What is Machine Learning?

人工智慧 目標

ARTIFICIAL INTELLIGENCE

Human Intelligence Exhibited by Machines

Early artificial intelligence stirs excitement.

機器學習 方法

MACHINE LEARNING

Approach to Achieve Artificial Intelligence

Machine learning begins to flourish.

深度學習

DEEP LEARNING

Technique for Implementing Machine Learning

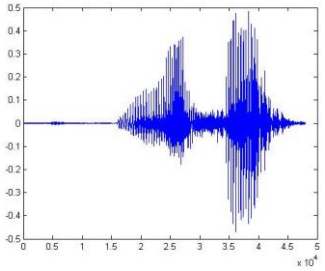
Deep learning breakthroughs drive AI boom.

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.

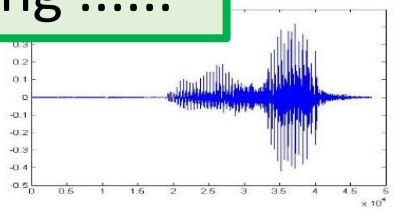
https://blogs.nvidia.com/blog/2016/07/29/whats-difference-artificial-intelligence-machine-learning-deep-learning-ai/

What is Machine Learning?

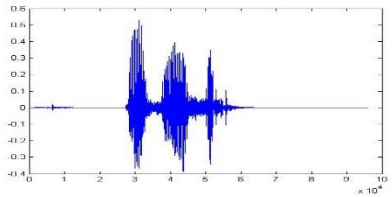


You said “Hello”

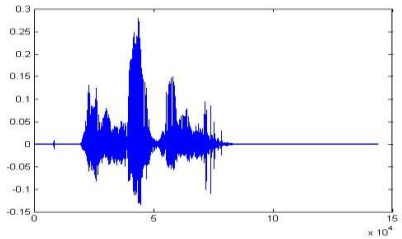
Learning ……



“Hi”



“How are you”



“Good bye”

A large amount of audio data

You write the program for learning.

What is Machine Learning?

Learning ……

This is “cat”

You write the program for learning.

“monkey”

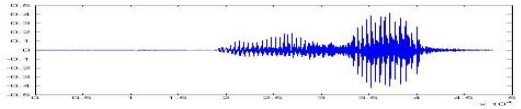
“cat”

“dog”

A large amount of images

Machine Learning
≈ Looking for a Function

- **Speech Recognition**

$f($  $)=$ “How are you”

- **Image Recognition**

$f($  $)=$ “Cat”

- **Playing Go**

$f($  $)=$ “5-5” (next move)

- **Dialogue System**

$f($ “Hi” $)=$ “Hello”

(what the user said) (system response)

Framework

Image Recognition:

$f($  $)=$ “cat”

A set of function

Model

$f_1, f_2 \cdots$

$f_1($  $)=$ “cat”

$f_2($  $)=$ “money”

$f_1($  $)=$ “dog”

$f_2($  $)=$ “snake”

Framework

Image Recognition:

$f($  $)=$ "cat"

A set of function

Model

$f_1, f_2 \cdots$

Goodness of function f

Training Data

$f_1($  $)=$ "cat"

$f_2($  $)=$ "money"

Better!

$f_1($  $)=$ "dog"

$f_2($  $)=$ "snake"

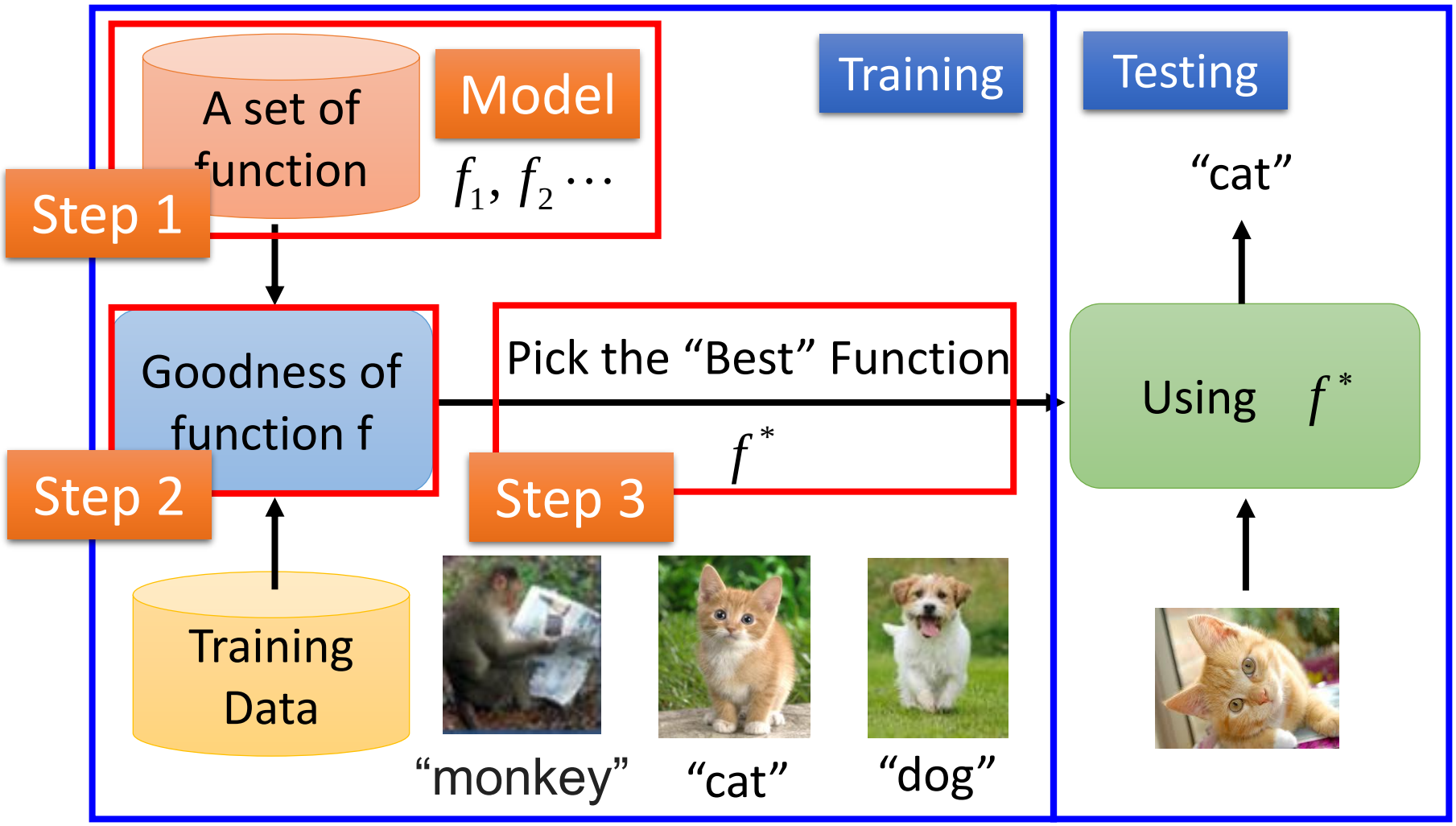
function input:   

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

Framework

Image Recognition:

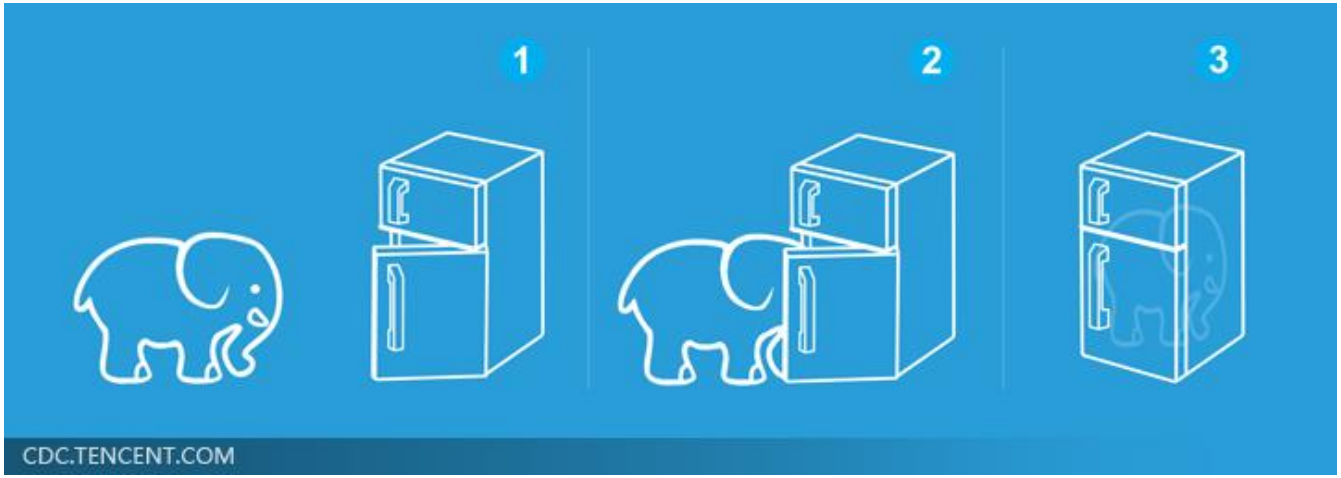
$f($  $)=$ "cat"



Machine Learning is so simple ……

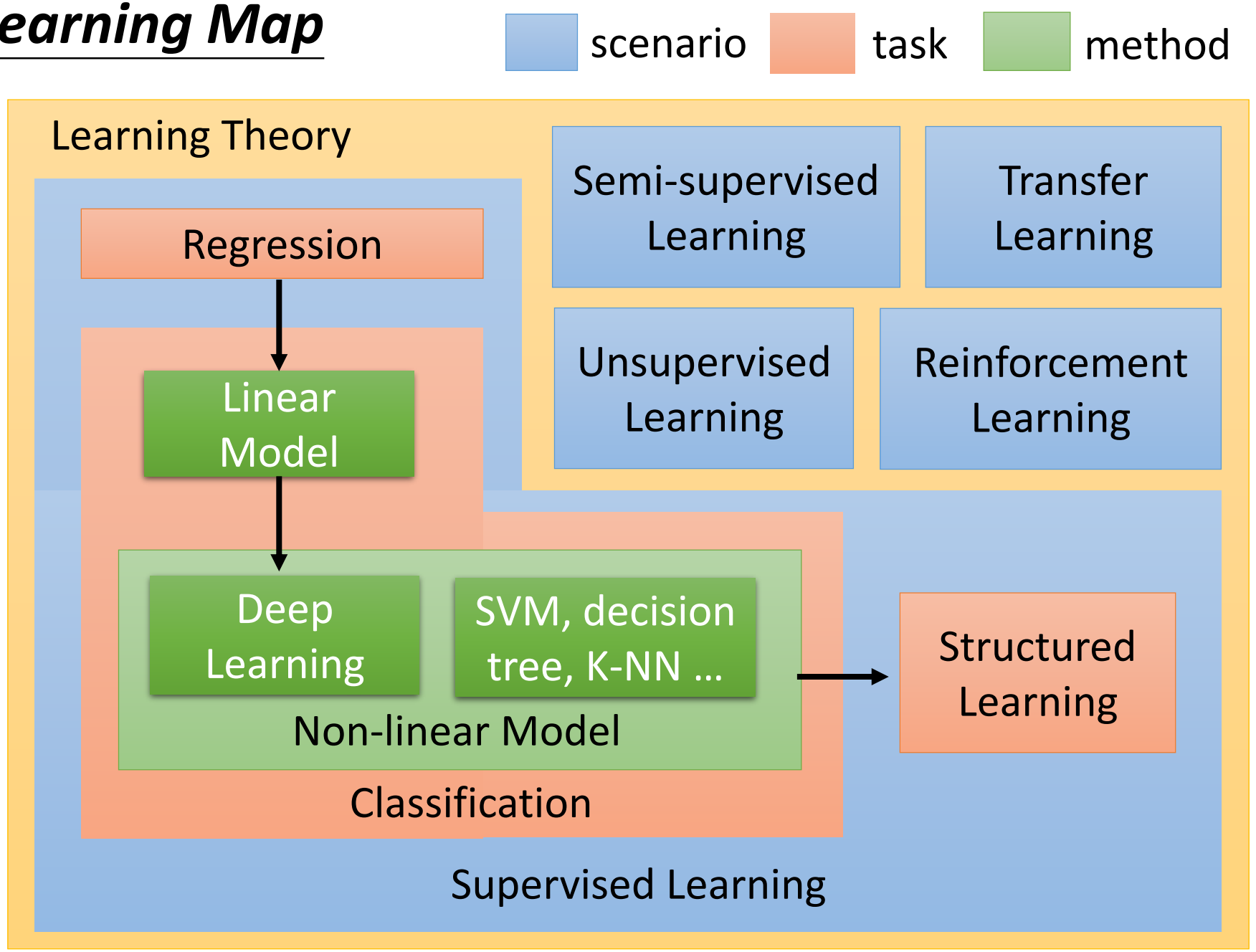
Step 1: define a set of function → Step 2: goodness of function → Step 3: pick the best function

就好像把大象放進冰箱 ……



Learning Map

Learning Map

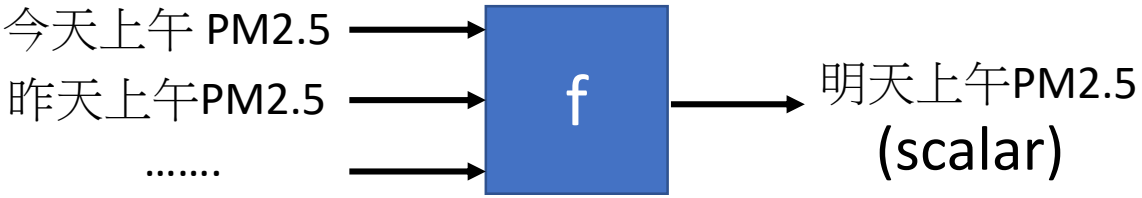


Learning Map

Regression

The output of the target function f is "scalar".

預測 PM2.5



Training Data:

Input:

9/01 上午 PM2.5 = 63　9/02 上午 PM2.5 = 65

Output:

9/03 上午 PM2.5 = 100

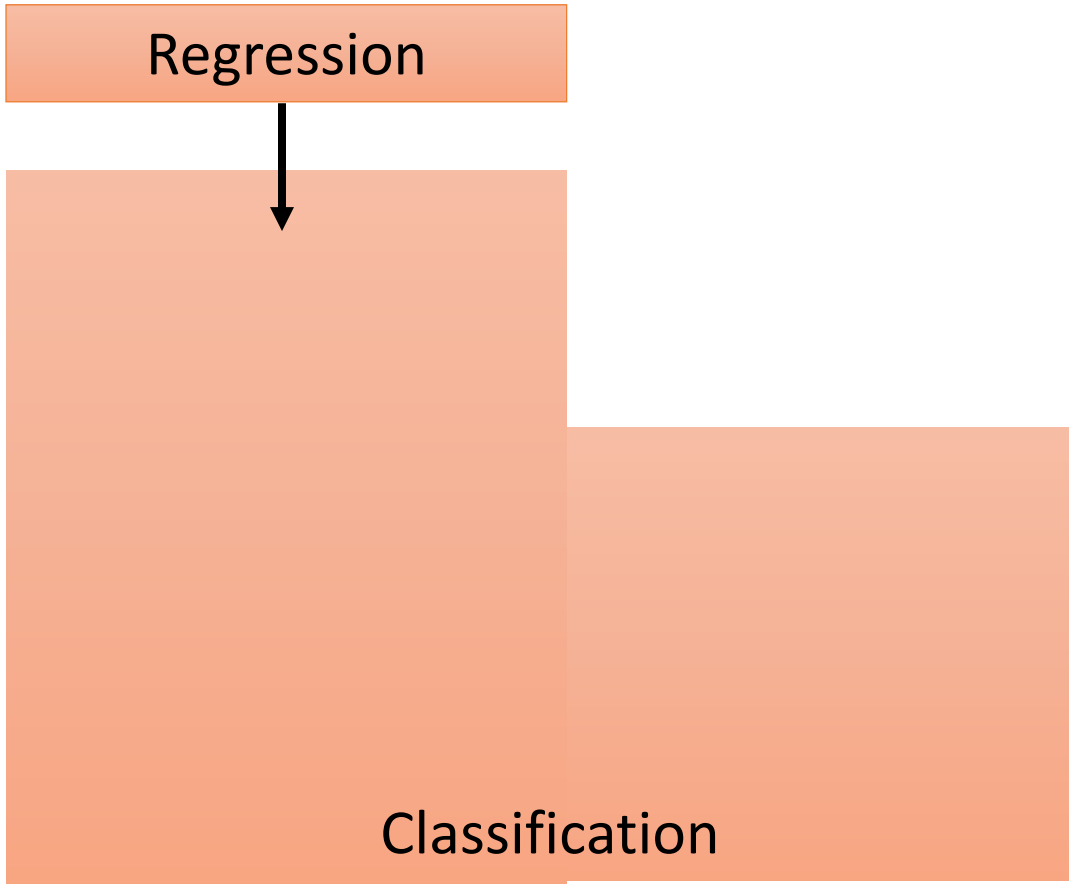
Input:

9/12 上午 PM2.5 = 30　9/13 上午 PM2.5 = 25

Output:

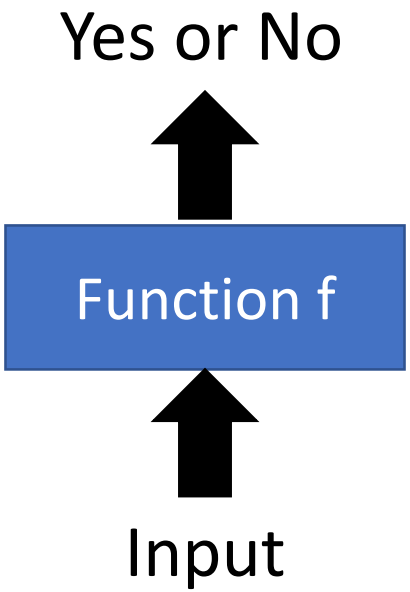
9/14 上午 PM2.5 = 20

Learning Map

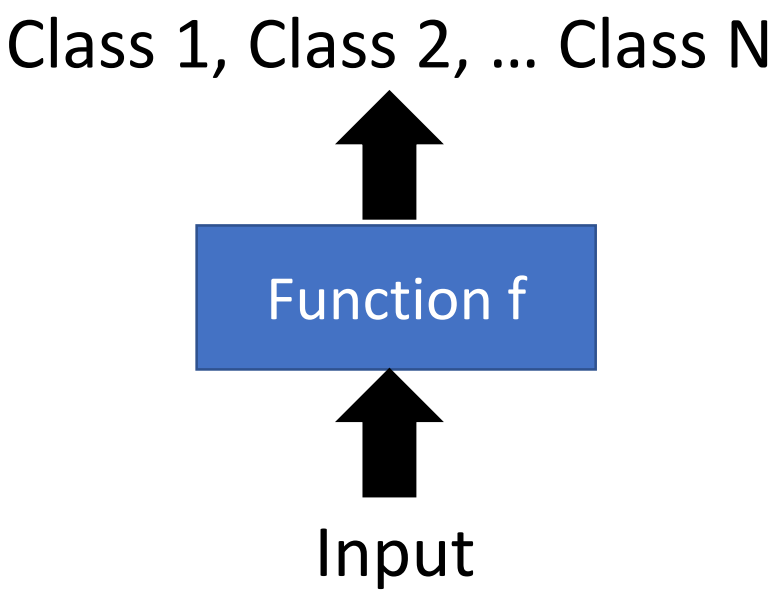


Classification

- Binary Classification

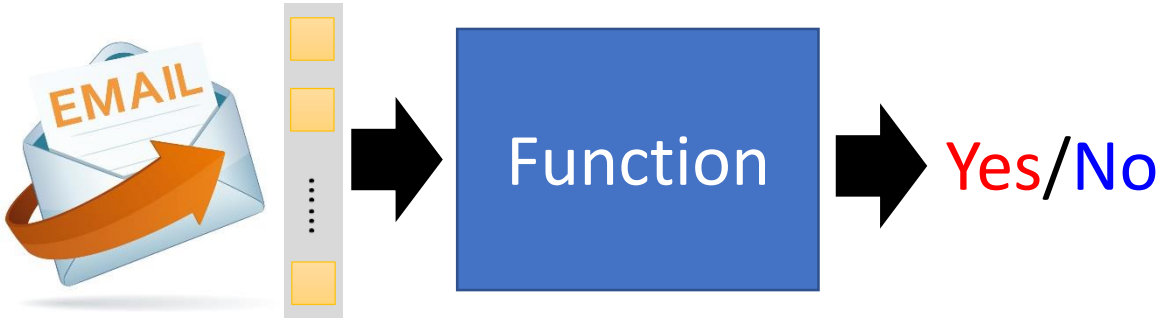


- Multi-class Classification



Binary Classification

Spam filtering



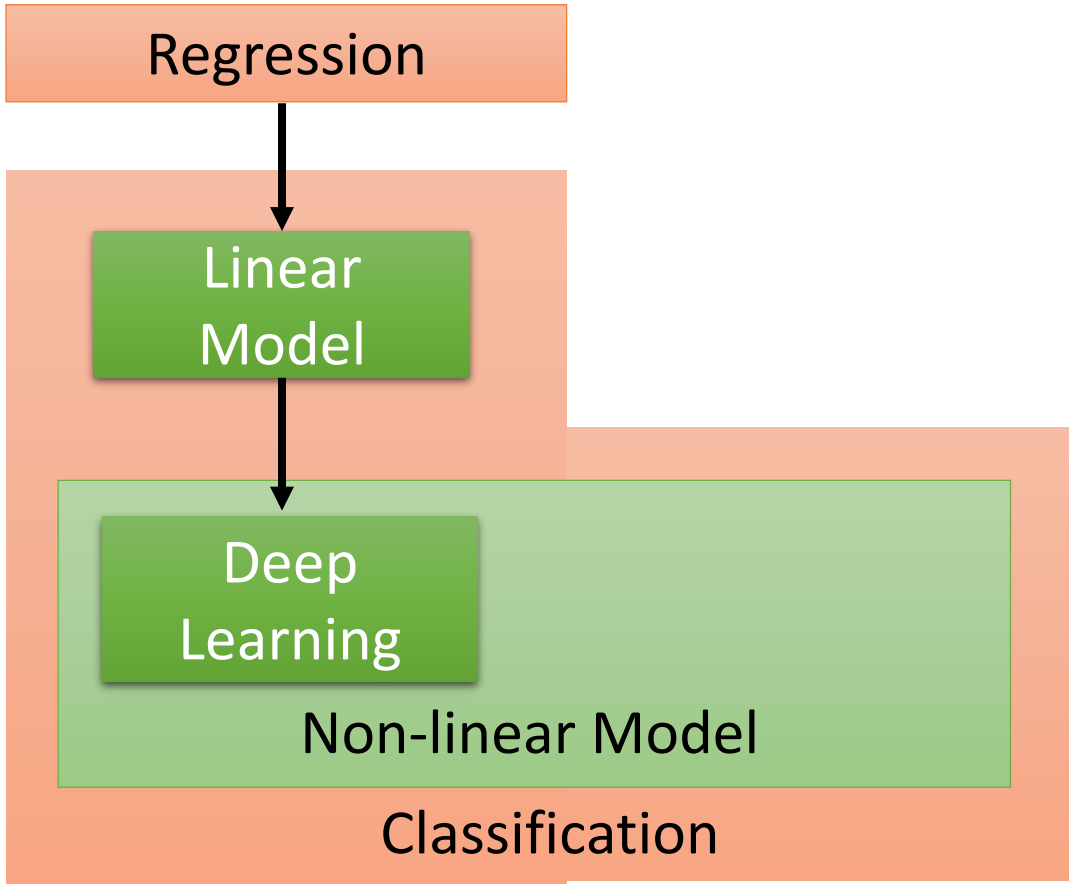
Training Data

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

Multi-class Classification

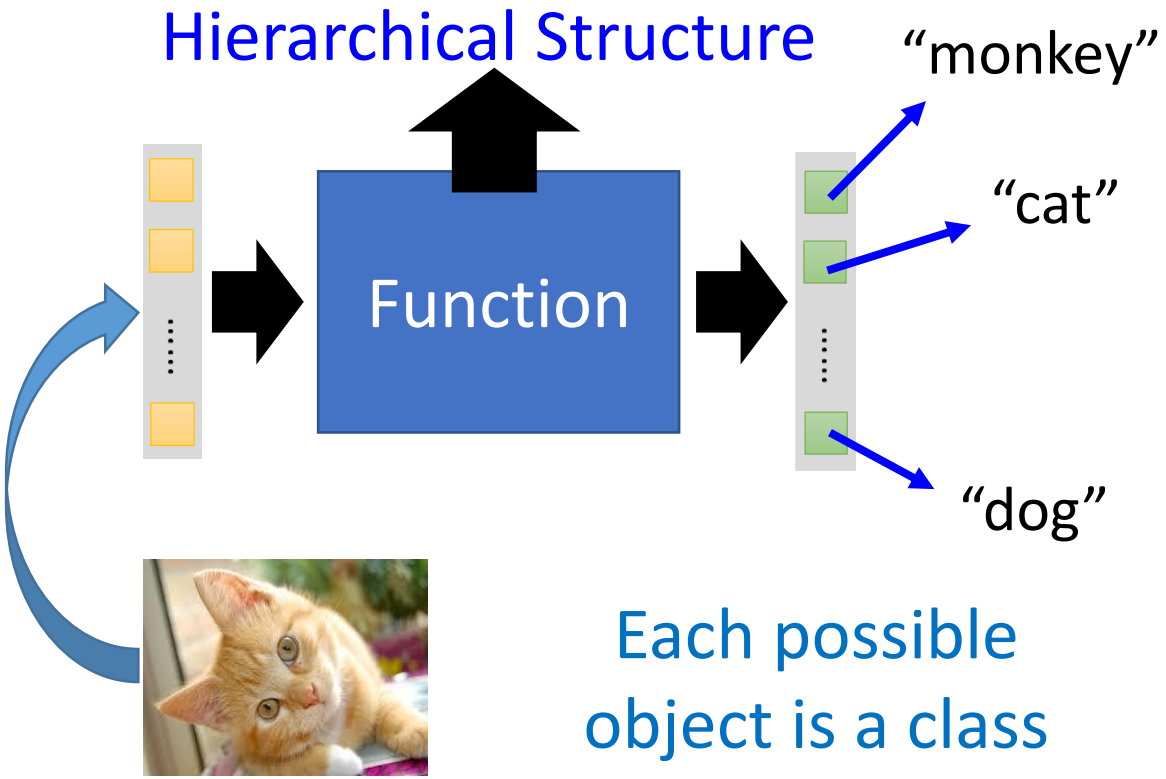
Document Classification

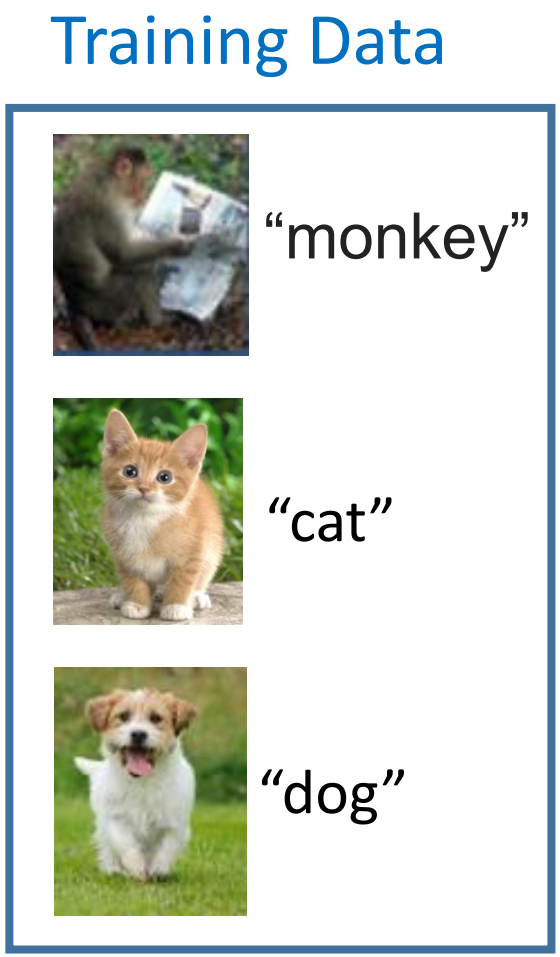
Learning Map



Classification - Deep Learning

- Image Recognition





Classification - Deep Learning

- Playing GO

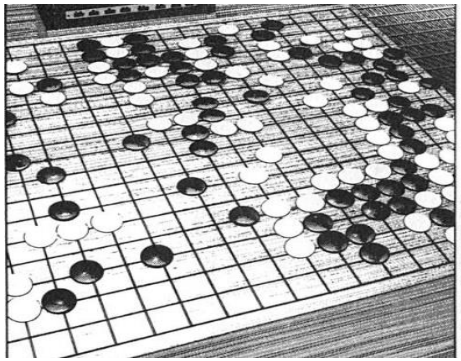
Function

Next move

Each position is a class

(19 x 19 classes)

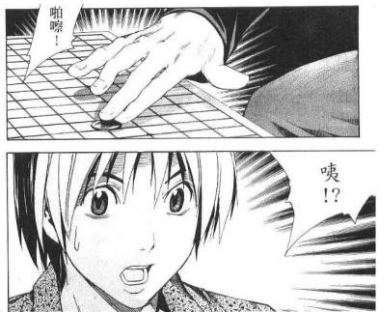
Training Data



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

Function

Next move

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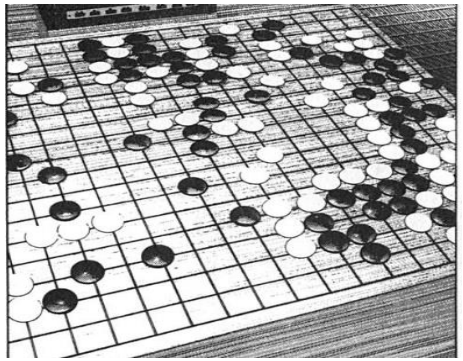
Training Data



一堆棋譜

進藤光 v.s. 社清春

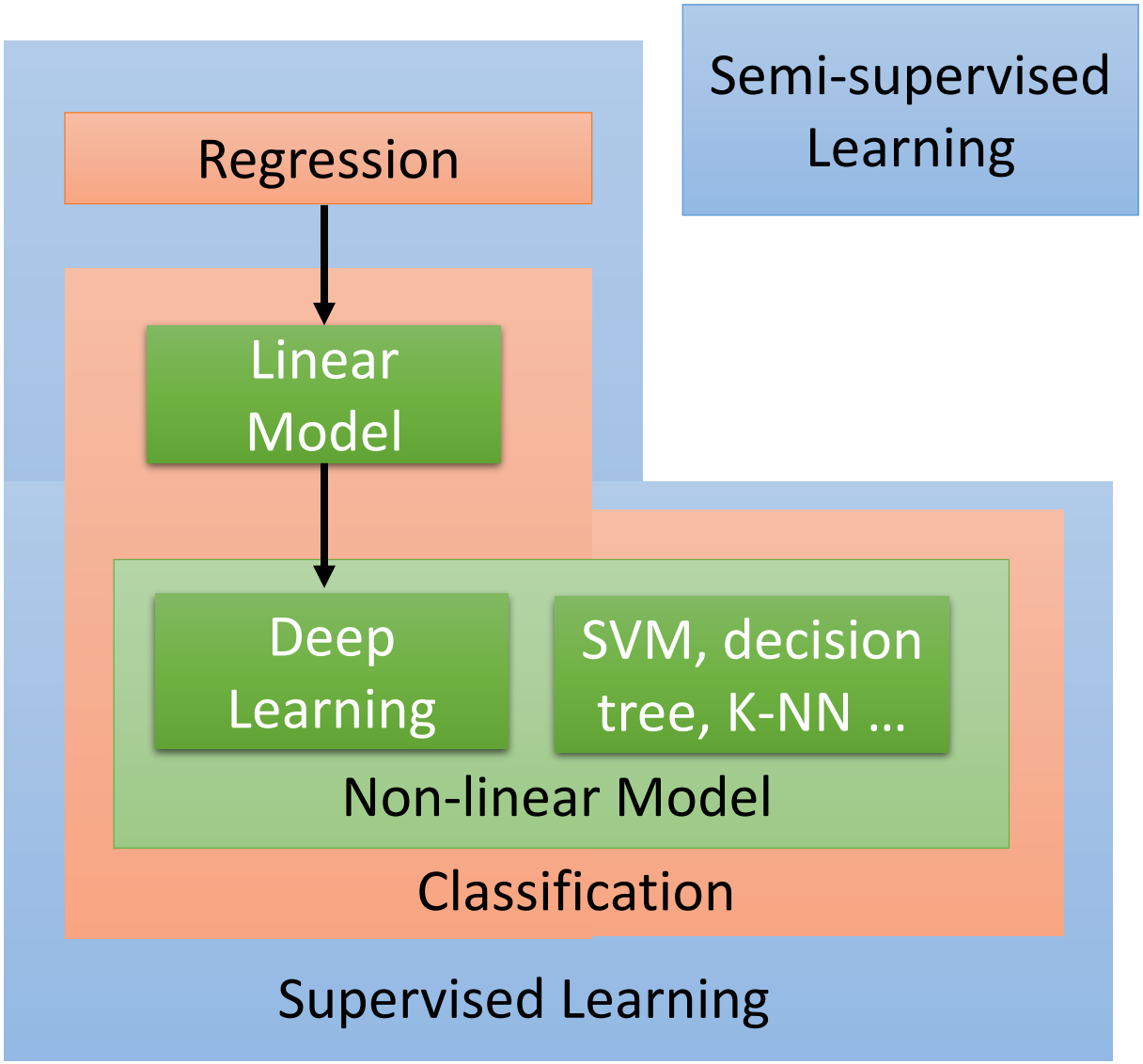
黑: 5之五 → 白: 天元 → 黑: 五之5

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:

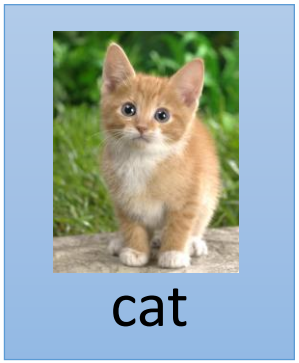
Input/output pair of target function

Function output = label

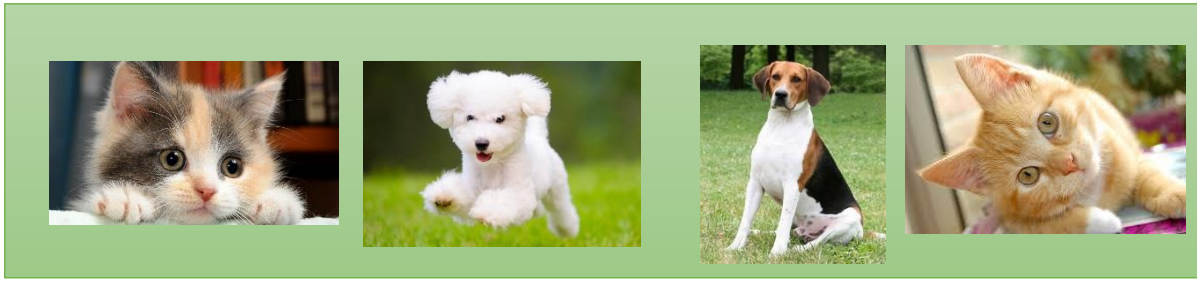
Semi-supervised Learning

For example, recognizing cats and dogs

Labelled data

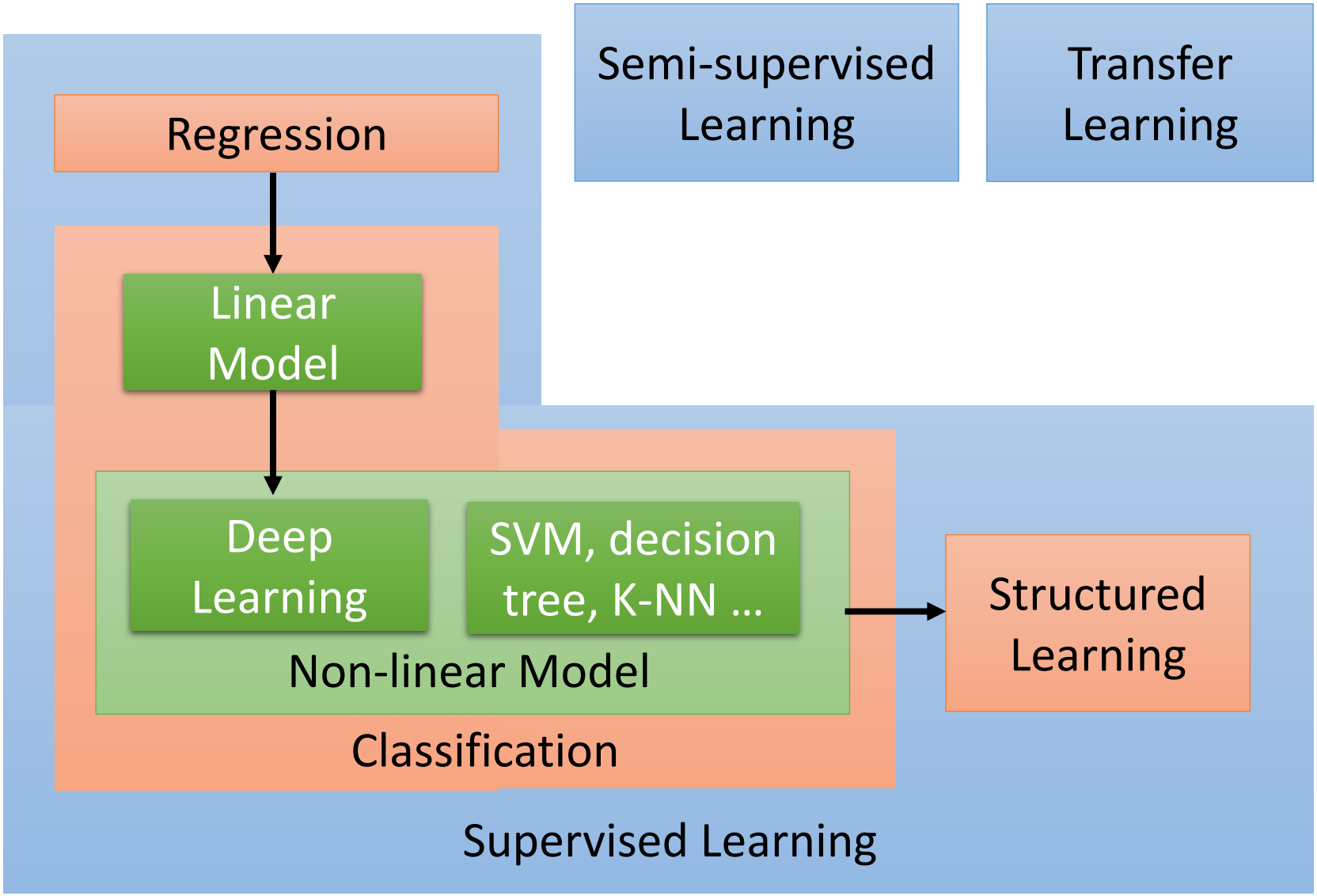


Unlabeled data



(Images of cats and dogs)

Learning Map



Transfer Learning

For example, recognizing cats and dogs

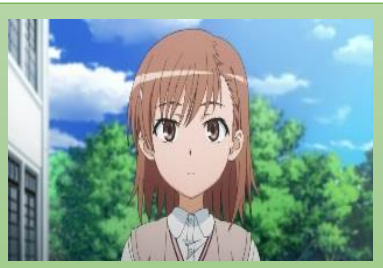
Labelled data

cat

dog

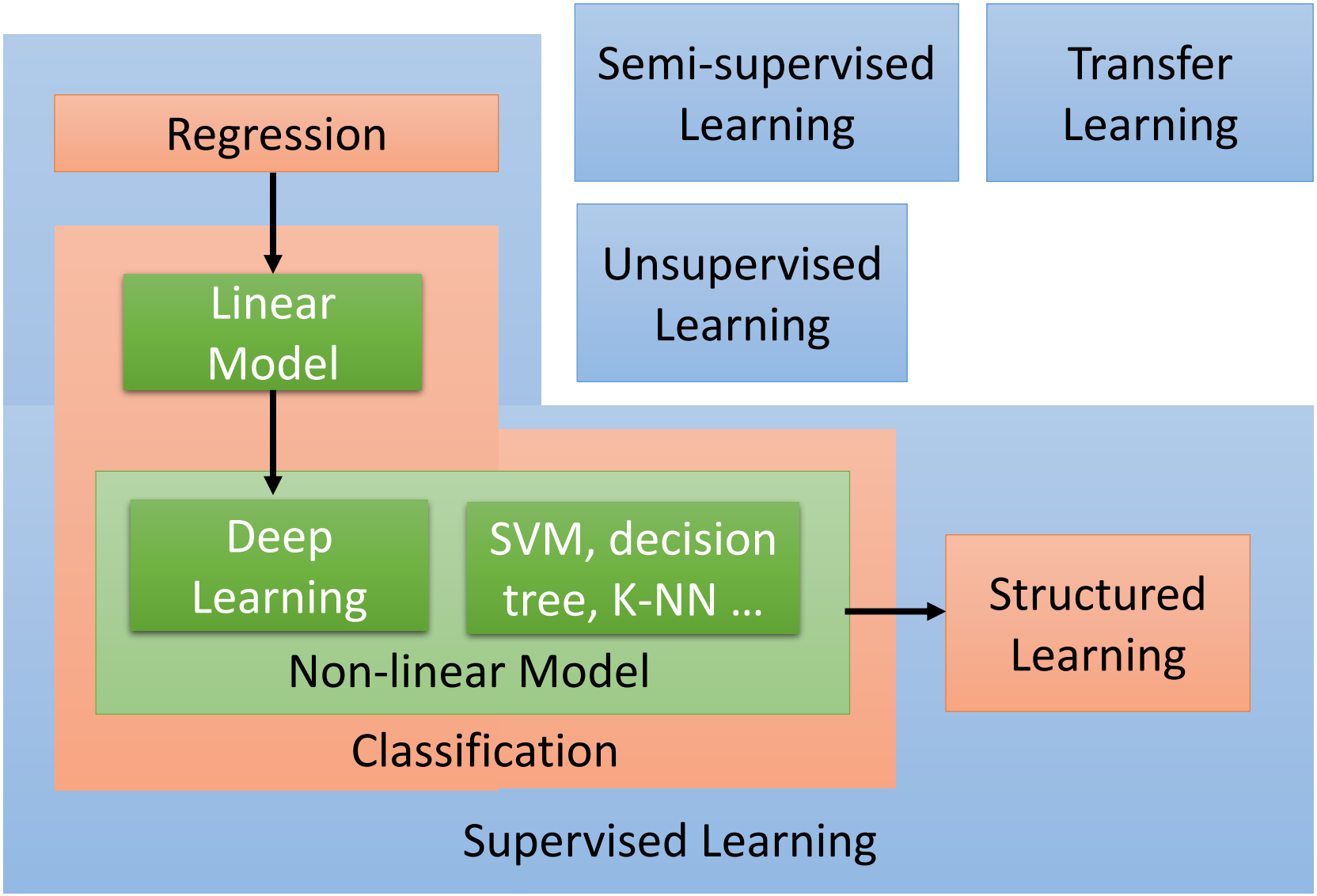
elephant

Haruhi



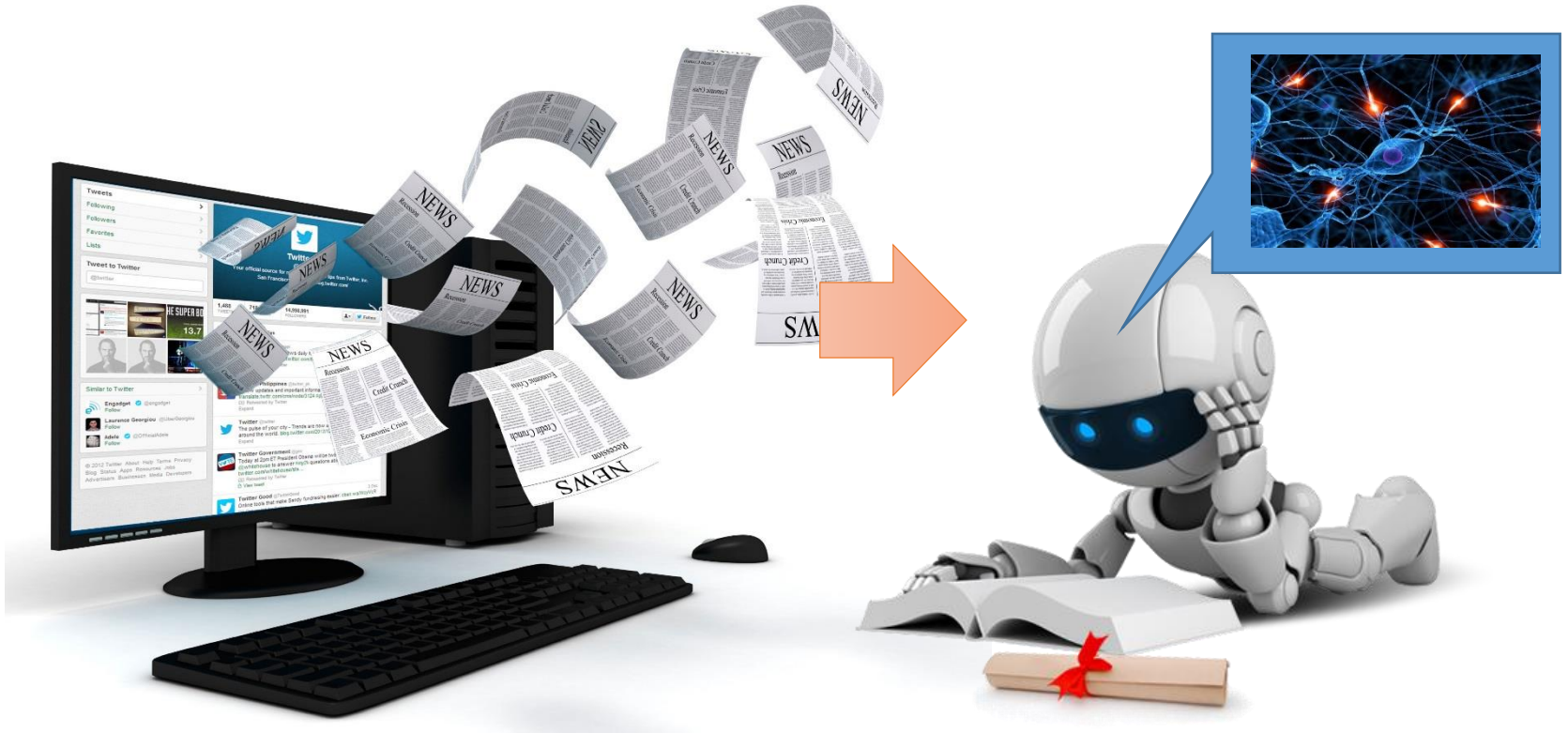
Data not related to the task considered
(can be either labeled or unlabeled)

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

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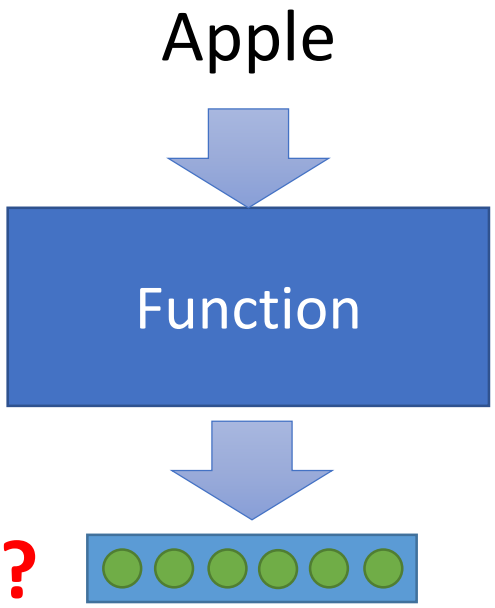


Training data is a lot of text

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

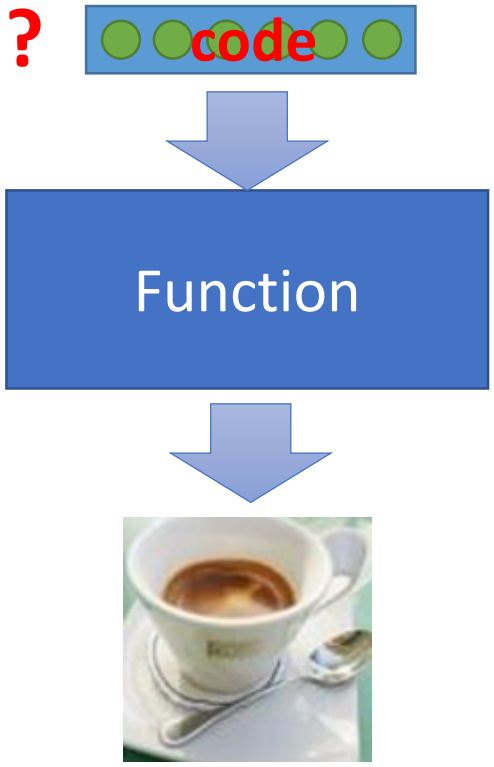
Unsupervised Learning

Draw something!

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

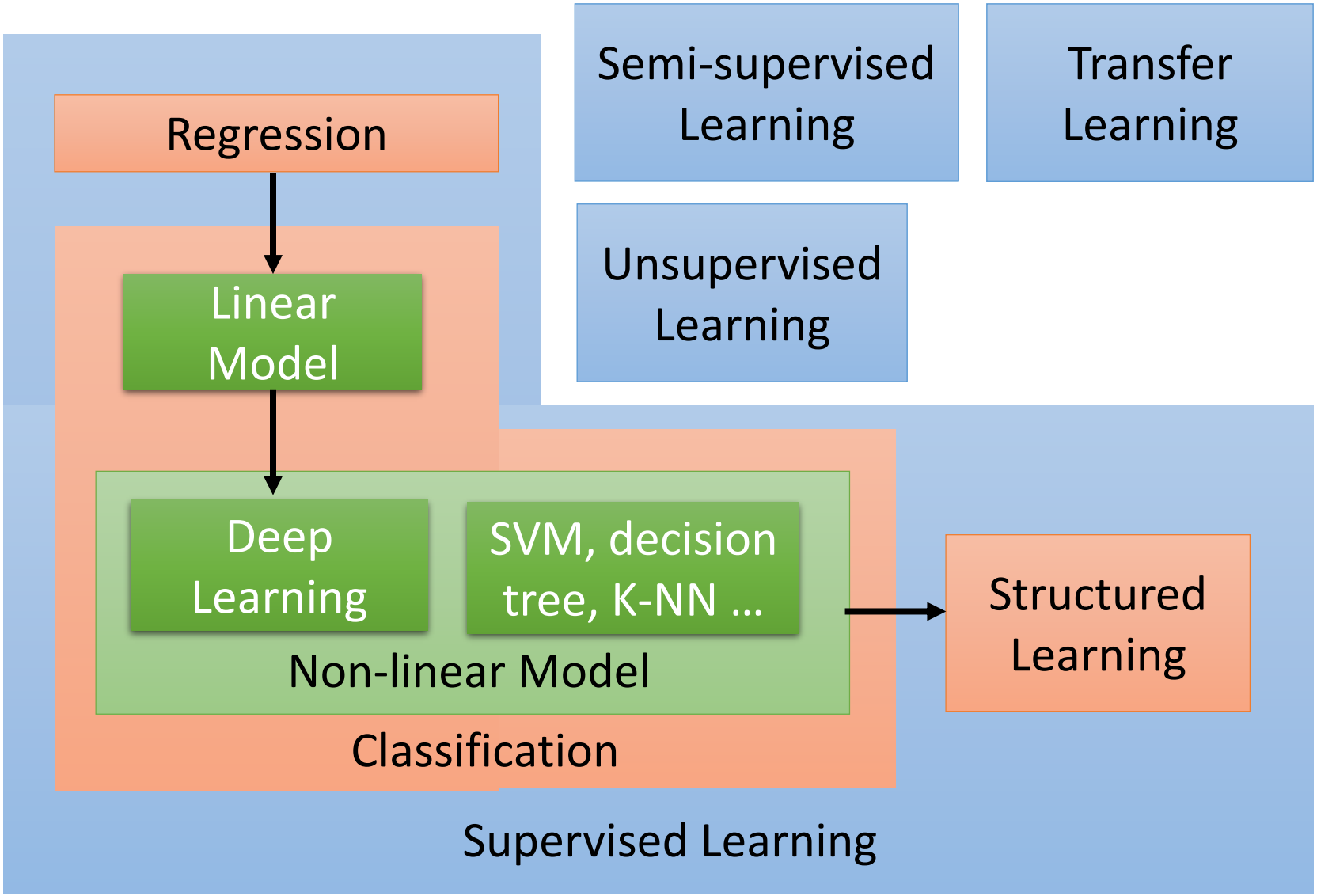
Unsupervised Learning

- Machine Drawing

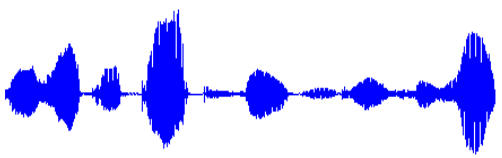


Training data is a lot of images

Learning Map



Structured Learning
- Beyond Classification



f

“大家好，歡迎大家來修機器學習”

Speech Recognition

“機器學習”

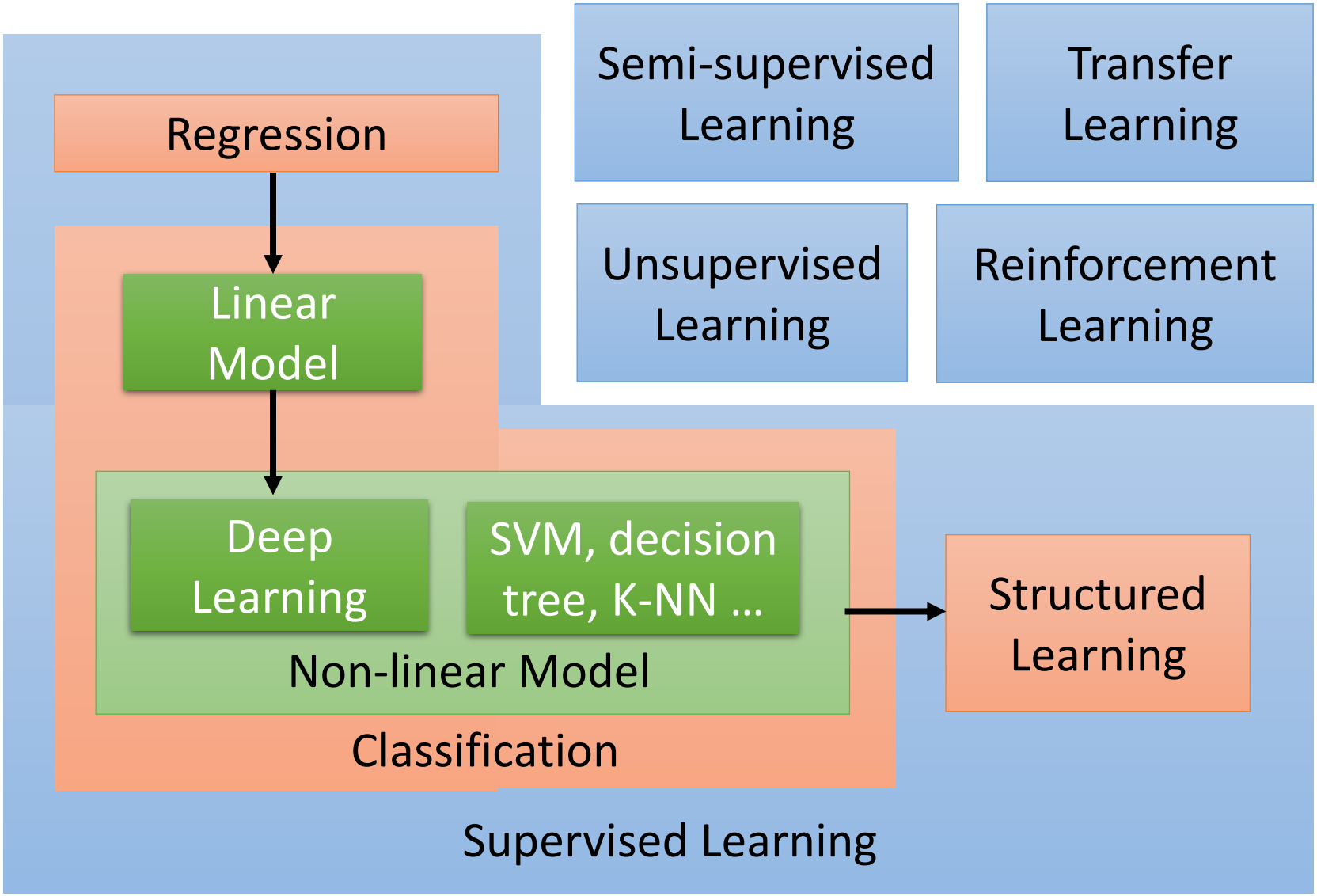
f

“Machine Learning”

Machine Translation

人臉辨識

Learning Map

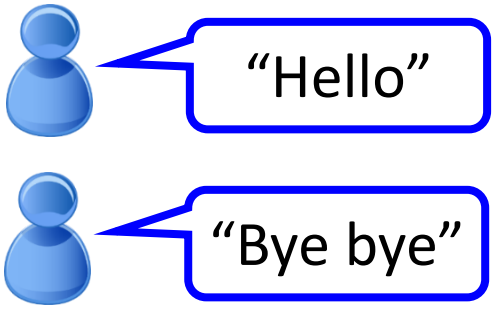


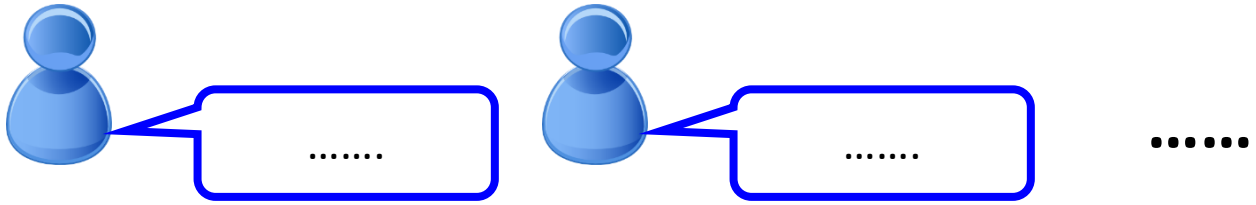
Reinforcement Learning

Supervised v.s. Reinforcement

- Supervised

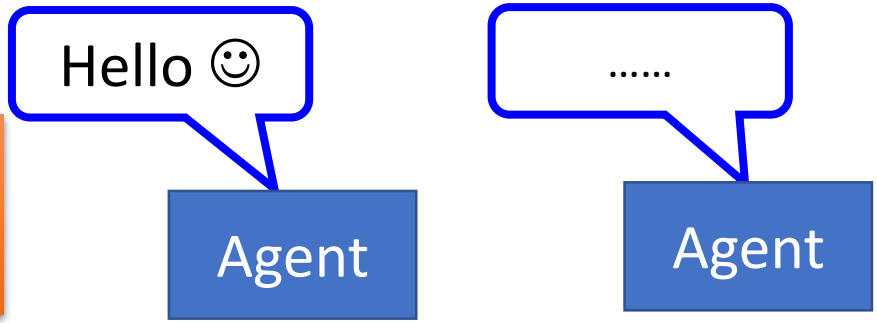
Learning from teacher





Bad

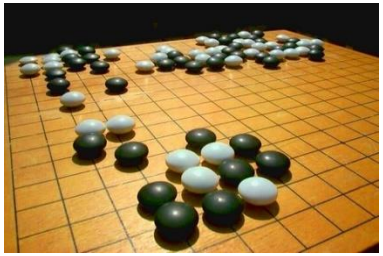
Learning from critics



Supervised v.s. Reinforcement

- Supervised:

Next move:
"5-5"



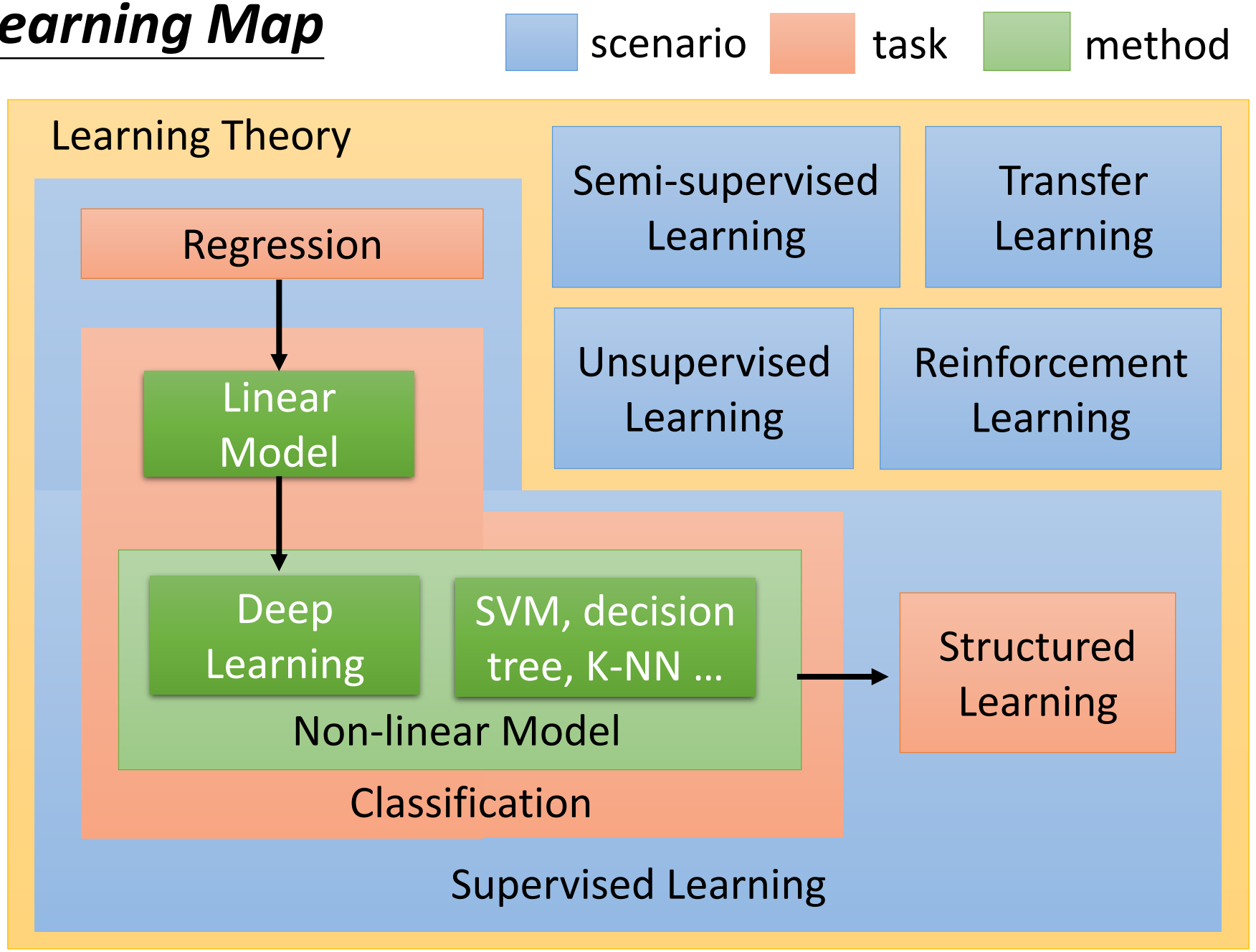
Next move:
"3-3"

- Reinforcement Learning

First move → …… many moves …… → Win!

Alpha Go is supervised learning + reinforcement learning.

Learning Map



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

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

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

http://www.gvm.com.tw/webonly_content_10787.html

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