

Introduction of this course

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ARTIFICIAL INTELLIGENCE

Early artificial intelligence stirs excitement.

人工智慧 目標



人類設定好的
天生本能

MACHINE LEARNING

Machine learning begins to flourish.

機器學習 手段



DEEP LEARNING

Deep learning breakthroughs drive AI boom.

深度學習



1950's

1960's

1970's

1980's

1990's

2000's

2010's

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.

人類設定好的天生本能

- E.g. You want to build a Chat-bot ...
 - If there is “turn off” in the input, then “turn off the music” (hand-crafted rules)
 - You can say “Please turn off the music” or “Can you turn off the music?”. Smart?
 - What if someone says “Please don’t turn off the music”
- Weakness of hand-crafted rules
 - Hard to consider all possibilities
 - 永遠無法超越創造者
 - Lots of human efforts (not suitable for small industry)

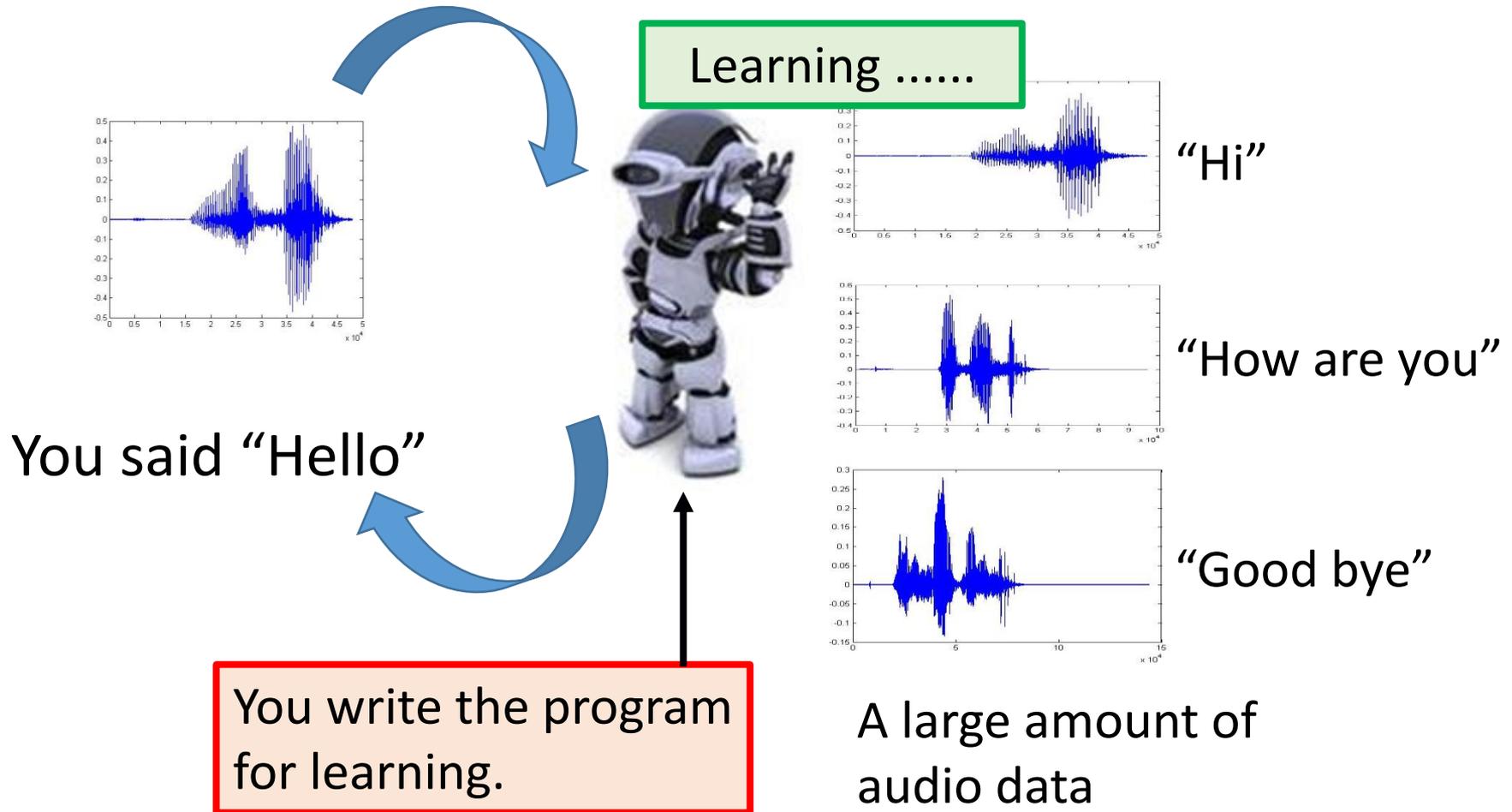
人類設定好的天生本能

- AI?

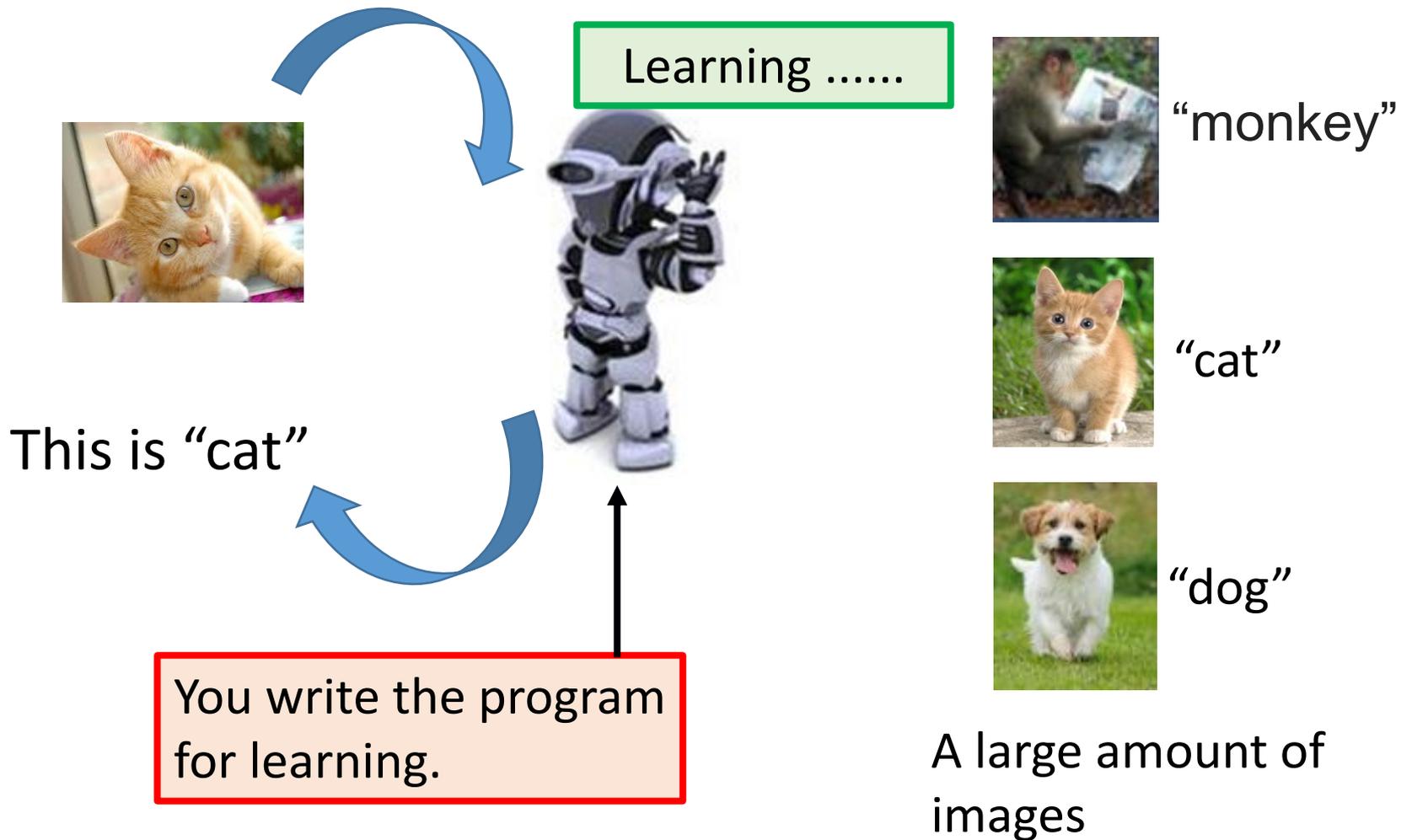
[http://www.committstrip.com/en/2017/06/07/ai-inside/?](http://www.committstrip.com/en/2017/06/07/ai-inside/)

Shared on Yann
LeCun's FB

What is Machine Learning?



What is Machine Learning?



Machine Learning ≈ Looking for a Function

- Speech Recognition

$$f\left(\text{[audio waveform]}\right) = \text{“How are you”}$$

- Image Recognition

$$f\left(\text{[cat image]}\right) = \text{“Cat”}$$

- Playing Go

$$f\left(\text{[go board image]}\right) = \text{“5-5” (next move)}$$

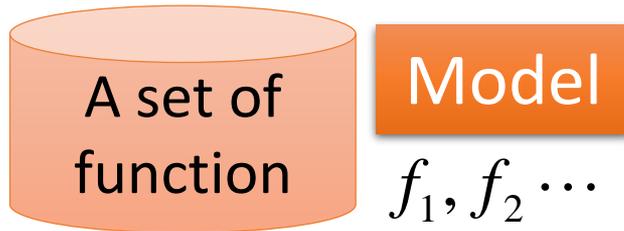
- Dialogue System

$$f\left(\begin{array}{l} \text{“Hi”} \\ \text{(what the user said)} \end{array}\right) = \begin{array}{l} \text{“Hello”} \\ \text{(system response)} \end{array}$$

Framework

Image Recognition:

$$f\left(\text{img of a cat}\right) = \text{"cat"}$$



$$f_1\left(\text{img of a cat}\right) = \text{"cat"}$$

$$f_2\left(\text{img of a cat}\right) = \text{"money"}$$

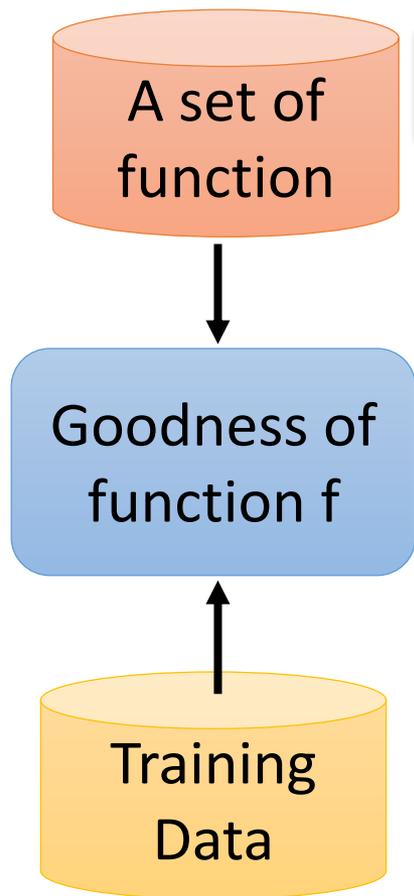
$$f_1\left(\text{img of a dog}\right) = \text{"dog"}$$

$$f_2\left(\text{img of a dog}\right) = \text{"snake"}$$

Framework

Image Recognition:

$$f(\text{img_cat}) = \text{"cat"}$$



Model
 $f_1, f_2 \dots$

$f_1(\text{img_cat}) = \text{"cat"}$	$f_2(\text{img_cat}) = \text{"money"}$
$f_1(\text{img_dog}) = \text{"dog"}$	$f_2(\text{img_dog}) = \text{"snake"}$

Better!

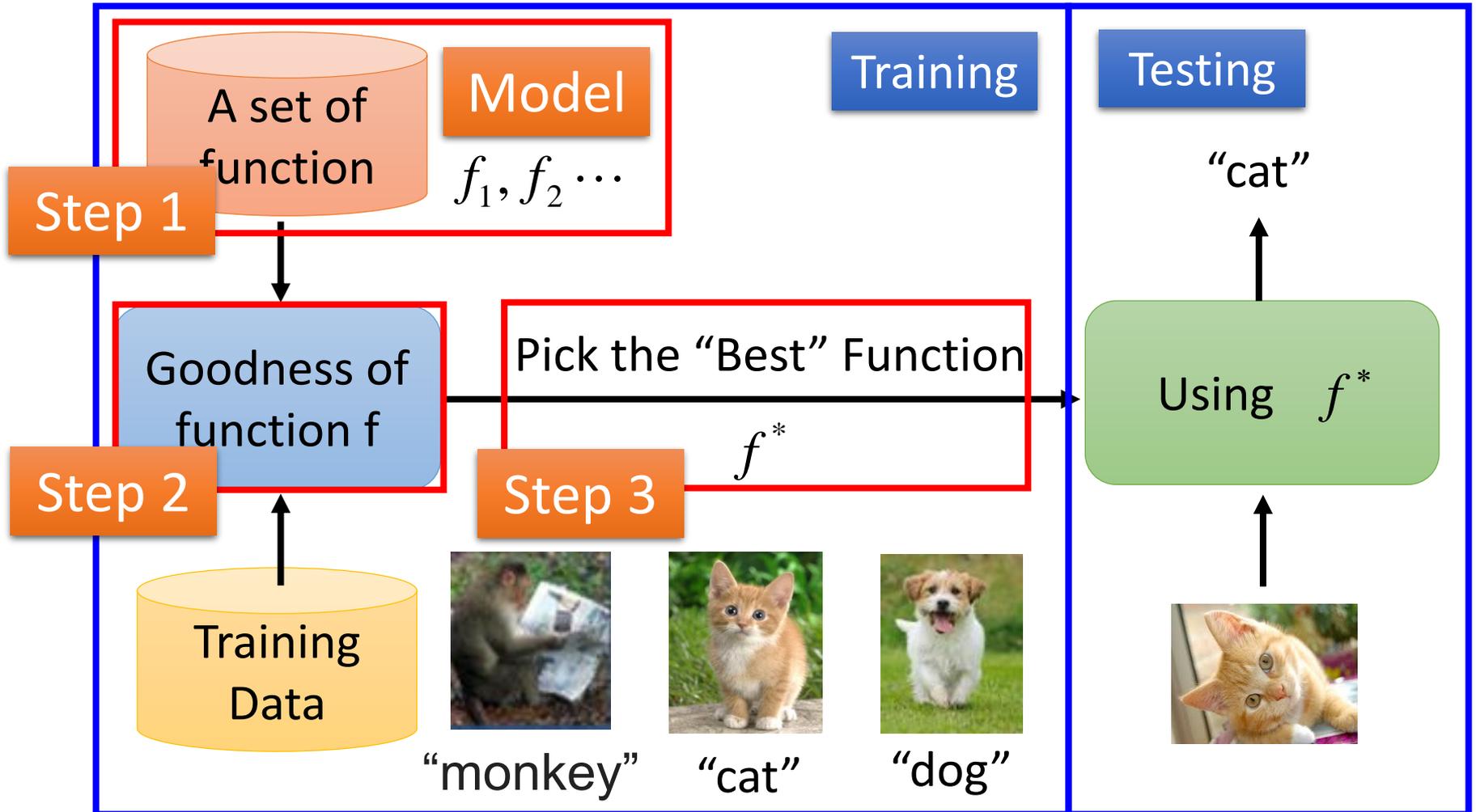
function input:   

function output: "monkey" "cat" "dog"

Framework

Image Recognition:

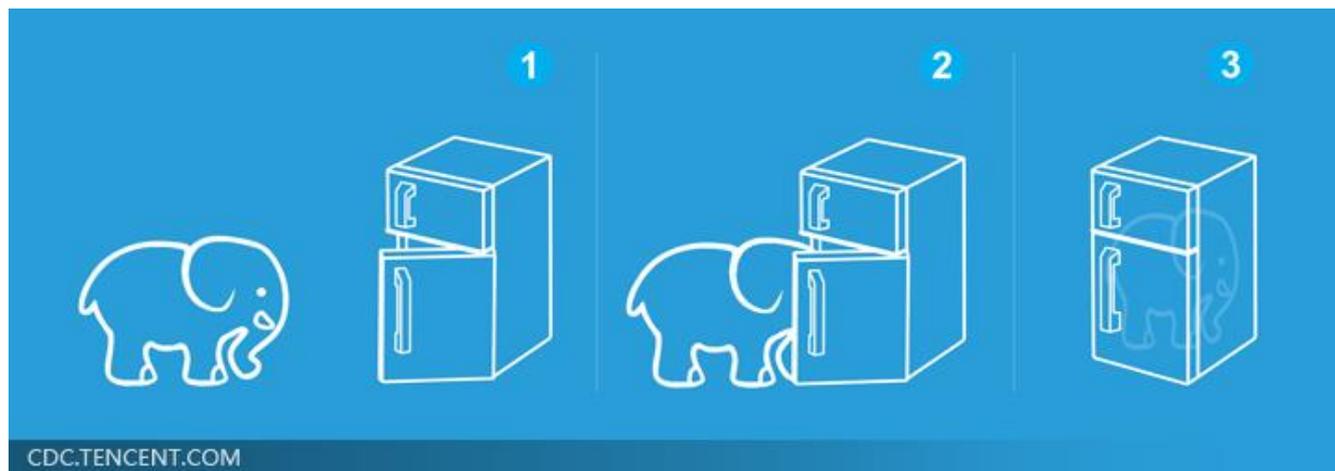
$$f(\text{Image of a cat}) = \text{"cat"}$$



Machine Learning is so simple

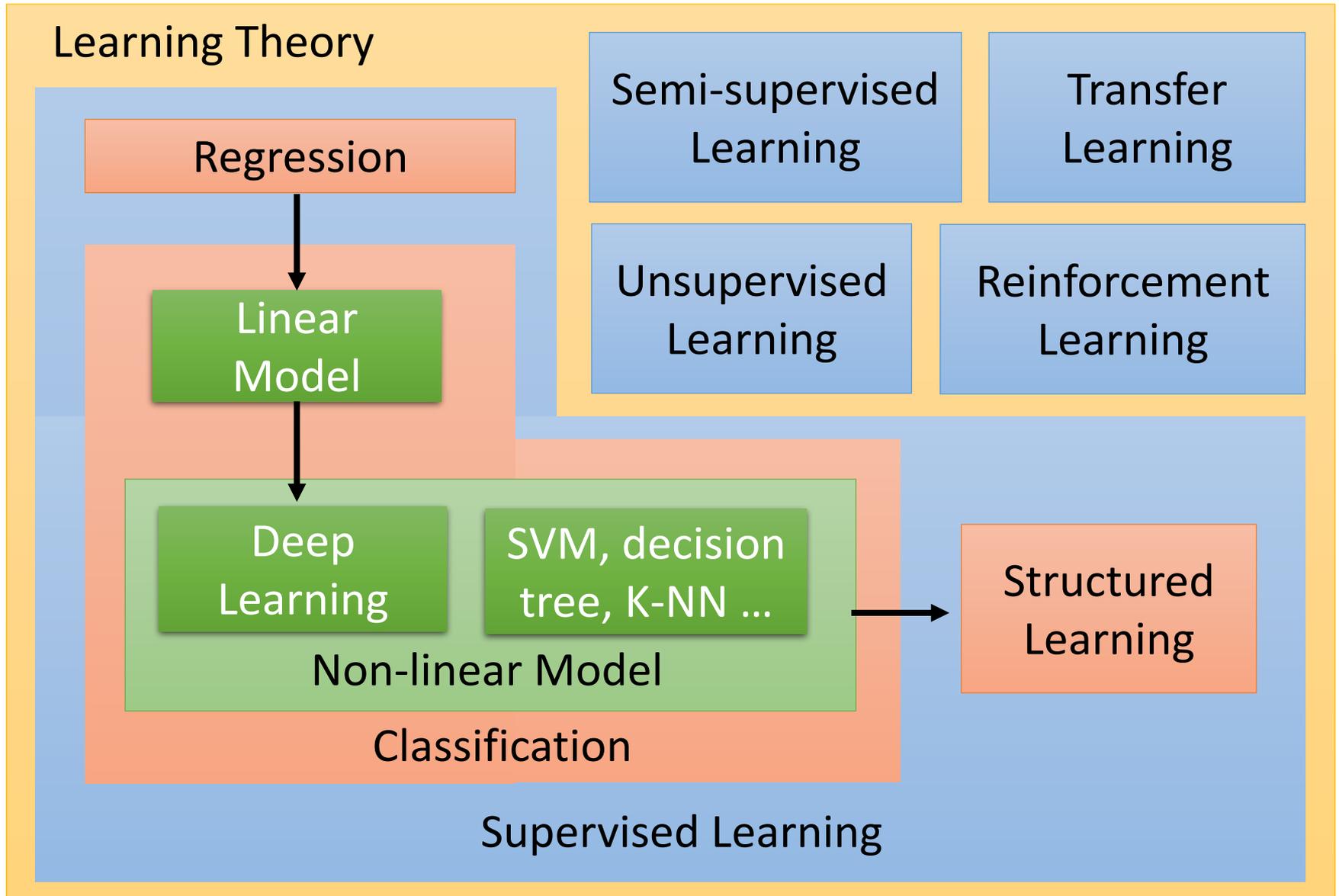


就好像把大象放進冰箱



Learning Map

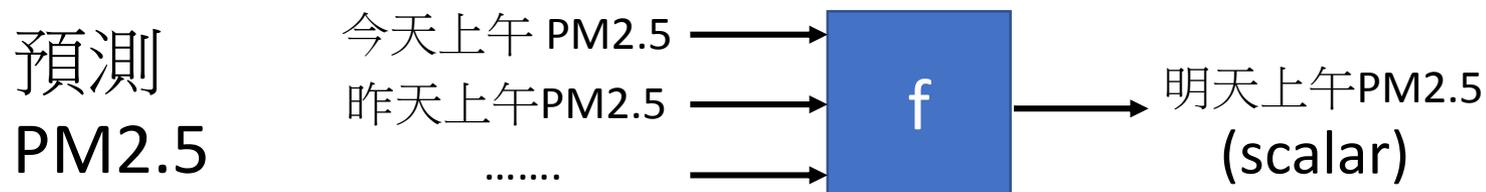
Learning Map



Learning Map

Regression

The output of the target function f is “scalar”.



Training Data:

Input:

9/01 上午 PM2.5 = 63 9/02 上午 PM2.5 = 65

Input:

9/12 上午 PM2.5 = 30 9/13 上午 PM2.5 = 25

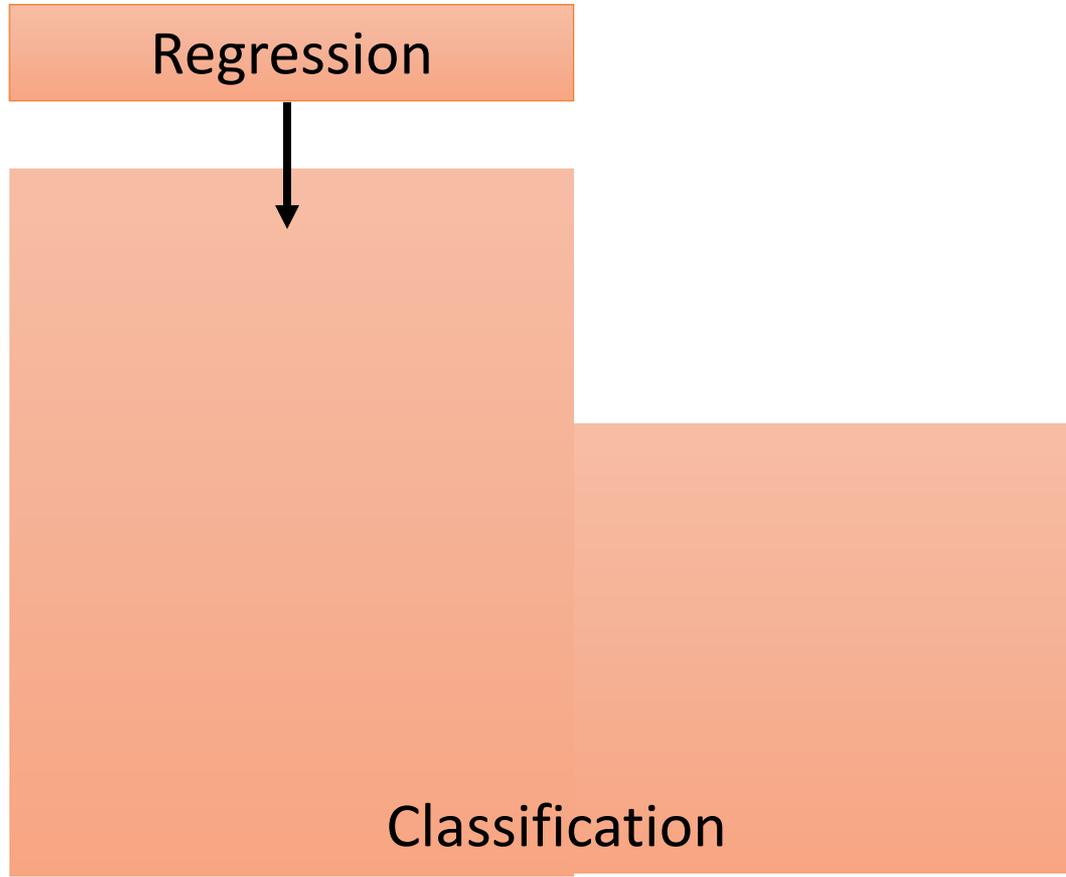
Output:

9/03 上午 PM2.5 = 100

Output:

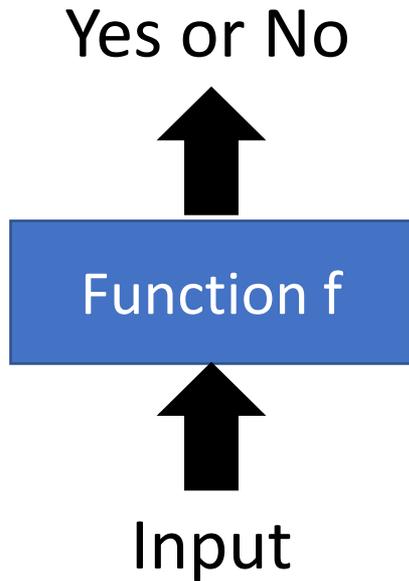
9/14 上午 PM2.5 = 20

Learning Map

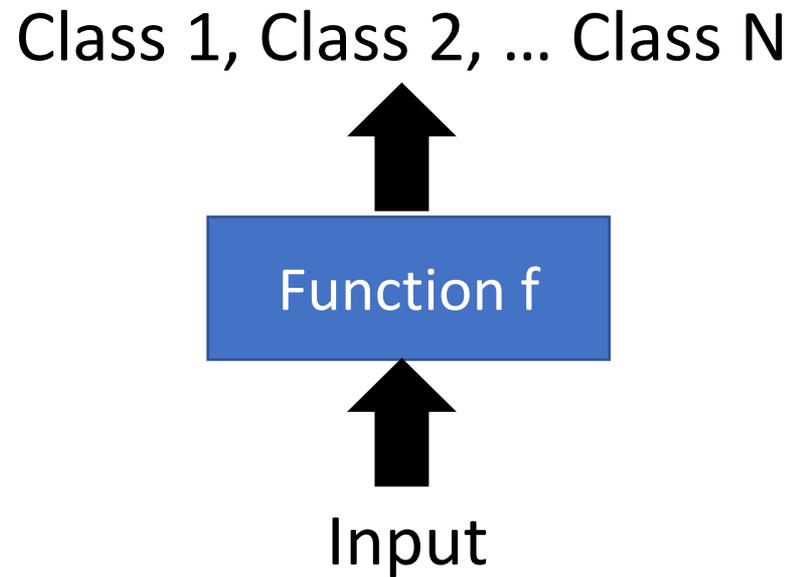


Classification

- Binary Classification

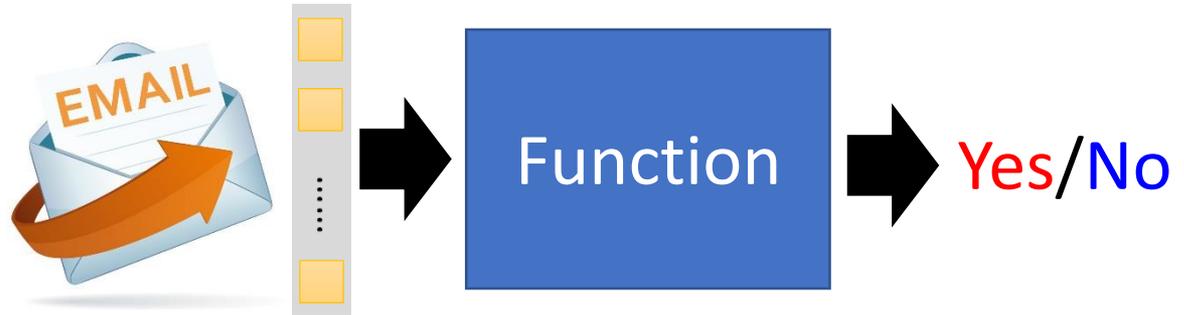


- Multi-class Classification



Binary Classification

Spam
filtering



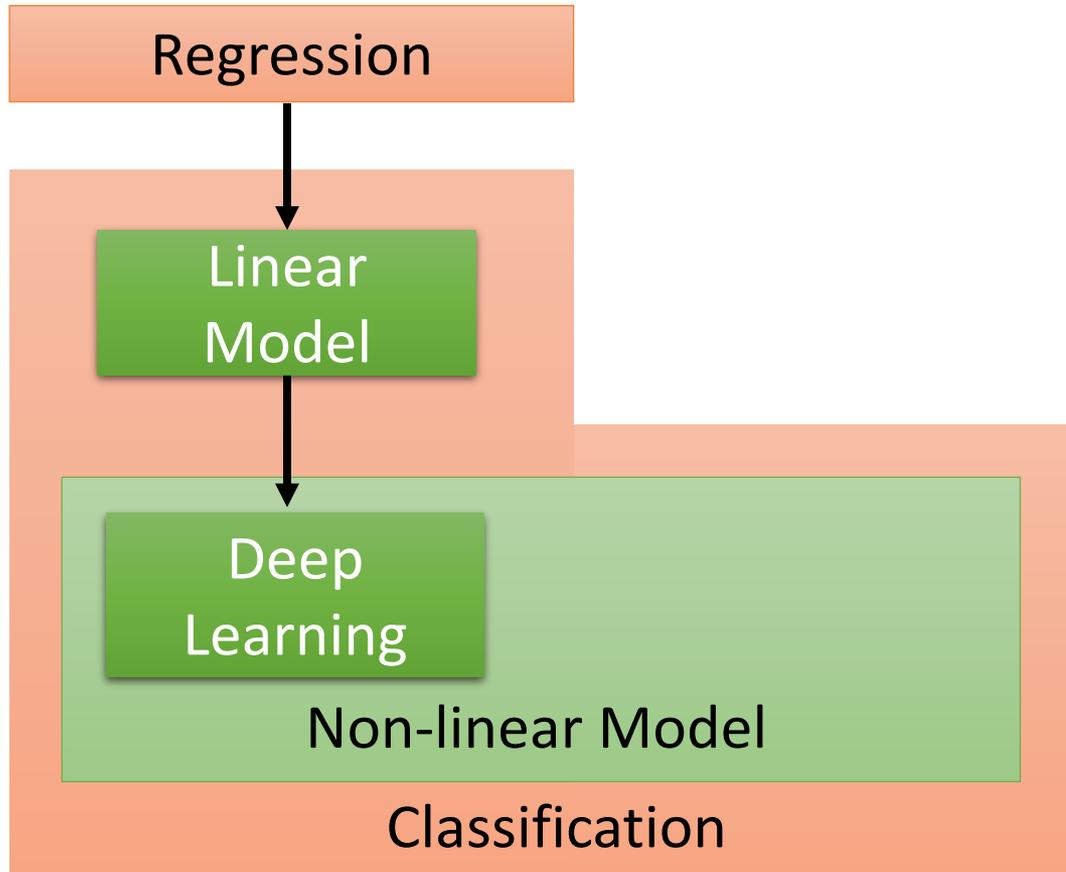
(<http://spam-filter-review.toptenreviews.com/>)

Multi-class Classification

Document Classification

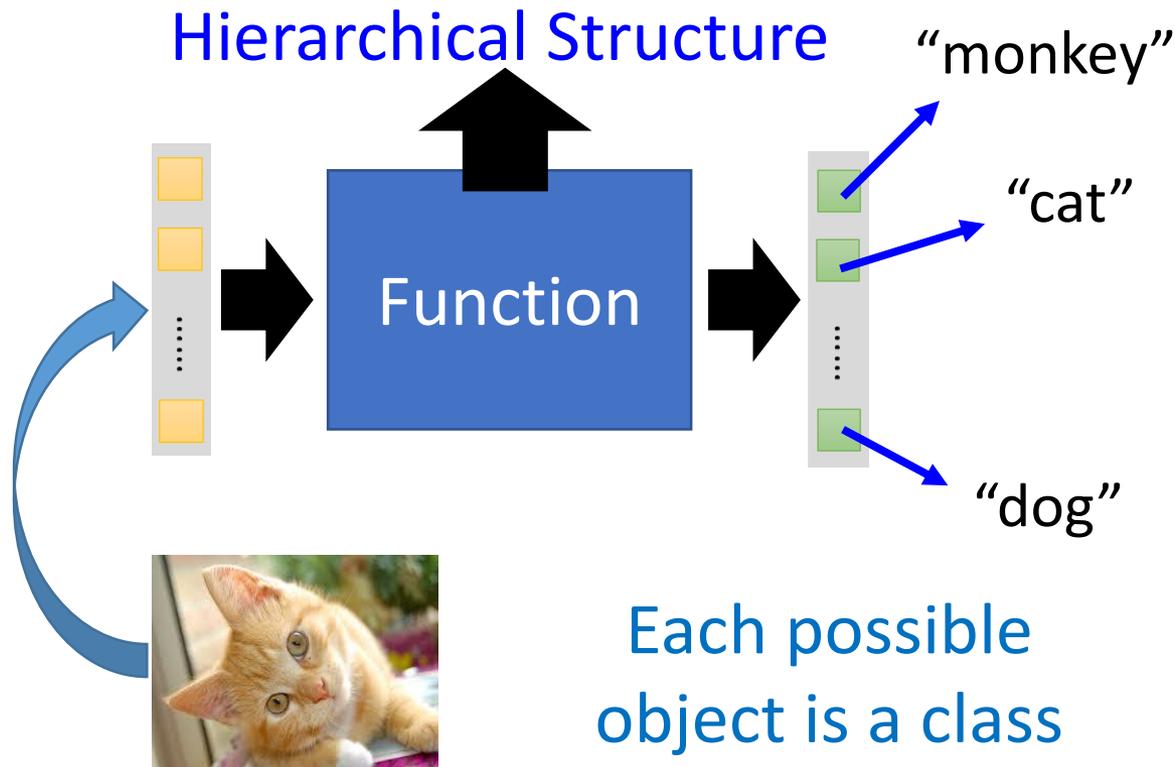


Learning Map



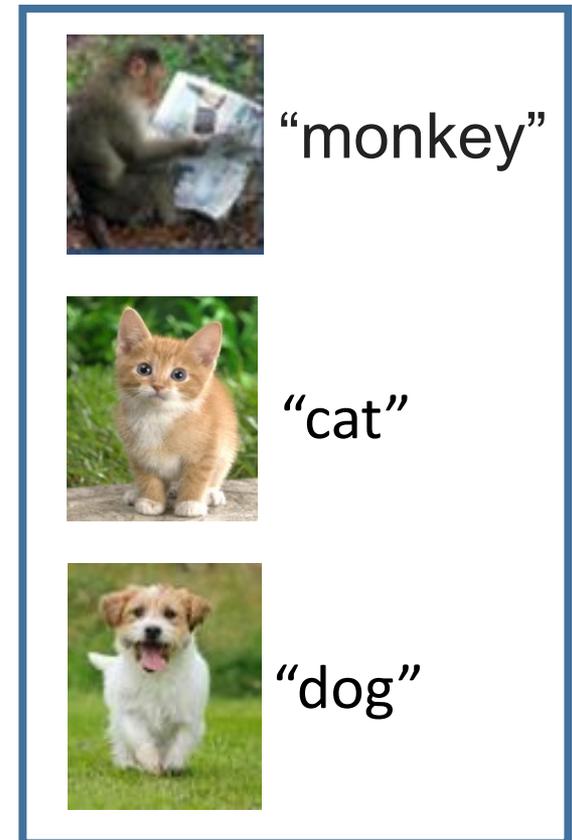
Classification - Deep Learning

- Image Recognition



Each possible object is a class

Training Data



Classification - Deep Learning

- Playing GO

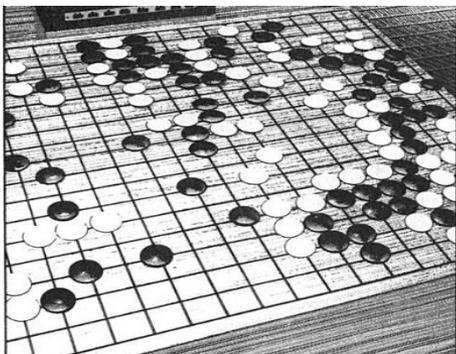


Function



Next move
Each position
is a class
(19 x 19 classes)

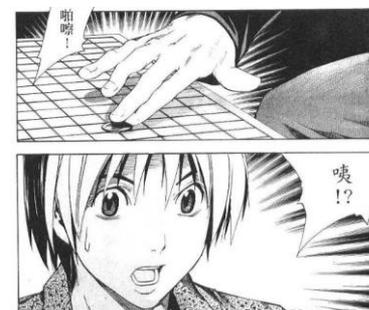
Training Data



一堆棋譜

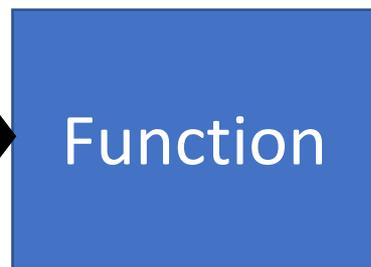
進藤光 v.s. 社清春

黑: 5之五 → 白: 天元 → 黑: 五之5



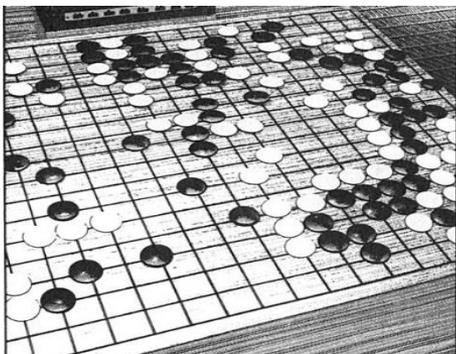
Classification - Deep Learning

- Playing GO



Next move
Each position
is a class
(19 x 19 classes)

Training Data



一堆棋譜

進藤光 v.s. 社清春

黑: 5之五 → 白: 天元 → 黑: 五之5

Input:

黑: 5之五



Output:

天元

Input:

黑: 5之五、白: 天元

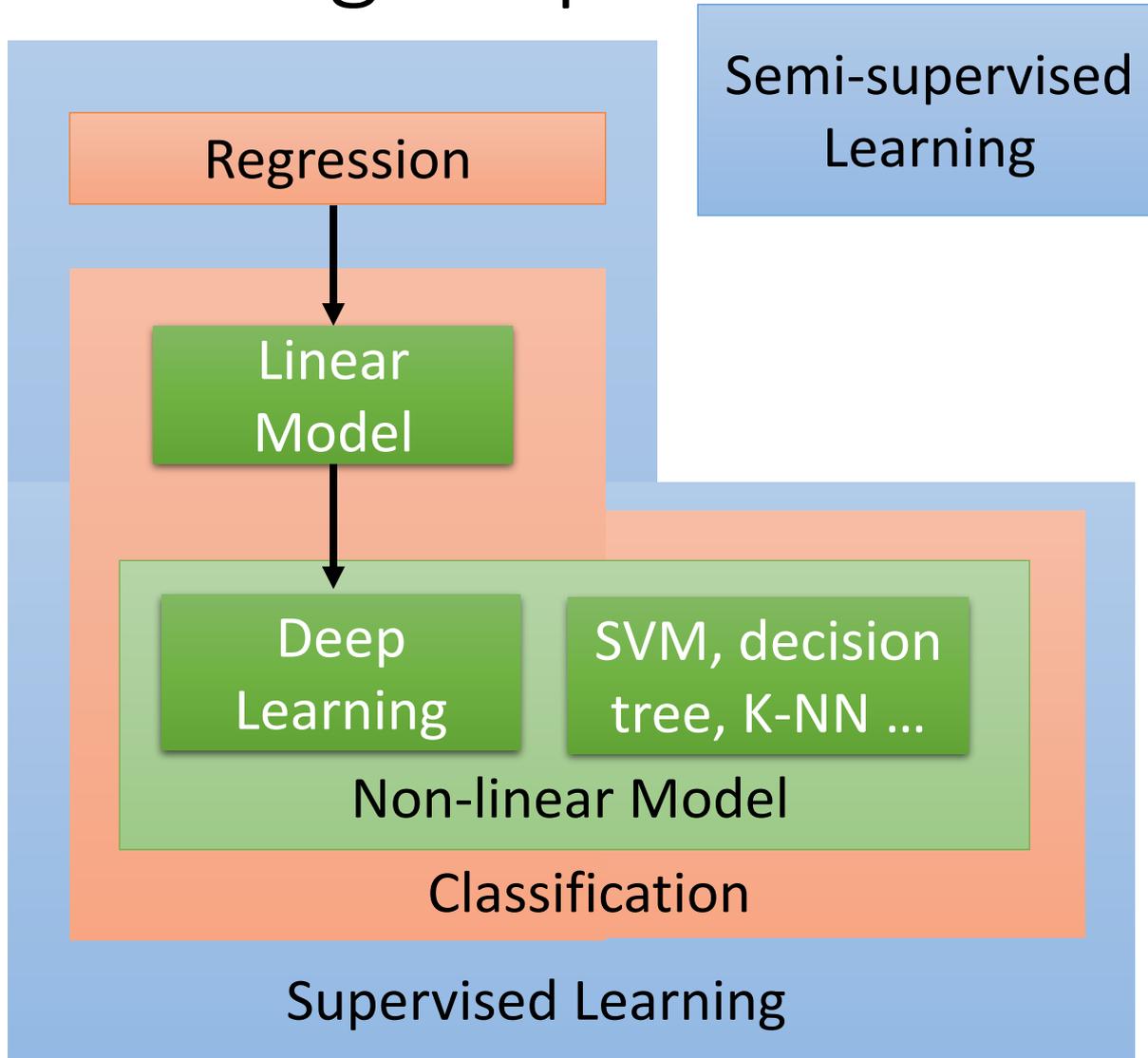


Output:

五之5

Learning Map

Hard to collect a large amount of labelled data



Training Data:

Input/output pair of target function

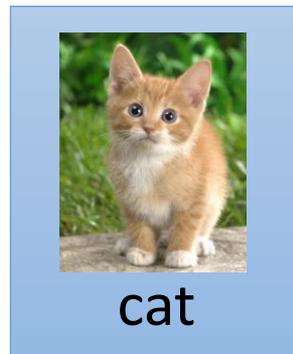
Function

output = label

Semi-supervised Learning

For example, recognizing cats and dogs

Labelled
data

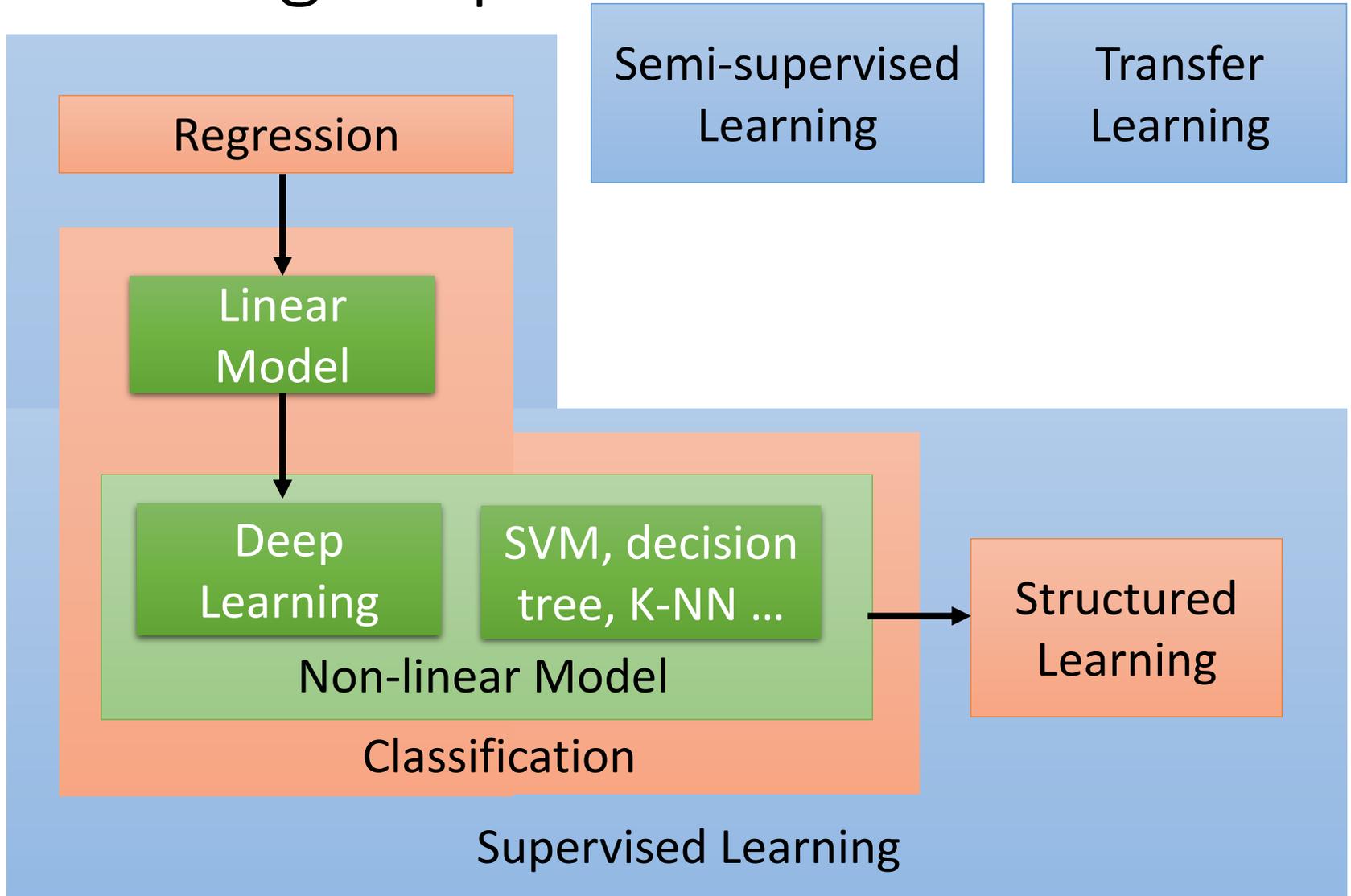


Unlabeled
data



(Images of cats and dogs)

Learning Map



Transfer Learning

For example, recognizing cats and dogs

Labelled
data



cat



dog



elephant

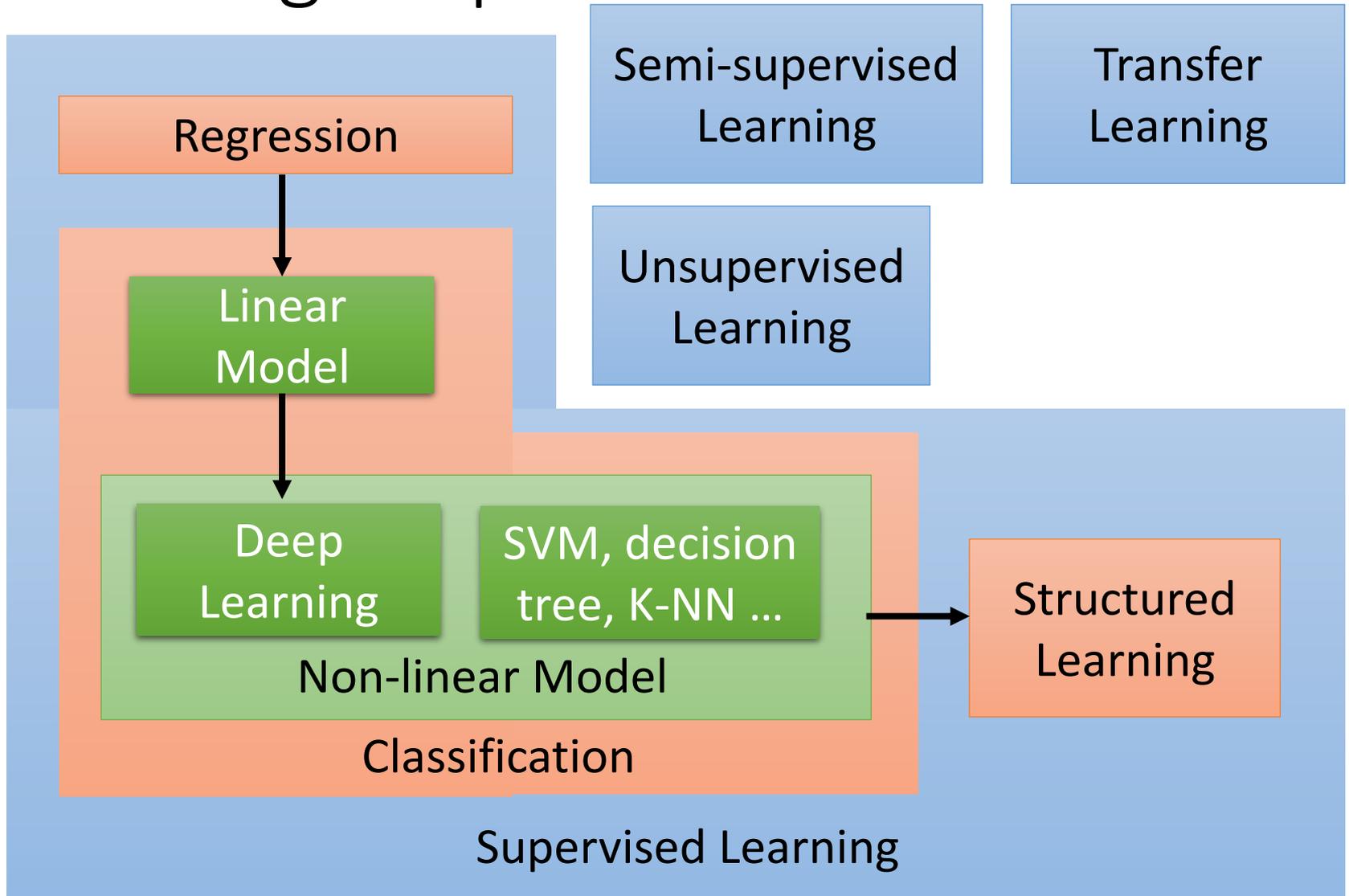


Haruhi



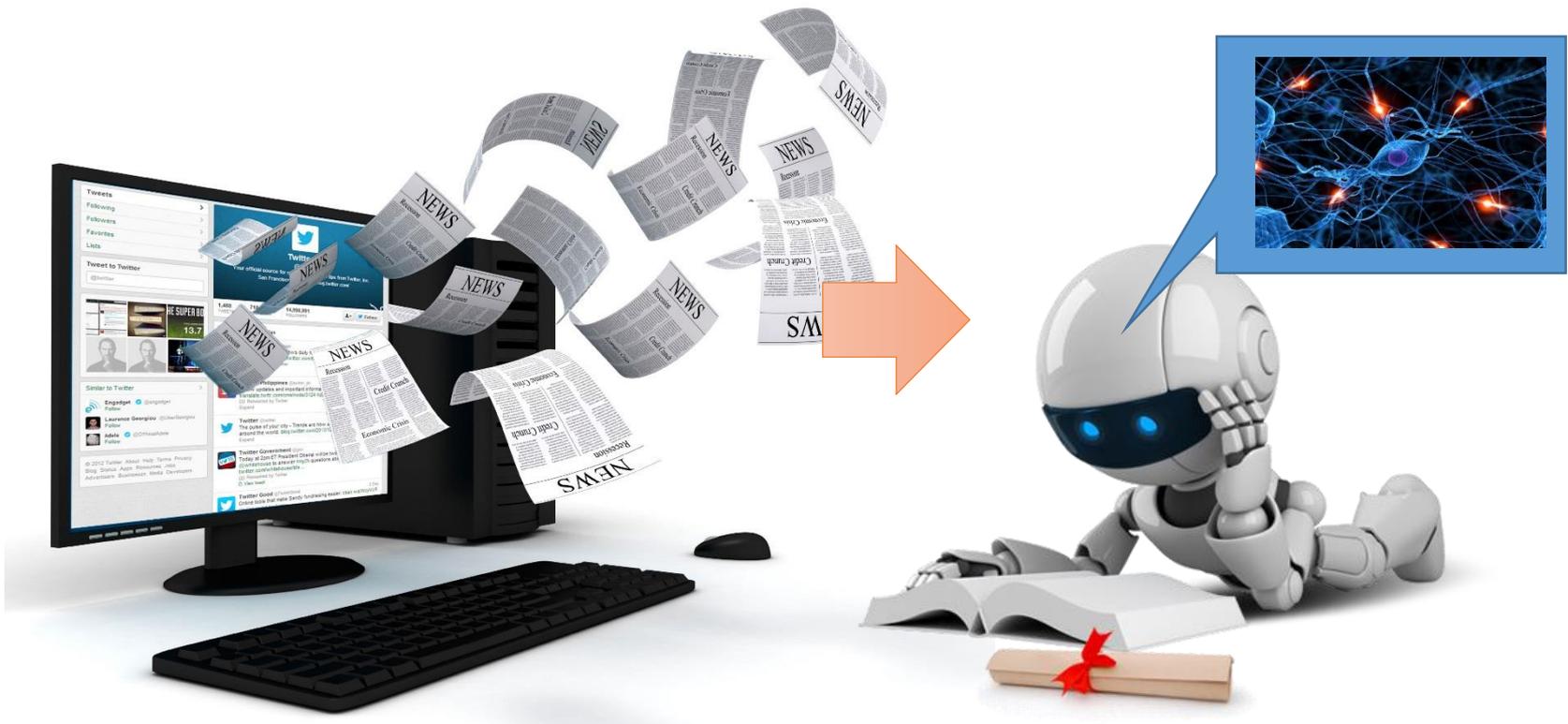
Data not related to the task considered
(can be either labeled or unlabeled)

Learning Map



Unsupervised Learning

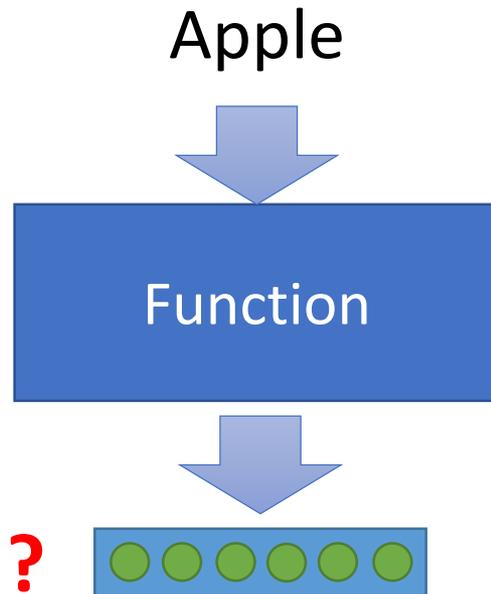
- Machine Reading: Machine learns the meaning of words from reading a lot of documents



<http://top-breaking-news.com/>

Unsupervised Learning

- Machine Reading: Machine learns the meaning of words from reading a lot of documents



Training data is a lot of text



<https://garavato.files.wordpress.com/2011/11/stacksdocuments.jpg?w=490>

Unsupervised Learning



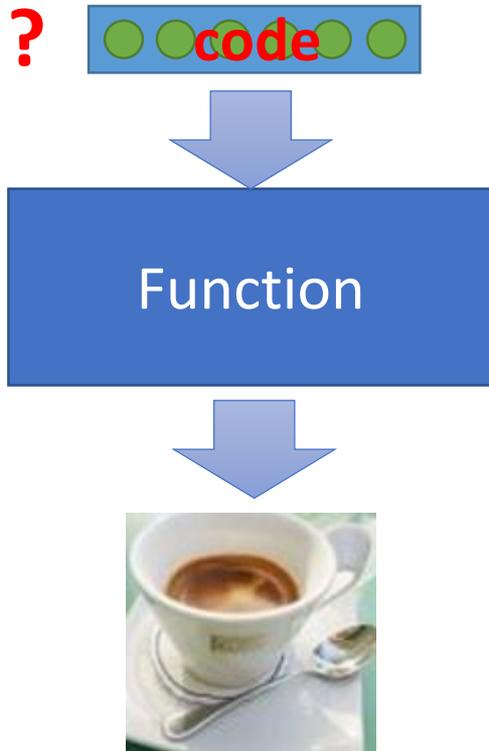
Draw something!



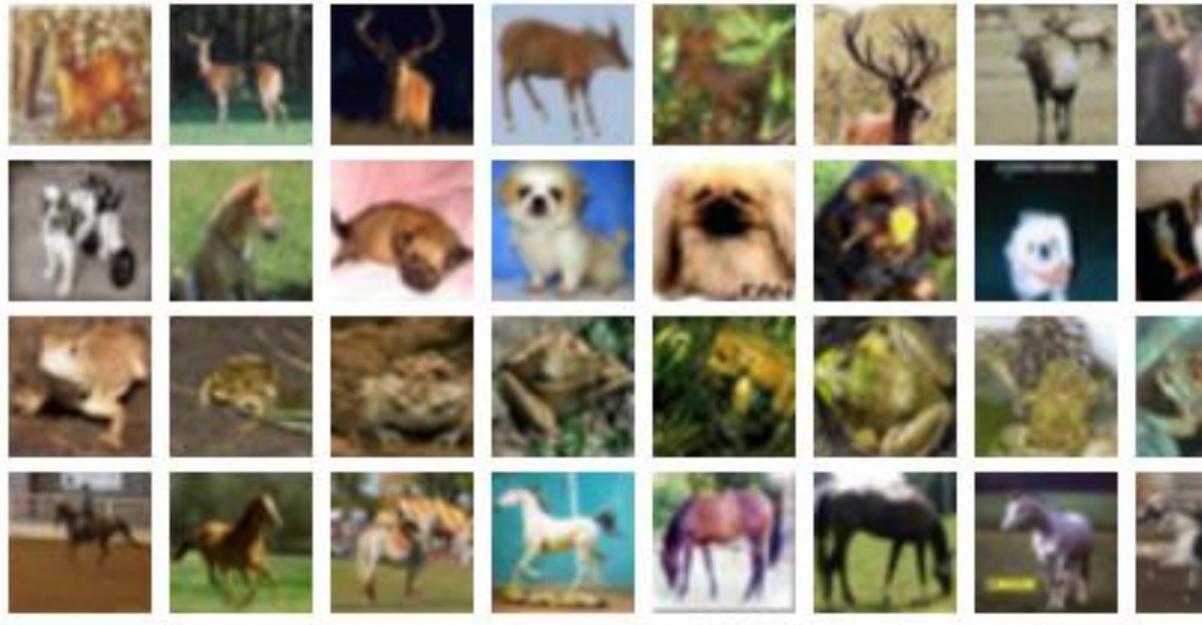
<http://ttic.uchicago.edu/~klivescu/MLSLP2016/>
(slides of Ian Goodfellow)

Unsupervised Learning

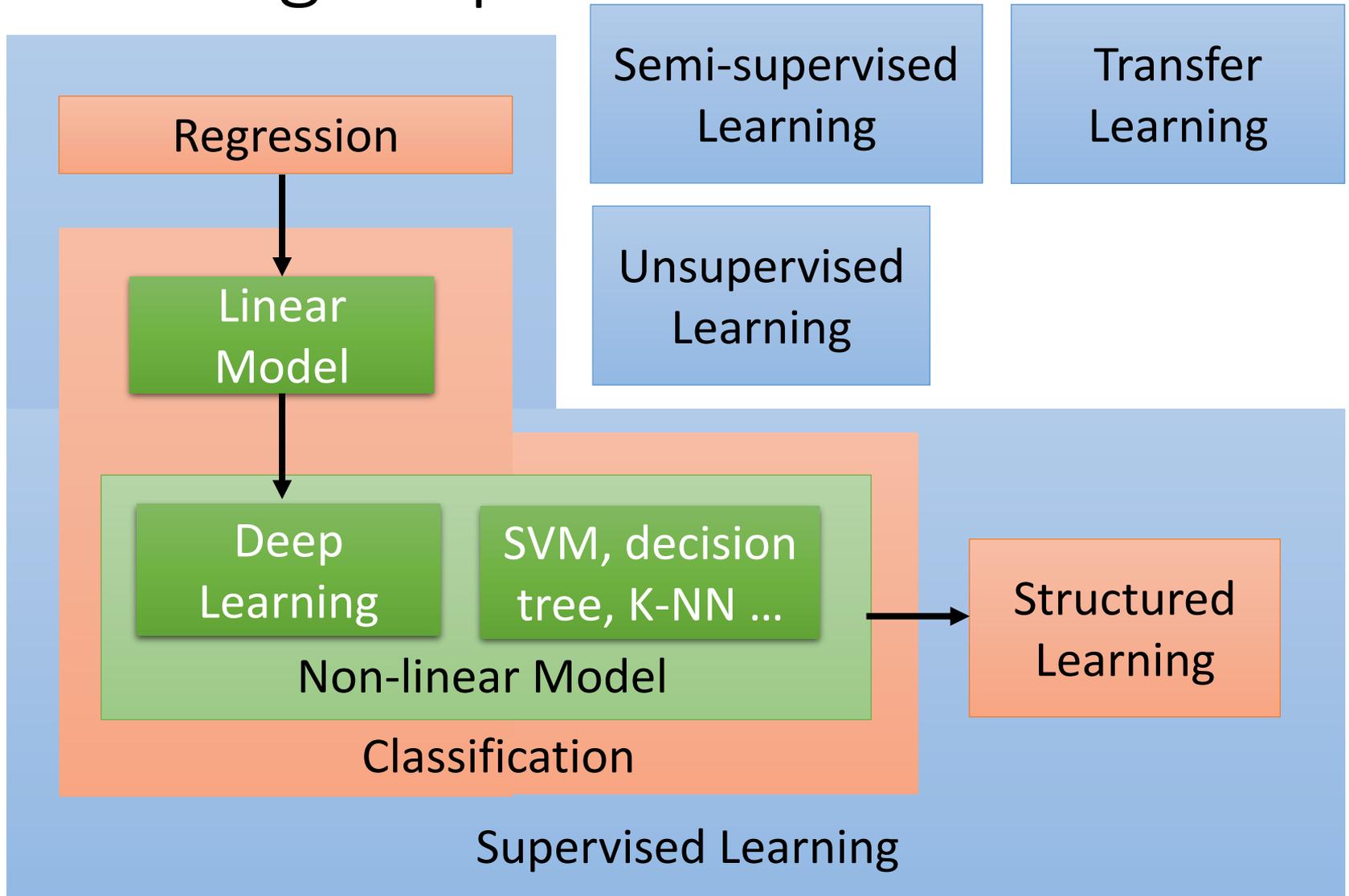
- Machine Drawing



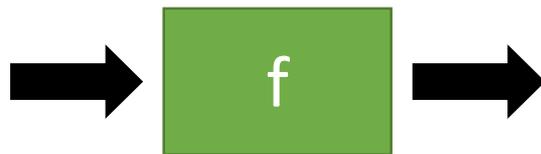
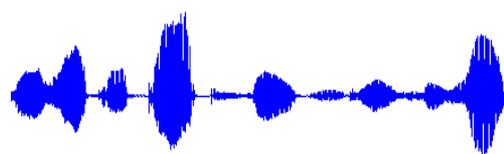
Training data is a lot of images



Learning Map



Structured Learning - Beyond Classification



“大家好，歡迎大家來修機器學習”

Speech Recognition

“機器學習”



“Machine Learning”

Machine Translation

人臉辨識

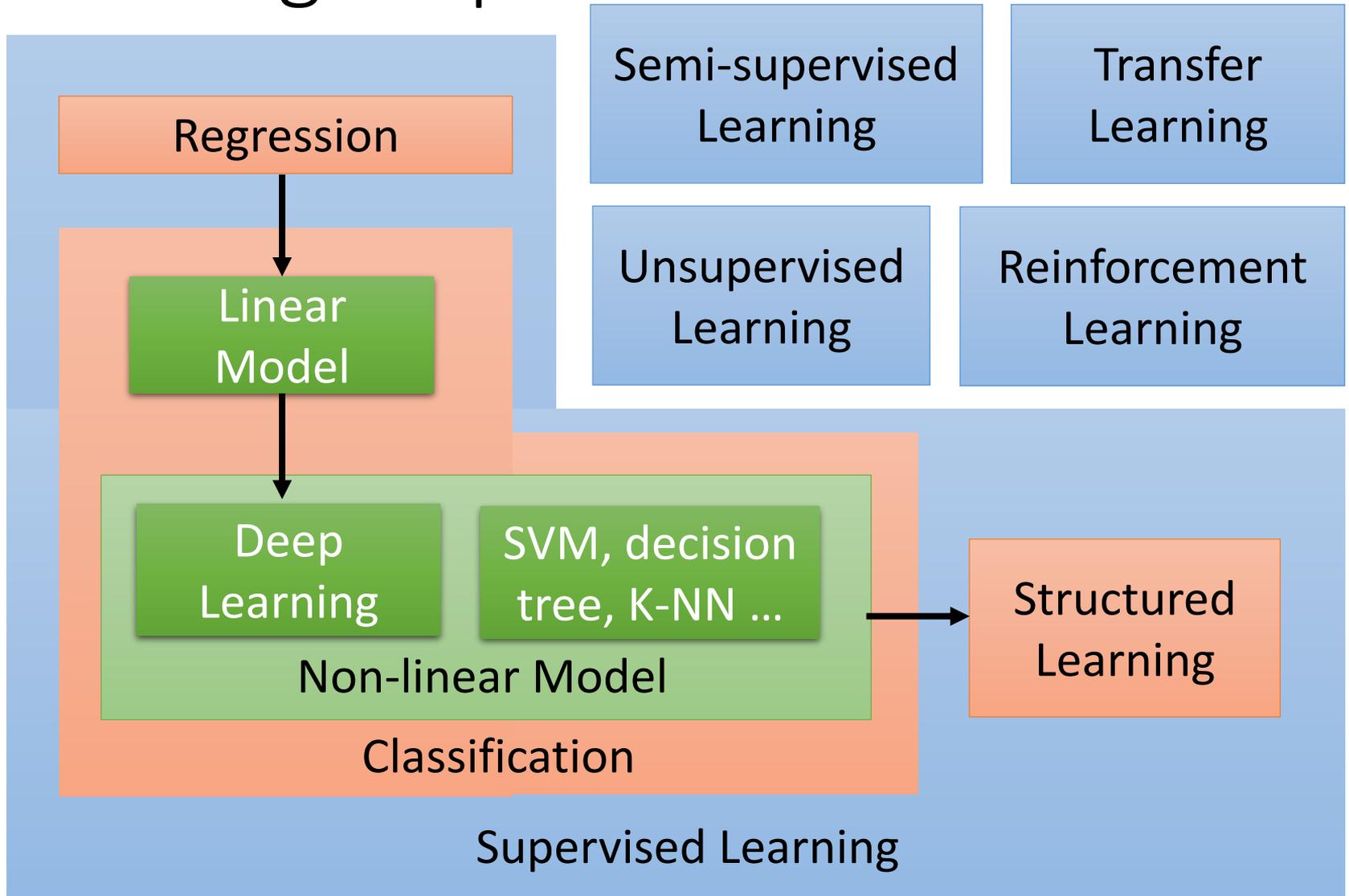


長門

春日

實玖瑠

Learning Map



Reinforcement Learning



Supervised v.s. Reinforcement

- Supervised

Learning from teacher

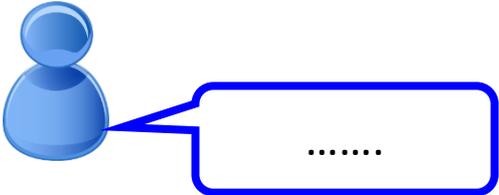
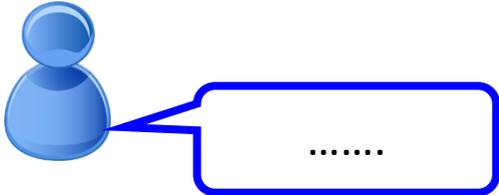


Say "Hi"



Say "Good bye"

- Reinforcement



.....

Learning from critics



Agent



Agent



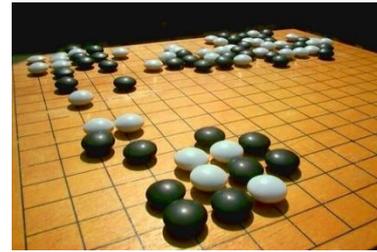
Bad

Supervised v.s. Reinforcement

- Supervised:



Next move:
"5-5"



Next move:
"3-3"

- Reinforcement Learning

First move → many moves → Win!

Alpha Go is supervised learning + reinforcement learning.

Learning Map



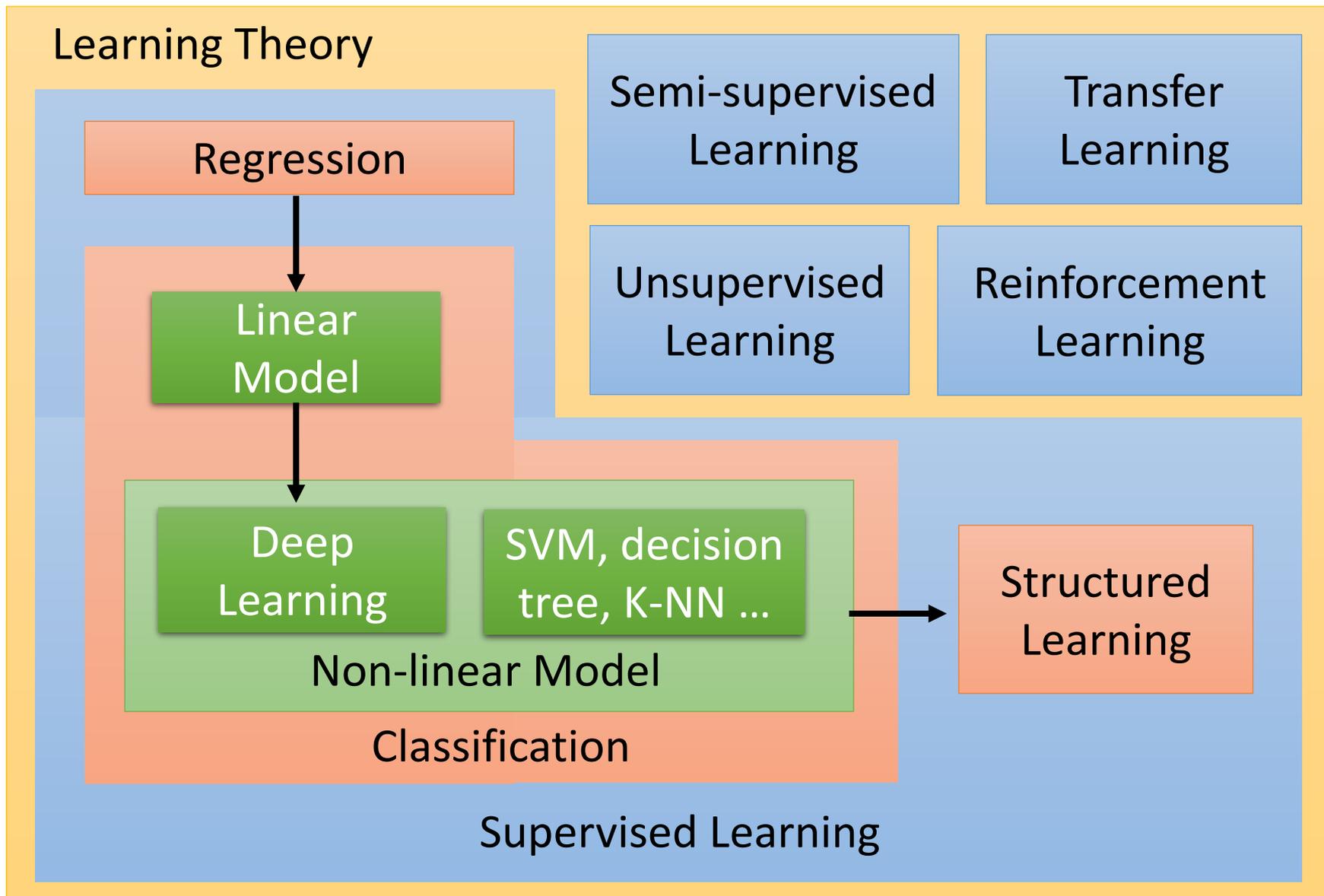
scenario



task



method





<http://www.express.co.uk/news/science/651202/First-step-towards-The-Terminator-becoming-reality-AI-beats-champ-of-world-s-oldest-game>

Why we need to learn Machine Learning?

AI 即將取代部分的工作? 新工作: AI 訓練師

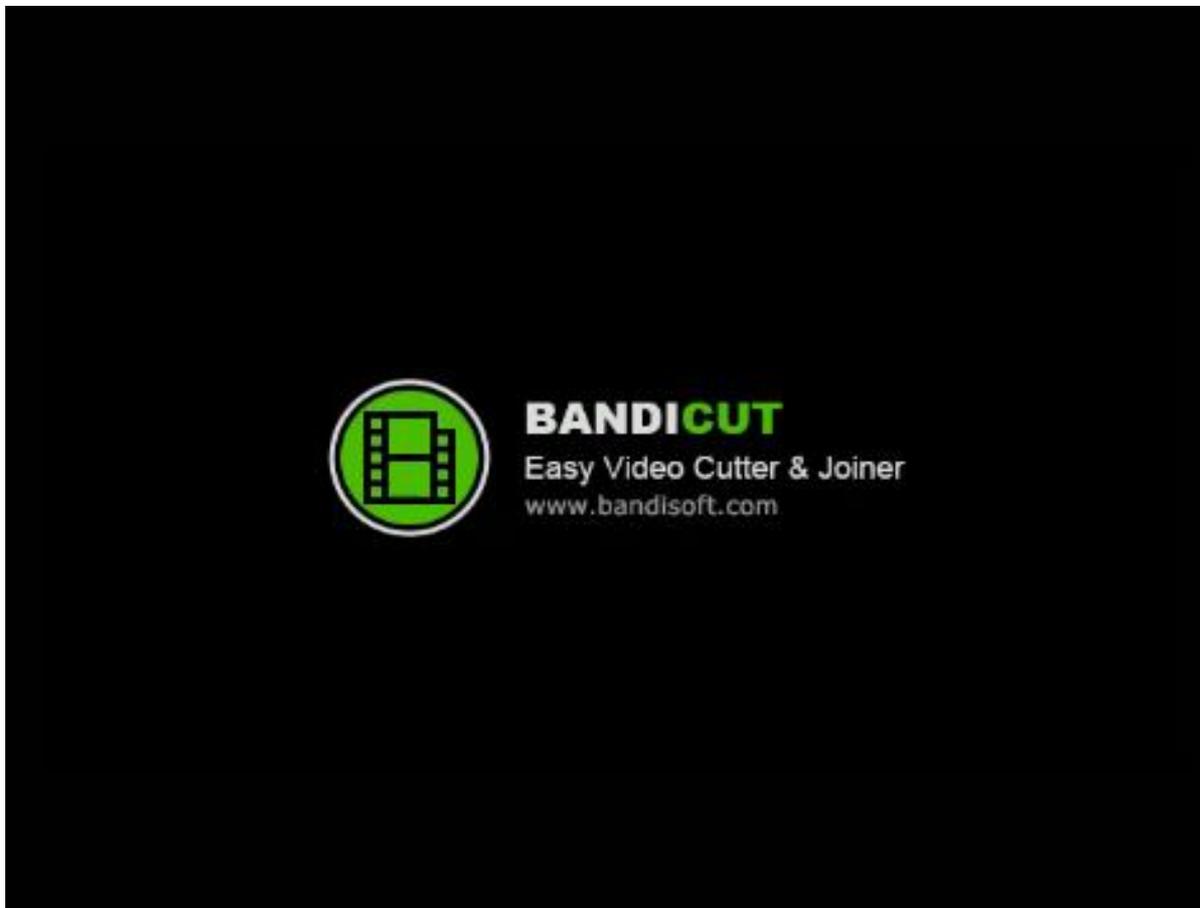
AI 訓練師



機器不是自己會學嗎？
為什麼需要 AI 訓練師

戰鬥是寶可夢在打，
為什麼需要寶可夢訓練師？

神奇寶貝第5集 尼比市的決鬥



https://www.youtube.com/watch?v=uUOZZb8eJ_k

AI 訓練師

Step 1:
define a set
of function



Step 2:
goodness of
function



Step 3: pick
the best
function

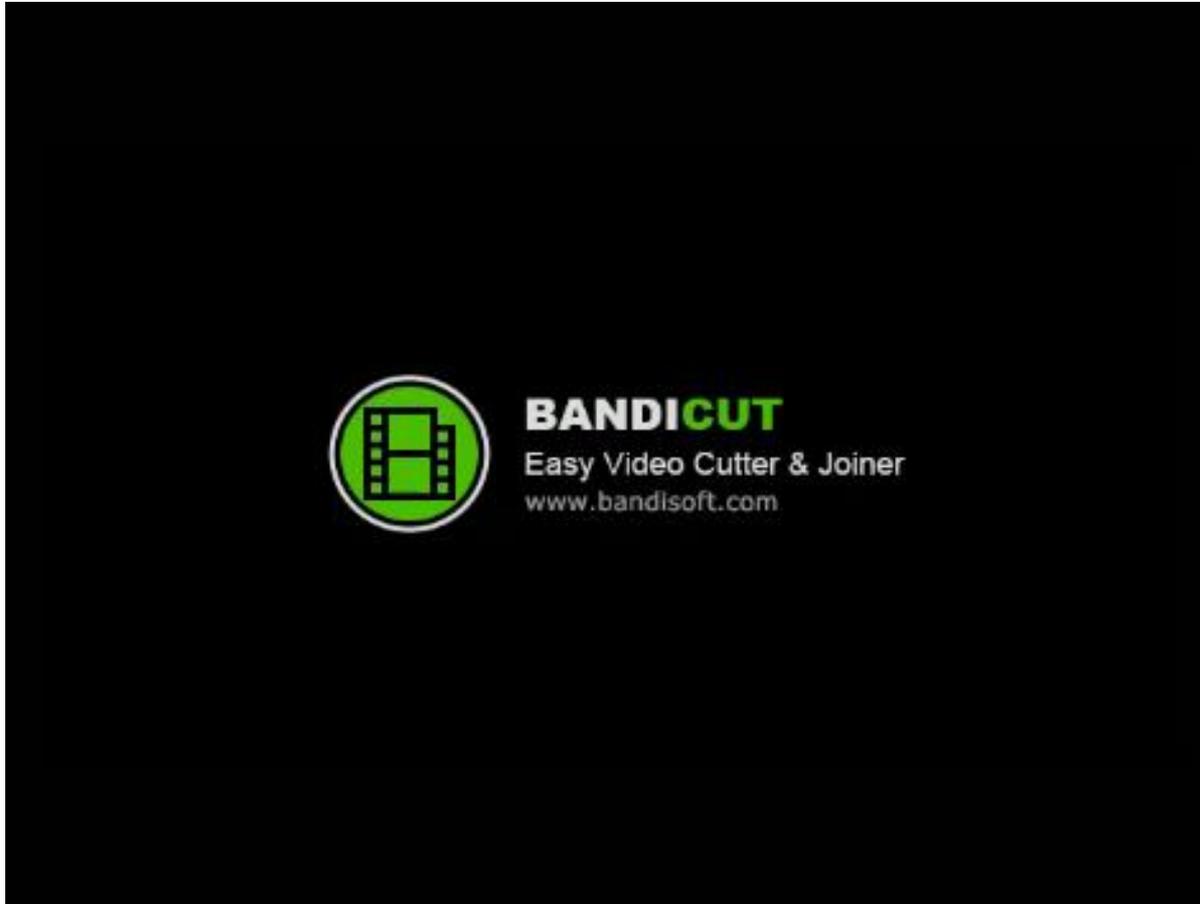
寶可夢訓練師

- 寶可夢訓練師要挑選適合的寶可夢來戰鬥
 - 寶可夢有不同的屬性

AI 訓練師

- AI訓練師要挑選合適的 model, loss function
 - 不同 model, loss function 適合解決不同的問題

神奇寶貝第106集 噴火龍·就決定是你了



https://www.youtube.com/watch?v=4G_aoKiCDc4

AI 訓練師

Step 1:
define a set
of function



Step 2:
goodness of
function



Step 3: pick
the best
function

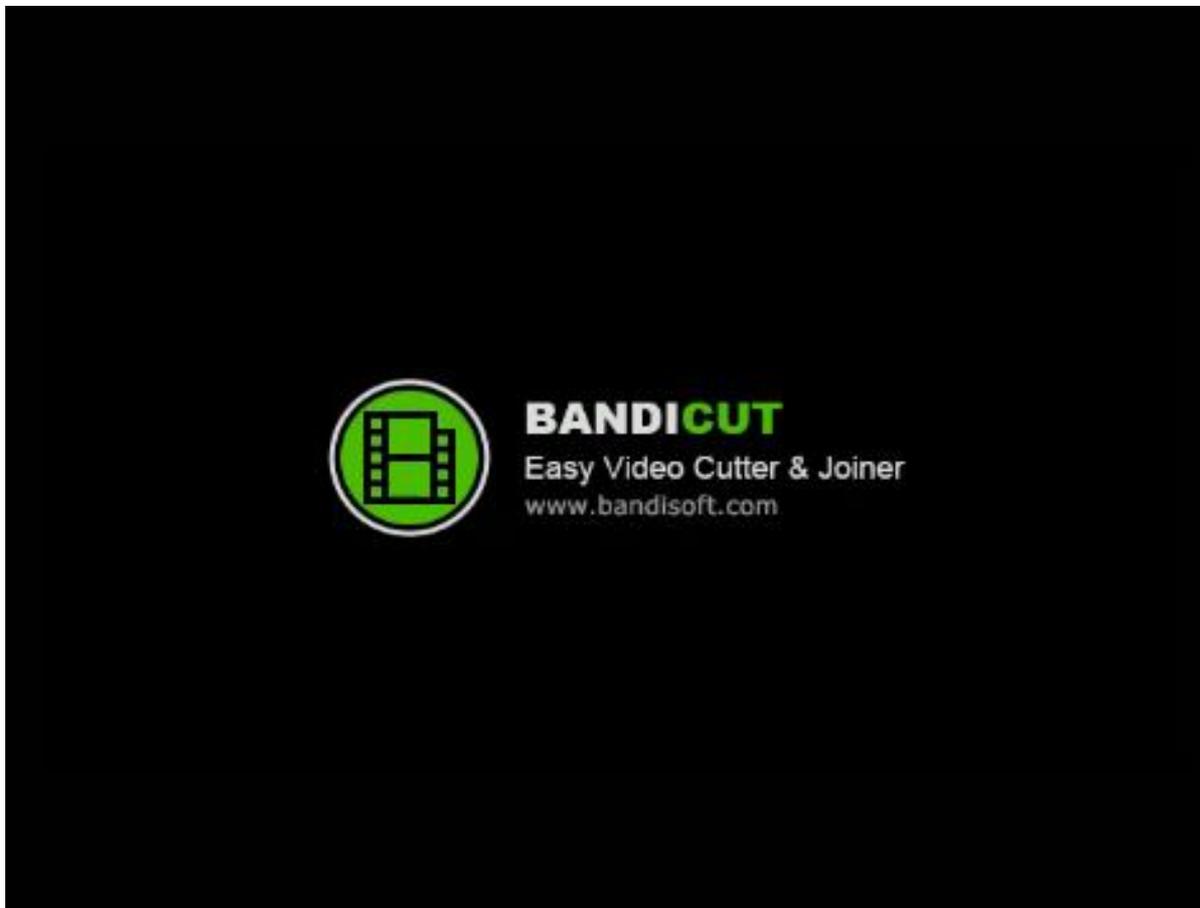
寶可夢訓練師

- 寶可夢訓練師要挑選適合的寶可夢來戰鬥
 - 寶可夢有不同的屬性
- 召喚出來的寶可夢不一定聽話
 - E.g. 小智的噴火龍
 - 需要有經驗的寶可夢訓練師

AI 訓練師

- AI訓練師要挑選合適的 model, loss function
 - 不同 model, loss function 適合解決不同的問題
- 不一定能找出 best function
 - E.g. Deep Learning
 - 需要有經驗的 AI 訓練師

大家還記得寶可夢的開場嗎？



<https://www.youtube.com/watch?v=NyCNkq4ByzY>

AI 訓練師

- 厲害的 AI ， AI 訓練師功不可沒
- 讓我們一起朝 AI 訓練師之路邁進

