

商業、人工智慧與類神經網路

# Businesses, Artificial Intelligence, and Artificial Neural Networks

蔡瑞煌

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# COGNITIVE PROJECTS BY TYPE

We studied 152 cognitive technology projects and found that they fell into three categories.

Process automation

**ROBOTICS &  
COGNITIVE  
AUTOMATION**

RPA (robotic process automation)

**71**

47%

**COGNITIVE  
INSIGHT**

(through data analysis)

**57**

38%

**COGNITIVE  
ENGAGEMENT**

(with customers and employees)

**24**

15%

by T. H. Davenport & R. Ronanki

HBR, Jan.-Feb. 2018

中文版 [https://www.hbrtaiwan.com/article\\_content\\_AR0007644.html](https://www.hbrtaiwan.com/article_content_AR0007644.html)

# How do we cope with problems in businesses?

- (collected) Data
- Professionals or Intelligence Systems
- Insights

# Data

- Text data
- Numeric data
- Voice / talk
- Image / video
- Big Data

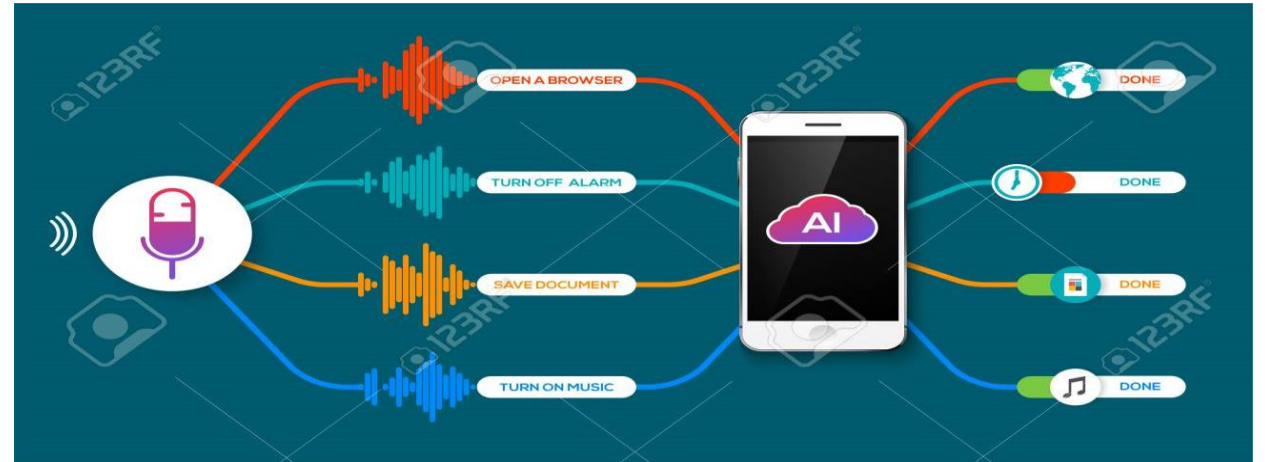


['吳王夫差敗越于夫椒/', '越子以甲楯五千保于會稽/', '伍員曰/不可/臣聞之/樹德莫如滋/去疾莫如盡/昔有過澆殺斟灌以伐斟鄩/滅夏後相/後緡方娠/逃出自竇/歸于有仍/生少康焉/為仍牧正/綦澆能戒之/澆使椒求之/逃奔有虞/為之庖正/以除其害/虞思於是妻之以二姚/而邑諸綸/有田一成/有眾一旅/能布其德/而兆其謀/以收夏眾/撫其官職/使女艾諜澆/使季杼誘豷/遂滅過戈/' ]

Student ID	First Name	Last Name	Credits completed	GPA
34933	Victoria	Slater	36	3.27
93759	Justin	McNeil	82	3.54
20847	Jessica	Bennett	56	2.87
65947	Michelle	Dolin	112	3.81
24956	David	Price	57	2.34
65692	Franklin	Mullins	13	3.72
24271	Alissa	Lee	77	2.96

# Data

- Text data
- Numeric data
- Voice / talk
- Image / video
- Big Data
- ....





# Data

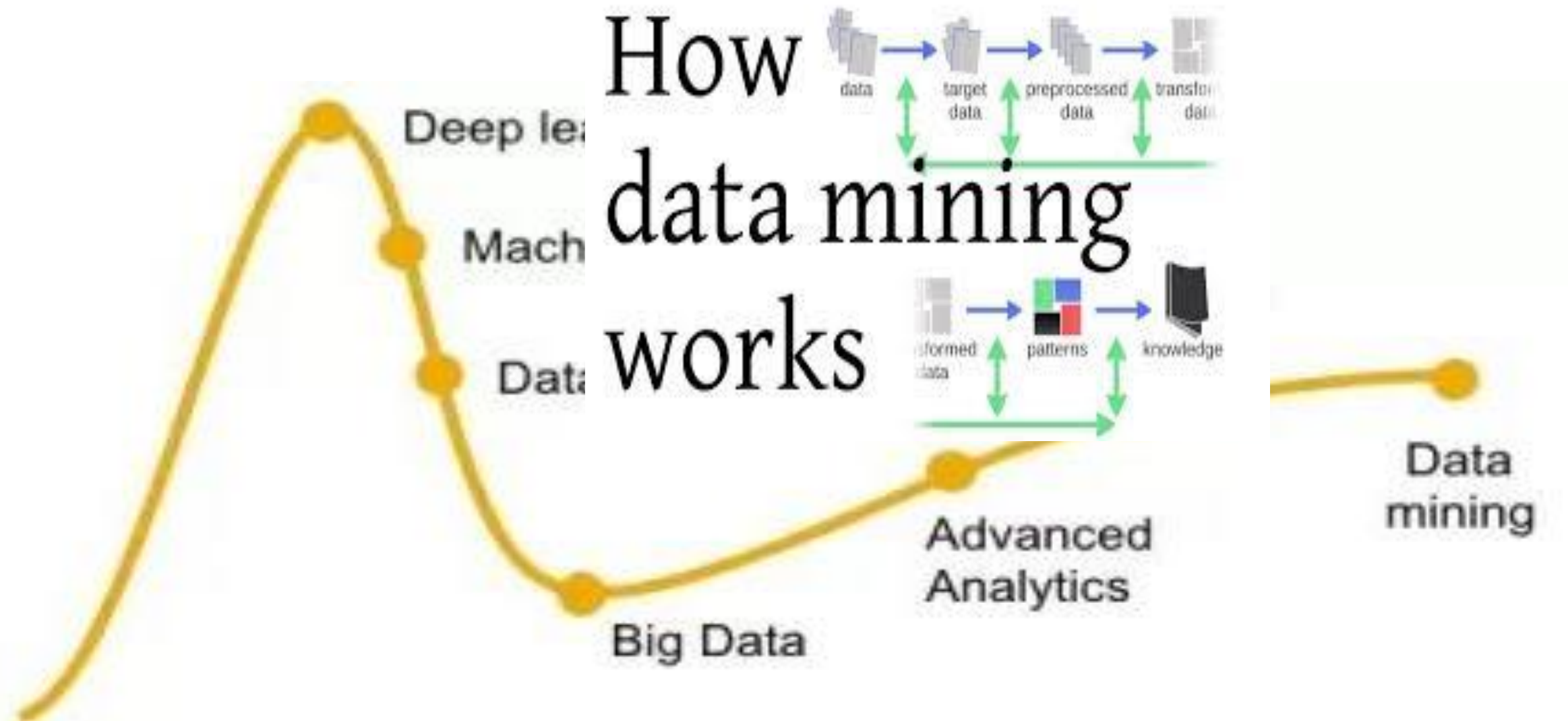
- Text data
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- Voice / talk
- Image / video
- Big Data
- ....



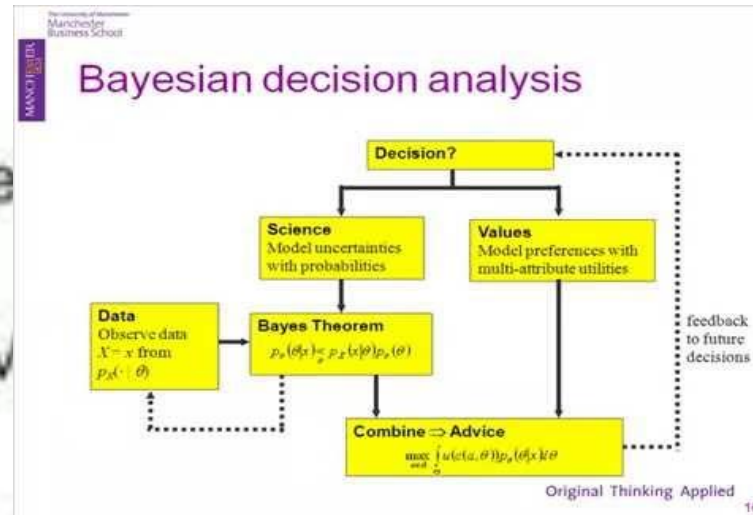
**Volume Velocity Variety And Value Big Data Challenges**



# Tools for extracting insights from data



# Tools for extracting insights from data



Predictive  
Analytics

Data Science

Data  
mining

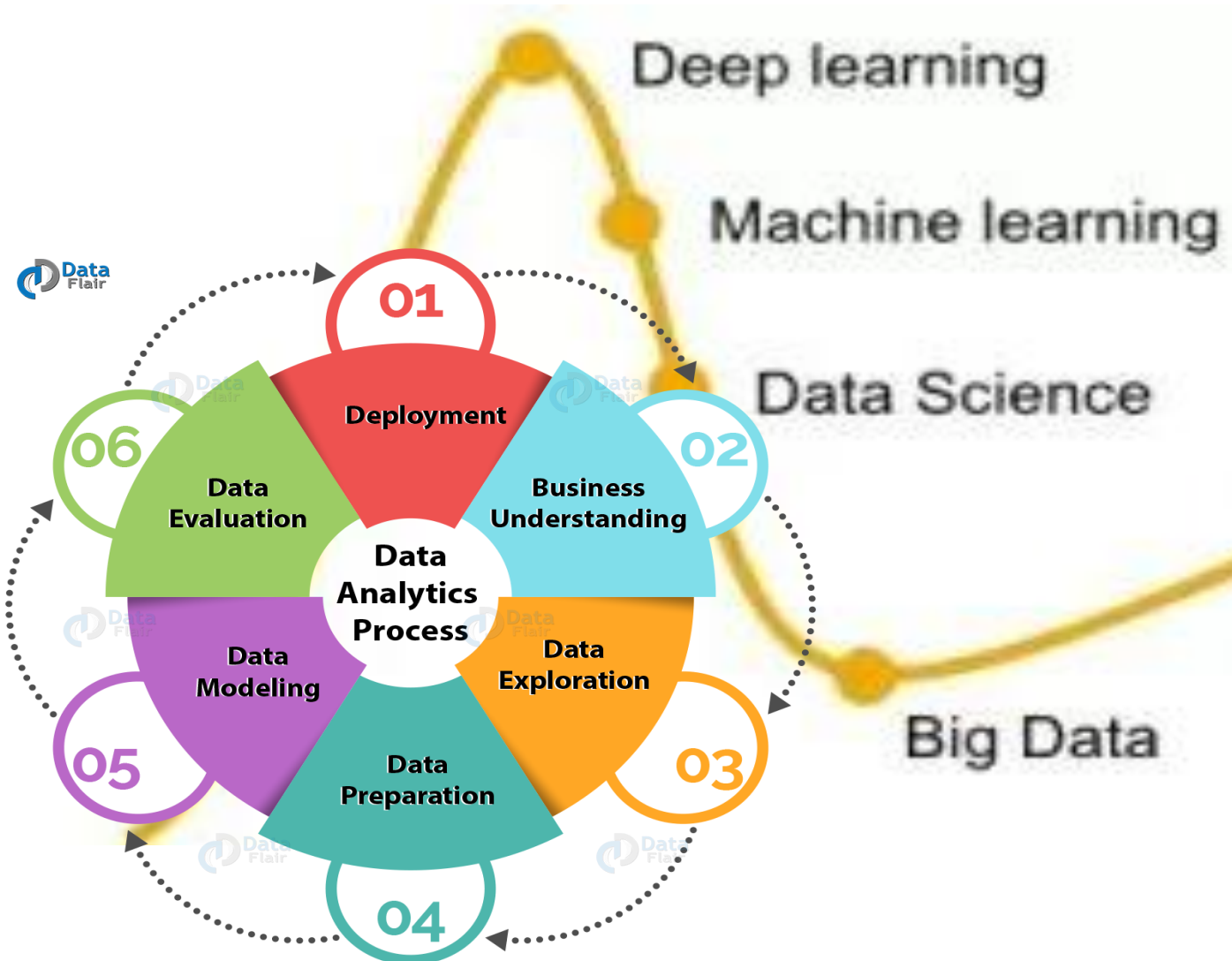
Advanced  
Analytics

Big Data

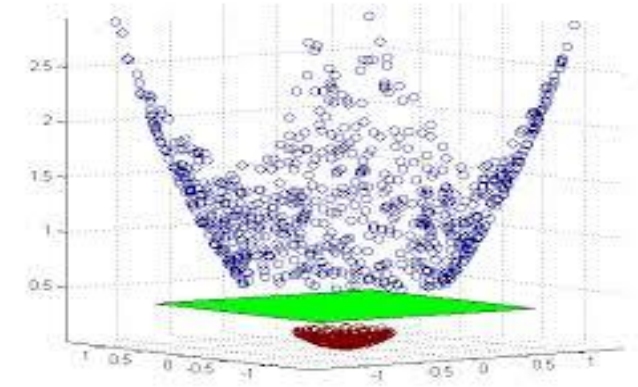
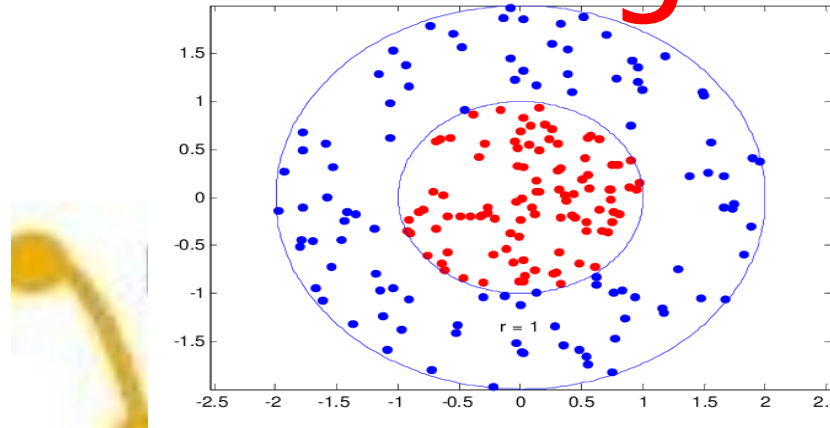
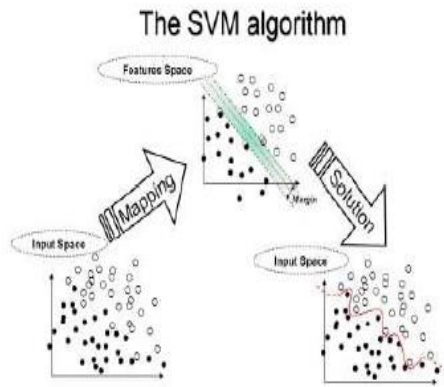
Business Intelligence



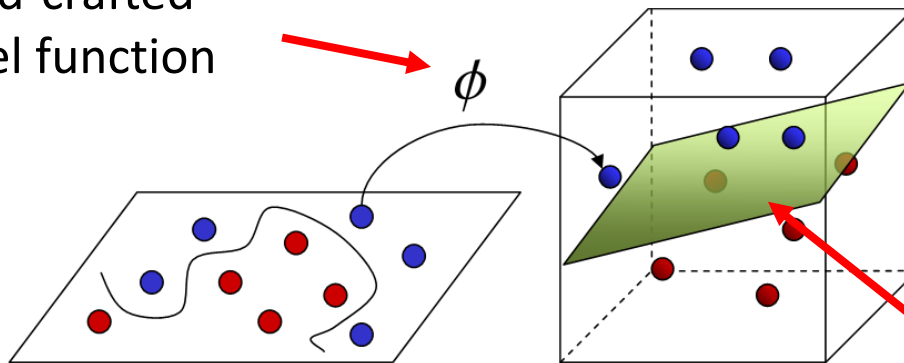
# Tools for extracting insights from data



# Tools for extracting insights from data



Hand-crafted  
kernel function



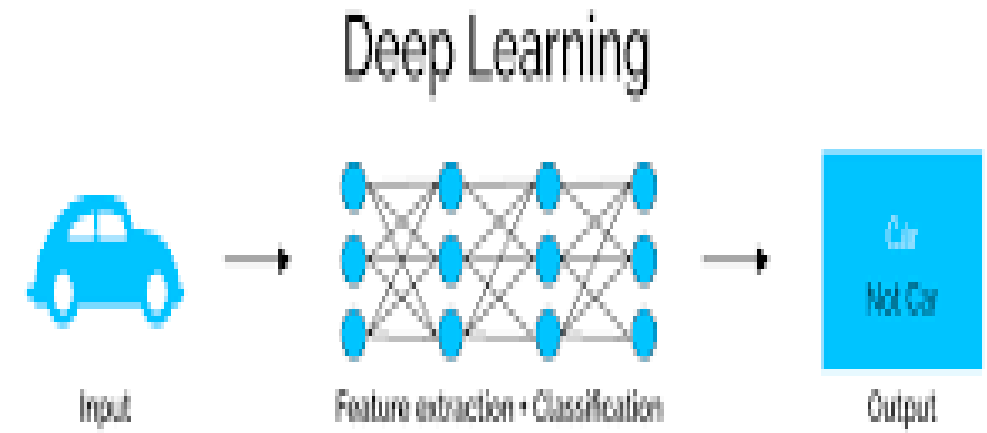
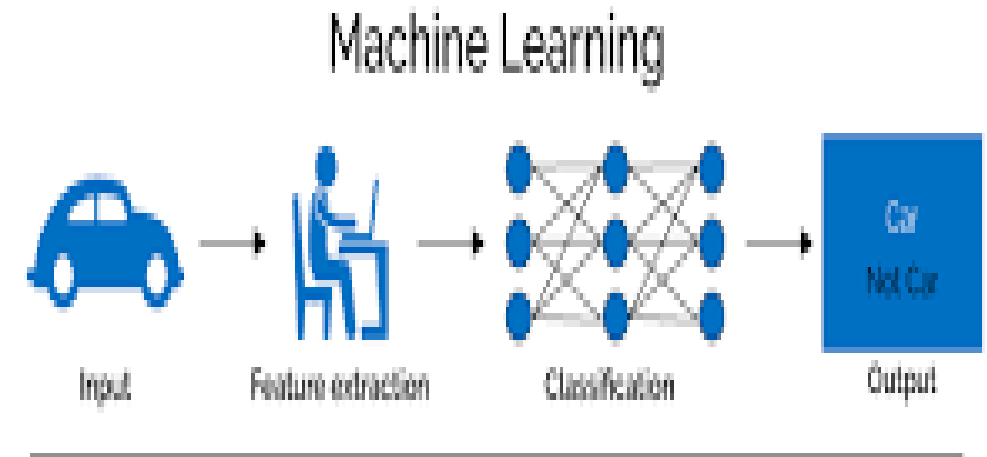
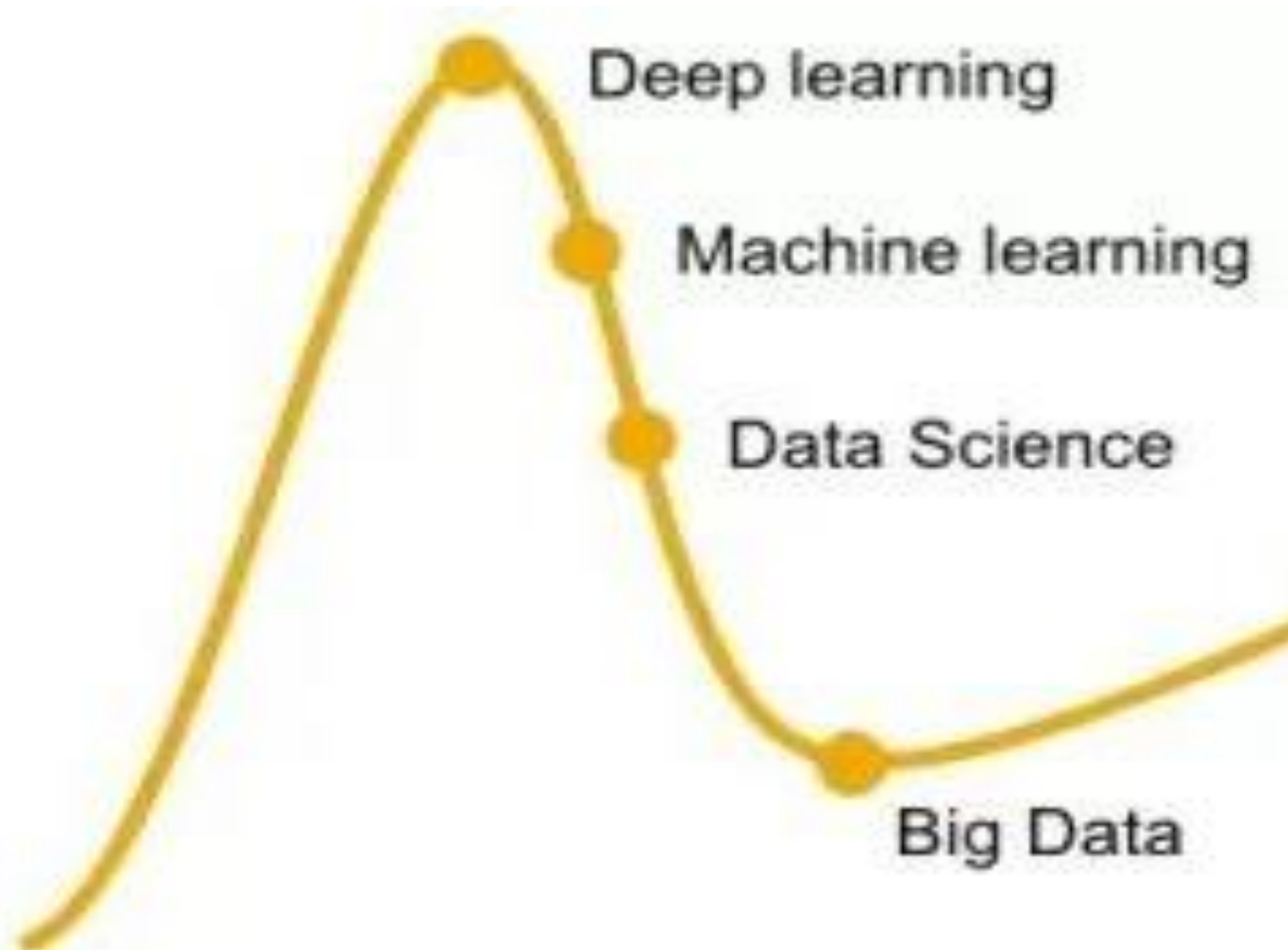
Input Space

Feature Space

Apply simple  
classifier

Source of image: [http://www.gipsa-lab.grenoble-inp.fr/transfert/seminaire/455\\_Kadri2013Gipsa-lab.pdf](http://www.gipsa-lab.grenoble-inp.fr/transfert/seminaire/455_Kadri2013Gipsa-lab.pdf)

# Tools for extracting insights from data



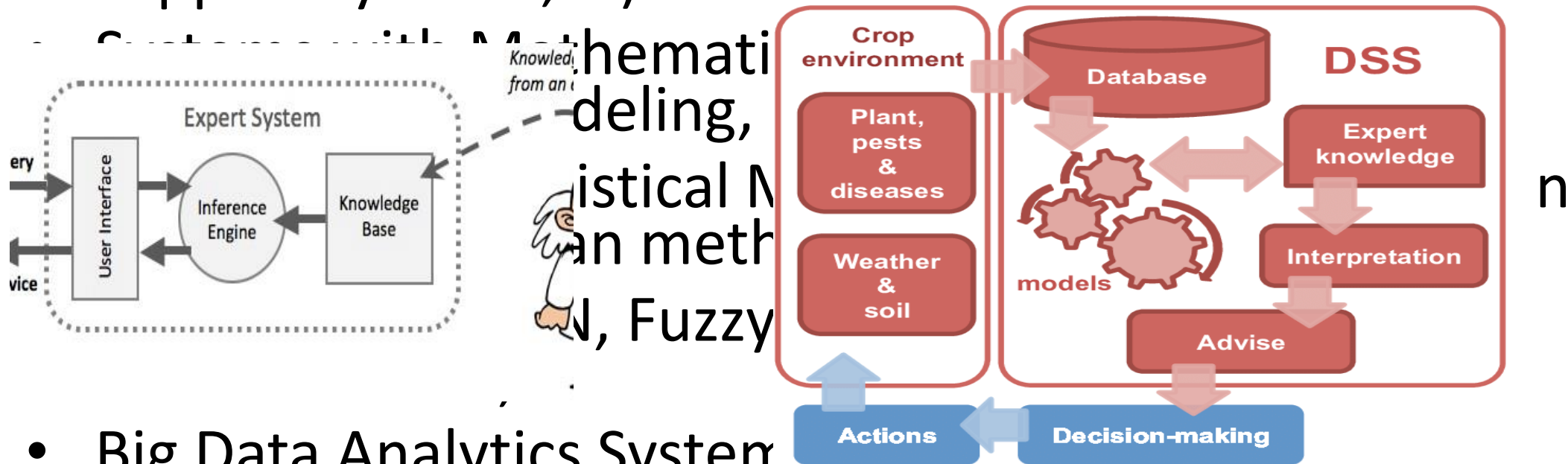
# 人工智慧

- 人工智慧亦稱**機器智慧**，指由人製造出來的機器所表現出來的智慧。通常人工智慧是指透過普通**電腦**程式來呈現人類智慧的技術。該詞也指出研究這樣的智慧系統是否能夠實現，以及如何實現。同時，有些預測則認為人類的無數職業也逐漸被其取代。
- 人工智慧在一般教材中的定義領域是「**智慧主體** ( intelligent agent ) 的研究與設計」，智慧主體指一個可以**觀察**周遭環境並作出**行動**以達致**目標**的系統。於1955年的定義是「製造**智慧機器**的科學與工程」。
- 有人將人工智慧定義為「**系統**正確**解釋**外部資料，從這些資料中**學習**，並利用這些知識透過靈活適應**實現**特定目標和任務的能力」。
- 人工智慧的研究是**高度技術性和專業的**，各分支領域都是深入且**各不相通**的，因而涉及範圍極廣。人工智慧的研究可以分為幾個**技術問題**。
- 其分支領域主要集中在解決具體問題，其中之一是，如何使用各種不同的工具完成特定的應用程式。



系統 ... 解釋外部資料，從這些資料中學習，  
並利用 ... 知識 ... 實現 ...

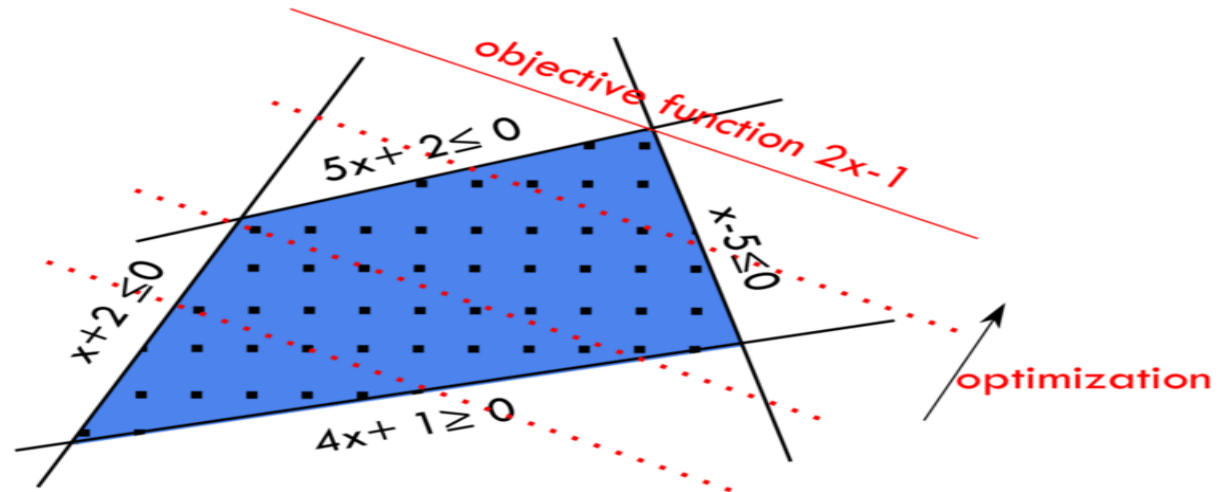
- Rule-based AI systems (e.g., expert systems, decision support systems, ...)



- Big Data Analytics Systems
- Machine Learning Systems
- Deep Learning Systems

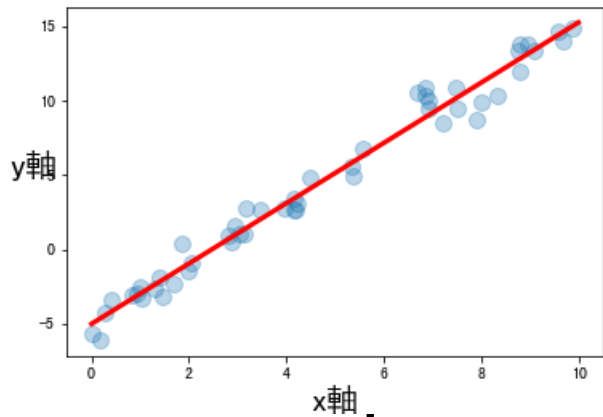
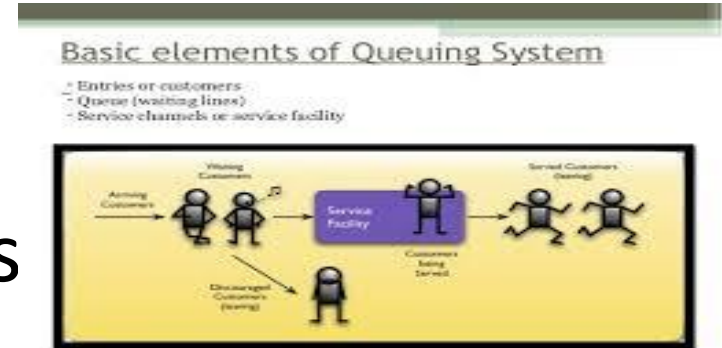
系統 ... 解釋外部資料，從這些資料中學習，  
並利用 ... 知識 ... 實現 ...

- Rule-based AI systems (e.g., expert systems, decision support systems, ...)
- Systems with Mathematical Models (e.g., linear programming modeling, ...)
- Systems with Statistical modeling, Bayesian
- Systems with ANN, Random forest, ...
- Big Data Analytics Systems
- Machine Learning Systems
- Deep Learning Systems



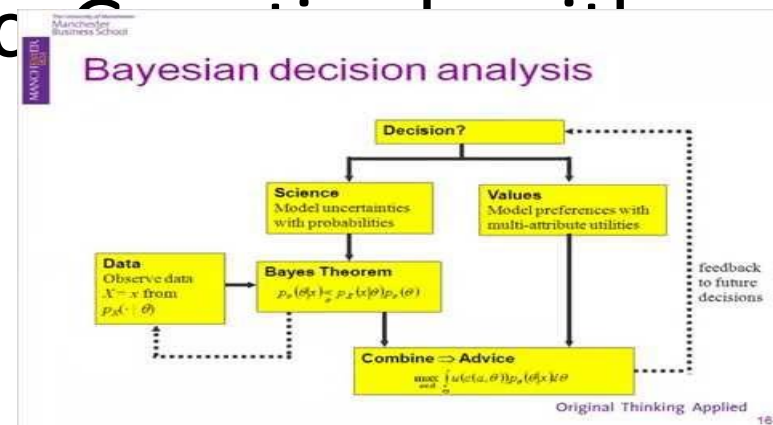
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- Rule-based AI systems (e.g., expert support systems, ...)
- Systems with Mathematical Models programming modeling, ...)
- Systems with Statistical Models (e.g., linear regression modeling, Bayesian method, Queuing method, ...)



ANN, Fuzzy logic, ...

Analytics Systems  
Learning Systems  
Reasoning Systems







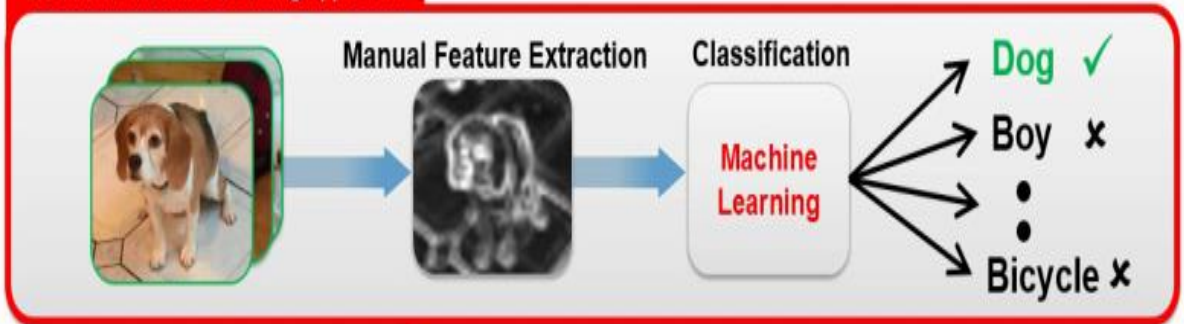
# 系統 ... 解釋外部資料，從這些資料中學習， 並利用 ... 知識 ... 實現 ...

- Rule-based AI systems (e.g., support systems, ...)
- Systems with Mathematical programming modeling, ...)
- Systems with Statistical Modeling, Bayesian methods, ...)
- Systems with ANN, Fuzzy logic, Random forest, ...
- Big Data Analytics Systems
- Machine Learning Systems
- Deep Learning Systems

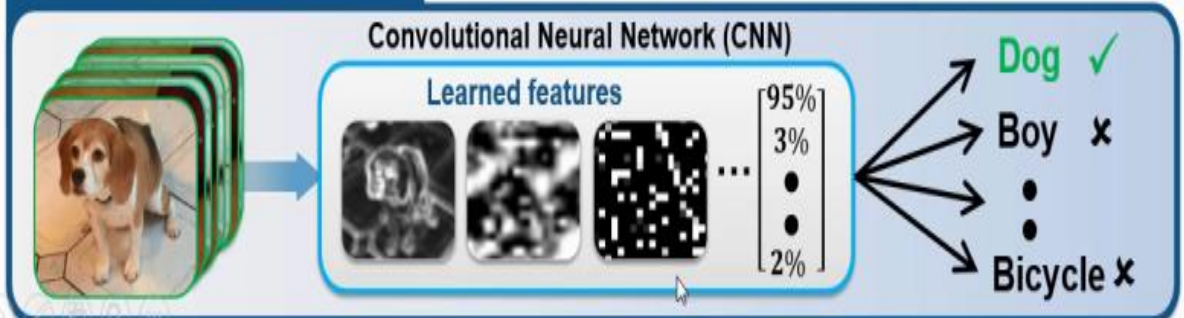
## Deep Learning

Deep learning is a **machine learning** technique that can learn **useful representations or features** directly from images, text and sound

### Traditional Machine Learning approach



### Deep Learning approach



系統 ... 解釋外部資料，從這些資料中學習，  
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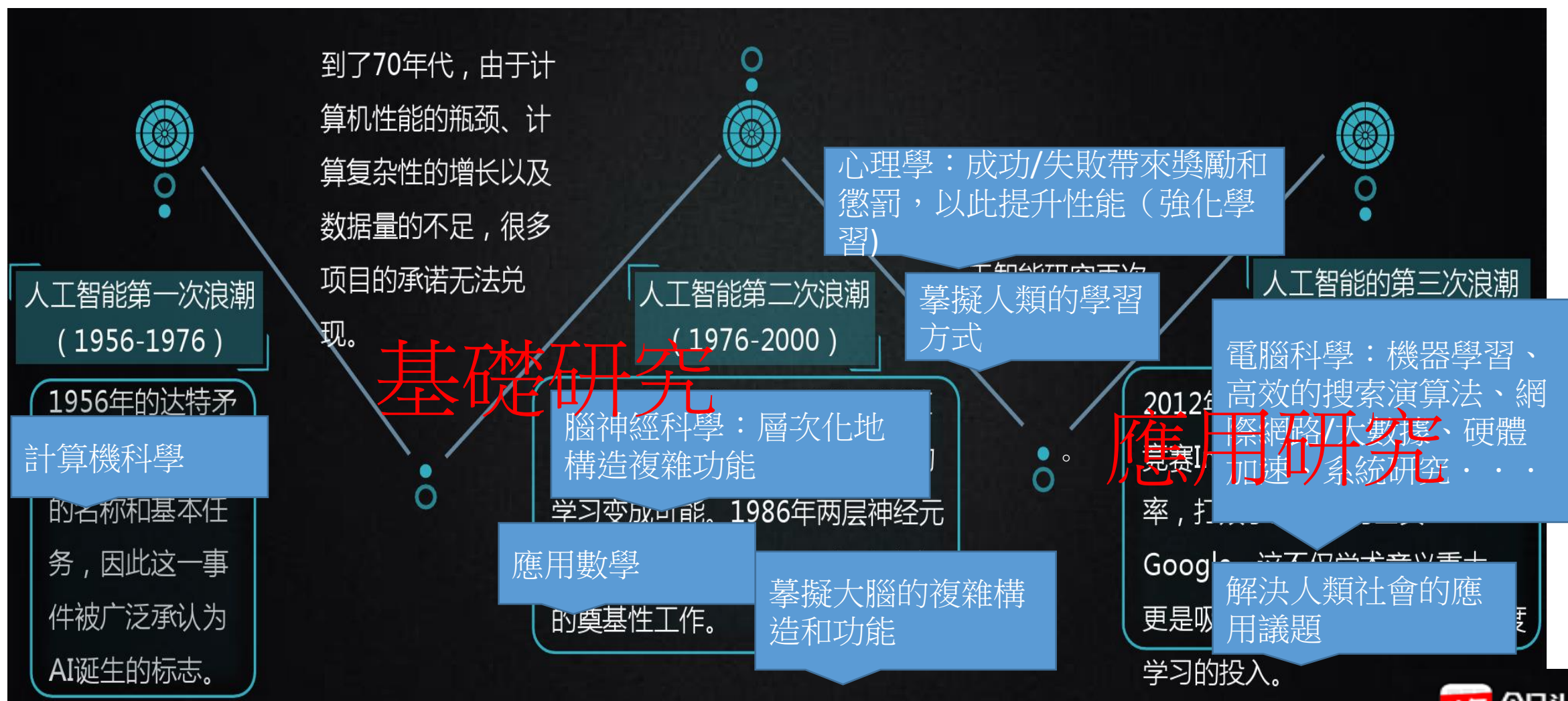
- Rule-based AI systems (e.g., expert systems, decision support systems, ...)
- Systems with Mathematical Models (e.g., linear programming modeling, ...)
- Systems with Statistical Models (e.g., linear regression modeling, Bayesian method, Queuing method, ...)
- Systems with ANN, Fuzzy logic, Genetic algorithm, Random forest, ...
- Big Data Analytics Systems
- Machine Learning Systems
- Deep Learning Systems

All of them lead to the  
intelligent system

# AI tools

- Artificial Intelligence (**AI**), Artificial Neural Networks (**ANN**), Text Mining (**TM**), Data Mining (**DM**), Business Intelligence (**BI**), Big Data Analytics (**BDA**), Machine Learning (**ML**), Deep Learning (**DL**) and so on.
- What is the difference between **the old AI** and **the new AI**?

# 起起伏伏的 AI 歷史





## Birth of AI

- **Information Theory** – digital signals
- Cybernetics – thinking machines
- The Turing Test
- Symbolic reasoning

## Focus on Specific 'Intelligence'

- **Expert Systems** (knowledge)
- Neural Networks make a comeback
- Optical character recognition
- Speech recognition

## Focus on Specific Problems

- **Machine learning**
- **Deep learning** – pattern analysis / classification
  - Big data: large databases
  - Fast processors to crunch data
  - High-speed networks

### 1. AI 理論

### 2. AI 系統:

#### a. 規則型 (Rule-based)

#### b. 學習型 (Learning-based)

##### b1. 機器學習型

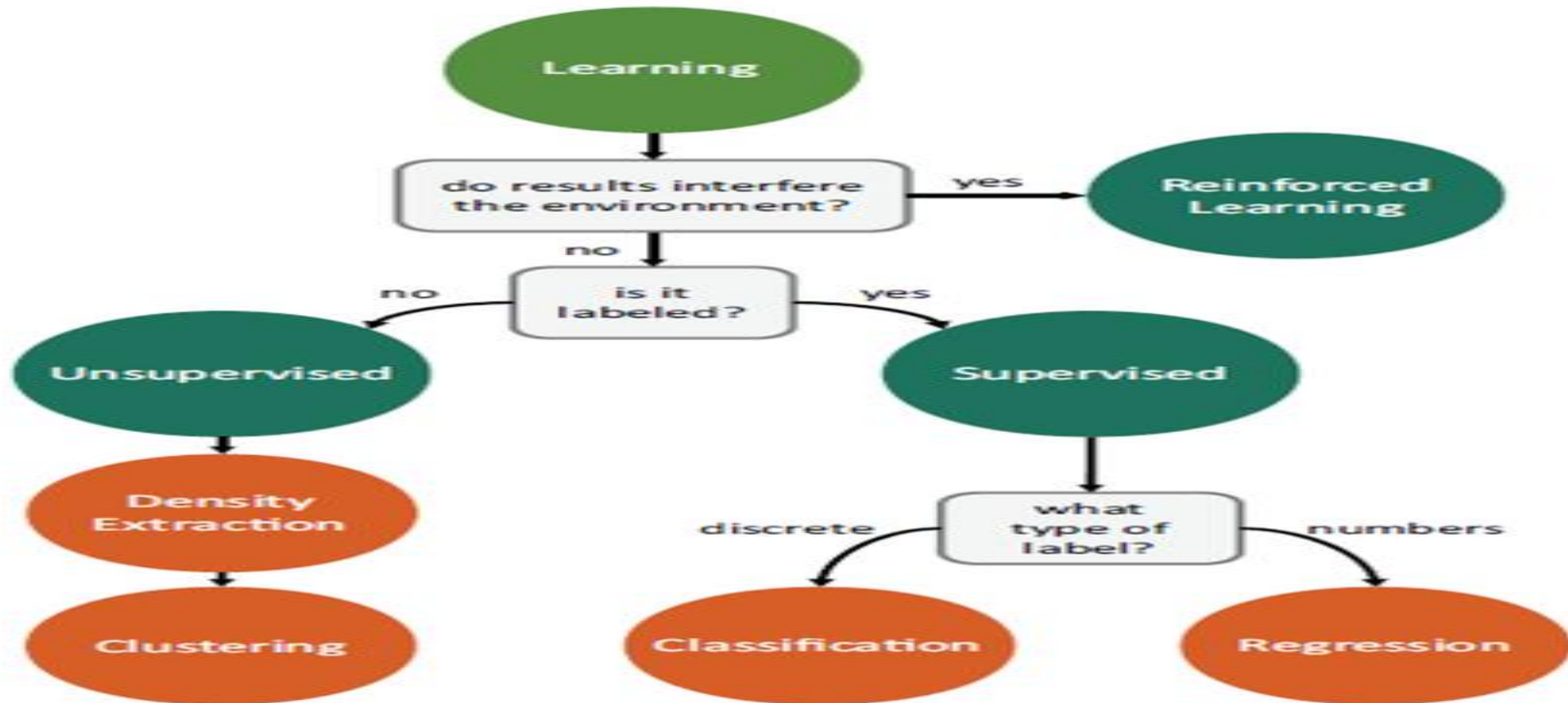
##### b2. 深度學習型

### 3. AI應用: 智慧運輸、智慧醫療、智慧製造、...

AI Winter I

AI Winter II

# New AI systems -- Learning-based AI systems



**Fig. 1: Machine learning methods categorization**

# Types of Learning

**Supervised:** Learning with a **labeled training set**

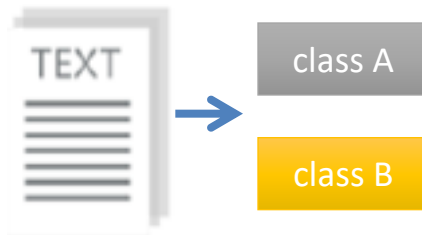
Example: email **classification** with already labeled emails

**Unsupervised:** Discover **patterns** in **unlabeled data**

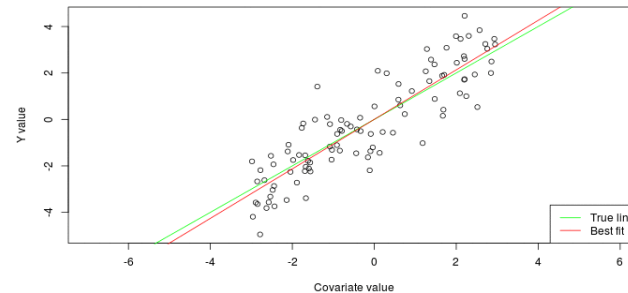
Example: **cluster** similar documents based on text

**Reinforcement learning:** learn to **act** based on **feedback/reward**

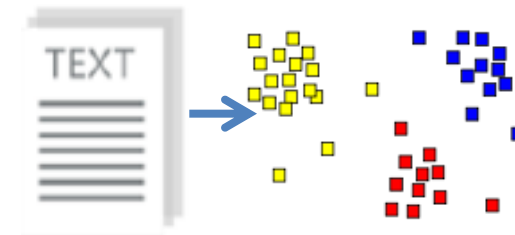
Example: learn to **play** Go, reward: **win or lose**



Classification



Regression

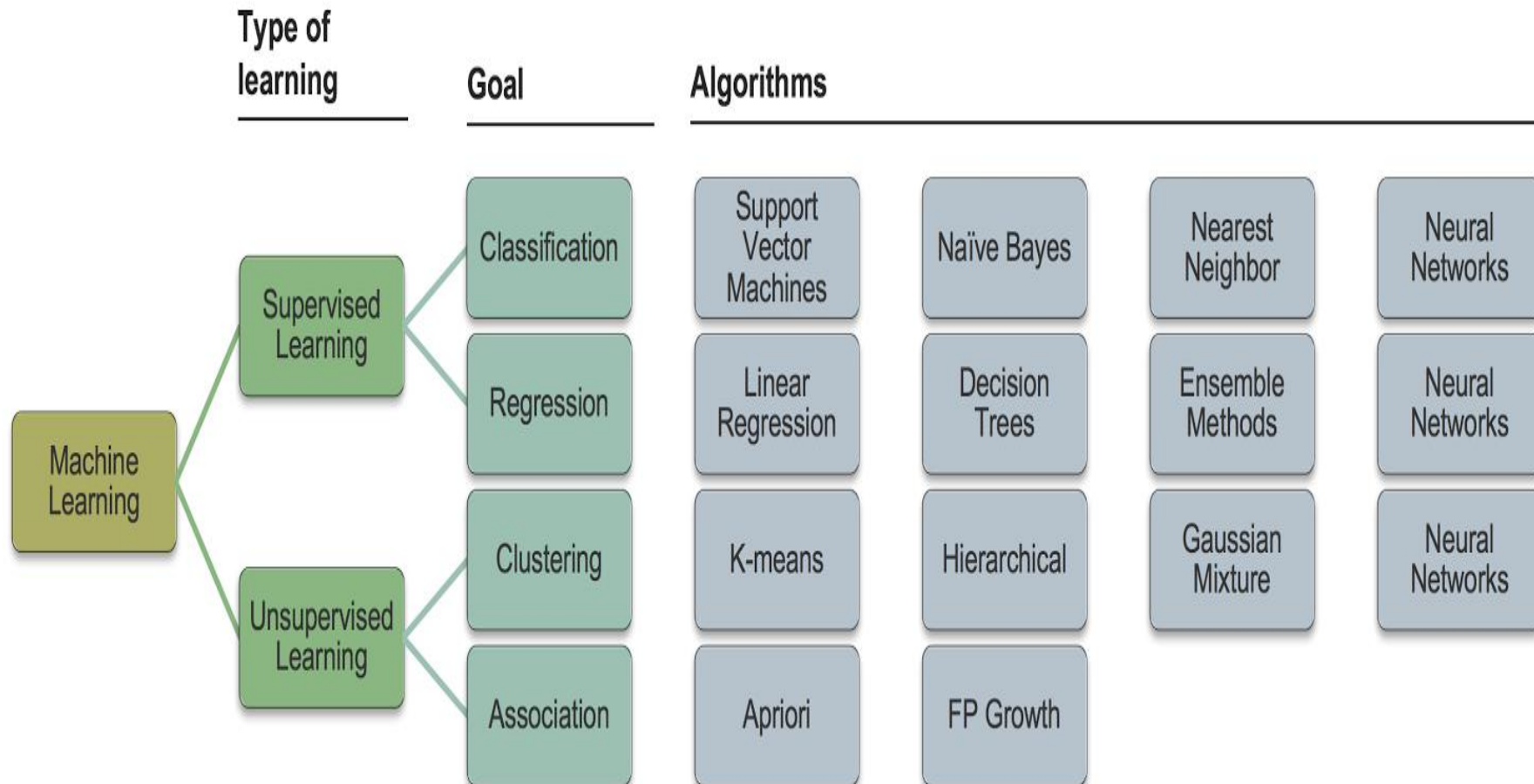


Clustering

Anomaly Detection  
Sequence labeling

...

# Types of Learning





# ANN是根基於腦神經科學, 應用數學/ 心理學, 以及電腦科學

## 應用研究

利用電腦解決人類社會的應用議題



## 基礎研究

摹擬大腦的複雜構造和功能

**Neuroscience:** (+50yrs)

- Composing complex features hierarchically

摹擬人類的學習方式

**Psychology:** (+100yrs)

- success/failure shapes the model, improves performance (reinforcement learning)

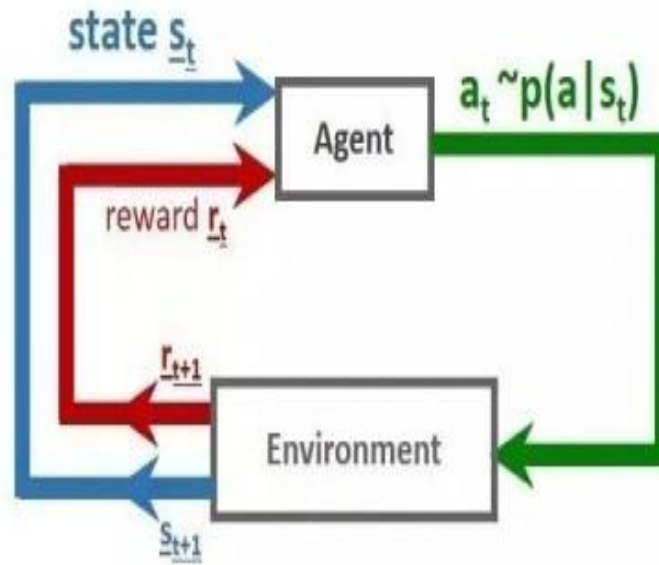
**Computer science:** (+30yrs)

- Machine learning
- Efficient search algorithm
- Internet/big data
- Hardware acceleration
- **System research**
- ...

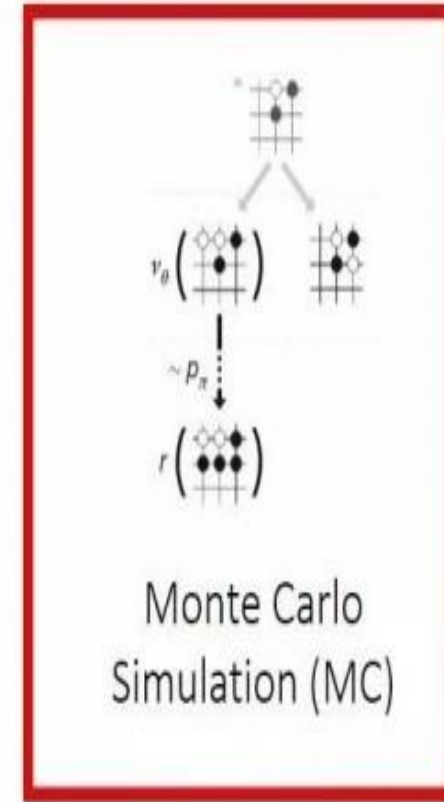
# AlphaGo不僅是深度學習



Deep Learning  
(DL)



Reinforcement Learning



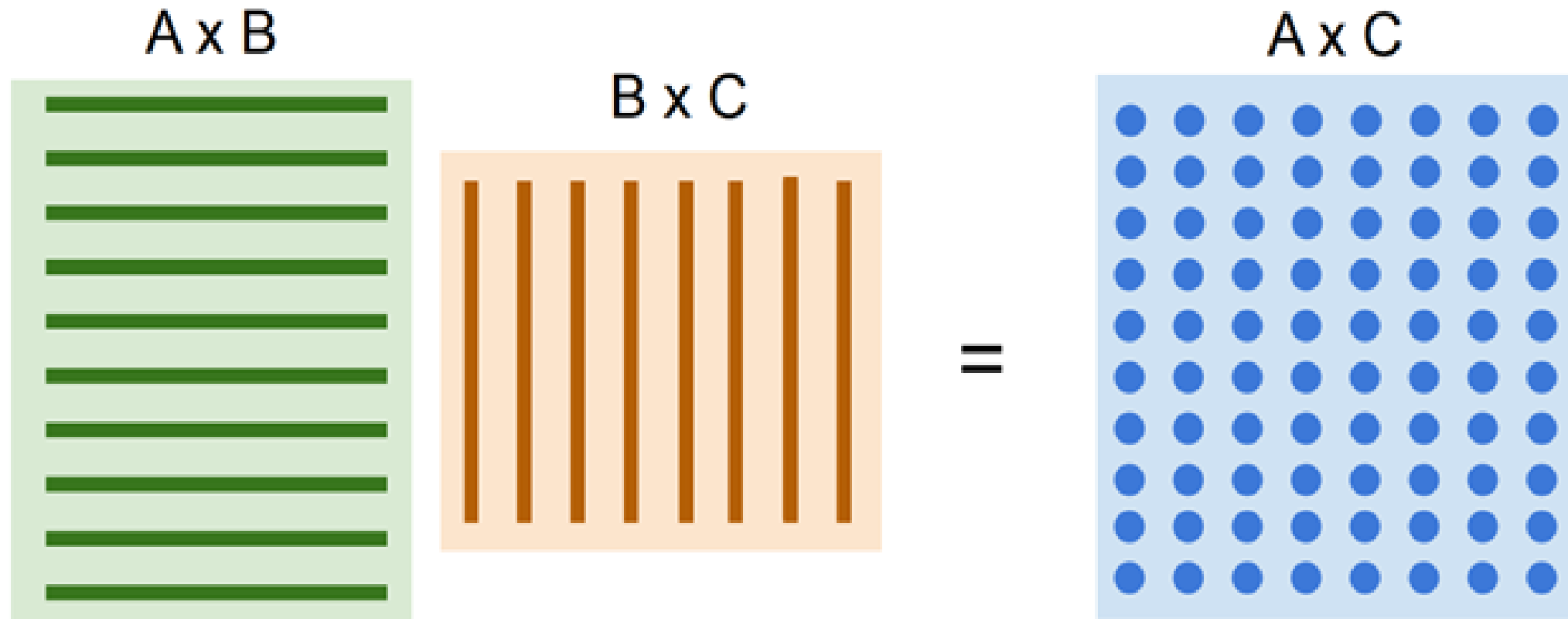
# Ingredients for deep learning



# Computation

- Facebook使用**256顆GPU**，把訓練時間降低到一個小時，如果沒有這樣的平台，請問需要多久時間？
- 四百萬台幣買一台DGX-1有**8顆GPU**，大約**30小時**。
- 這意味著至少要等到明天才能知道新設計的網路表現如何
- 商湯(AI新創公司)建立一個具有**800+顆GPU**的AI雲平台

# Example: Matrix Multiplication





# CPU vs GPU

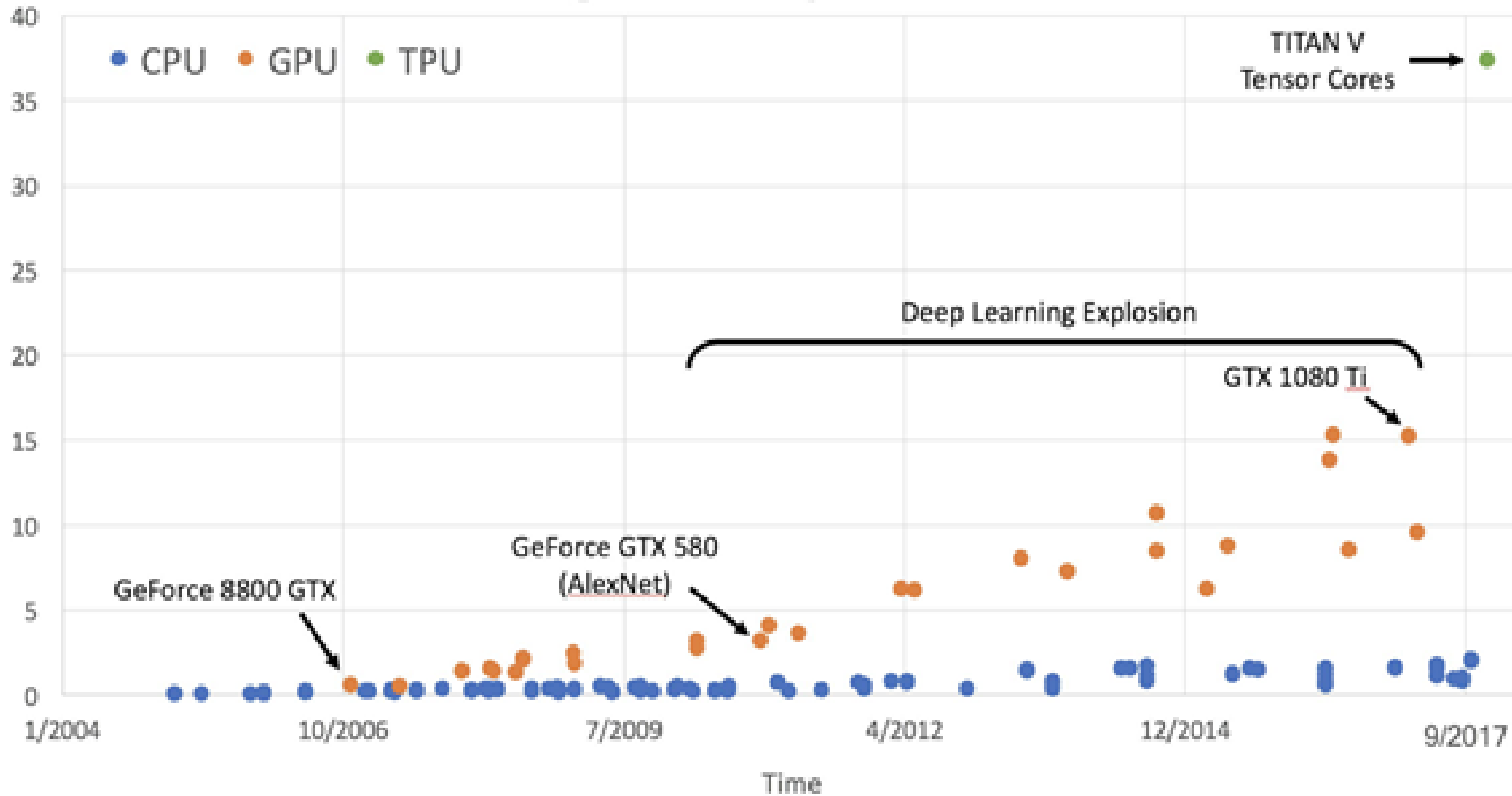
	Cores	Clock Speed	Memory	Price	Speed
<b>CPU</b> (Intel Core i7-7700k)	4 (8 threads with hyperthreading)	4.2 GHz	System RAM	\$385	~540 GFLOPs FP32
<b>GPU</b> NVIDIA RTX 2080 Ti	3584	1.6 GHz	11 GB GDDR6	\$1099	~13 TFLOPs FP32 ~114 TFLOPs FP16
<b>GPU (Data Center)</b> NVIDIA V100	5120 CUDA, 640 Tensor	1.5 GHz	16/32 GB HBM2	\$2.5/hr (GCP)	~8 TFLOPs FP64 ~16 TFLOPs FP32 ~125 TFLOPs FP16
<b>TPU</b> Google Cloud TPUv3	2 Matrix Units (MXUs) per core, 4 cores	?	128 GB HBM	\$8/hr (GCP)	~420 TFLOPs (non-standard FP)

**CPU:** Fewer cores, but each core is much faster and much more capable; great at sequential tasks

**GPU:** More cores, but each core is much slower and "dumber"; great for parallel tasks

**TPU:** Specialized hardware for deep learning

## GigaFLOPs per Dollar



# Programming GPUs

- CUDA (NVIDIA only)
  - Write C-like code that runs directly on the GPU
  - Optimized APIs: cuBLAS, cuFFT, cuDNN, etc
- OpenCL
  - Similar to CUDA, but runs on anything
  - Usually slower on NVIDIA hardware
- HIP <https://github.com/ROCm-Developer-Tools/HIP>
  - New project that automatically converts CUDA code to something that can run on AMD GPUs
- Stanford CS 149: <http://cs149.stanford.edu/fall19/>

# A zoo of frameworks!

Caffe  
(UC Berkeley)



Caffe2  
(Facebook)  
mostly features absorbed  
by PyTorch

Torch  
(NYU / Facebook)



PyTorch  
(Facebook)

Theano  
(U Montreal)



TensorFlow  
(Google)

We'll focus on these

PaddlePaddle  
(Baidu)

Chainer  
(Preferred Networks)  
The company has officially migrated its research  
infrastructure to PyTorch

MXNet  
(Amazon)  
Developed by U Washington, CMU, MIT,  
Hong Kong U, etc but main framework of  
choice at AWS

CNTK  
(Microsoft)

JAX  
(Google)

And others...

# The point of deep learning frameworks

- (1) Quick to develop and test new ideas
- (2) Automatically compute gradients
- (3) Run it all efficiently on GPU (wrap cuDNN, cuBLAS, OpenCL, etc)



# 人工智慧應用研發

The current AI can support three business needs:

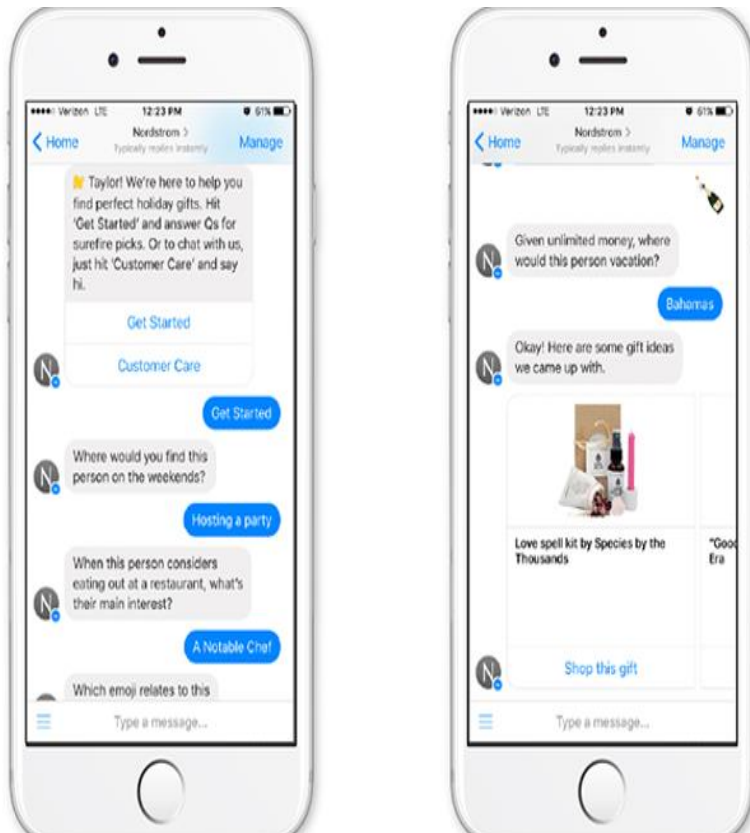
1. automating business processes (商業流程自動化),
2. gaining (cognitive) insight through data analysis (透過資料分析取得見解), and
3. (cognition) engaging with customers and employees (與顧客和員工交流互動).

by T. H. Davenport & R. Ronanki  
HBR, Jan.-Feb. 2018

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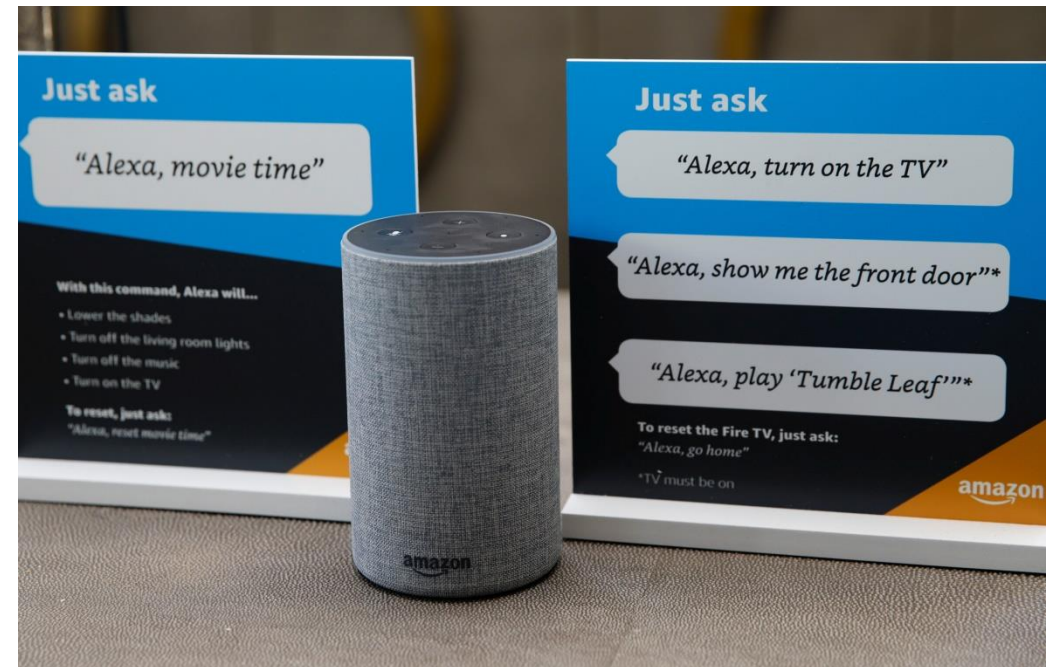
# Cognitive Engagement

## Chatbot



## Amazon Alexa

**Alexa**是亞馬遜公司推出的一款智能助理，最初用於Amazon Echo智能音箱。該產品由Amazon Lab126開發，是一名女性語音助手。



# 白駕車、智慧機器人、...



# AI-as-a-Services (AlaaS)

<b>AWS</b>	<b>Google</b>	<b>Microsoft</b>	<b>IBM</b>	<b>Salesforce</b>	<b>SenseTime</b>
AI Services	ML Services	Azure AI Services	Application/Micro-service	Application	Solution Layer
			AI APIs & In-house AI custom model		
	ML Data Curation		Data Lake and Data Store	Data Services	
ML Services	Pre-train, Custom model		Machine & Deep learning		Platform Layer
ML Framework & Infrastructure					
	AI Platform	AI Tools		AI Platform Services	
	Google Cloud Colaboratory	AI Infrastructure	Distributed Computing and Infrastructure	Multitenant Infrastructure	Technology Layer

# 現今的AI應用研發

研發新的AI應用系統(完整的訓練資料、好的學習演算法、強大的計算能力)

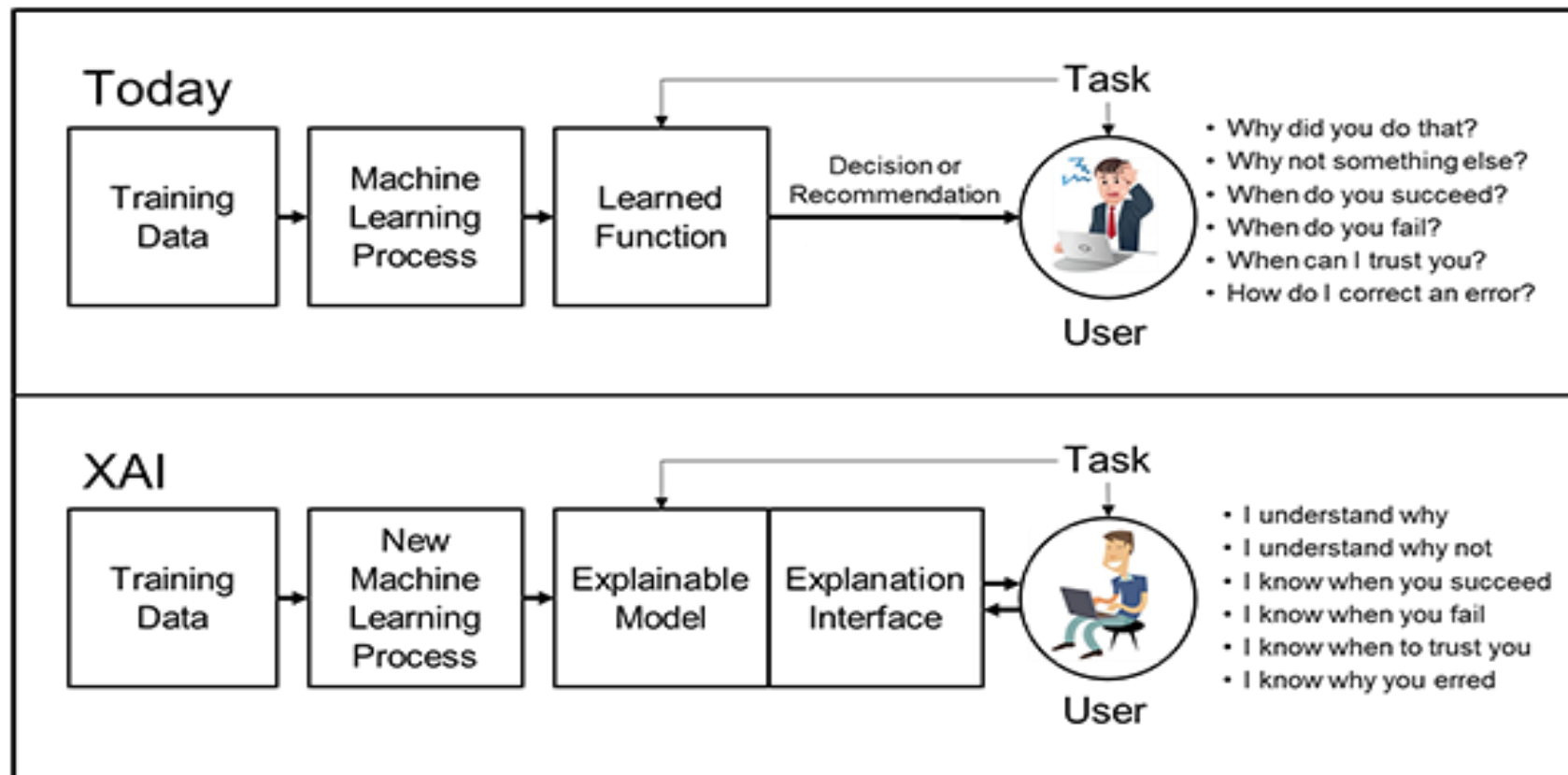
- (1) 科技基礎建設，以滿足雲運算、大數據分析、AI運算等需求
- (2) 跨領域人才，或組成一個精英團隊，包括應用領域專家、AI專家和電腦系統專家
- (3) AI應用的知識和經驗，或促使精英團隊之知識互相分享、融合，而形成新知識
- (4) 整個完備之資訊系統
- (5) 務實的投資

應用研發: 效率、效益、價值



# Black Box

美國國防高級研究計劃局(DARPA)於2017年發起了XAI (Explainable AI) 項目



# AI之現在與未來

## 弱AI

- 專注在一個領域，媲美那個領域之專業人士

## 強AI

- 專注在很多個領域，媲美每個領域之專業人士

## 超AI

- 專注在很多個領域，且優於每個領域之專業人士