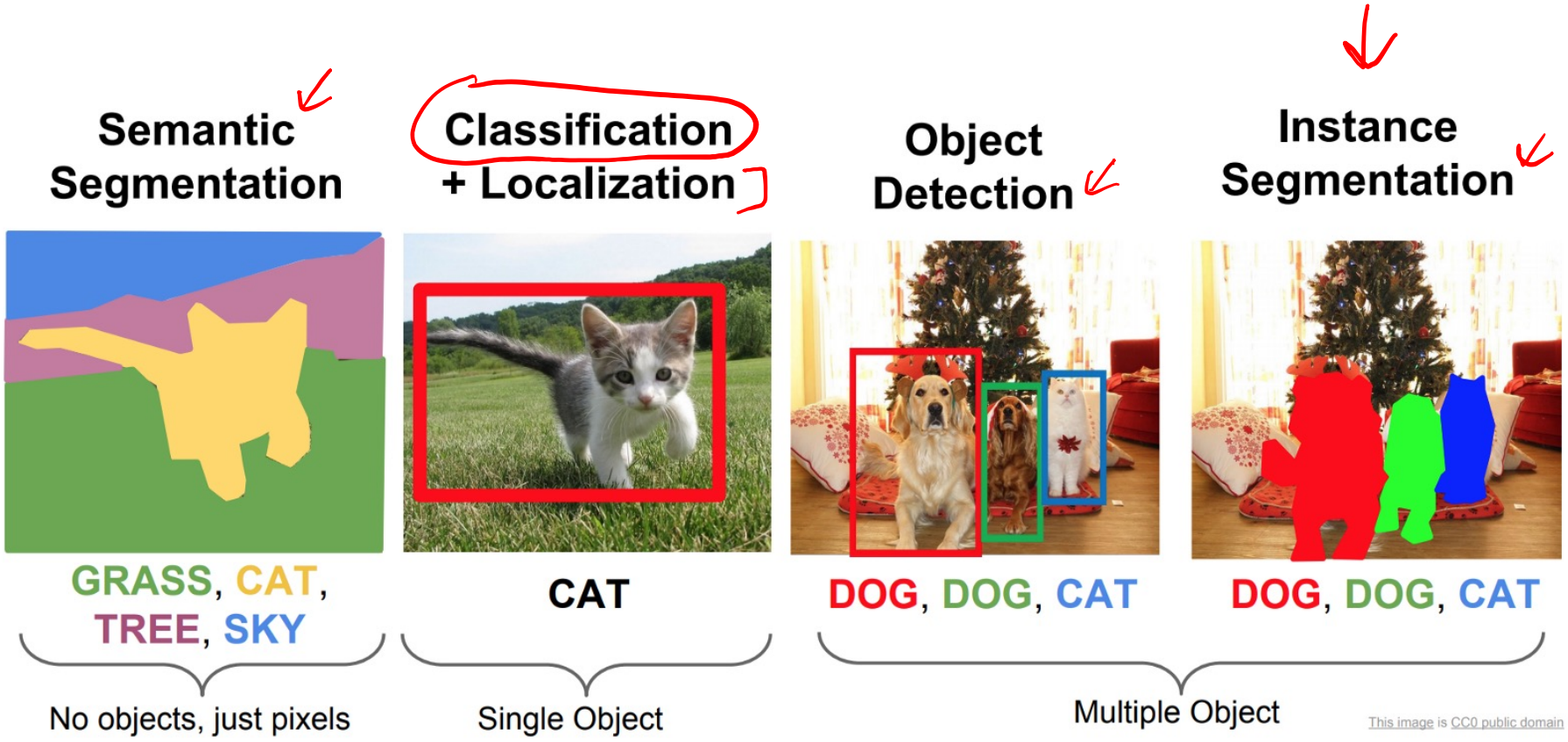


Deep Learning for Computer Vision: Convolutional Neural Networks (CNN)



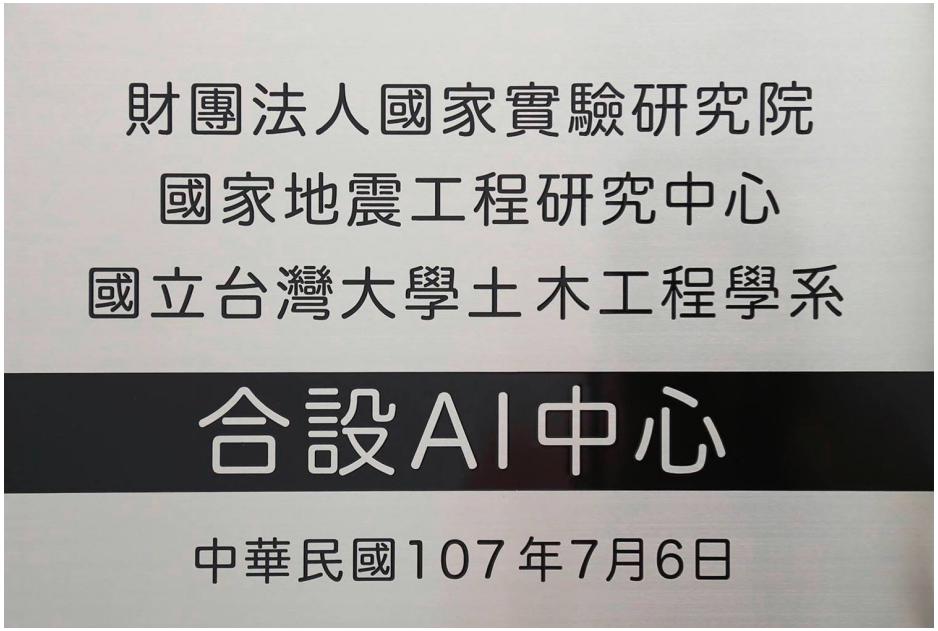
source: https://ujjwalkarn.me/2016/08/11/intuitive-explanation-convnets/

Computer Vision with CNN



source:http://cs231n.stanford.edu/slides/2018/cs231n_2018_lecture11.pdf

In addition to this course …



國震+土木增建
13F

http://**AI**Engineer.tw

Mission

- Advance engineering practice with AI.
- Train next-generation engineers in AI era.

AI Center 大學生實習計畫

近年來AI人工智慧技術發展迅速，而在土木工程中其應用價值亦逐漸受到矚目。

本中心正致力於發展AI技術在土木界的無限可能，並透過此次計劃提供有興趣的大專學生探索此領域的絕佳機會、培養其未來在研究上的實力。

2020.08.31

- 臺大土木系博士班於2019招生新增「人工智慧工程應用」領域
- 春季班、秋季班
- 每月三萬元獎學金*

AI will not replace engineers, but
engineers who use AI will replace those who do not.

Welcome on board!