Introduction to Deep Learning

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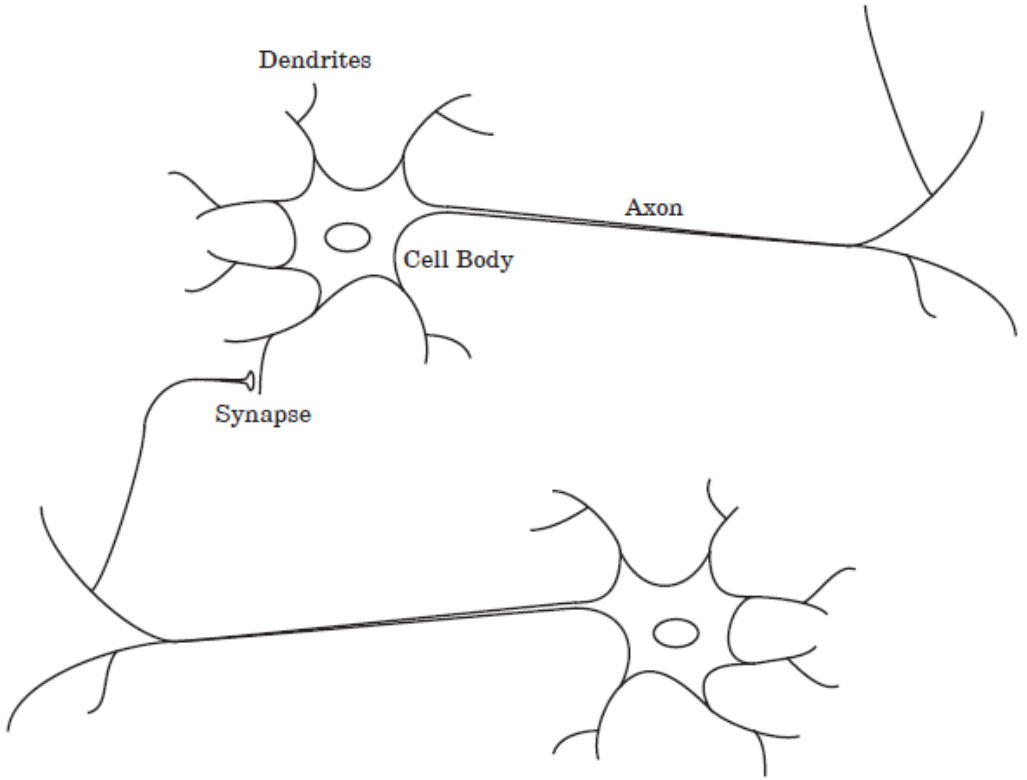
Outline

1. ANN: Biological Inspiration
2. Deep Learning?
3. Applications
4. Deep Neural Networks
    - Convolutional Neural Networks
    - Recurrent Neural Networks
    - Generative Adversarial Networks
    - Autoencoders

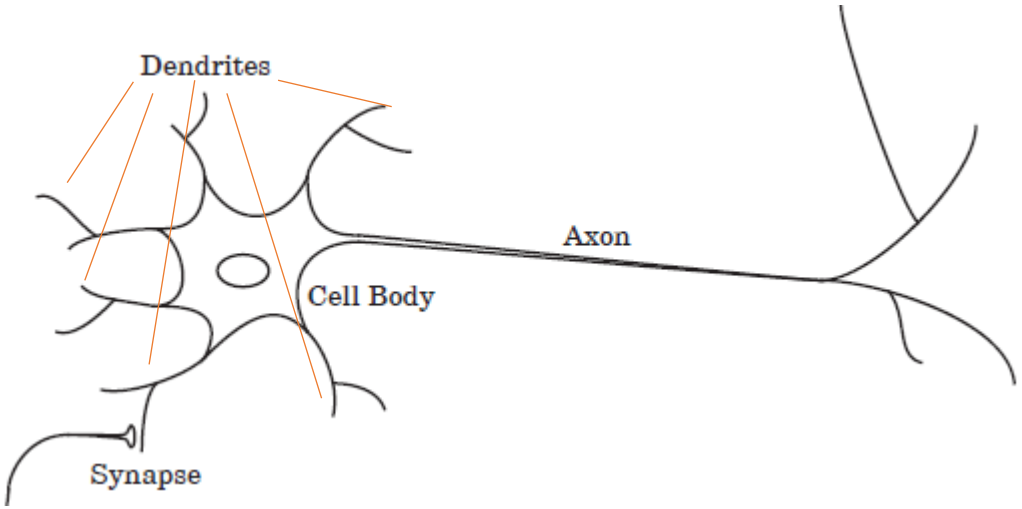
ANN: Biological Inspiration

- Biological motivation
  - Biological learning system (brain)
  - Complex network of neurons

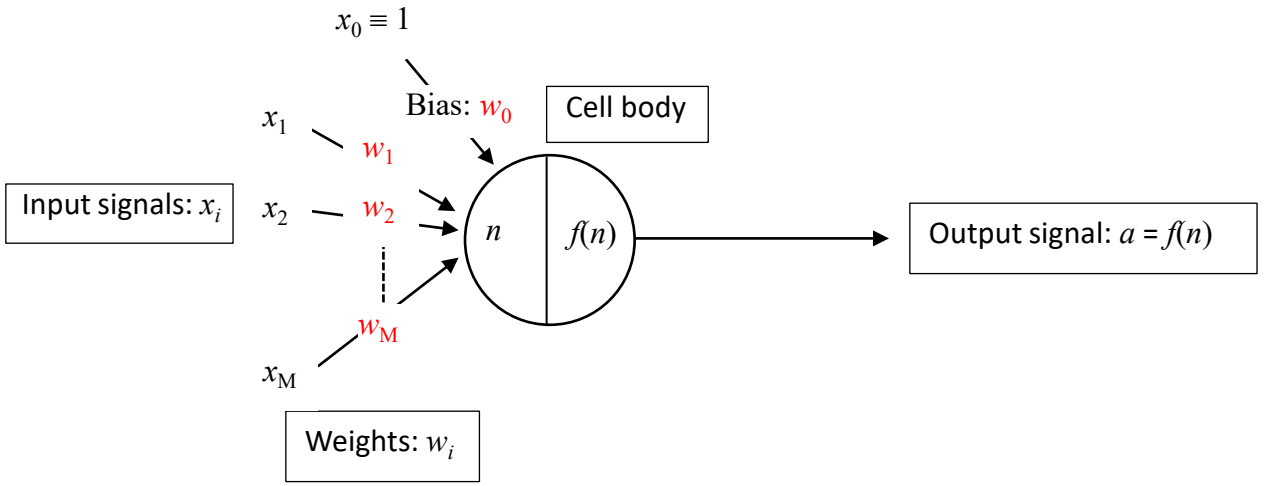


Artificial Neuron

Biological Neuron



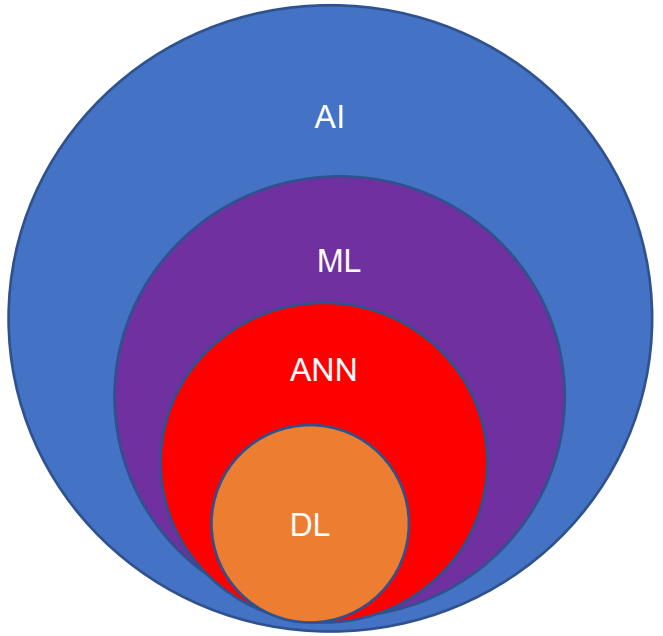
Artificial Neuron



Dendrites (樹突)	⟷	Input signals (x_i)
Synapses (突觸)	⟷	Weights (w_i)
Cell Body (細胞體)	⟷	Cell Body (n, $f(n)$)
Axon (軸突)	⟷	Output signal (a)

Deep Learning?

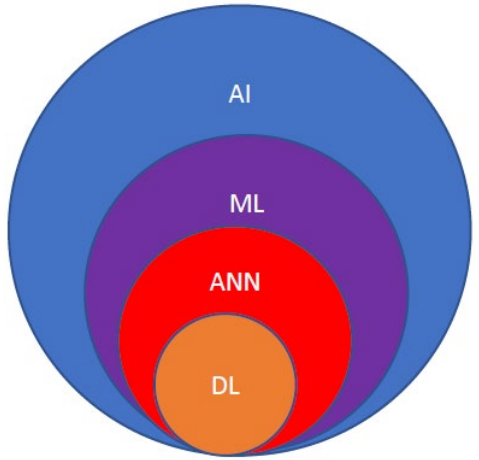
- AI (Artificial Intelligence)
- ML (Machine Learning)
- ANN (Artificial Neural Networks人工神經網路)
- DL (Deep Learning)



AI and ML

- AI is a branch of computer science emphasizing the simulation(模擬) of human intelligence.

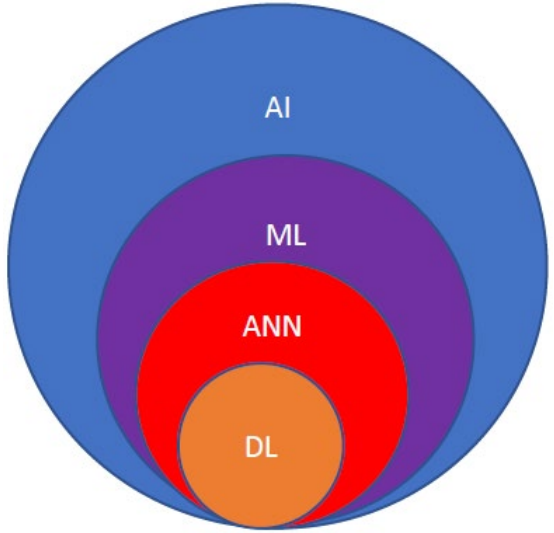
- ML is a subfield of AI dealing with the problem of constructing algorithms of acquiring knowledge through observed data/experiences.



ANN and DL

- ANN is part of a broader family of ML methods inspired by biological neural systems(生物神經網路).

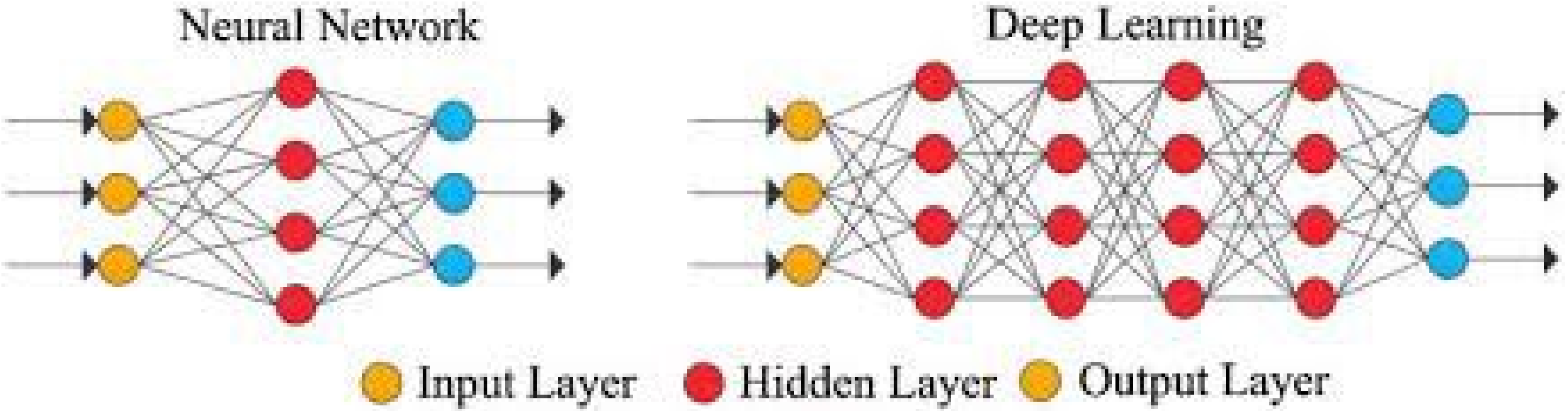
- DL is a computational model based on ANN with representation learning.
  - Representation learning is learning representations of input data that make it easier to extract useful information when performing classifications or predictions.



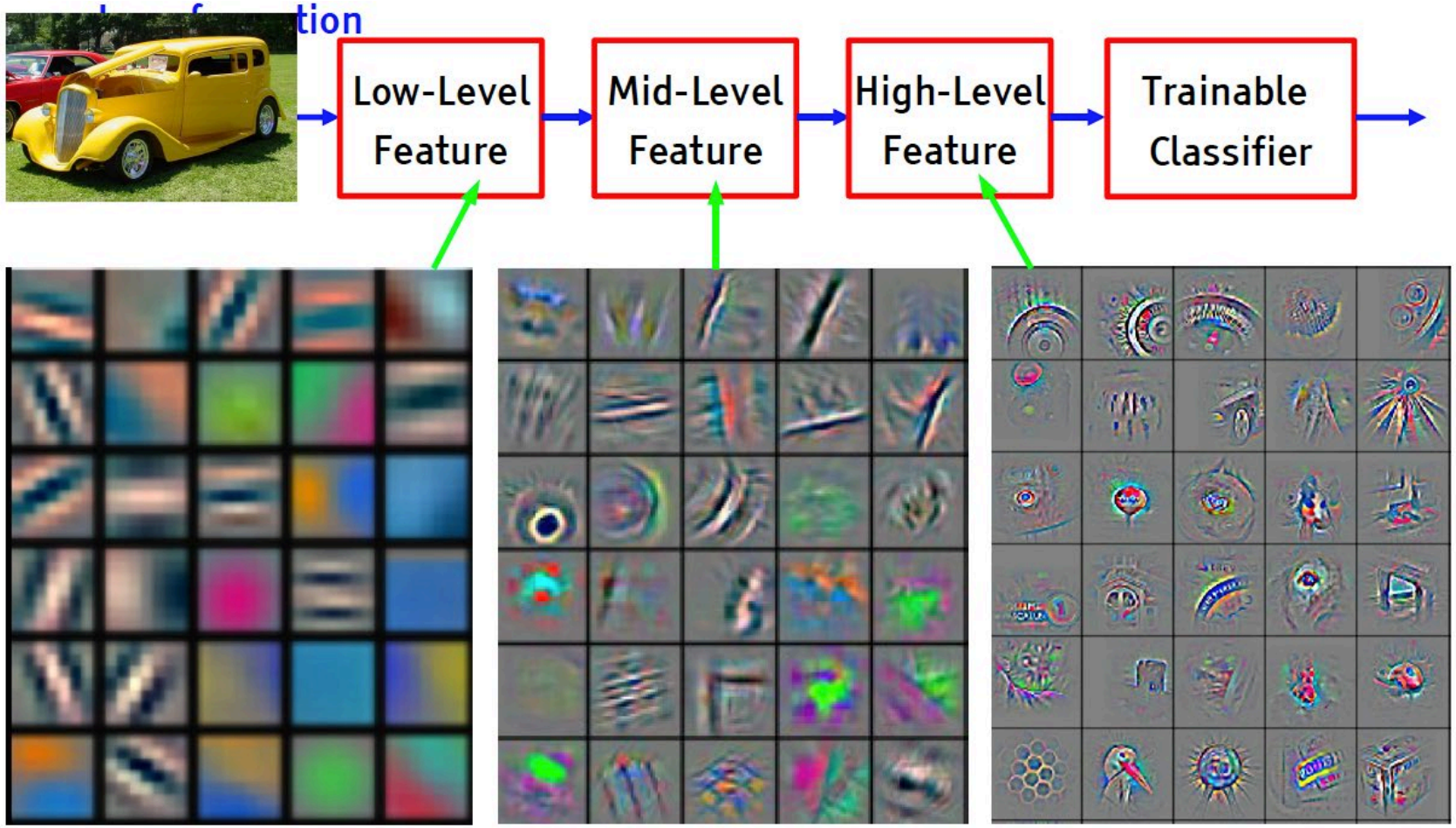
資料在高維度的轉換當中，可以去萃取出足夠而抽象的資訊，去進行預測

深度學習只是將特徵-特徵之間的轉換模式以 層-層 之間的轉換實現，而高維的特徵向量以 層 的形式呈現。所以越深的網路代表著經過多次的函數處理跟萃取，所萃取的資訊的抽象程度越高，抽象程度越高，就越接近人類所想像的。

ANN and DL


Neural Network
Deep Learning
Input Layer
Hidden Layer
Output Layer

Deep Learning
= Learning Hierarchical(分層的) Representations



Feature visualization of convolutional net trained on ImageNet from [Zeiler & Fergus 2013]

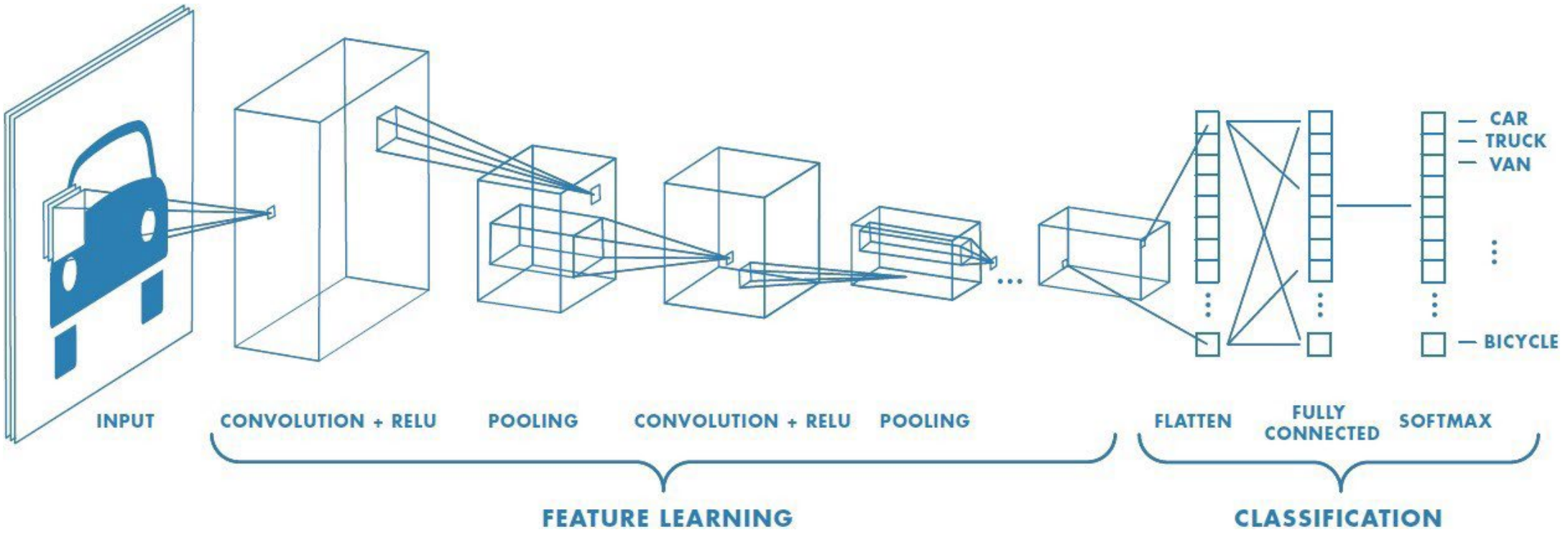
Why Deep Learning?
為什麼要學深度學習

- Hardware 硬體
  - Increase compute power 增加計算能力
  - For example: GPU (圖形處理器(=顯卡))
- Algorithms 演算法
  - Progress in algorithms
- Data 資料
  - Collections of great volume data from various sources are available

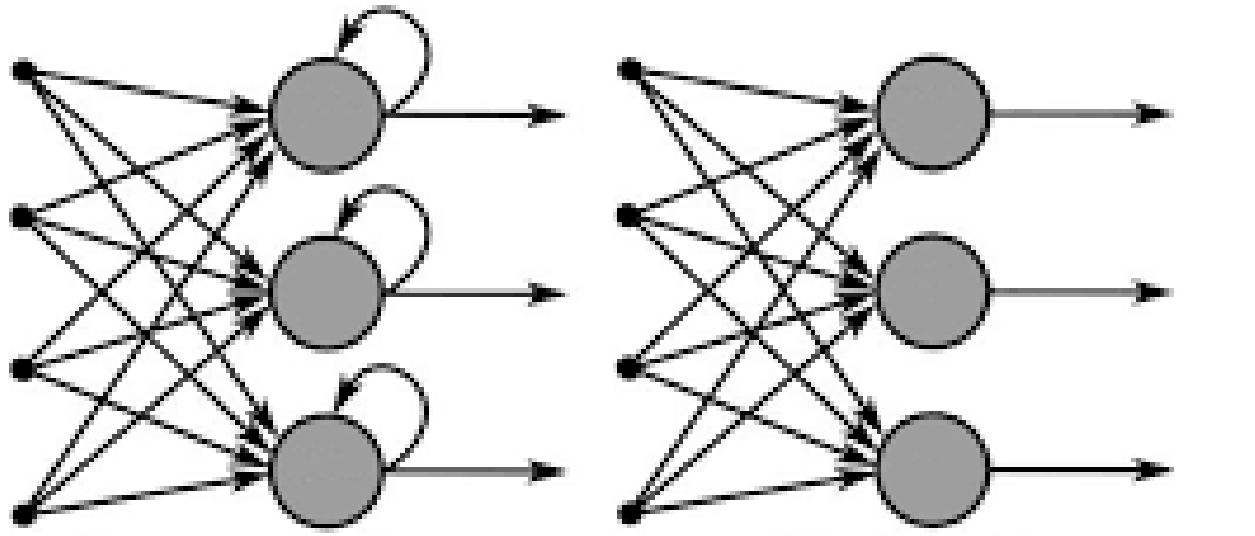
Applications應用

- The applications are expanding because Deep Learning are good at solving problems, not just in engineering(工程), science(科學), and mathematics(數學), but in medicine(醫學), business(商業), finance(金融), and literature(文學) as well.
  - For example:
    - character recognition(字符識別),
    - text classification(文本分類)and categorization,
    - medical and health care(醫療和保健),
    - diagnosis(診斷),
    - computer vision(電腦視覺),
    - speech recognition(語音識別),
    - natural language processing(自然語言處理),…

Convolutional (卷積) Neural Networks



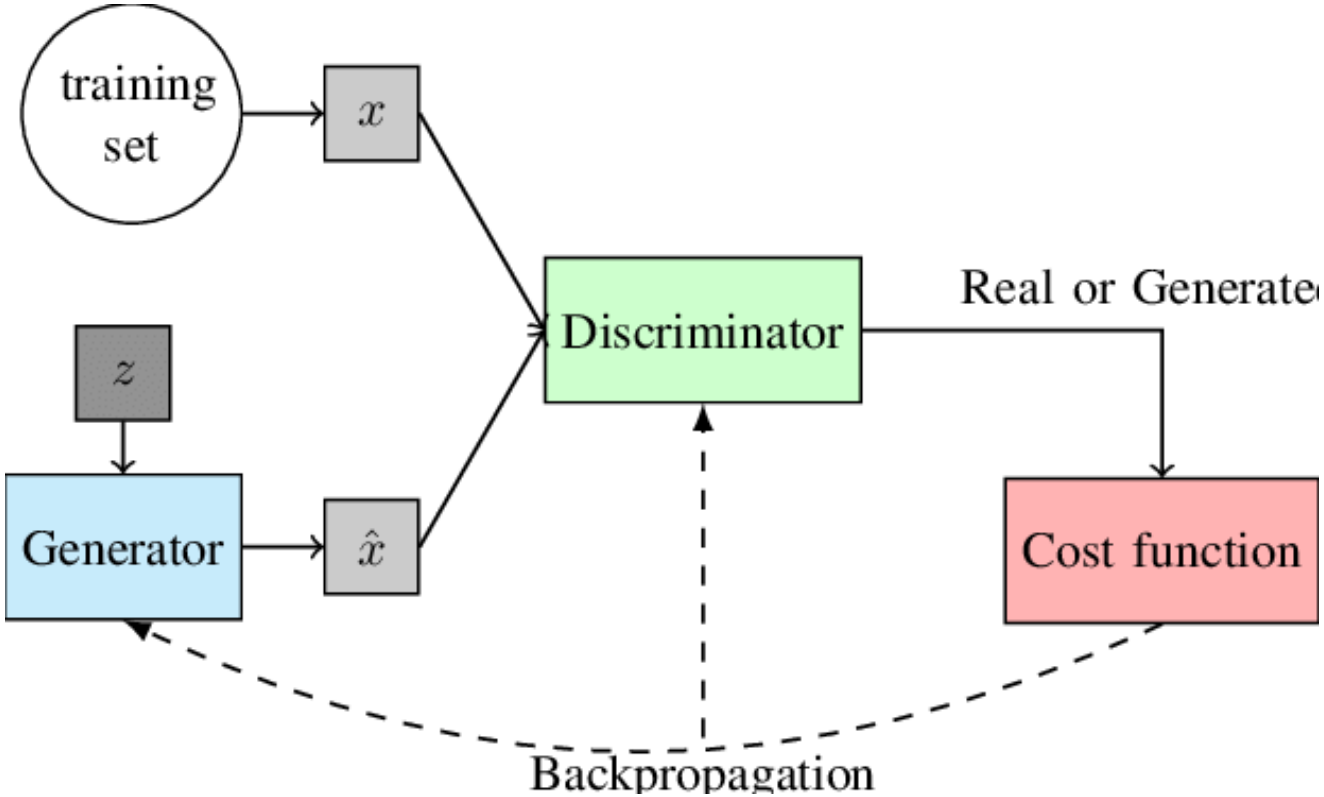
Recurrent Neural Networks



Recurrent Neural Network

Feed-Forward Neural Network

Generative Adversarial Networks(生成對抗網絡)



Autoencoders(自動編碼器)