Introduction to Artificial Intelligence

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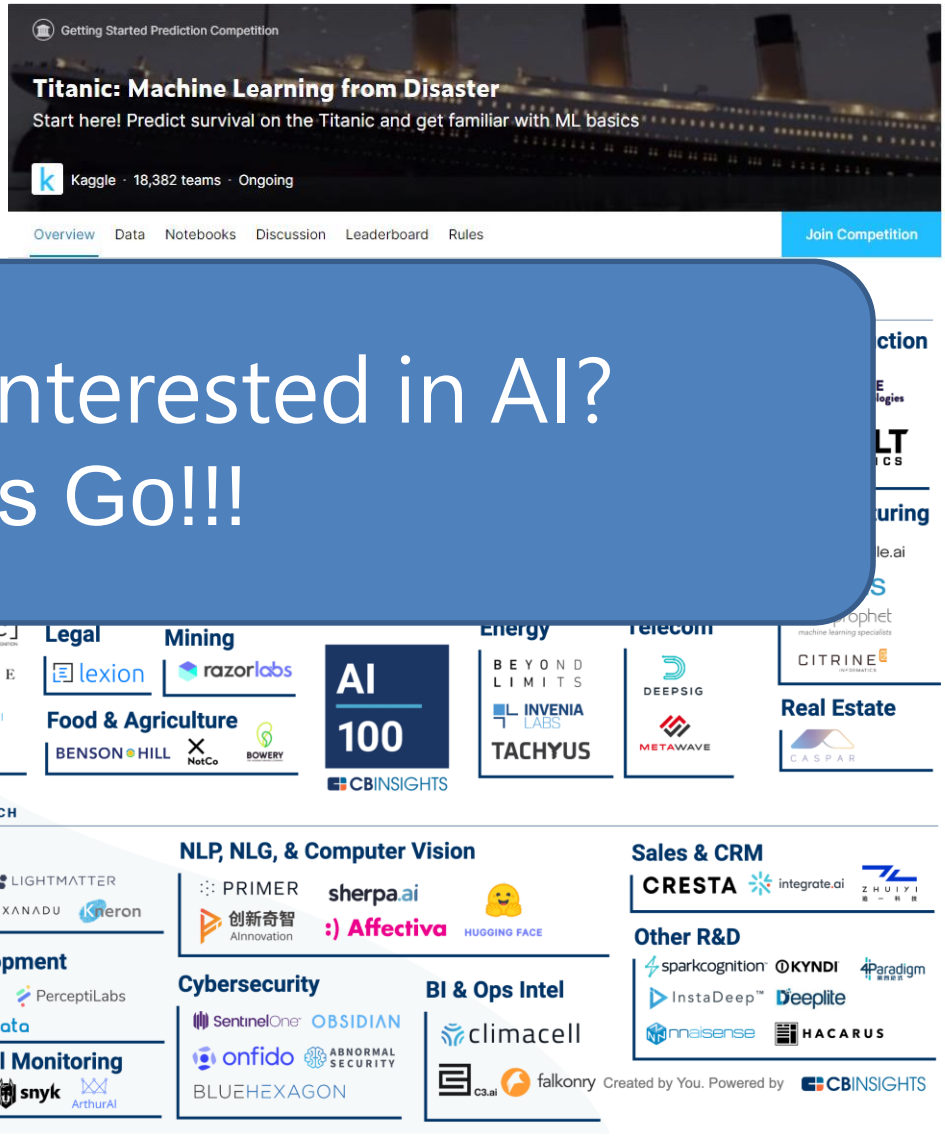
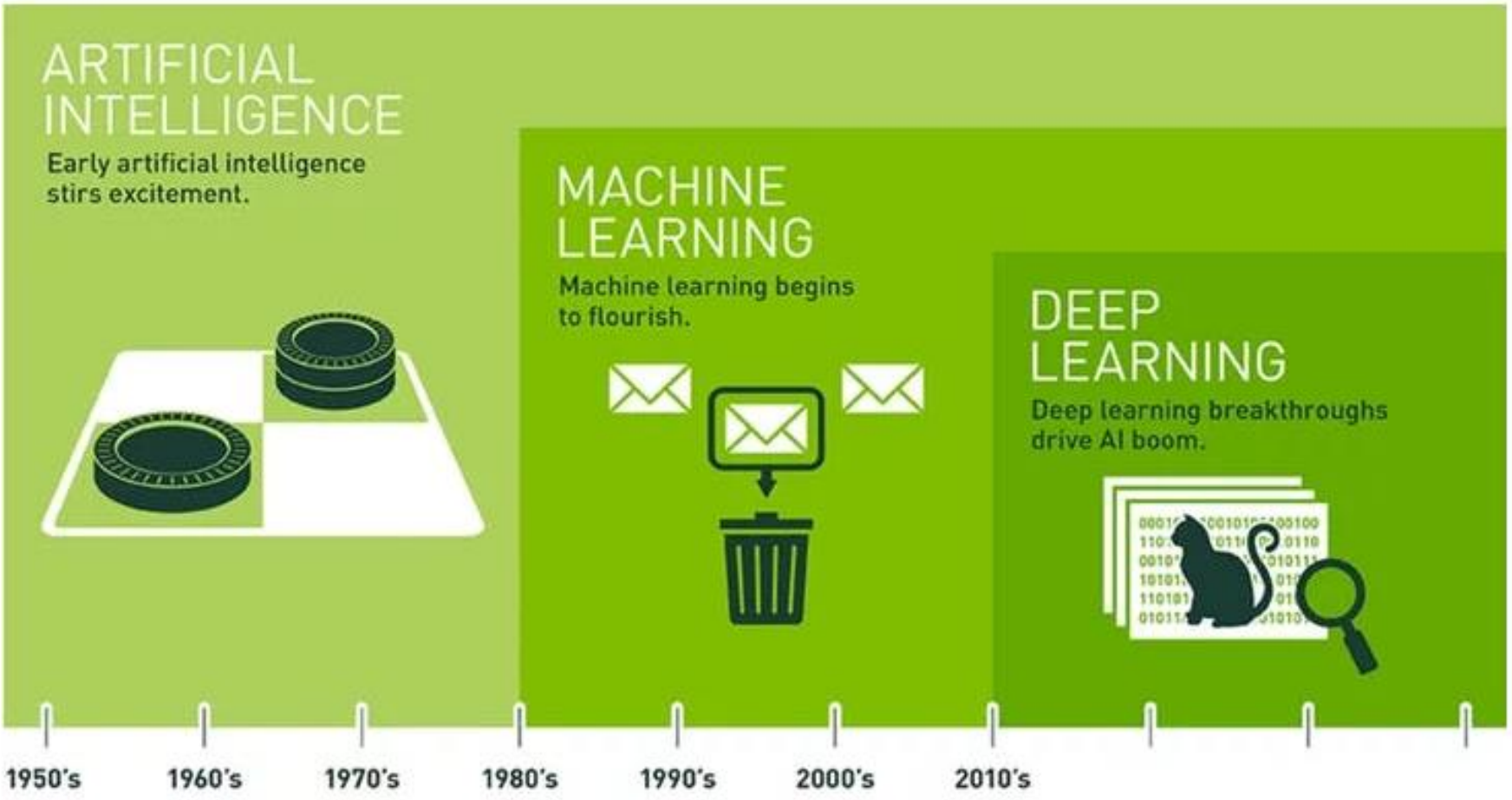
Thanks to the slides of Prof. P. Domingos from Washington University, Prof. H.-T. Lin and Prof. Lee Hung-Yi Lee from NTU.

After Learn AI……

- Analyze historical event
  - Titanic
- E
- Find a good job
- Build a startup



AI, ML, DL



圖片來源：NVIDIA

Story of ML and DL

- 1950, Artificial Intelligence
- 1980-2006, Machine learning
  - 1980 Artificial Neural Network
  - 1986 Back Propagation is proposed to solve the complex computation in neural network.
    - Gradient Vanish Problem
  - Decision Tree, Forest Tree, Support Vector Machine, …becomes popular.
- 2006, Prof. Hinton utilized Restricted Boltzmann Machine to train neural network.
- Bad impression of neural network. =>Deep Learning.
  - Decision Tree, Forest Tree, Support Vector Machine becomes shallow learning.

Story of ML and DL

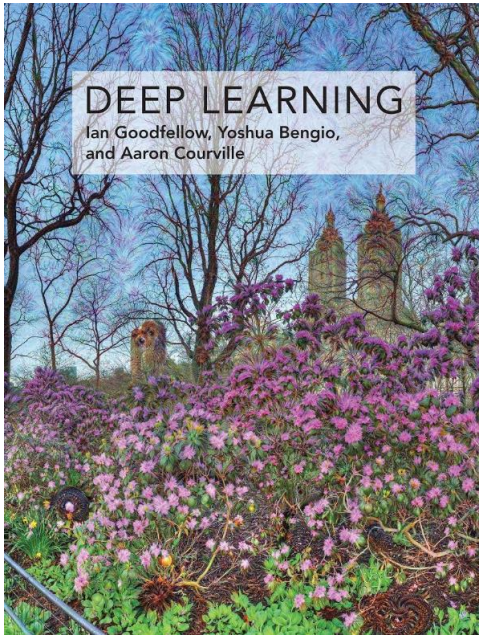
- ImageNet is the biggest image recognition database in the world.
- In fact, since the launch of the ImageNet competition in 2007, the results of the error rate is roughly 30%, 29%, 28% in each year's competitions.
- 2012, Prof. Hinton used deep learning (AlextNet) to make error rate become 16.42%.

The Father of Deep Learning

- 2013, Google bought the company of Prof. Geoffrey Hinton and his two students.
- Geoffrey Hinton becomes the father of deep learning.

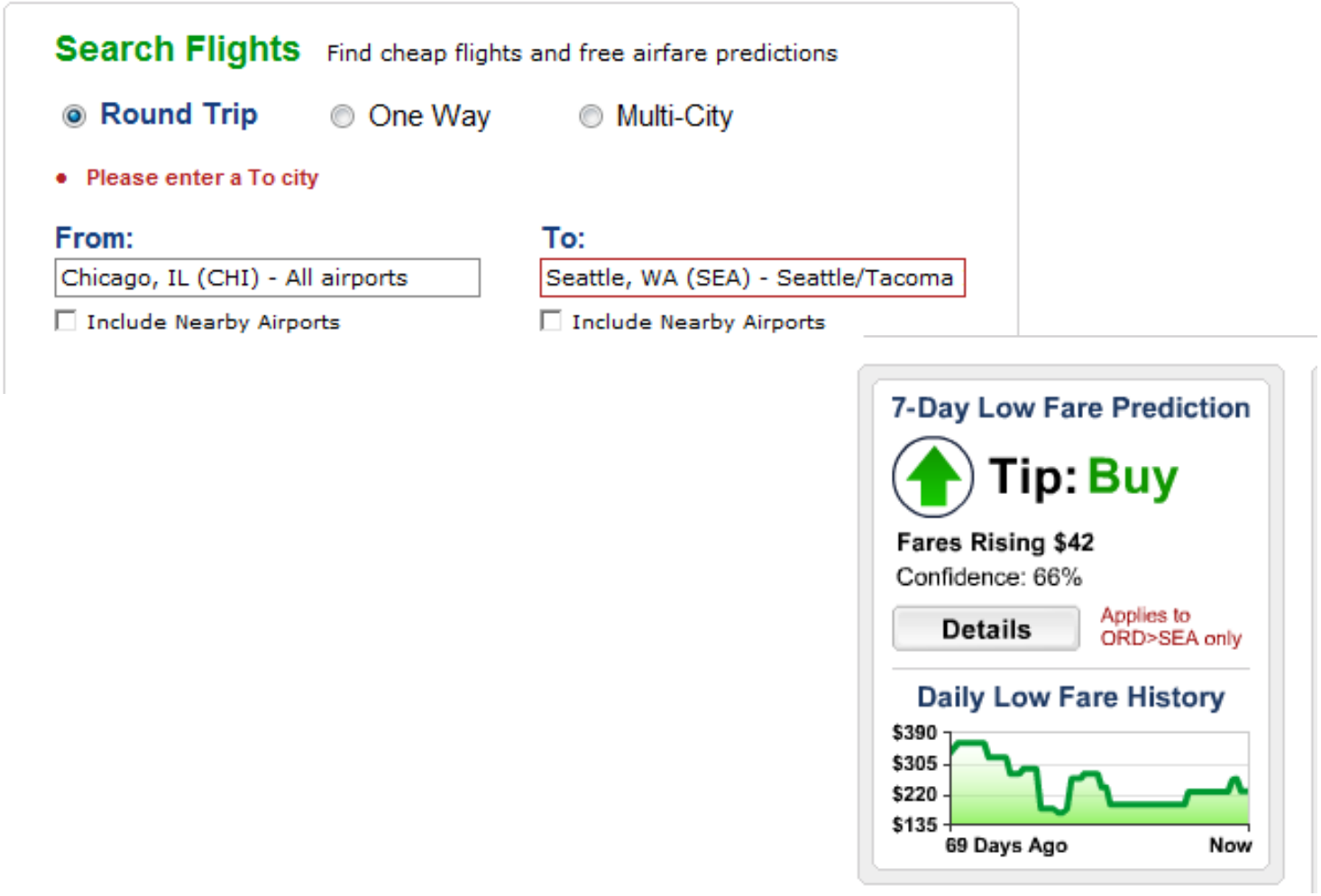
AI三巨頭

- Geoffrey Hinton、Yoshua Bengio、Yann LeCun got ACM Turing Award in 2018.
- Geoffrey Hinton
  - Father of deep learning
- Yoshua Bengio
  - The author of Deep Learning book
- Yann LeCun
  - Father of CNN
- They share self-labeling will be the important topic in the next generation of AI.



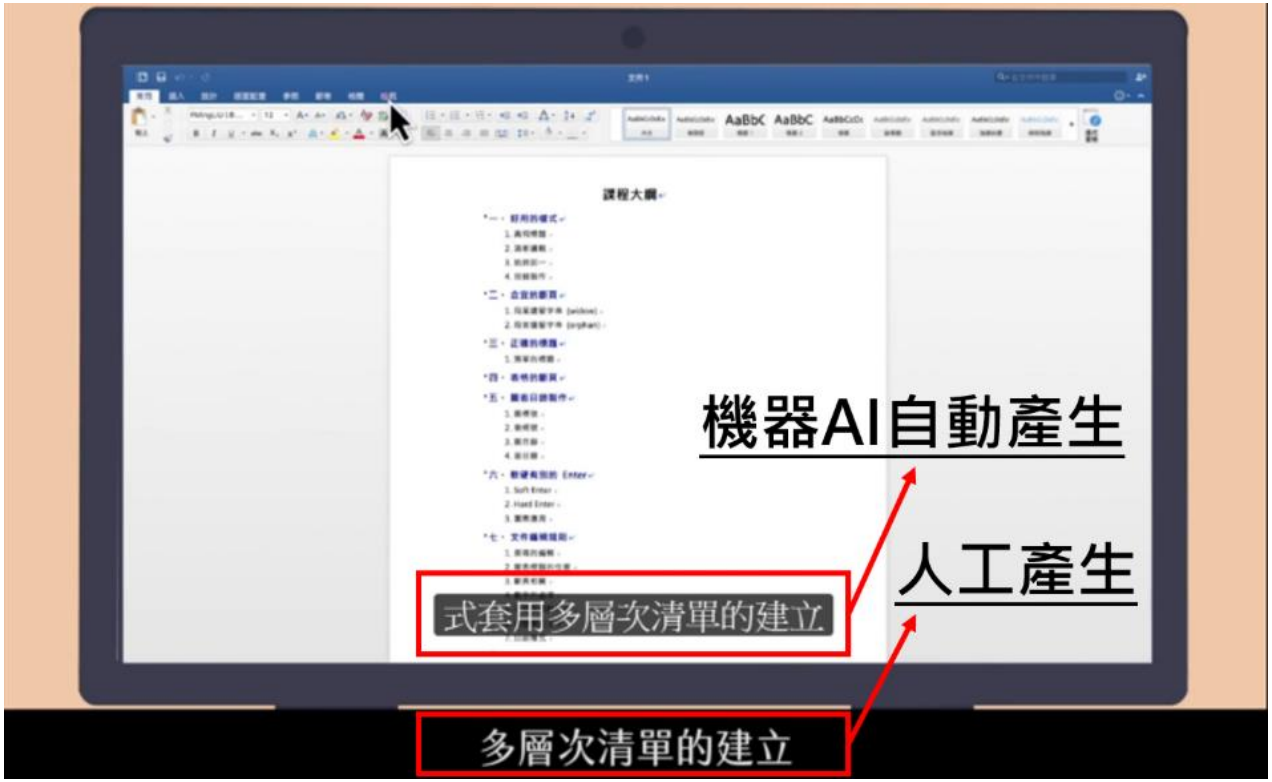
What AI can do?

Predict the Price of Stock



Automatic Speech Recognition

- Automatic Speech Recognition
  - Add subtitles automatically

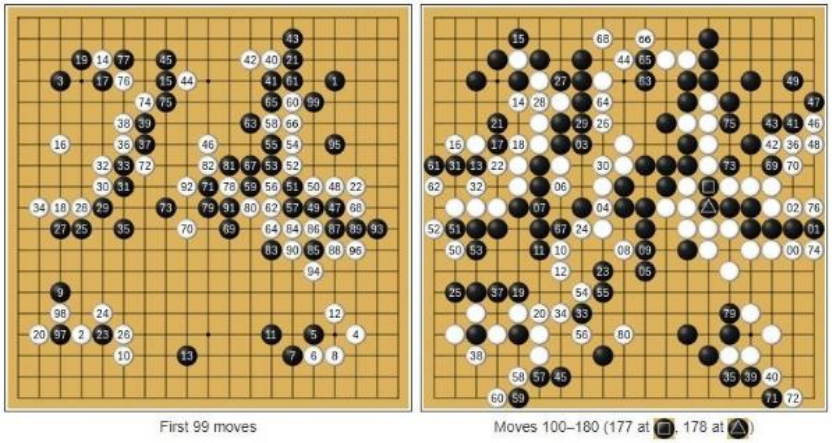


https://www.youtube.com/watch?v=qeEA_Frm9Jw

Alpha Go

「神之一手」奪全球讚賀，卻認為贏在系統錯誤

與AlphaGo的第四局比賽中，執白子的李世乭下出的第78手棋──這被譽為「神之一手」的一步棋，讓AlphaGo表現失常，進而逆轉局勢拿下比賽。這局棋為世人所稱頌。韓國棋手安永吉（An Younggil）聲稱，這場比賽是李世乭的最傑出的一局棋，一場足以流芳後世的經典對弈。



李世乭對決AlphaGo第4局下出被世人譽為「神之一手」的78手，導致後續AlphaGo判斷失常，進而拿下比賽。

圖片來源：Wikipedia

外界相信，這一局向全球揭示了人類勝過電腦的可能性，但李世乭認為，他能從AlphaGo手中拿下一勝，是因為AI在面對出乎預料棋步時的「缺陷」。

Image Caption Generation

- Automatic Image Caption Generation

"man in black shirt is playing guitar."

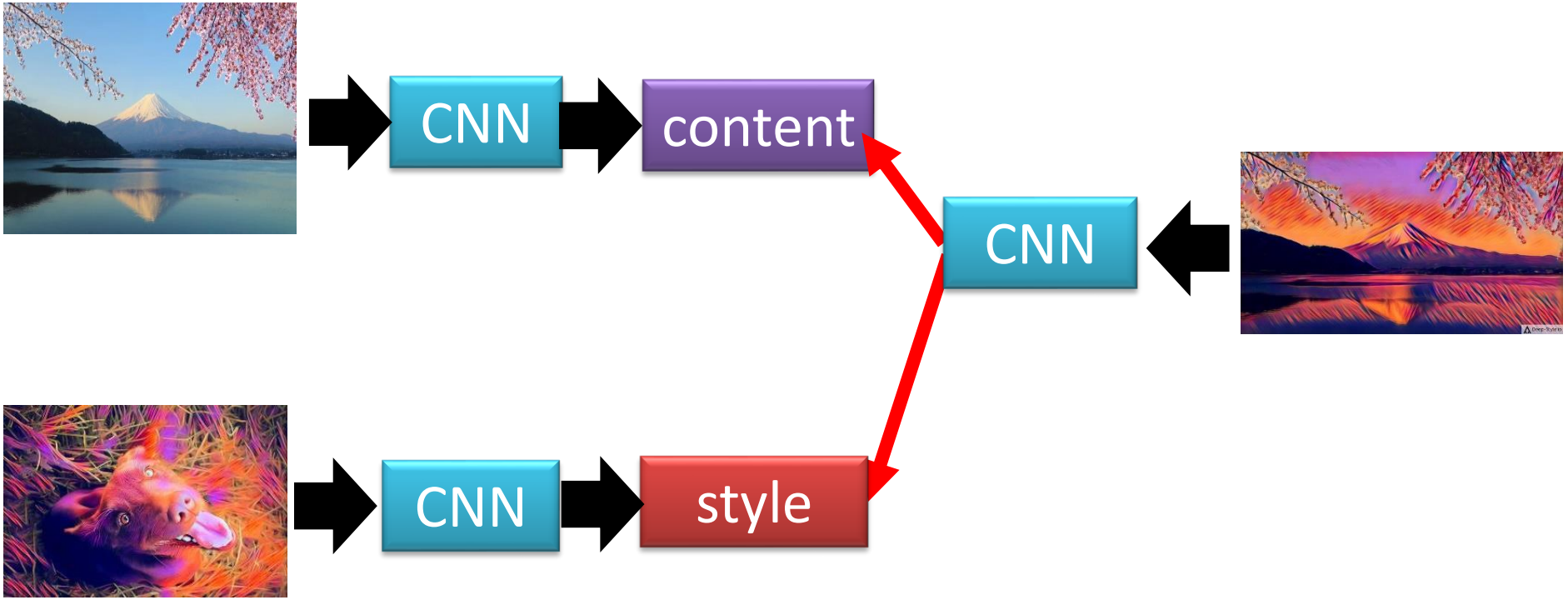
"construction worker in orange safety vest is working on road."

"two young girls are playing with lego toy."

Source:http://machinelearningmastery.com/inspirational-applications-deep-learning

Deep Style (1/2)

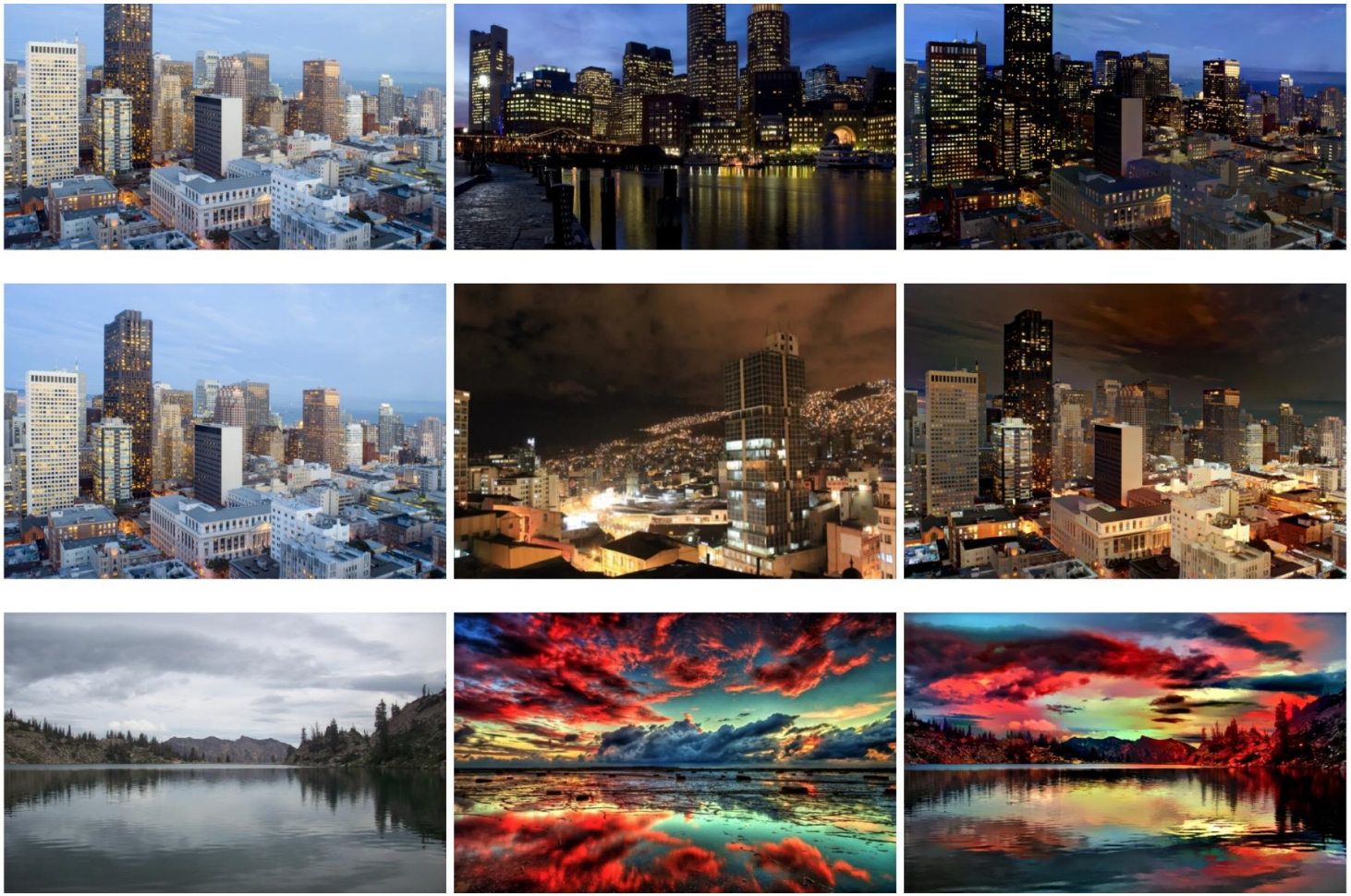
- Give a picture and transform to a famous painting.



A Neural Algorithm of Artistic Style https://arxiv.org/abs/1508.06576

Deep Style (2/2)

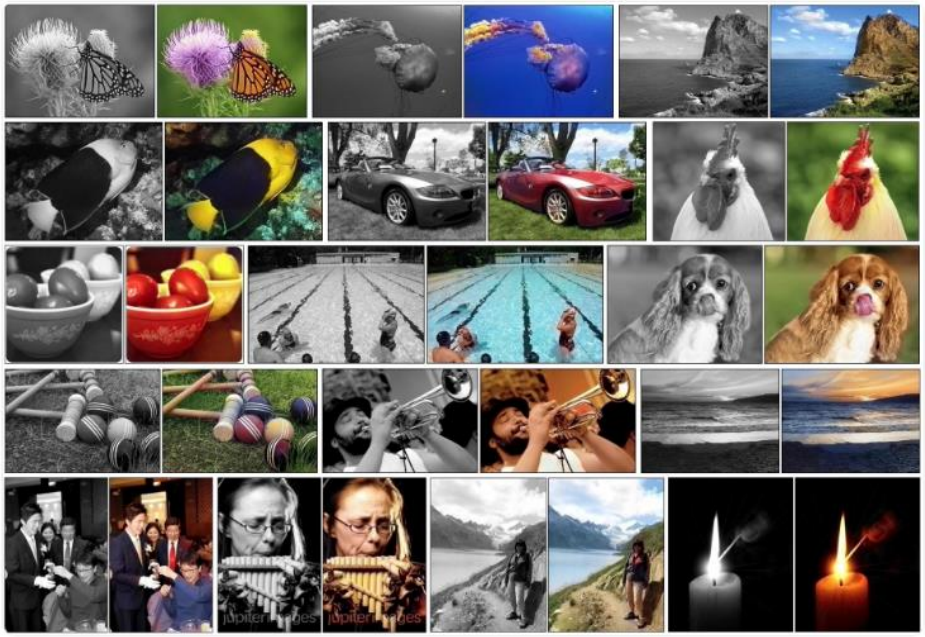
- Deep Photo Style Transfer



Fast Style Transfer

Automatic Colorization

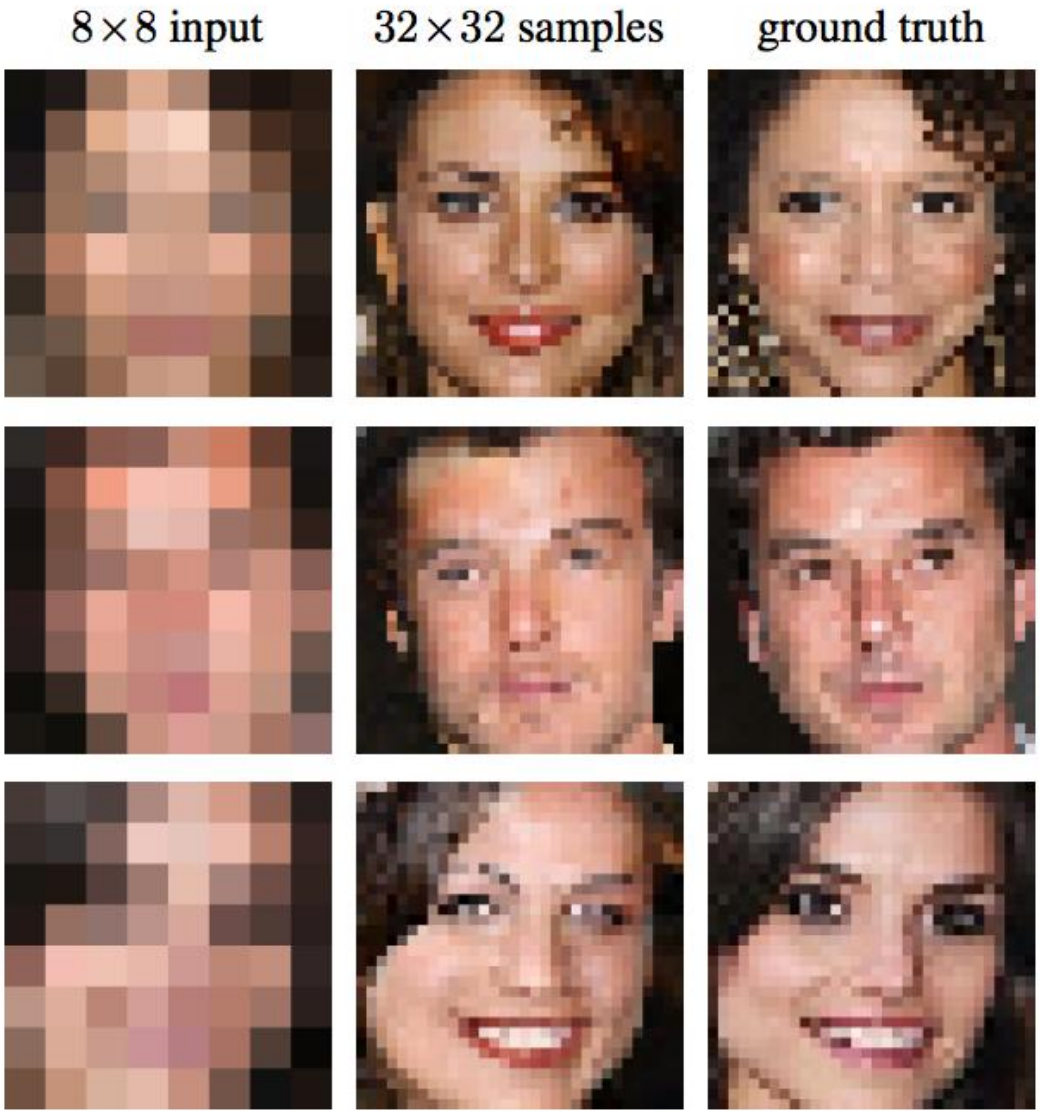
- Automatic Colorization of Black and White Images
  - Image colorization is the problem of adding color to black and white photographs.
  - Deep learning can be used to use the objects and their context within the photograph to color the image, much like a human operator might approach the problem.



http://demos.algorithmia.com/colorize-photos/

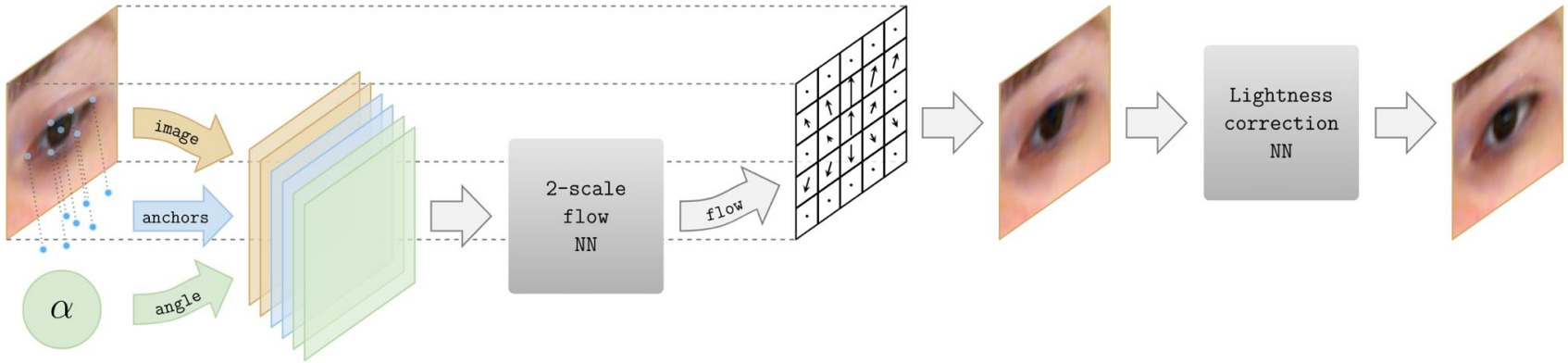
Source:http://machinelearningmastery.com/inspirational-applications-deep-learning/

Face Generation



DeepWarp (1/3)

- Add dynamic eyeballs to static pictures.
- http://sites.skoltech.ru/compvision/projects/deepwarp/



DeepWarp (2/3)

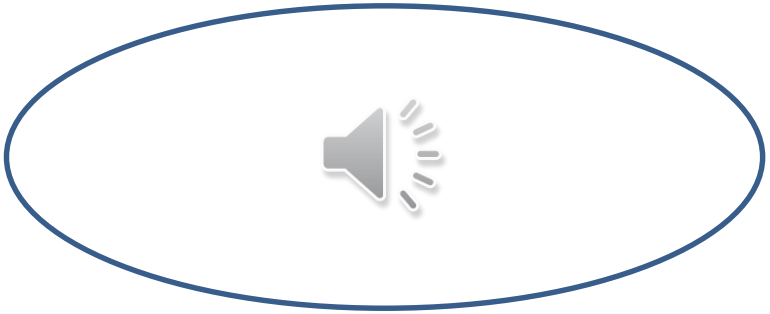
DeepWarp (3/3)

Lipnet

- LipNet: End-to-End Sentence-level Lipreading
- https://youtu.be/fa5QGremQf8

Music generation

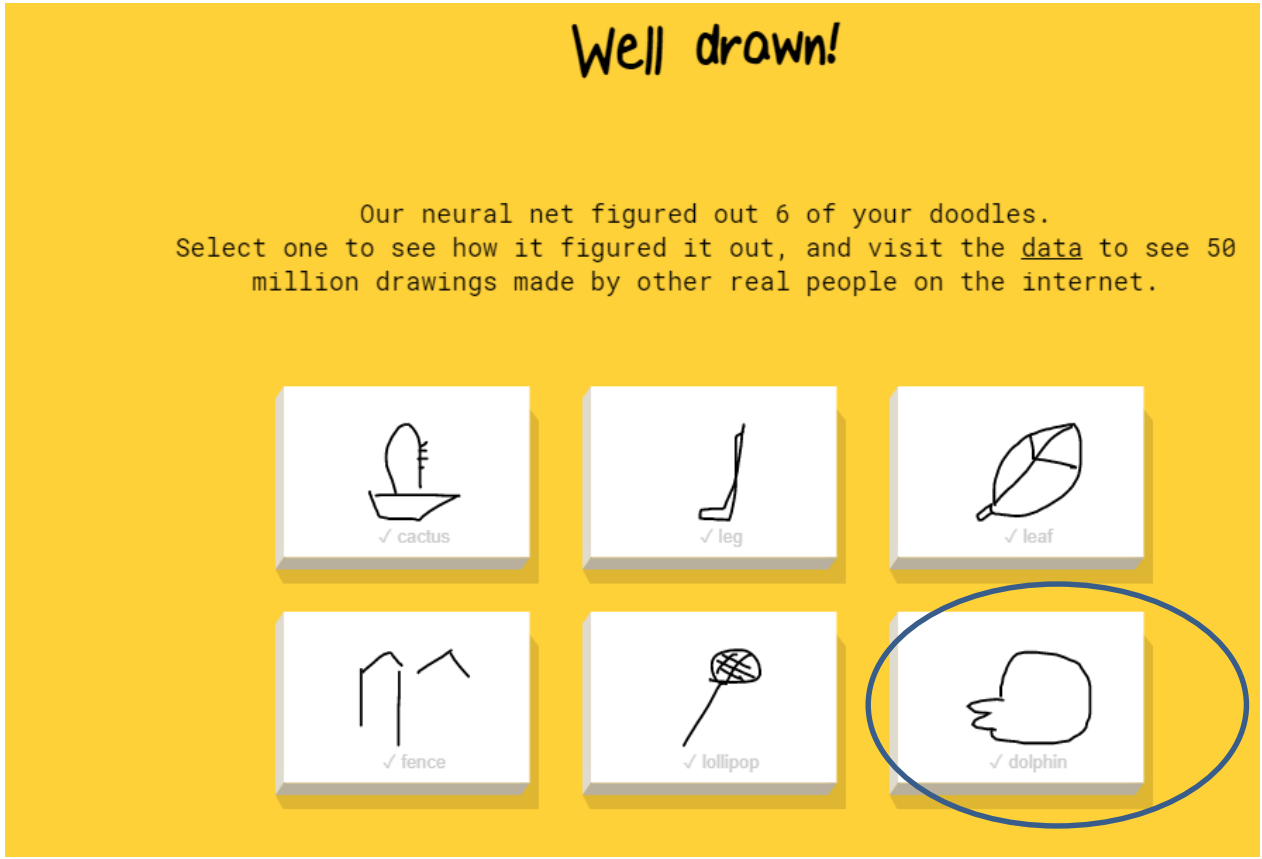
- Which one is the generated music?



This is generated by AI.

Google Quick Draw

- Differentiate what you are drawing
- https://quickdraw.withgoogle.com/



The model is good training!!

AI is so Powerful

- What can I do?
- Don’ t worried. Learn AI now and you can become AI’ s teacher.

From Learning to Artificial Intelligence

- What's learning?
  - knowledge or skill acquired by instruction or study

- What's artificial intelligence?

From Learning to Artificial Intelligence

- What's learning?
  - knowledge or skill acquired by instruction or study

- What's artificial intelligence?

  - Acquiring skill with experience accumulated/computed from data
  - Make machines act like human
- What's skill?

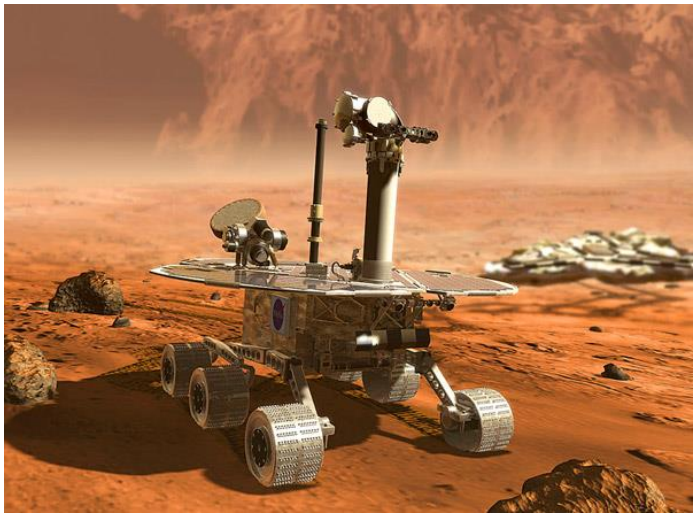
Skill

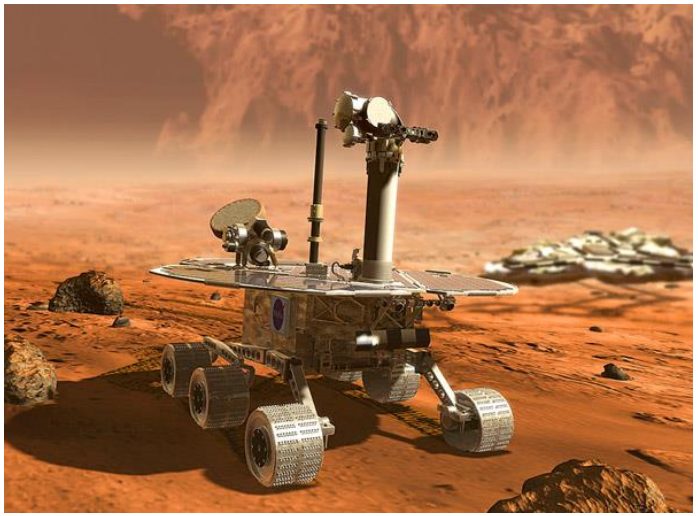
- Skill: improve the performance measurements (e.g., prediction, 3pts shooting percentage)
- Therefore, machine learning is defined to be the improvements on some performance measurements by computing from data.
- For example,
  - Network data -> **ML** -> Better flow control
  - Signal data -> **ML** -> Faster antenna direction detection
  - Sequential web log data -> **ML** -> Higher accuracy of anomaly detection/efficiency of caching algorithm
  - Stock data -> **ML** -> More money

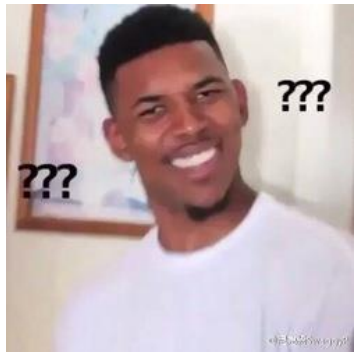
AI

- AI: an **alternative route** to build complicated systems
- Some Use Scenarios
  - when human cannot program the system manually
    - navigating on Mars
  - when human cannot 'define the solution' easily
    - speech/visual recognition
  - when needing rapid decisions that humans cannot do
    - high-frequency trading
  - when needing to be user-oriented in a massive scale
    - consumer-targeted marketing

Navigating on Mars







http://www.memebucket.com/mb/2015/02/I-got-it-423.png http://res.pokemon.name/common/pokemon/pgl/201.00.png

http://www.rutgersprep.org/kendall/7thgrade/cycleA_2008_09/ds/Mars-Rover.jpg https://cdn2.ettoday.net/images/2471/2471912.jpg

Visual Recognition

- Describe this thing using the appearance

http://www.georgjensen.com/zh-tw/jewellery/rings/~/productimages/600/0/0/3559000/
http://media.tiffany.com/is/image/Tiffany/EcomBrowseM/tiffany-city-hardwear-ball-ring-38089609_969582_ED_M.jpg
https://images.gamme.com.tw/news2/2016/34/73/paCYpaCYkJ6cqaSa.jpg
https://static.soufeel.com/media/catalog/product/cache/0/thumbnail/280x280/9df78eab33525d08d6e5fb8d27136e95/R/1/R165A.png

Key Essence of AI

- Exists some ‘underlying pattern’ to be learned
  - So performance measure can be improved
- But no programmable (easy) definition
  - So AI is required
- Somehow there is data about the pattern
  - So AI has inputs to learn from

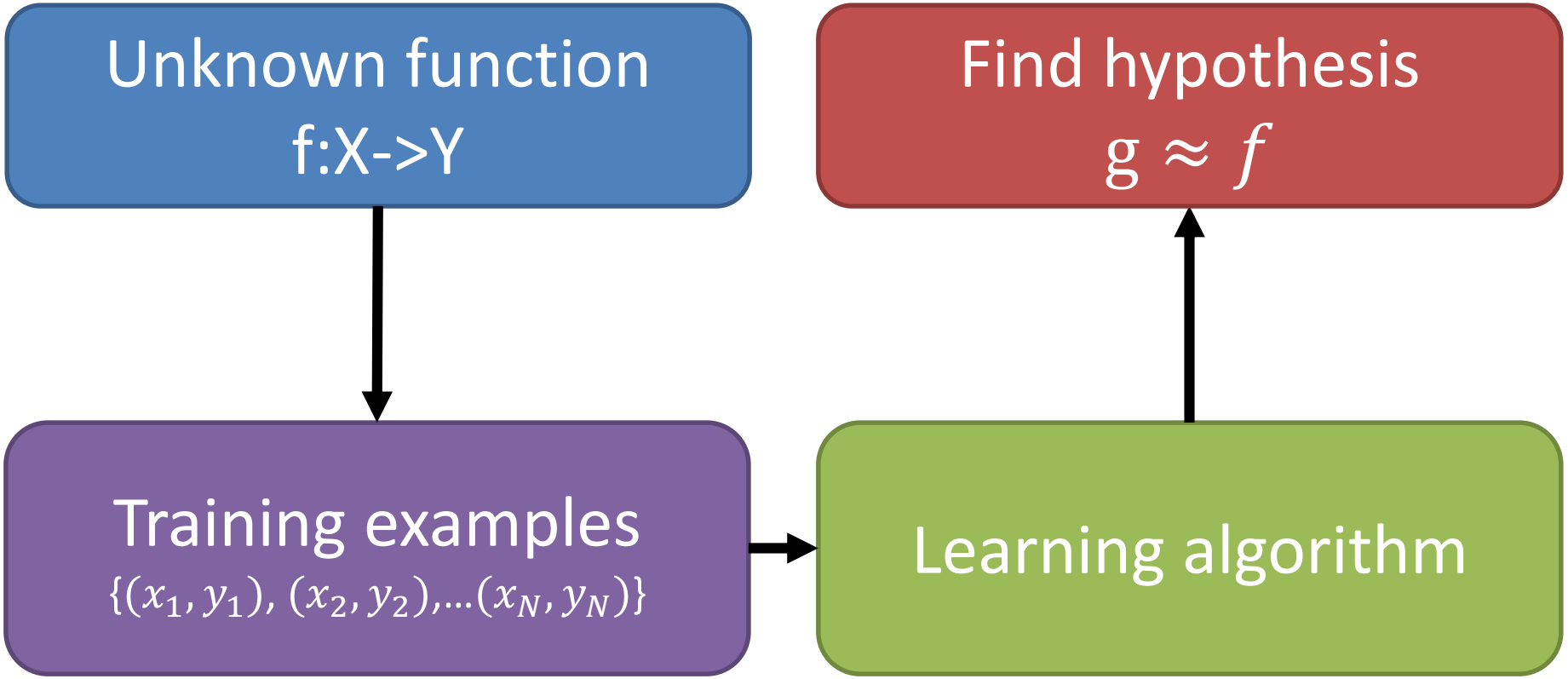
Which of the following is best suited for machine learning?

- 1. predicting whether the next cry of the baby girl happens at an even-numbered minute or not?
- 2. determining whether a given graph contains a cycle
- 3. deciding whether to approve credit card to some customer
- 4. guessing whether the earth will be destroyed by the misuse of nuclear power in the next ten years

Learning Problem Formulation

- Notation
  - **Input:** $x \in X$(application)
  - **Output:** $y \in Y$(good/bad after approving)
  - **Unknown pattern to be learned can be formulated as a function**
    - f: X->Y (ideal function)
  - **Data:** D=$\{(x_1, y_1), (x_2, y_2), \ldots (x_N, y_N)\}$
  - **Hypothesis:**
    - g:X->Y (hopefully can be as close to f as possible)

Learning Flow



- Artificial Intelligence: use data to compute hypothesis g that approximates target f

Learning is to find a function

- Voice Recognition

f() = 鳥叫聲

- Speech Recognition

f() = “我不知道你說什麼”

- Image recognition

f() = “Seafood”

- Channel estimation

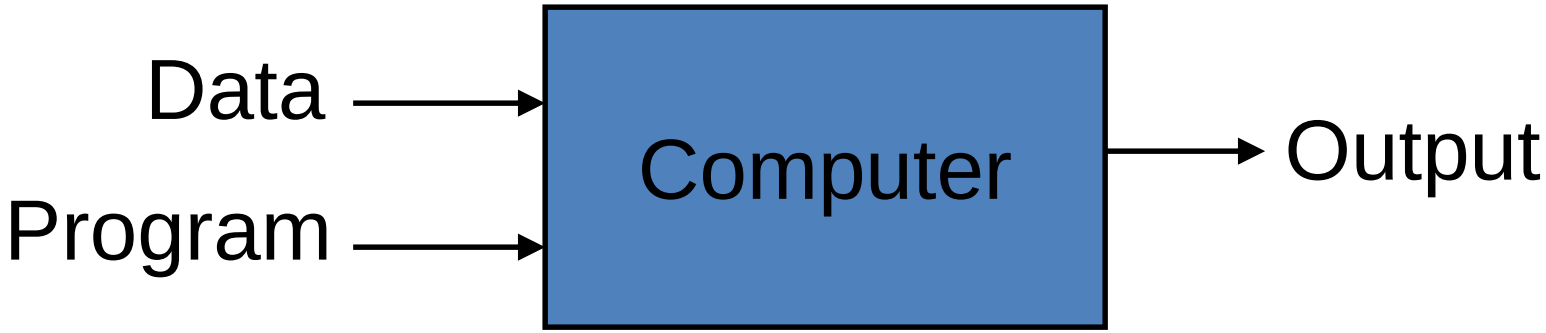
f(

) = Channel parameters

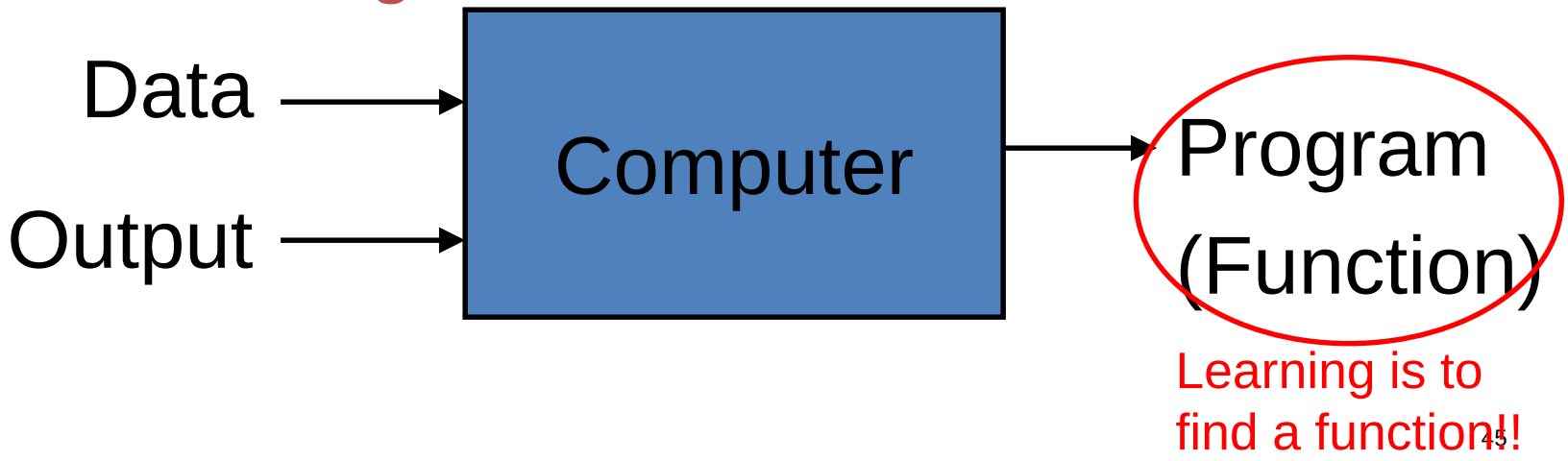
http://cdn1.itpro.co.uk/sites/itpro/files/images/dir_176/it_photo_88225.jpg
http://www.berkeleywellness.com/sites/default/files/field/image/ThinkstockPhotos-520490716_field_img_hero_988_380.jp
https://telcoantennas.com.au/site/sites/default/files/images/4G-cross-polarisation-low-signal-areas.png

Traditional Programming vs. ML

Traditional Programming



Machine Learning



Learning is to find a function!!

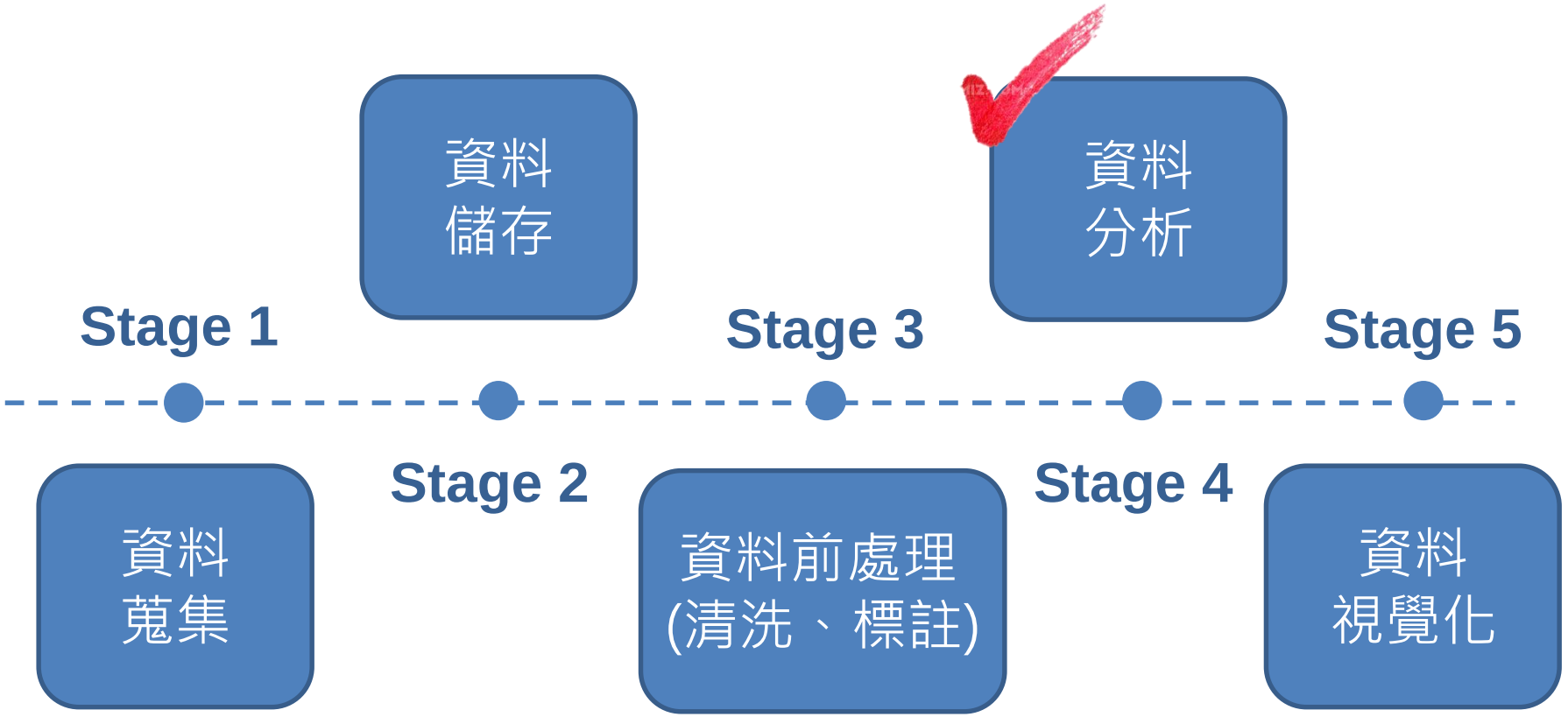
AI is so Easy

Like gardening

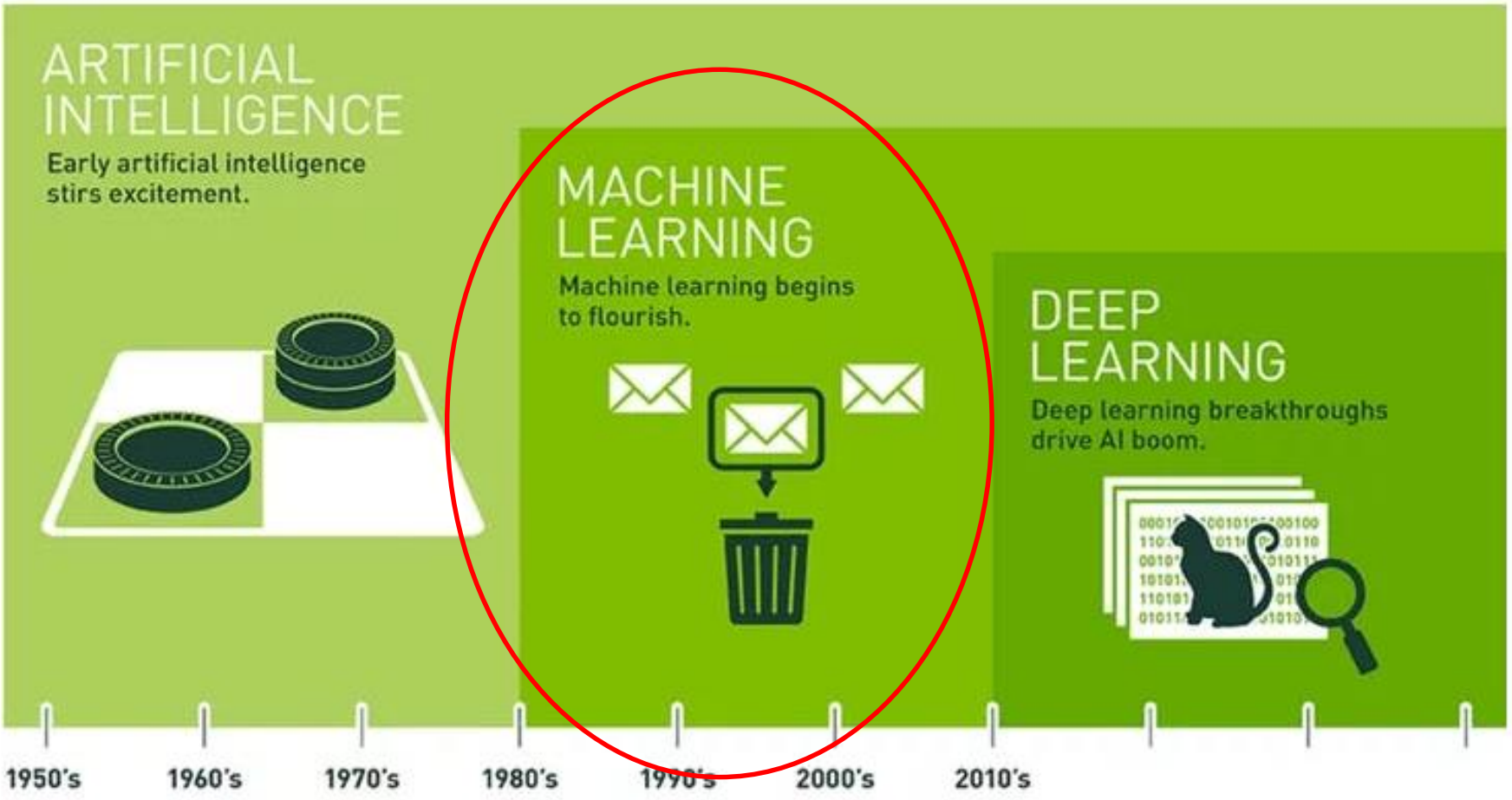
- **Seeds** = Algorithms
- **Nutrients** = Data
- **Gardener** = You
- **Plants** = Programs

You can do it!

AI and Data Analytics



人工智慧 (AI),機器學習 (ML), 深度學習(DL)



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