

Class 01: 機器學習簡介

蕭佳明
遠東科技大學 助理教授

github: <https://github.com/yihlonlin/Machine-Learning>

機器學習簡介

- 計畫課程簡介
- 機器學習簡介
- 環境建置與安裝
- 開源的資料集簡介
- 線上機器學習範例介紹
- 醫學專題實作

計畫課程簡介

計畫課程簡介

學習路徑	A. 核心課程	B. 進階課程	C. 應用課程
1.人工智慧系統平台 人才學習路徑 (Training for AI System Platforms)	資料科學、資料探勘、機器學習	平行計算、平行演算法	雲端系統、雲端運算
2.人工智慧電腦視覺 人才學習路徑 (Training for AI Computer Vision)	機器學習	深度學習、類神經網路、增強學習、圖模型、貝氏分析、機率模型	電腦視覺、影像處理、圖形識別

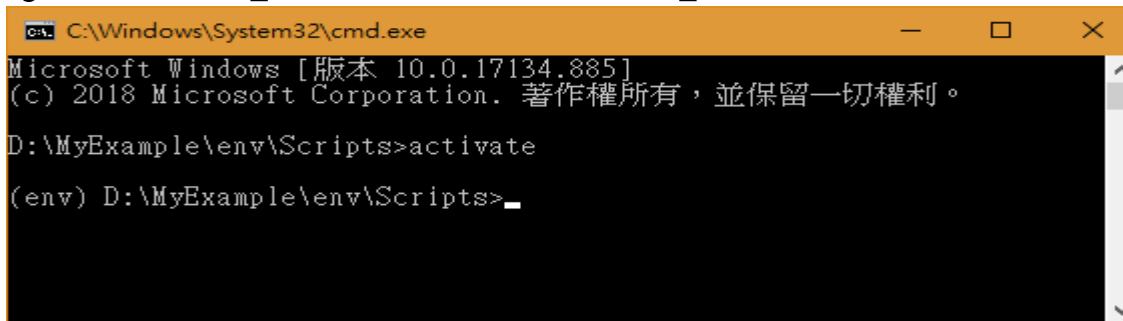
計畫課程簡介

學習路徑	A. 核心課程	B. 進階課程	C. 應用課程
3.自然語言處理 人才學習路徑 (Training for Natural Language Processing)	資料科學、資料探勘、機器學習	巨量資料、大數據分析、深度學習、類神經網路、圖模型	語音辨識、資訊擷取與搜尋、文字探勘、自然語言處理
4.人工智慧應用領域 人才學習路徑 (Training for AI Applications)	資料科學、資料探勘、機器學習、人工智能	資料視覺化、巨量資料、大數據分析、深度學習、類神經網路、圖模型、貝氏分析、機率模型、賽局理論、線性與非線性程式設計、演化式計算、模糊系統等	生物資訊分析、精準醫療、金融科技、製造資料分析、社群分析
5.人工智慧電腦對局 人才學習路徑 (Training for Computer Games)	人工智能	人工智能、增強學習、智慧代理	電腦對局
6.人工智慧機器人 人才學習路徑 (Training for Robotics)	機器學習、人工智能	深度學習、類神經網路、增強學習、智慧代理、賽局理論、線性與非線性程式設計、演化式計算、模糊系統	機器人、電腦視覺、語音辨識

環境建置與安裝

Virtual Environment

- C:\Users\user>pip install virtualenv
- D:\MyExample>virtualenv env
 - make env
- D:\MyExample>env\Scripts > activate
(env) D:\MyExample>pip install XXX
- D:\MyExample>env\Scripts > deactivate



Virtual Environment

- D:\MyExample>env\Scripts > activate
 - (env) D:\MyExample>pip install keras
 - (env) D:\MyExample>pip install jupyter
 - (env) D:\MyExample>pip install opencv-contrib-python
 - (env) D:\MyExample>pip install Sequential
 - (env) D:\MyExample>pip install utils
 - (env) D:\MyExample>pip install tensorflow

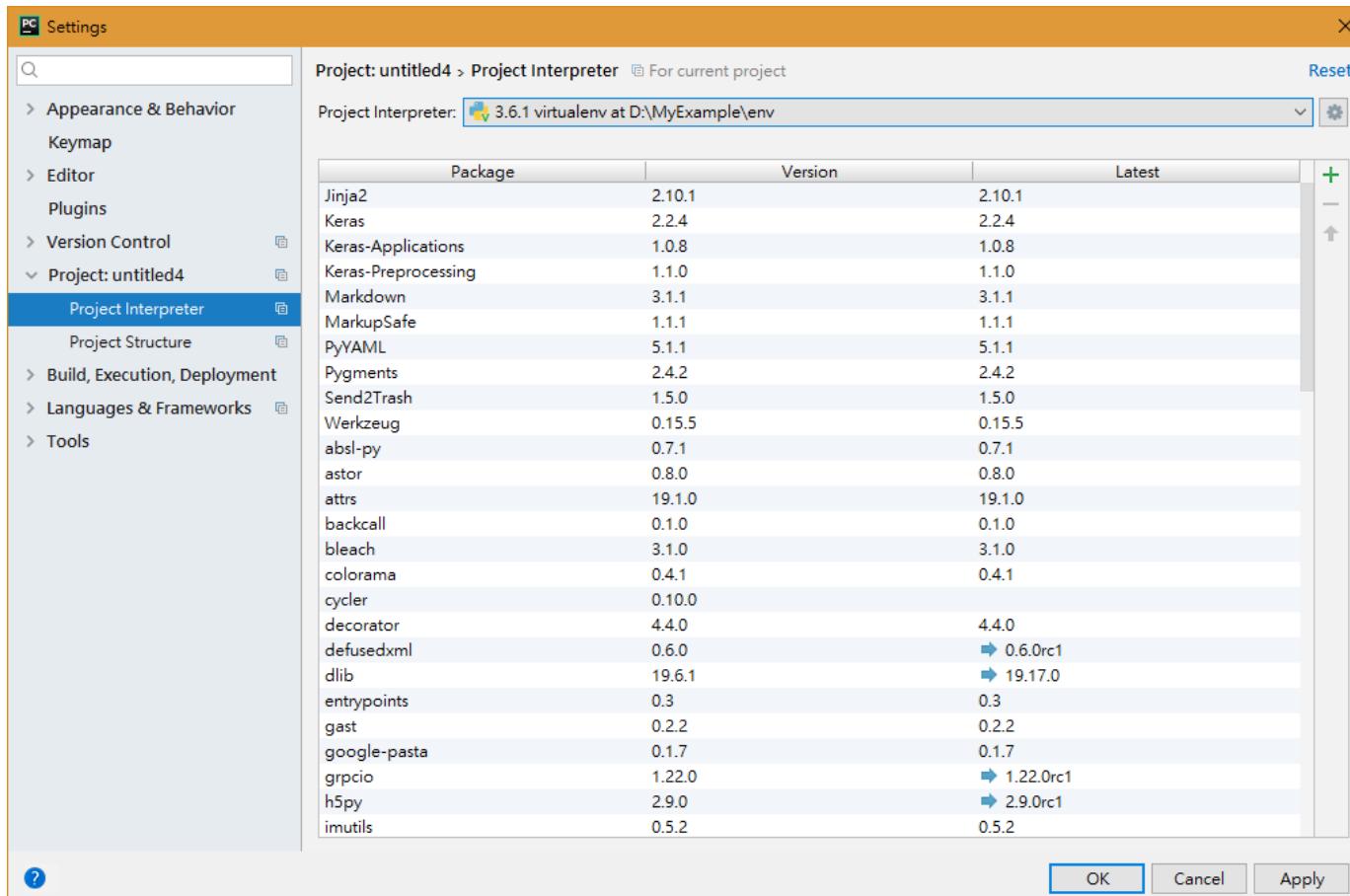
Virtual Environment

- D:\MyExample>env\Scripts > activate
 - (env) D:\MyExample>pip install imutils
 - (env) D:\MyExample>pip install dlib==19.6.1
 - (env) D:\MyExample>pip install mtcnn
 - (env) D:\MyExample>pip install matplotlib
 - (env) D:\MyExample>pip install pillow
 - (env) D:\MyExample>pip install pandas
 - (env) D:\MyExample>pip install pandas
 - (env) D:\MyExample>pip install sklearn
 - (env) D:\MyExample> pip install pydot

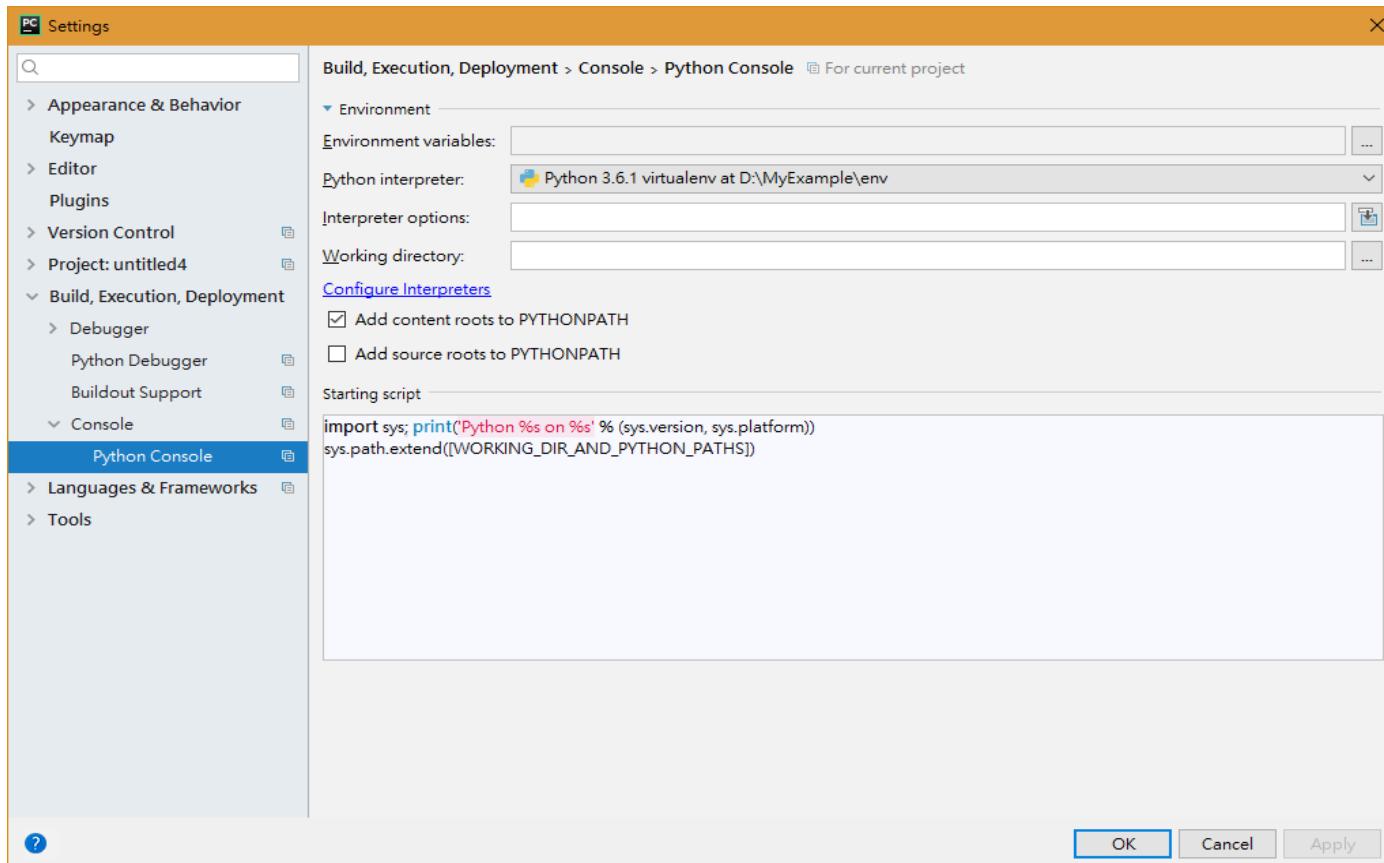
pip install requirements.txt

pip freeze > requirements.txt

PyCharm

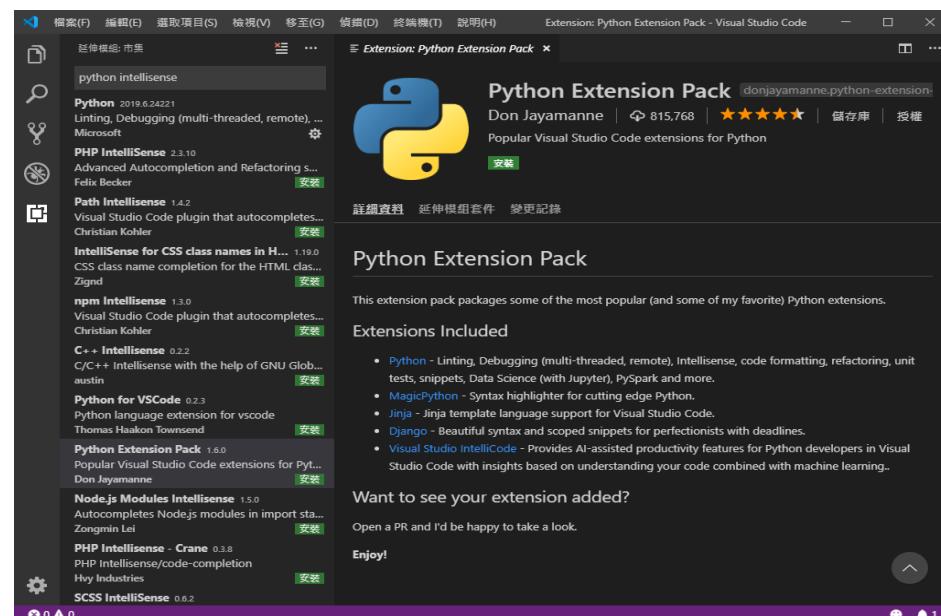


PyCharm



VS Code

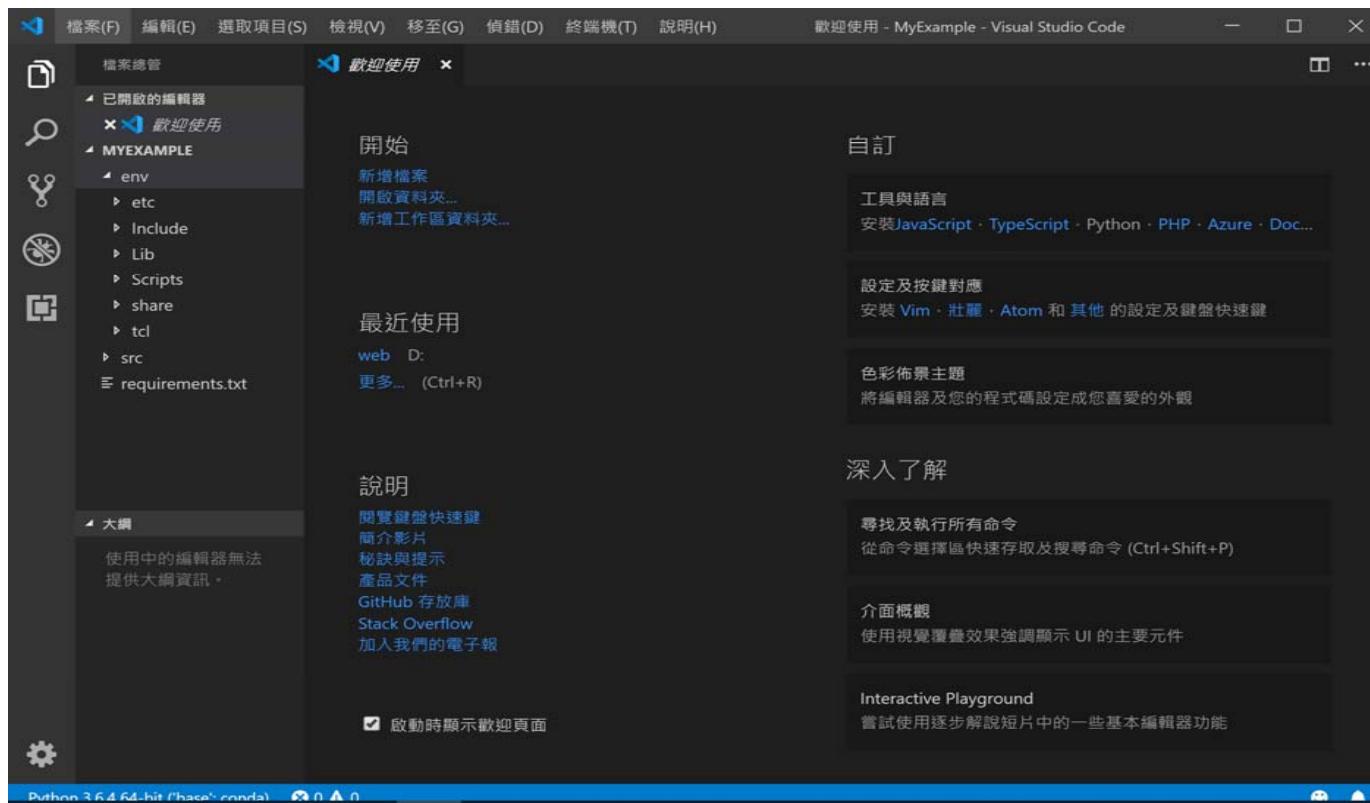
- Extension Pack
 - Chinese
 - Python (Reload)
 - IntelliSense/Auto-Completion
 - Linter pylint
 - Python Extension Pack



<http://www.weithenn.org/2018/05/python-journey-part02-how-to-use-vscode.html>
義守大學 I-SHOU UNIVERSITY

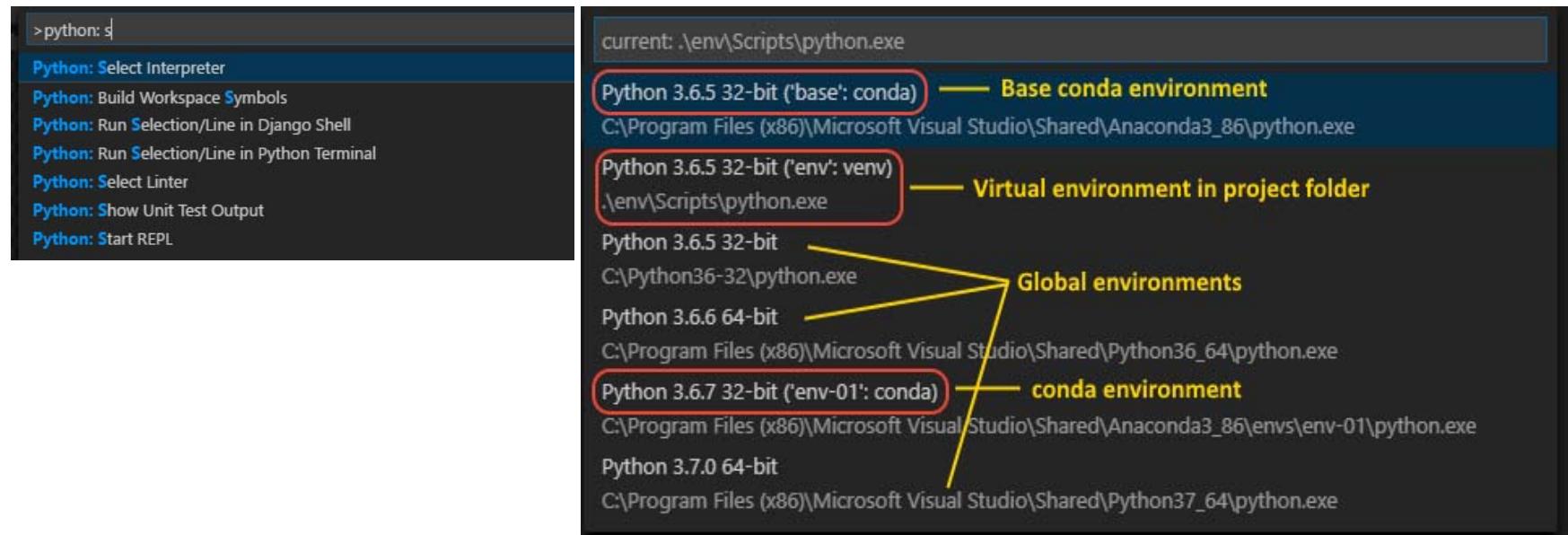
VS Code

- Open Folder



VS Code

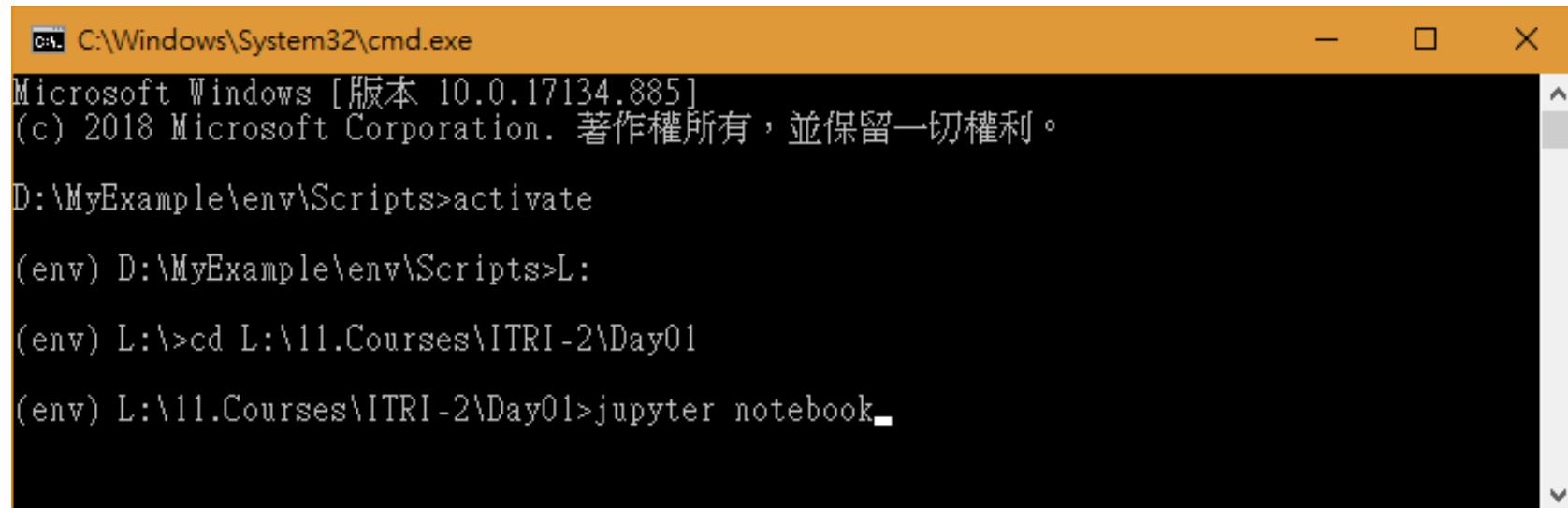
- Python: Select Interpreter (Ctrl+Shift+P)



- Windows size: ctrl+/-

Jupyter Notebook

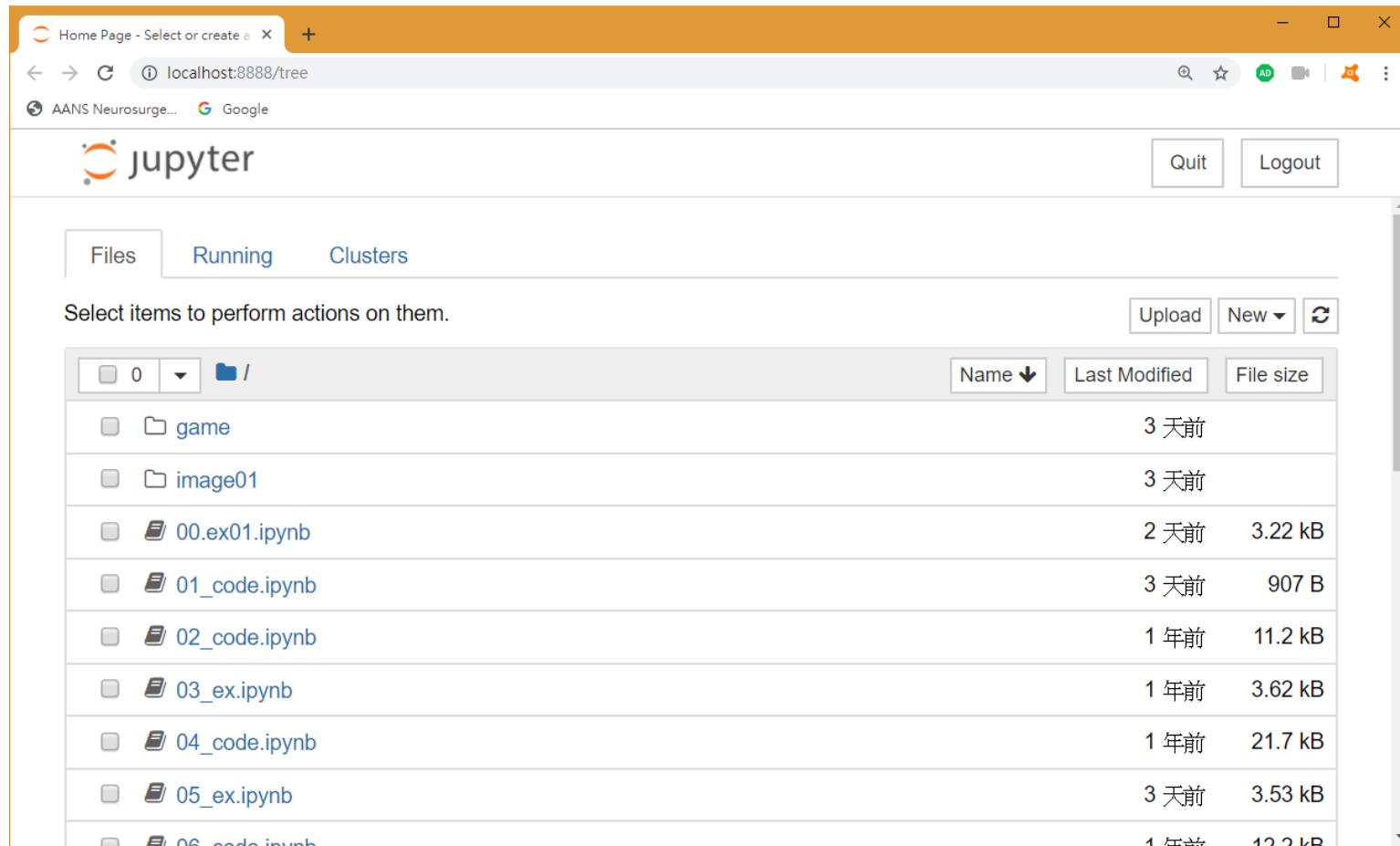
- D:\MyExample\env\Scripts>activate
- (env) D:\MyExample\env\Scripts>L:
- (env) L:\>cd L:\11.Courses\ITRI-2\Day01
- (env) L:\11.Courses\ITRI-2\Day01>jupyter notebook



```
C:\Windows\System32\cmd.exe
Microsoft Windows [版本 10.0.17134.885]
(c) 2018 Microsoft Corporation. 著作權所有，並保留一切權利。

D:\MyExample\env\Scripts>activate
(env) D:\MyExample\env\Scripts>L:
(env) L:\>cd L:\11.Courses\ITRI-2\Day01
(env) L:\11.Courses\ITRI-2\Day01>jupyter notebook
```

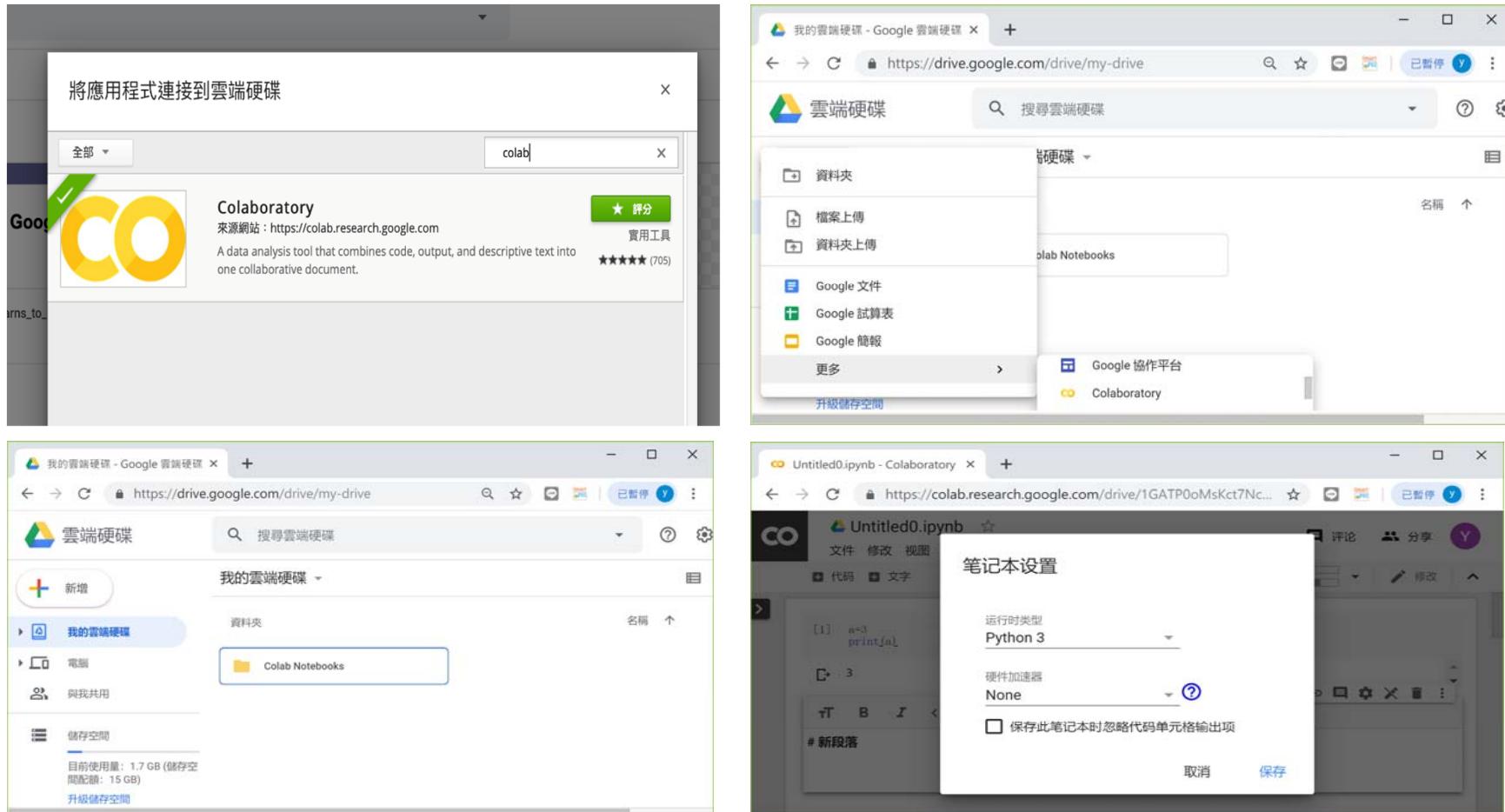
Jupyter Notebook



Google Colaboratory

- Google 提供深度學習運行的雲端空間
- Colab 如何GPU/TPU設定
- Colab 如何掛載雲端空間
- Colab 如何載入老師的雲端圖片
- 如何載入電腦圖片
- 程式路徑如何設定
- 時間限制(12 hr)

Google Colaboratory



<https://zhuanlan.zhihu.com/p/33466657>

Google Colaboratory

The screenshot shows the Google Colaboratory interface. At the top, there is a navigation bar with tabs: EXAMPLES, RECENT (which is selected), GOOGLE DRIVE, GITHUB, and UPLOAD. Below the navigation bar is a search bar labeled "Filter notebooks". A "grid" icon is also present. The main area displays a list of recent notebooks:

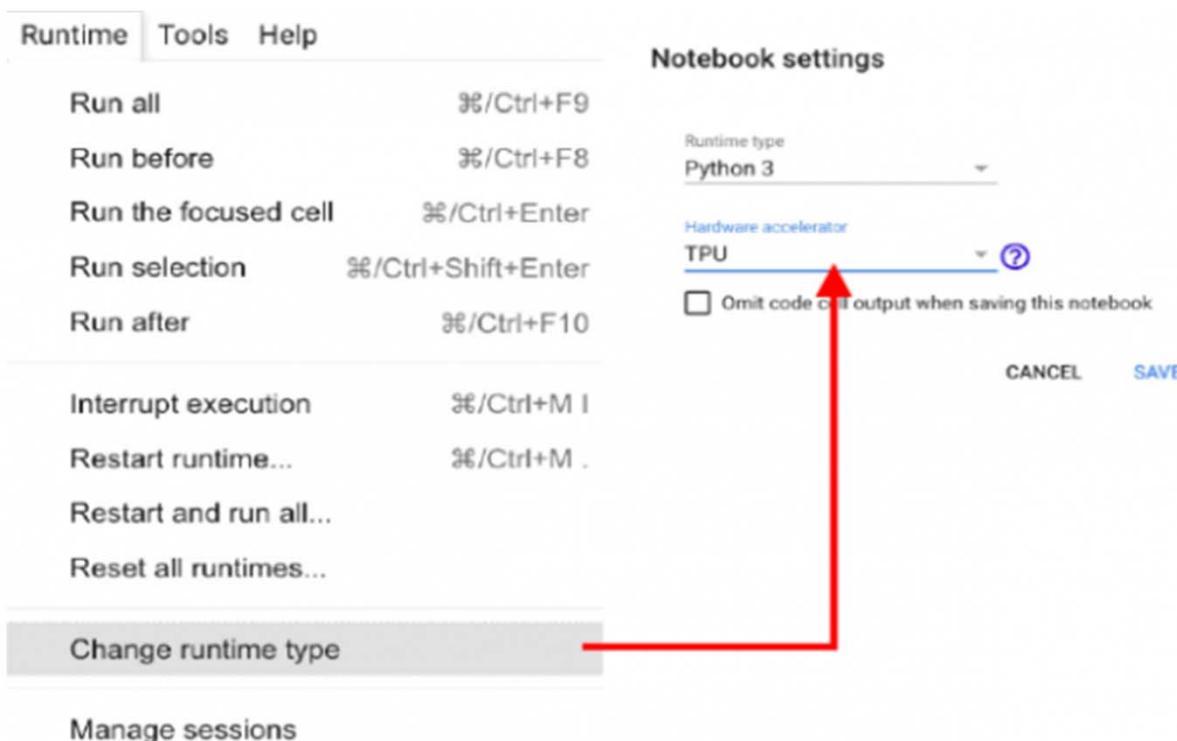
Title	First opened	Last opened	Actions
Hello, Colaboratory	13 days ago	0 minutes ago	
Untitled2.ipynb	3 minutes ago	3 minutes ago	
env-test.ipynb	12 minutes ago	12 minutes ago	
Copy of Assignment 3.ipynb	2 hours ago	2 hours ago	
Copy of Assignment 3.ipynb	3 hours ago	3 hours ago	

At the bottom right, there is a "NEW PYTHON 3 NOTEBOOK" button with a dropdown arrow and a "CANCEL" button.

<https://colab.research.google.com>

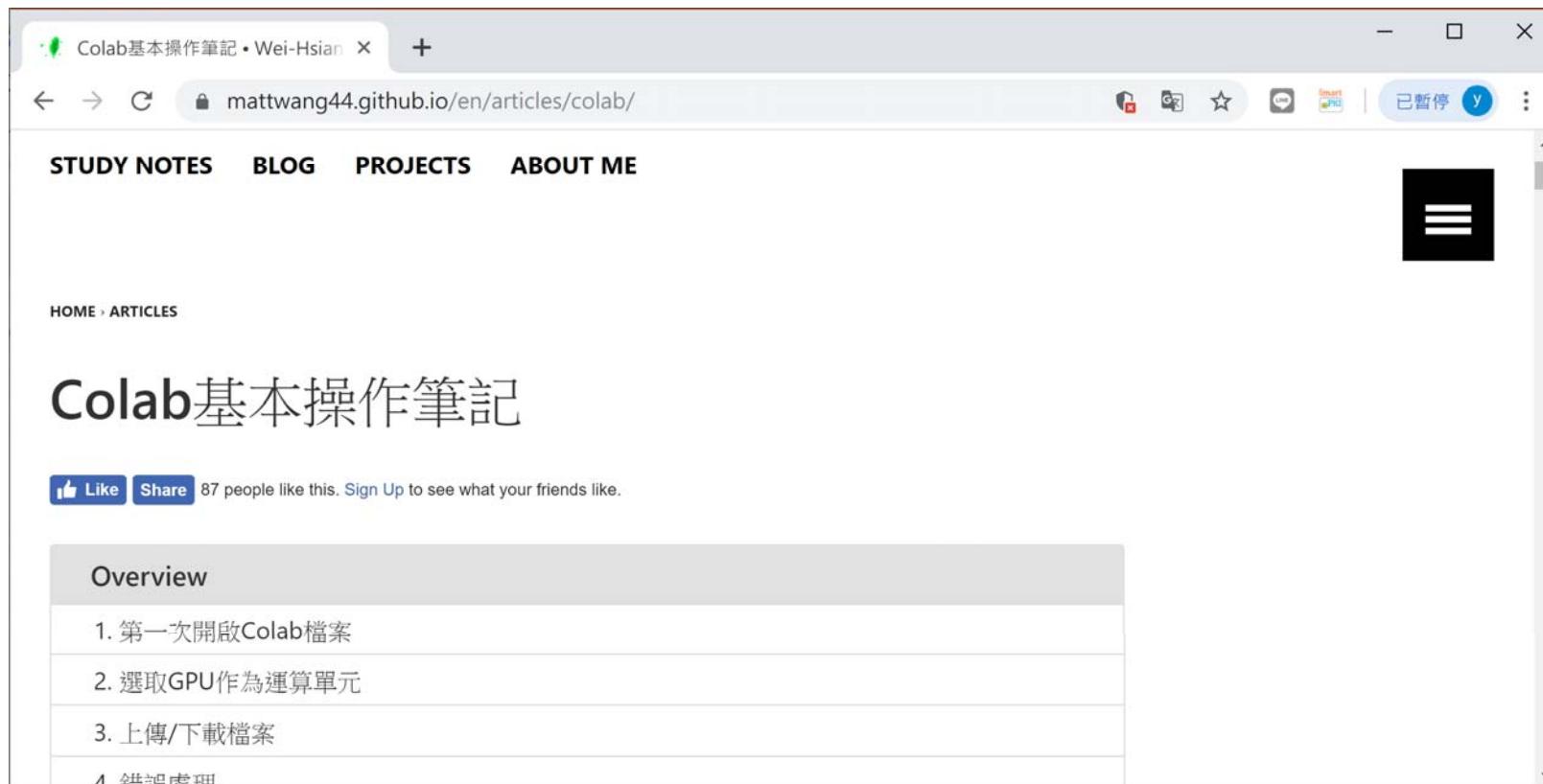
Google Colaboratory

- Runtime



<https://colab.research.google.com>

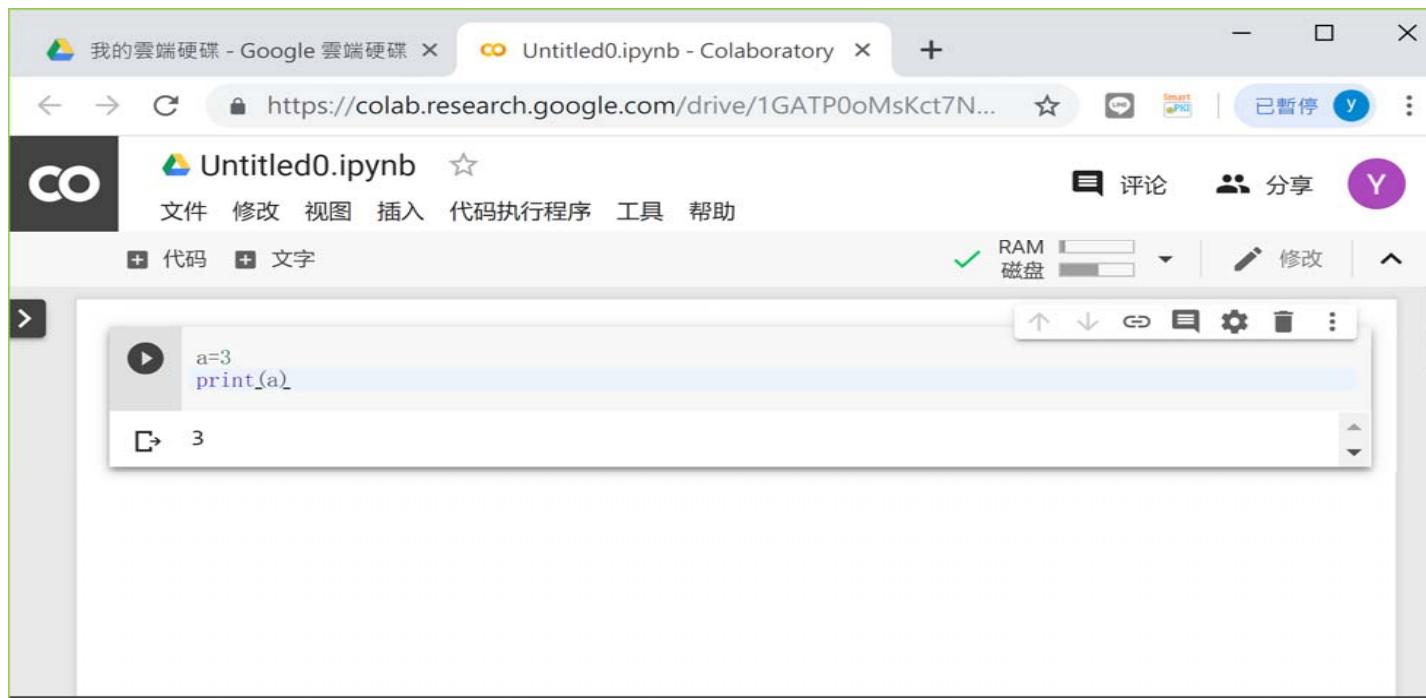
Google Colaboratory



<https://mattwang44.github.io/en/articles/colab/>

Google Colaboratory

- Google Drive/Colab Notebooks



Control+Enter

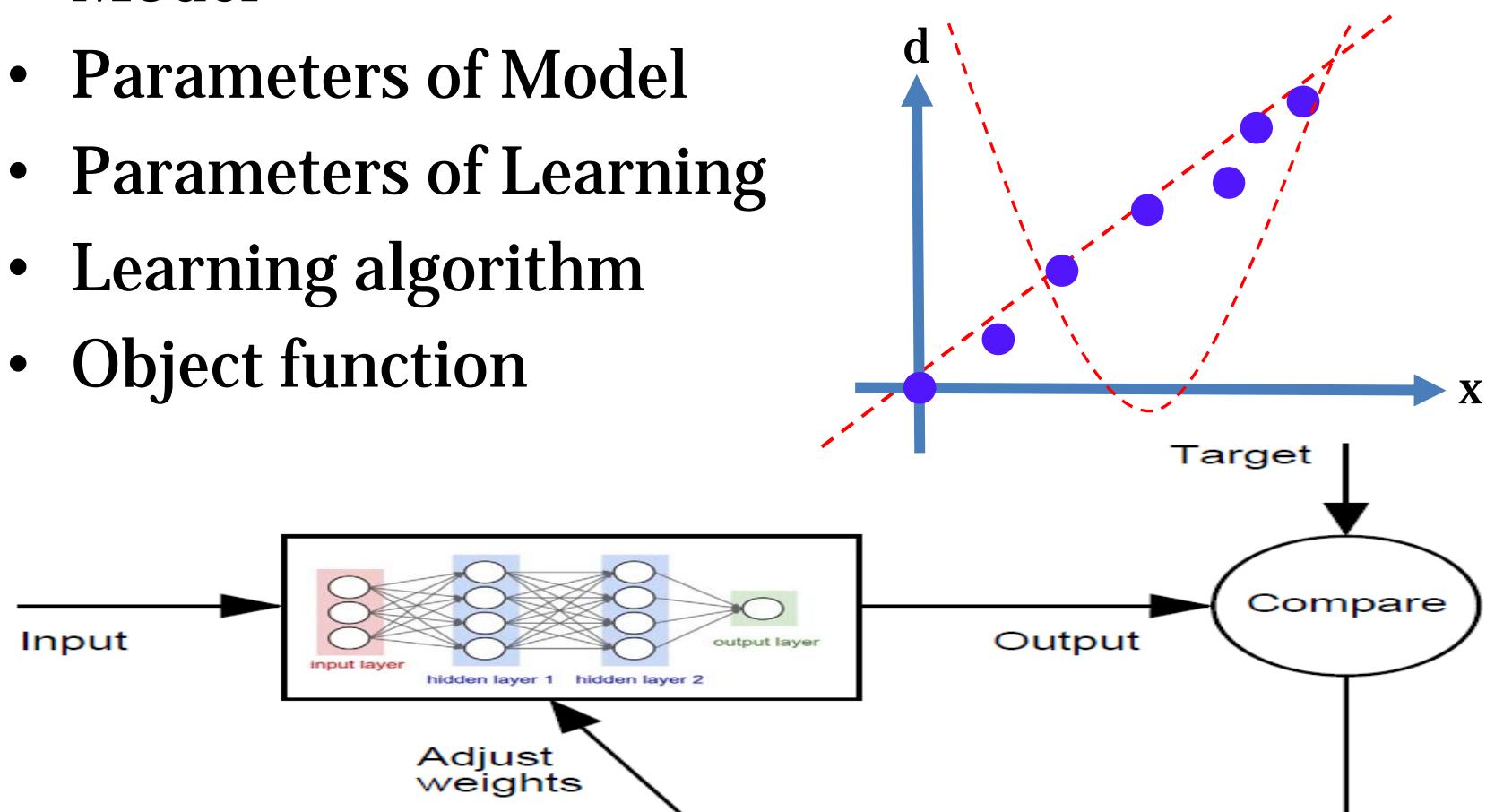
練習

- 第一次開啟Colab檔案
- 選取GPU作為運算單元
- 上傳/下載檔案
 - 開啟權限
 - 上傳/下載至Google Drive
 - 從GitHub下載
 - 安裝package

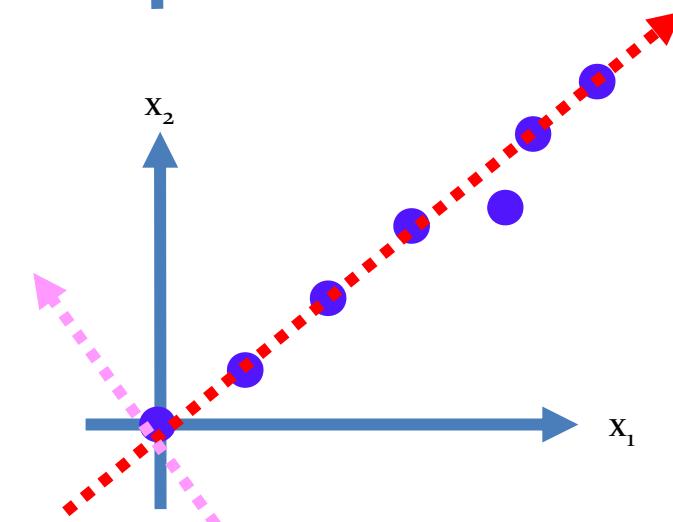
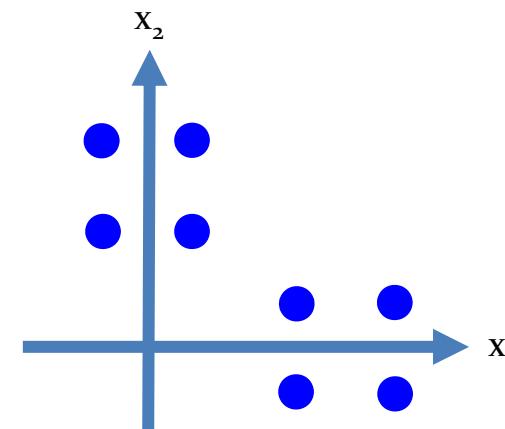
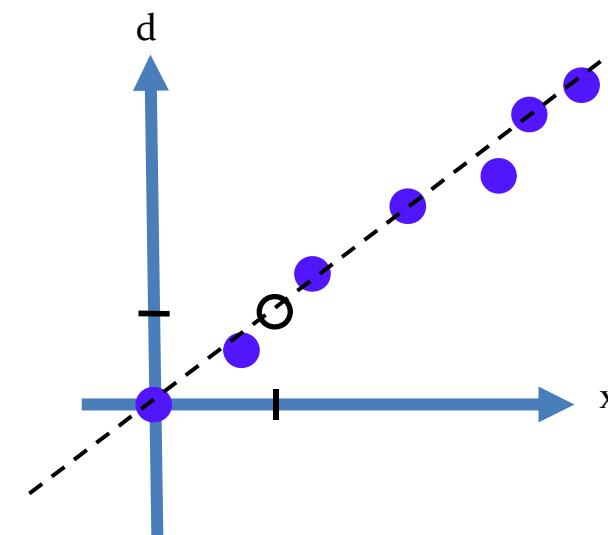
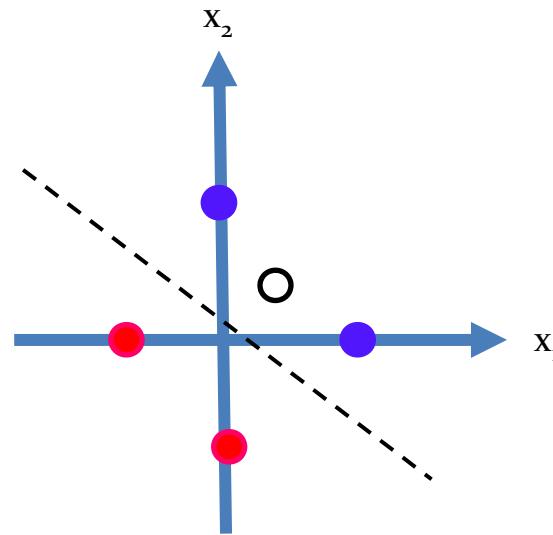
機器學習簡介

Supervised Learning

- Model
- Parameters of Model
- Parameters of Learning
- Learning algorithm
- Object function



Model Diagnostic



Supervised Learning

- In supervised learning, we have a dataset consisting of both **features** (input variables) and **labels** (output variables)
- The task is to construct an **estimator**(model) which enables to predict the labels of an instance given the set of features
- Two categories: **Classification** and **Regression**
 - Classification: the label is **discrete**
 - Regression: the label is **continuous**
- Split into **training** and **testing** datasets

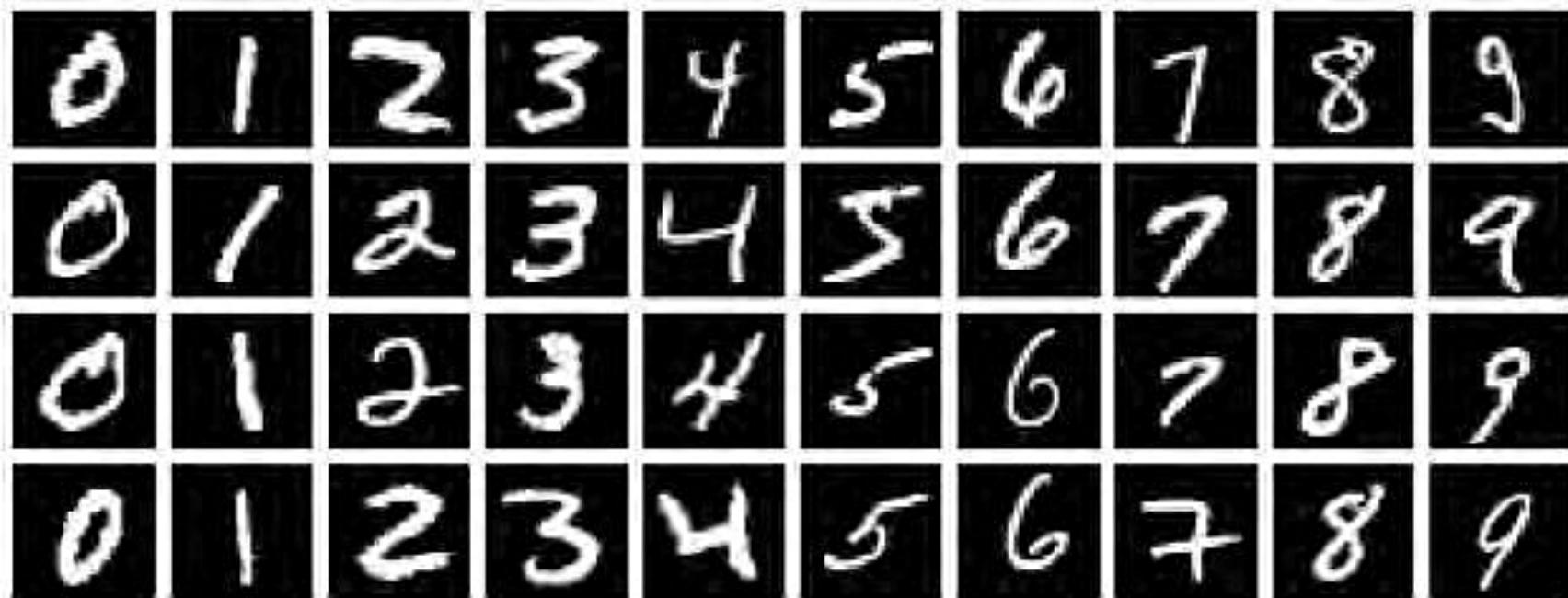
開源的資料集簡介

Datasets

- [UCI Machine Learning Repository](#)
- [Kaggle](#)
- [MNIST](#)
- [ImageNet](#)
- CIFAR-10/100
- MS-COCO
- Pascal VOC
- AIdea

MNIST

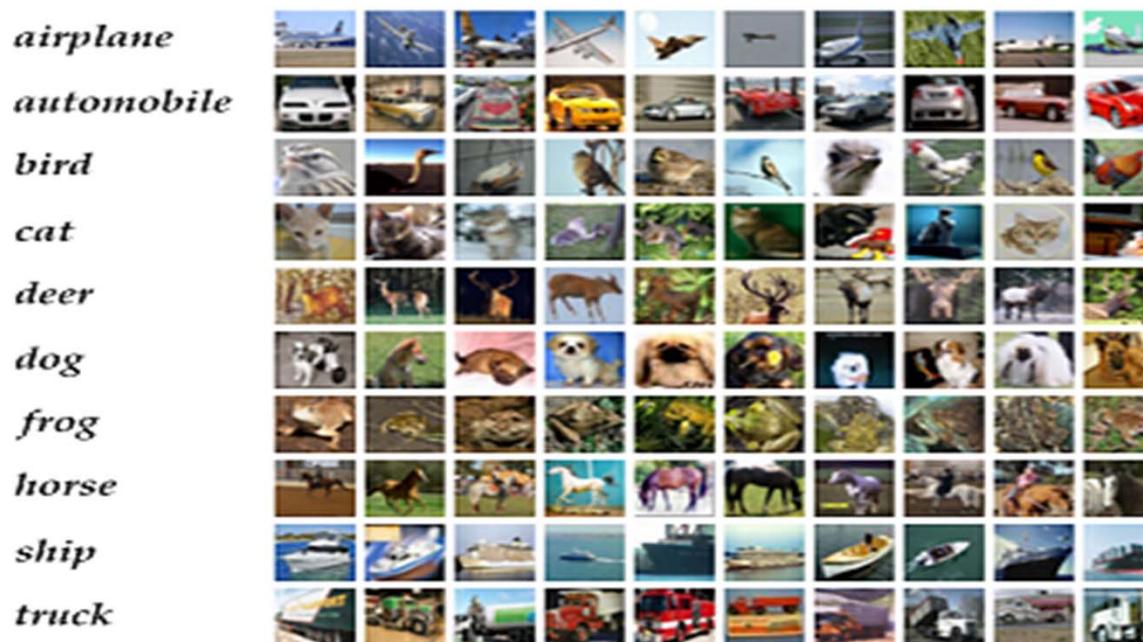
- handwritten digits
- 手寫數字分類



<http://yann.lecun.com/exdb/mnist/index.html>

CIFAR-10/100

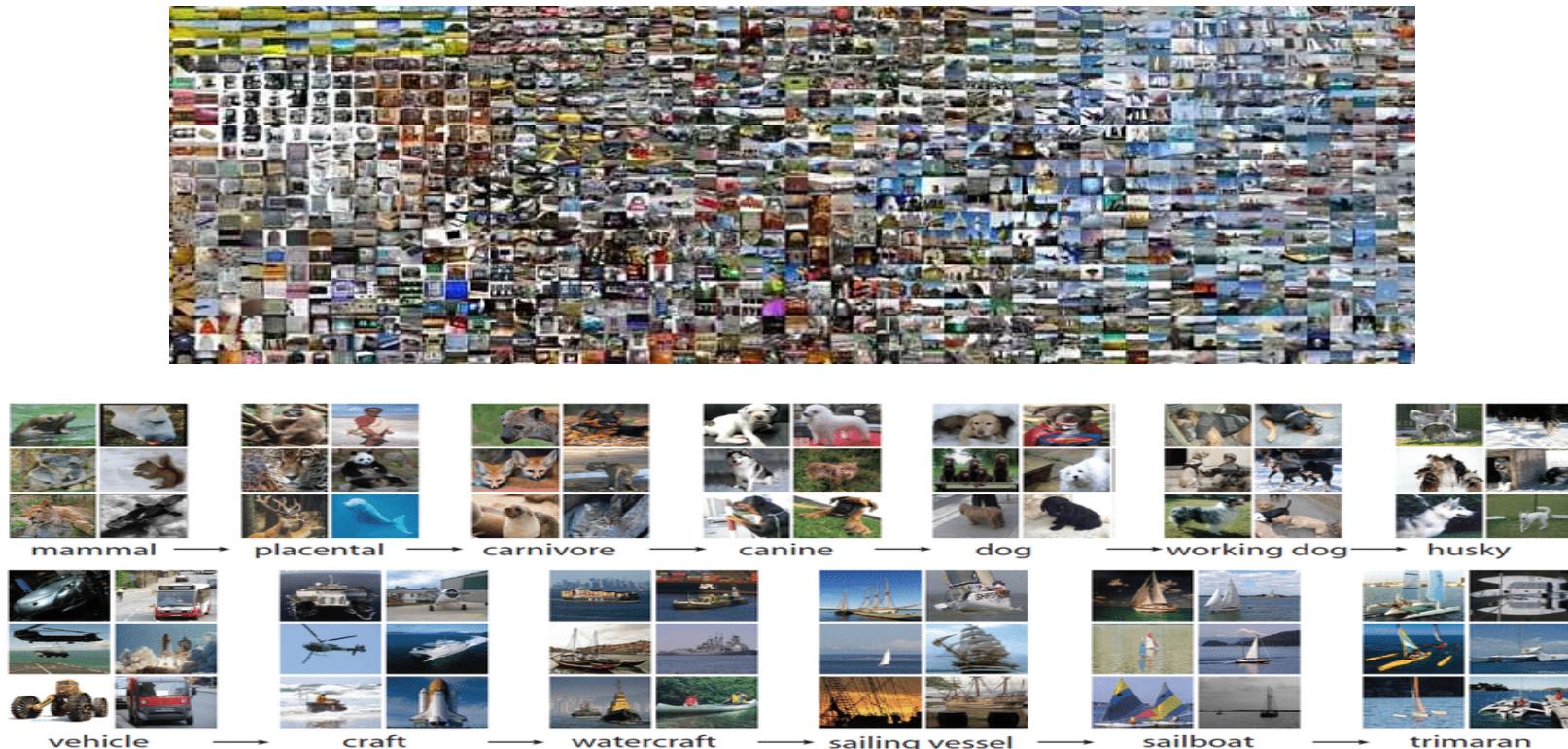
- 32×32 natural image dataset with 10/100 categories
- 影像分類



<http://www.cs.toronto.edu/~kriz/cifar.html>

ImageNet

- 影像分類



<http://www.image-net.org/about-stats>

MS-COCO

- 影像分類、影像定位、影像分割
- Common Objects in Context

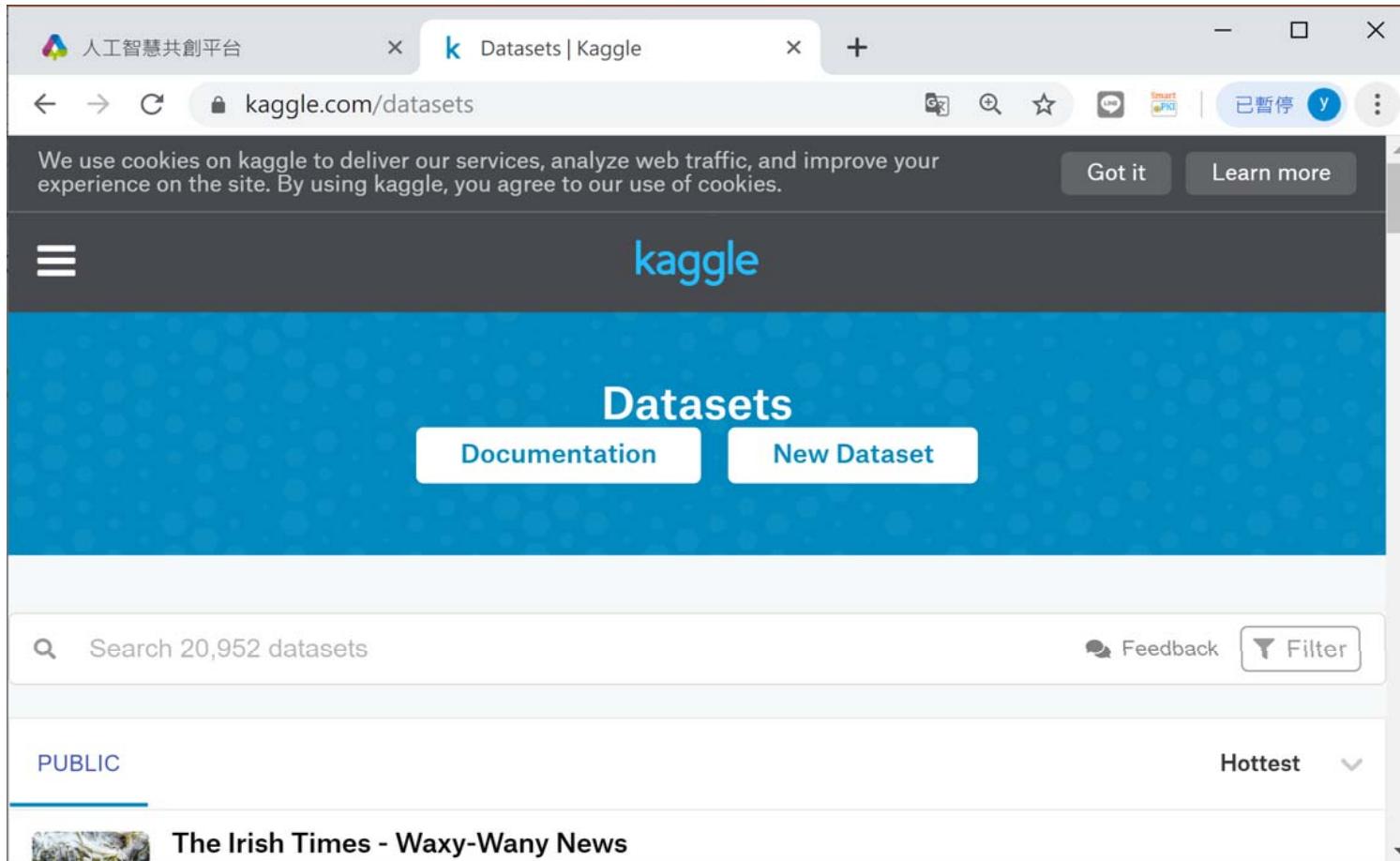


Pascal VOC

- 影像分類、影像定位、影像分割



Kaggle



<https://www.kaggle.com/datasets>

Aidea 人工智慧共創平台



<https://aidea-web.tw/>

義守大學 I-SHOU UNIVERSITY

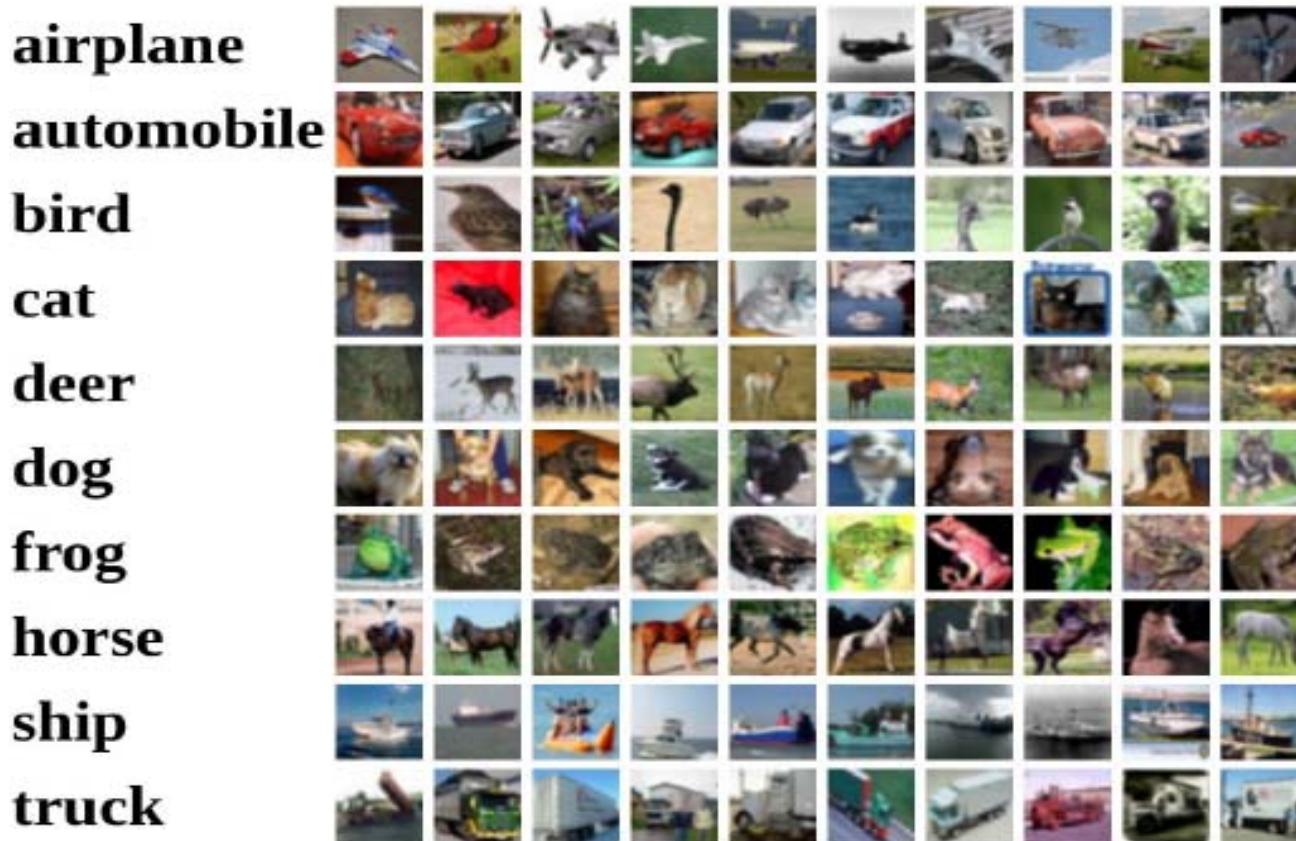
機器學習問題

Learning Problem

- 影像/數值
 - Text
 - Numerical →
 - Images
- Neural Networks
(Deep Learning)
- Text
 - Numerical
 - Images

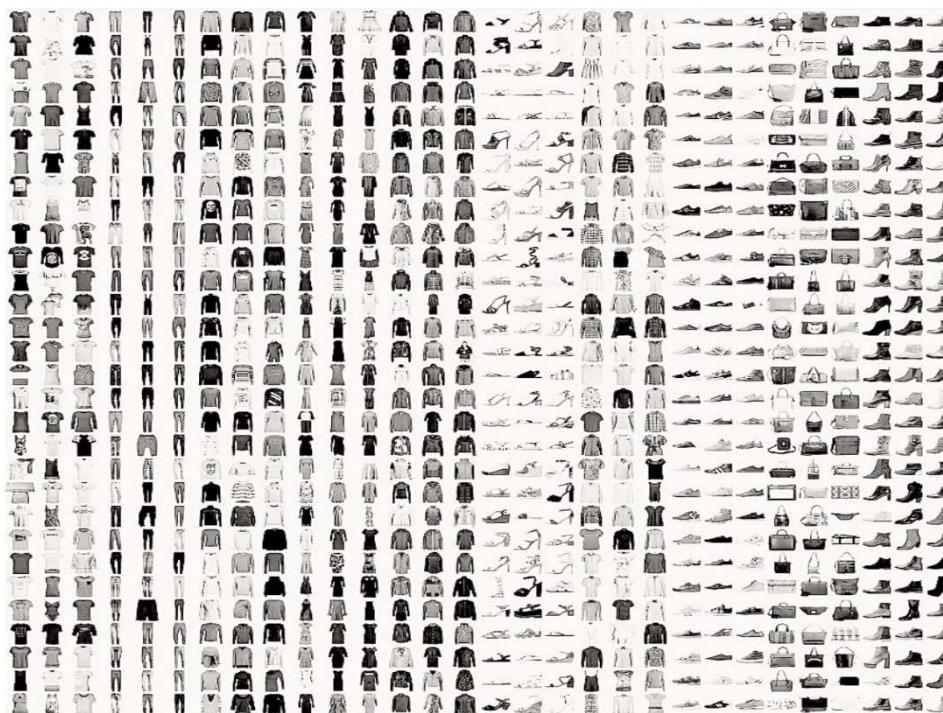
影像分類的目的

- 標籤值



影像分類的目的

- Fashion MNIST Dataset



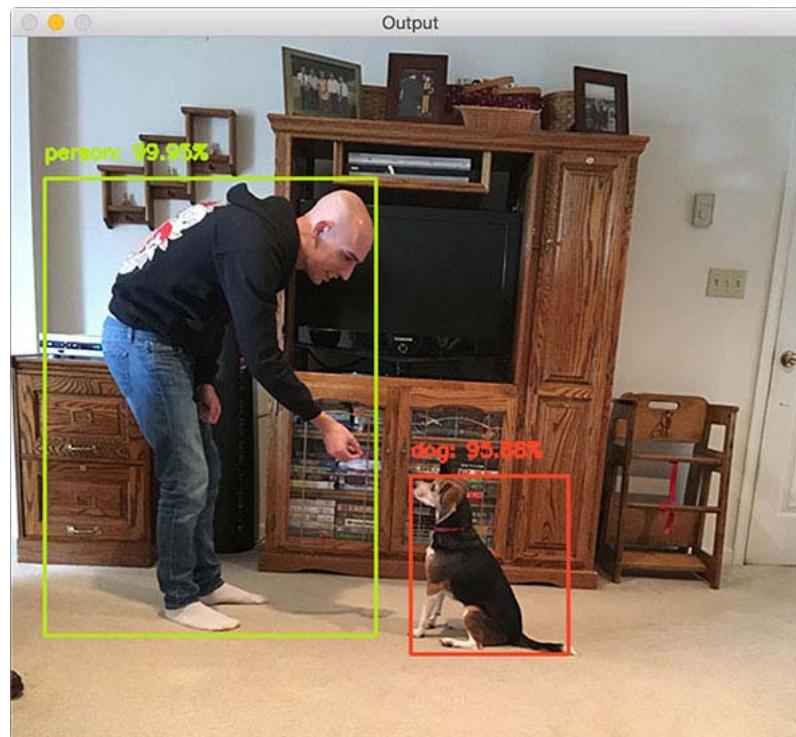
The 10 different class labels are:

- 0 T-shirt/top
- 1 Trouser
- 2 Pullover
- 3 Dress
- 4 Coat
- 5 Sandal
- 6 Shirt
- 7 Sneaker
- 8 Bag
- 9 Ankle boot

<https://towardsdatascience.com/the-4-convolutional-neural-network-models-that-can-classify-your-fashion-images-9fe7f3e5399d>

物件偵測的目的

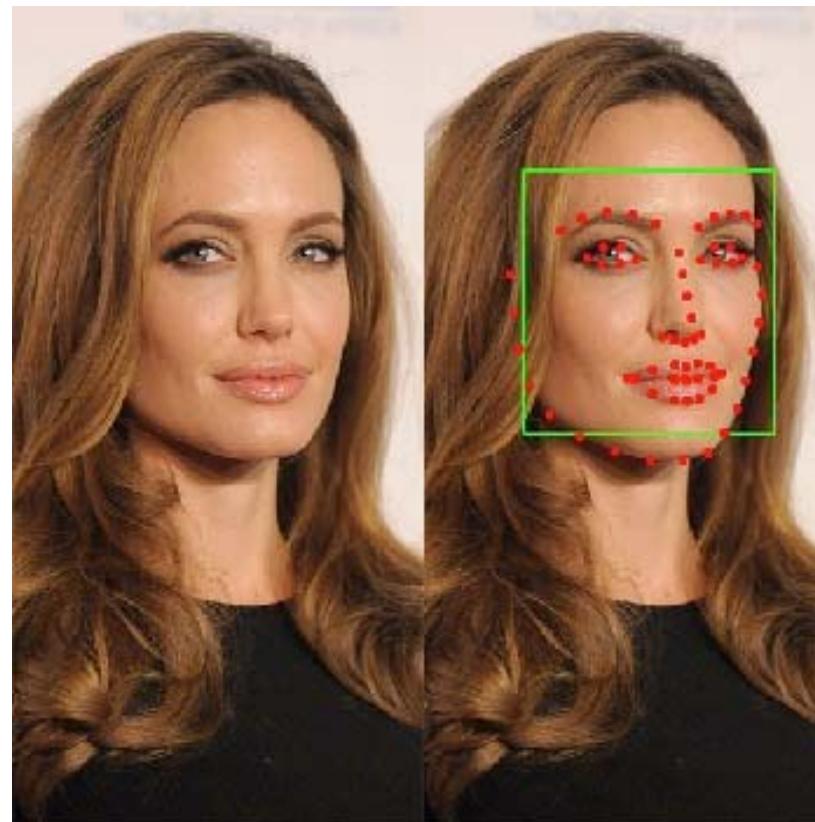
- 偵測物件邊界框位置 (x, y, w, h) 的4個參數



圖片來源: <https://www.pyimagesearch.com/2017/09/11/object-detection-with-deep-learning-and-opencv/>

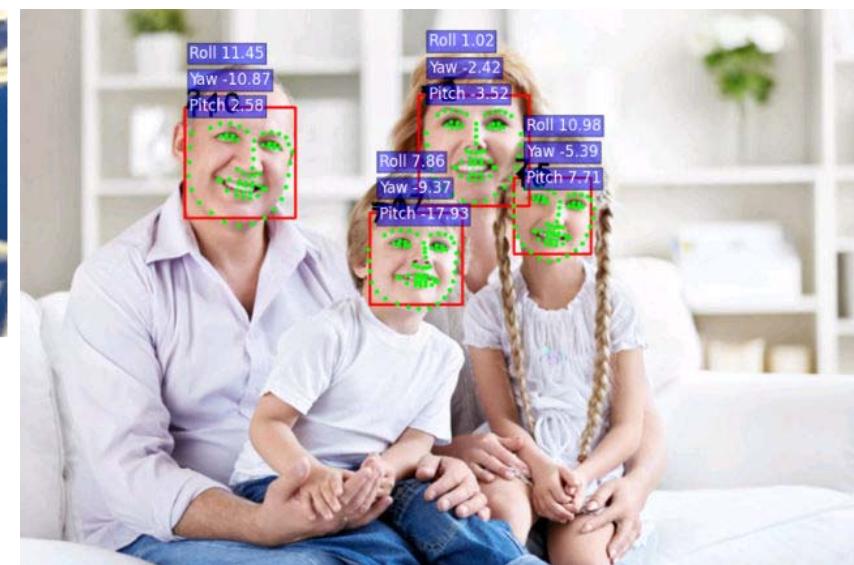
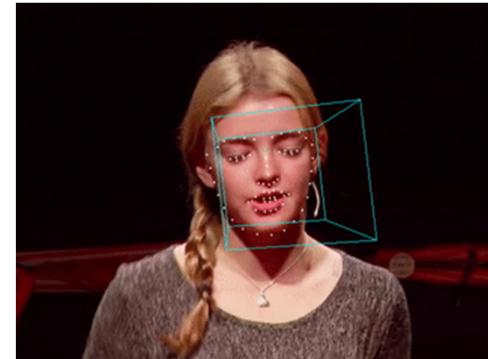
臉部特徵點的目的

- 偵測臉部**68**個關鍵點座標位置



資料來源: <https://juanzdev.github.io/TeethClassifier/>

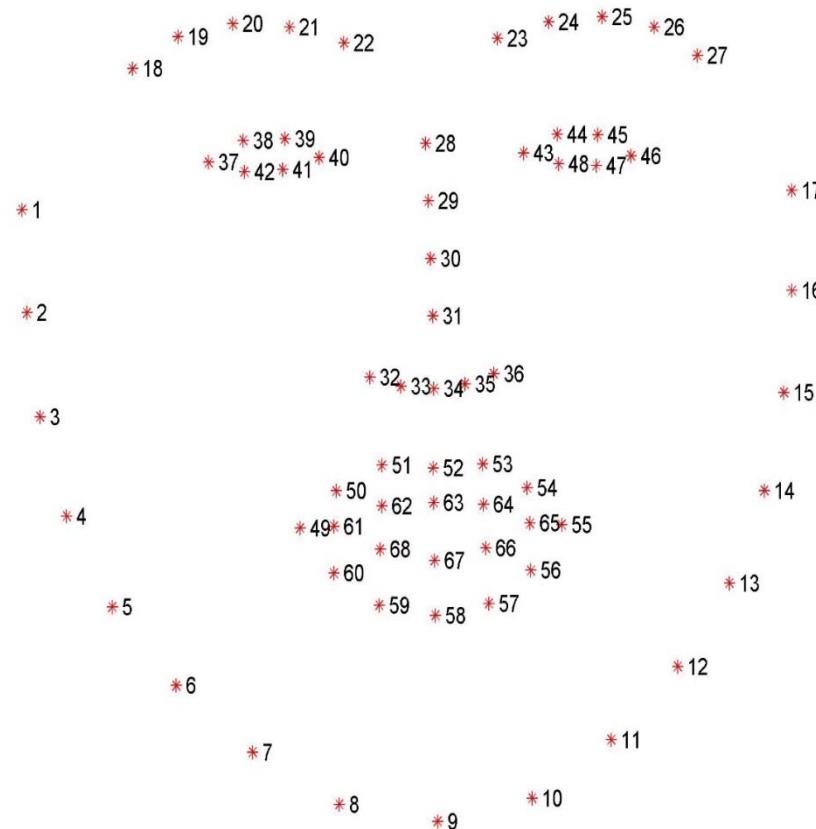
臉部特徵點的目的



資料來源: <https://github.com/yinguobing/cnn-facial-landmark>
義守大學 I-SHOU UNIVERSITY

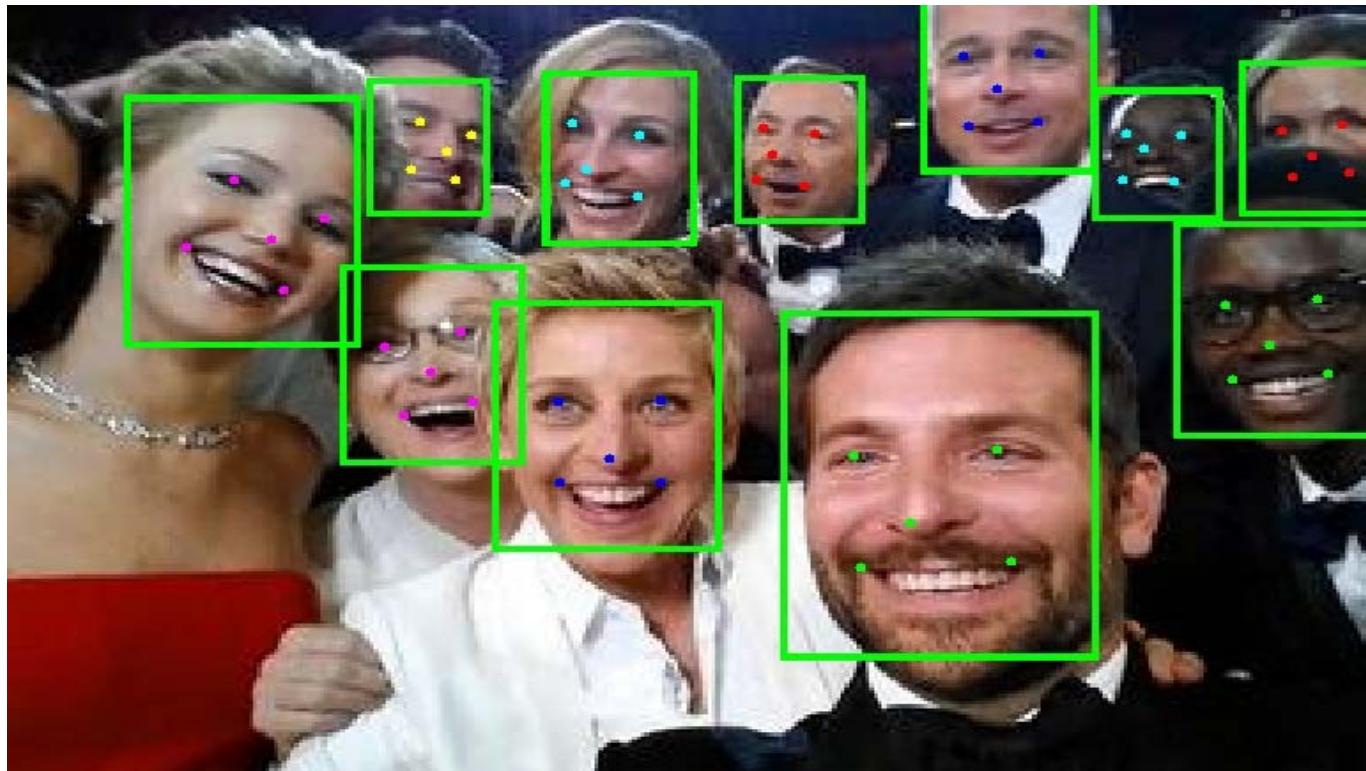
臉部特徵點的目的

- 68 points



臉部識別的目的

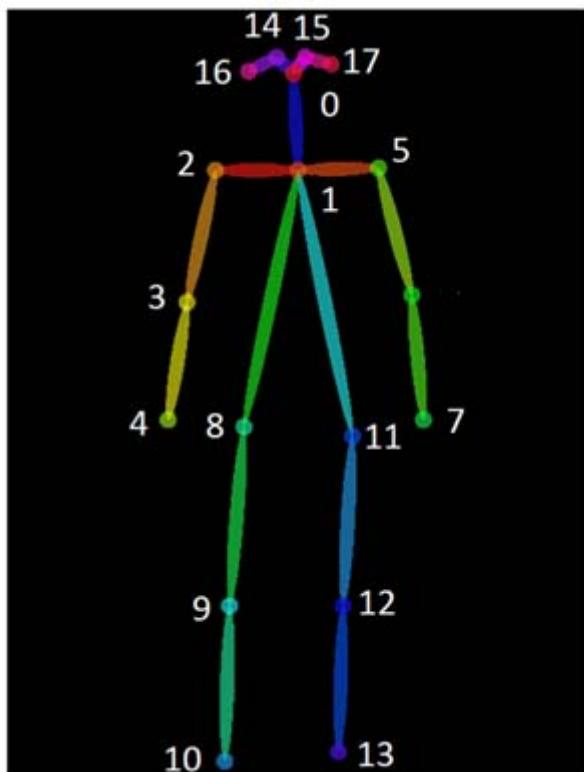
- Multi-task Cascaded Convolutional Networks



<https://www.youtube.com/watch?v=zZZcEu-iZnk>

人體骨架偵測的目的

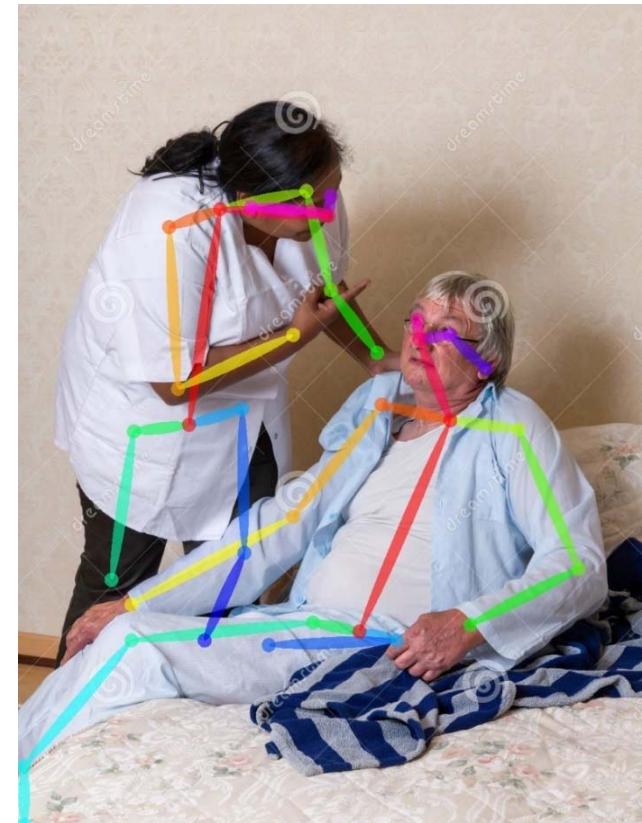
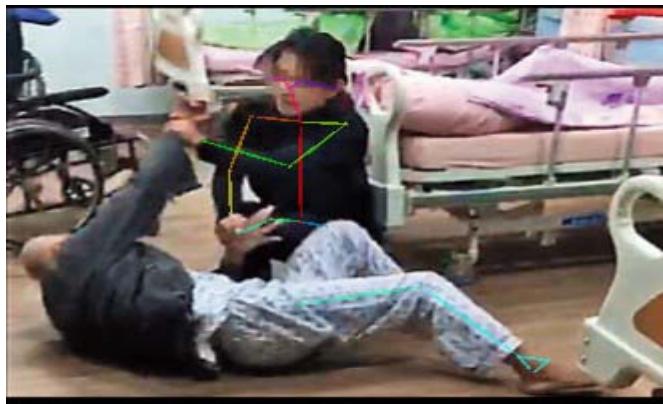
- 人體骨架偵測



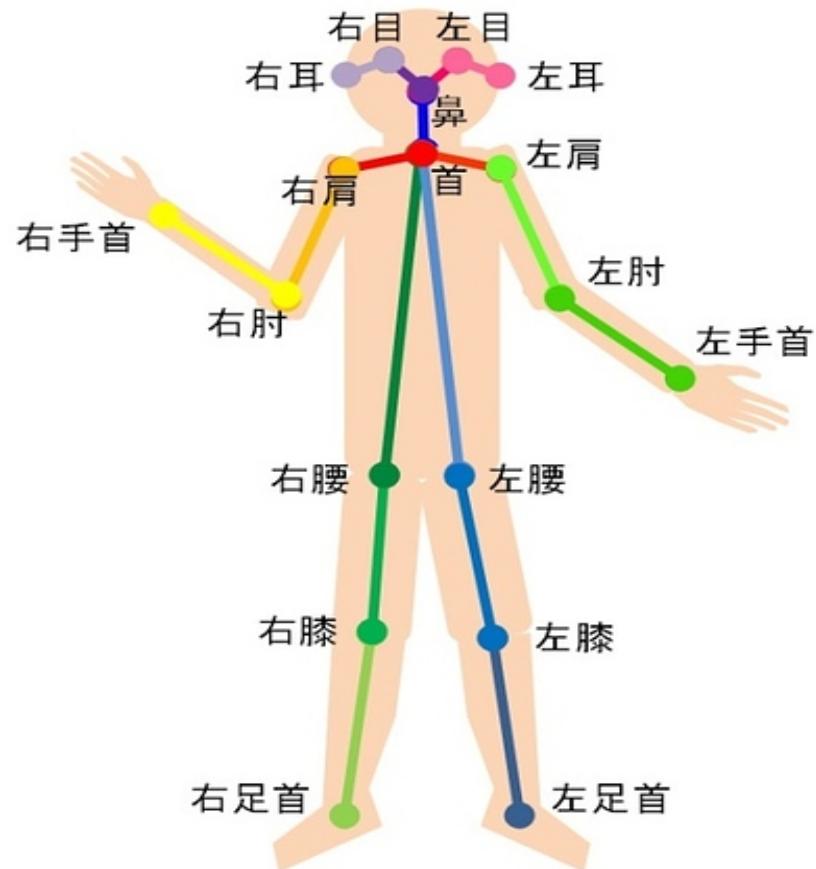
圖片來源: <https://blog.nanonets.com/human-pose-estimation-2d-guide/>

人體骨架偵測

- 找到肢體的18個關鍵點座標位置



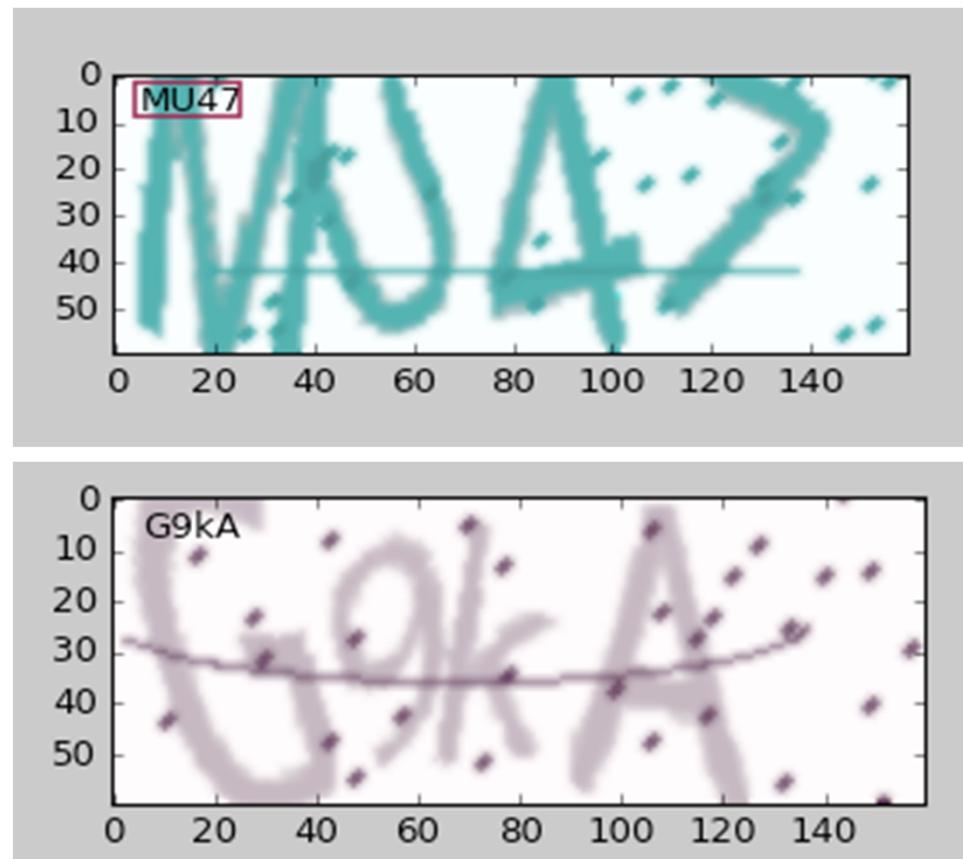
15 or 18 points



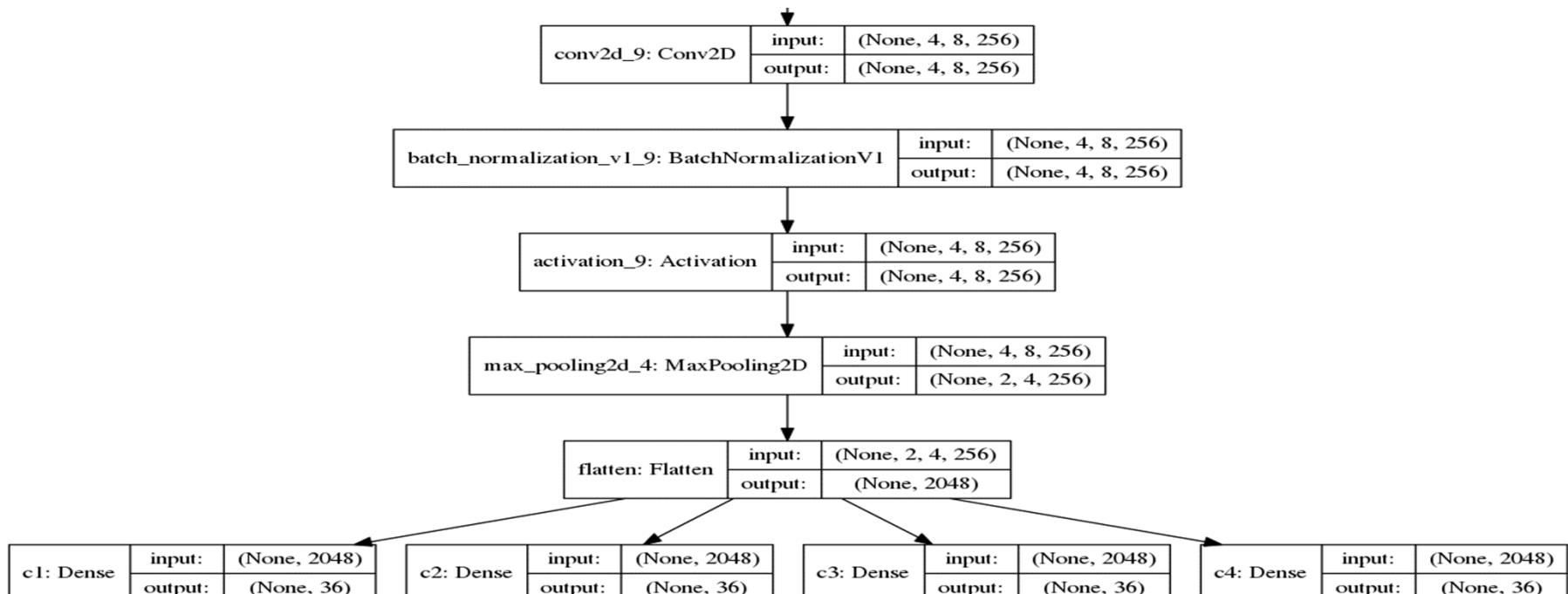
Realtime Multi-Person 2D Pose Estimation using Part Affinity Fields

Question & Answer

- 數字分類



驗證碼的目的



https://github.com/ypwhs/captcha_break

Learning Problem

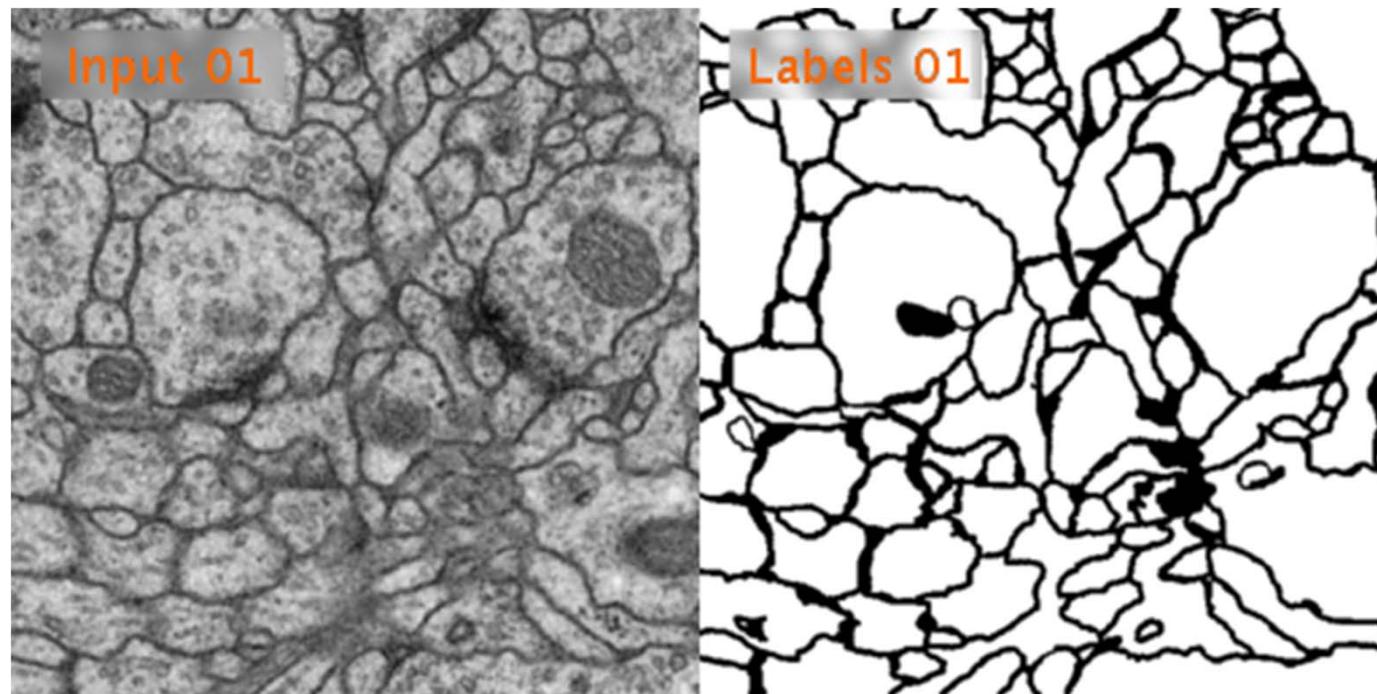
- Text
- Numerical
- Images

Neural Networks
(Deep Learning)

- Text
- Numerical
- Images

影像分割的目的

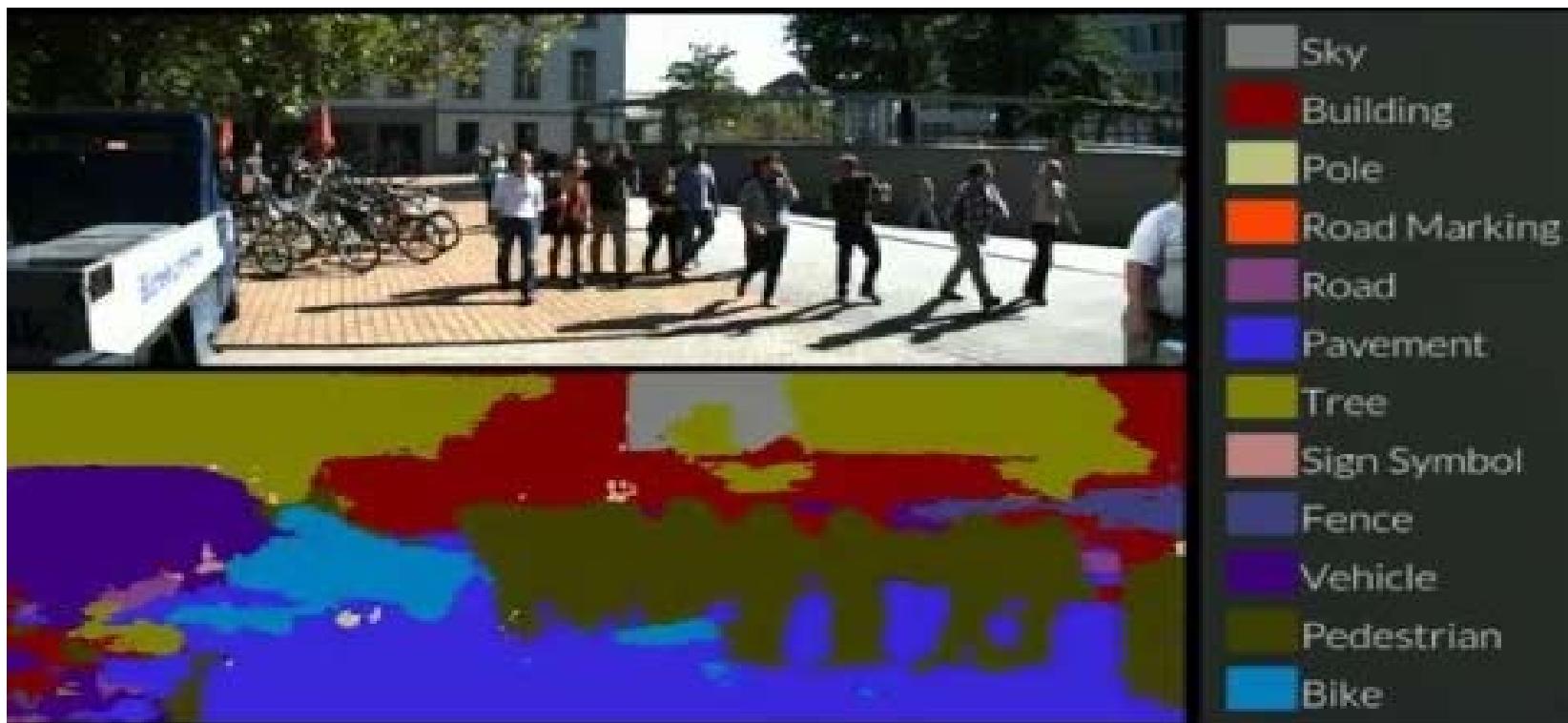
- Image Segmentation
- 像素點的標籤或索引值 (index)



U-Net: Convolutional Networks for Biomedical Image Segmentation.

語意分割的目的

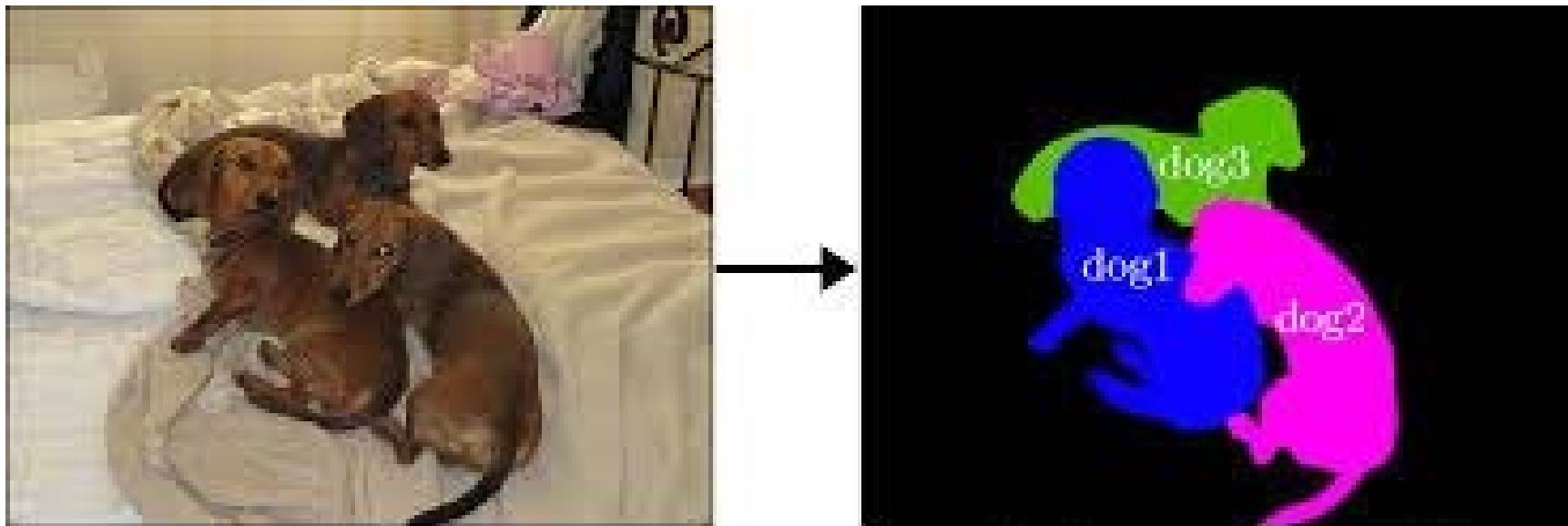
- Semantic segmentation: pixel-based



Source: A Deep Convolutional Encoder-Decoder Architecture for multi-class pixelwise segmentation (Semantic Segmentation using Deep Learning)

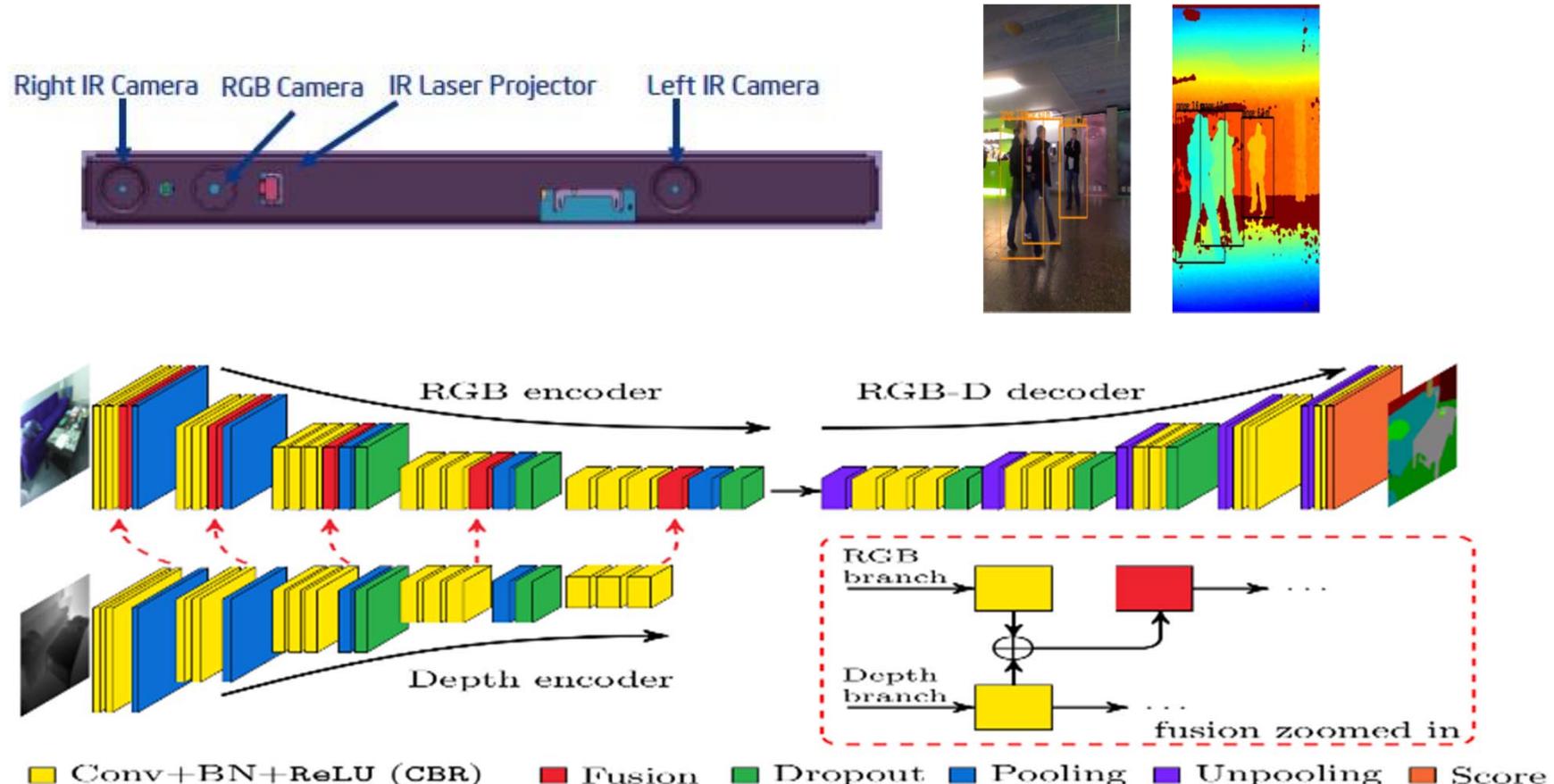
實體分割的目的

- Instance Segmentation



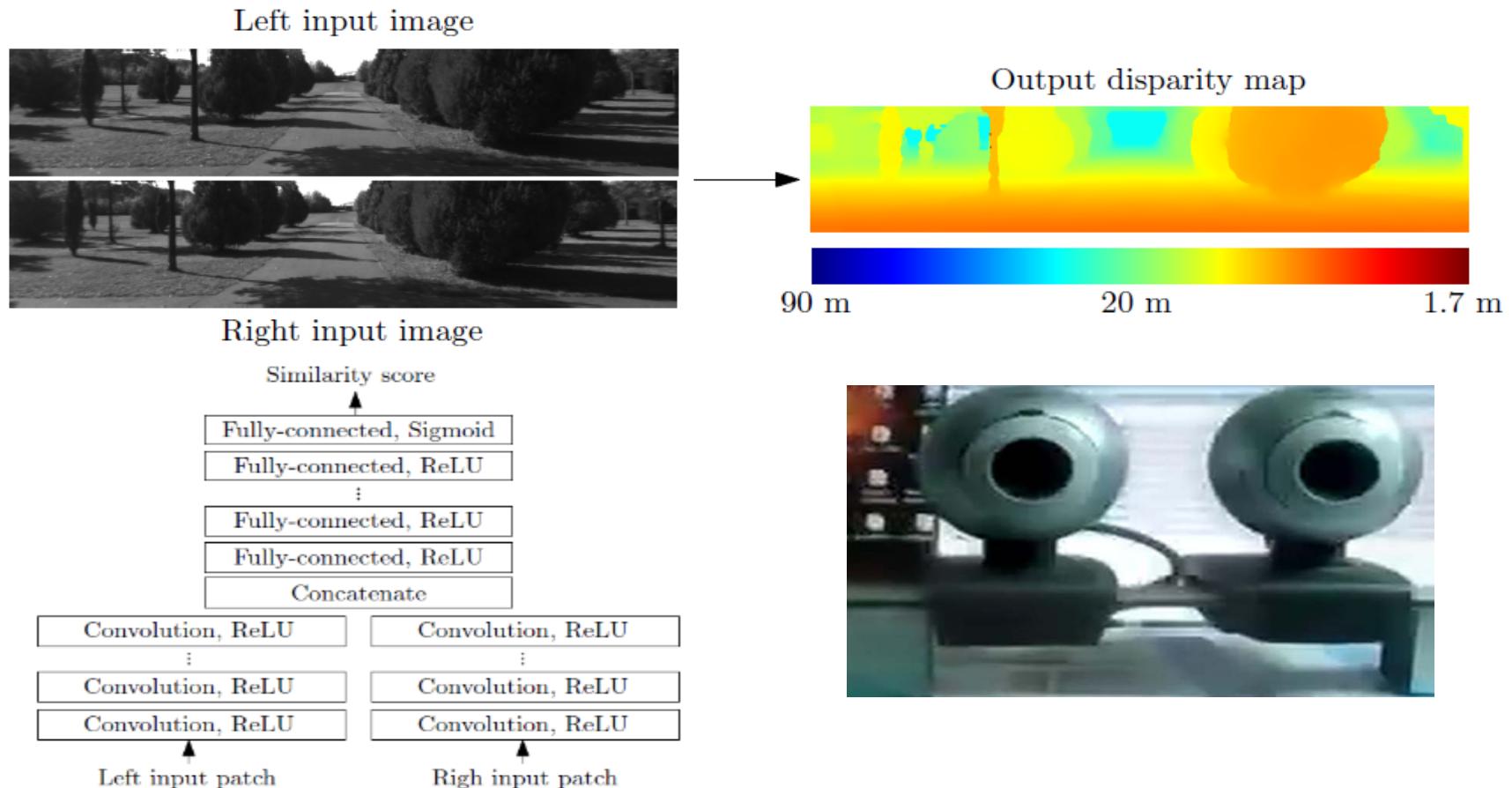
<http://publications.lib.chalmers.se/records/fulltext/250417/250417.pdf>

Depth Estimation



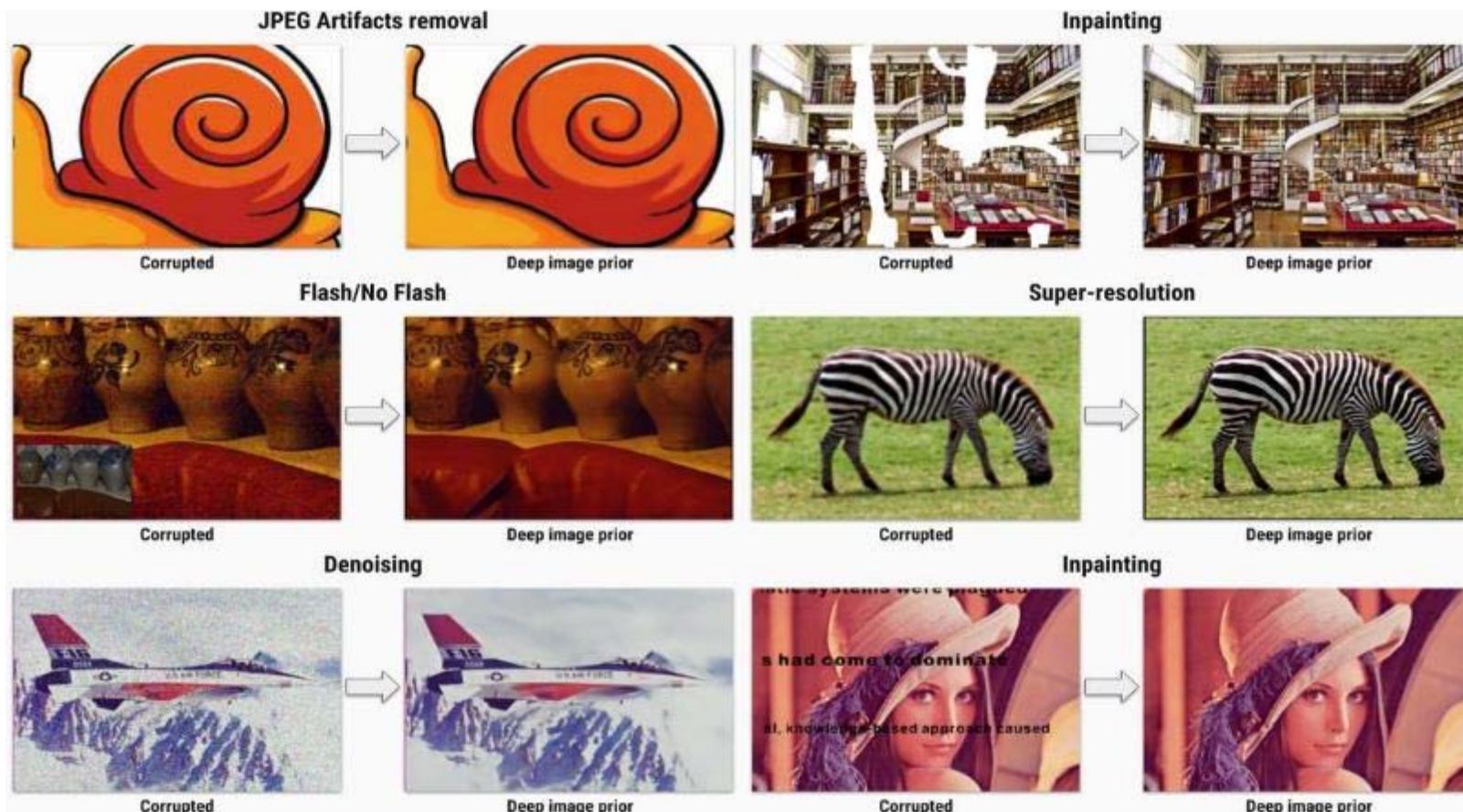
FuseNet: Incorporating Depth into Semantic Segmentation via Fusion-based CNN Architecture

Depth Estimation



FuseNet: Incorporating Depth into Semantic Segmentation via Fusion-based CNN Architecture

Inpainting & Denoising

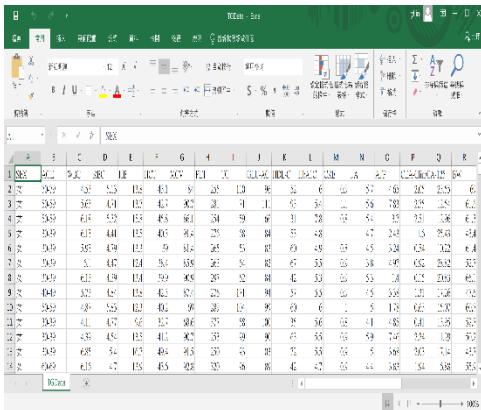


"Deep Image Prior": super-resolution, inpainting, denoising without learning on a dataset and pretrained networks.

Learning Problem

- 數值/數值
 - Text
 - Numerical → Neural Networks
(Deep Learning)
 - Images
- Text
 - Numerical
 - Images

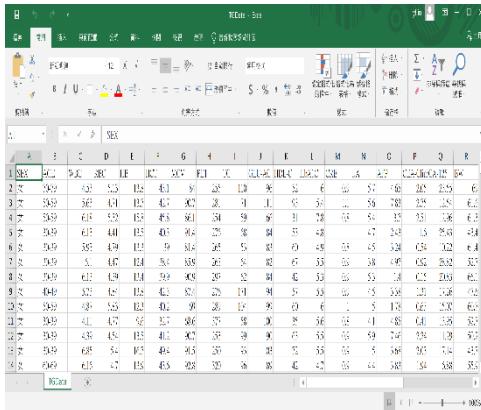
飯前血糖預測



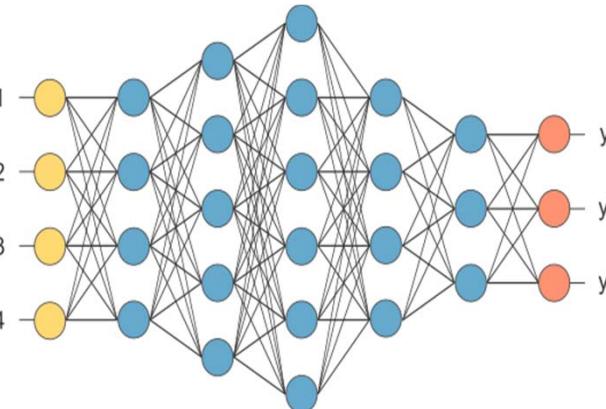
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
2.8	92	92	53	15	41	9	26	13	96	5	6	55	57	56	35	25	6
3.2	54	56	41	15	47	85	3	9	11	5	56	2	59	78	25	25	6
3.7	53	61	52	15	63	81	30	9	96	3	58	55	54	15	51	15	6
3.7	50	61	40	15	45	36	25	38	94	5	48	17	24	15	83	34	6
3.8	50	35	49	12	9	35	24	5	85	0	45	51	45	34	53	32	6
3.8	50	5	45	14	53	35	26	5	85	5	55	55	56	96	05	52	35
3.8	50	61	49	14	22	95	26	12	84	6	33	55	52	56	23	29	6
3.9	54	52	46	18	42	81	25	11	98	5	55	55	55	55	55	25	25
3.9	52	48	53	12	43	96	35	12	95	0	6	5	12	62	25	6	
3.9	50	41	45	56	55	86	35	38	96	2	56	55	41	45	61	35	6
3.9	50	49	45	15	41	95	35	9	90	5	55	55	59	74	25	18	6
3.9	50	68	54	15	45	45	35	5	85	5	55	55	55	58	95	53	45
3.9	50	61	47	15	45	95	35	6	85	4	45	55	55	44	38	34	35



飯前血糖預測



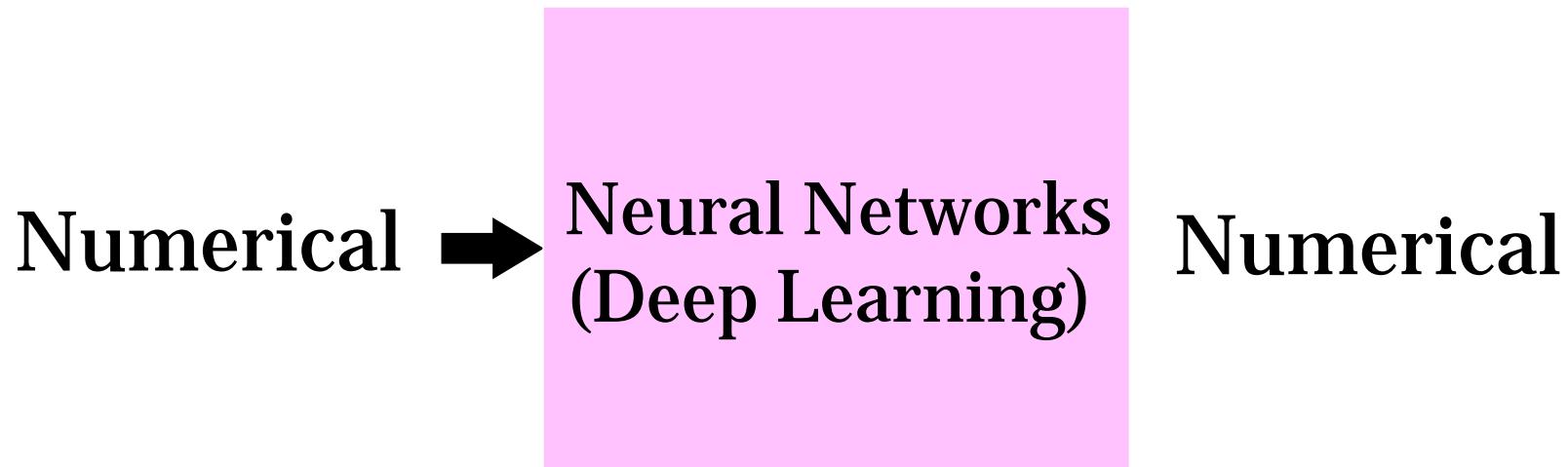
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
2.8	92	92	53	15	41	9	26	13	96	5	6	55	57	56	35	25	6
3.2	54	56	41	15	47	85	3	9	11	5	56	2	59	78	25	25	6
3.7	53	61	52	15	63	81	30	9	96	3	58	55	54	15	51	15	6
3.7	50	61	40	15	45	36	25	38	94	5	48	17	24	15	83	34	6
3.8	50	35	49	12	9	35	24	5	85	0	45	51	45	34	53	32	6
3.8	50	5	45	14	53	35	26	5	85	5	55	55	56	96	05	52	35
3.8	50	61	49	14	22	95	26	12	84	6	33	55	52	56	23	29	6
3.9	54	52	46	18	42	81	25	11	98	5	55	55	55	55	55	25	25
3.9	52	48	53	12	43	96	35	12	95	0	6	5	12	62	25	6	
3.9	50	41	45	56	55	86	35	38	96	2	56	55	41	45	61	35	6
3.9	50	49	45	15	41	95	35	9	90	5	55	55	59	74	25	18	6
3.9	50	68	54	15	45	45	35	5	85	5	55	55	55	58	95	53	45
3.9	50	61	47	15	45	95	35	6	85	4	45	55	55	44	38	34	35



飯前血糖預測

Question & Answer

- Lotto Problem



Model Problem

- 文字/數字
 - Text
 - Numerical →
 - Images
- Neural Networks
(Deep Learning)
- Text
 - Numerical
 - Images

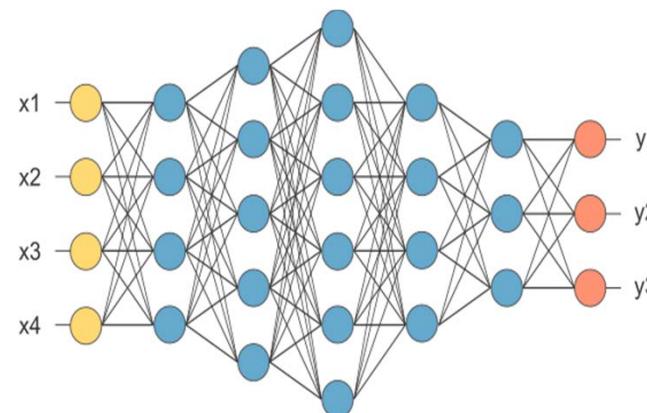
骨折病例文字探勘

1096 T-L Spine: AP+Lat * Degenerative change of lumbar and visible lower thoracic spine with spurring. * Mild anterolisthesis of L3 on L4 and mild retrolisthesis of L4 on L5 vertebra. * Narrowing of T11-12, L3-4, L4-5, L5-S1 intervertebral disc space. * Collapse of T12 vertebra status post vertebroplasty. * New compression fracture of T11 vertebra. * Calcification of abdominal aorta. * Decreased density of bone, suspect osteoporosis.



脊椎骨折
yes(1) or no(0)

1096 T-L Spine: AP+Lat * Degenerative change of lumbar and visible lower thoracic spine with spurring. * Mild anterolisthesis of L3 on L4 and mild retrolisthesis of L4 on L5 vertebra. * Narrowing of T11-12, L3-4, L4-5, L5-S1 intervertebral disc space. * Collapse of T12 vertebra status post vertebroplasty. * New compression fracture of T11 vertebra. * Calcification of abdominal aorta. * Decreased density of bone, suspect osteoporosis.



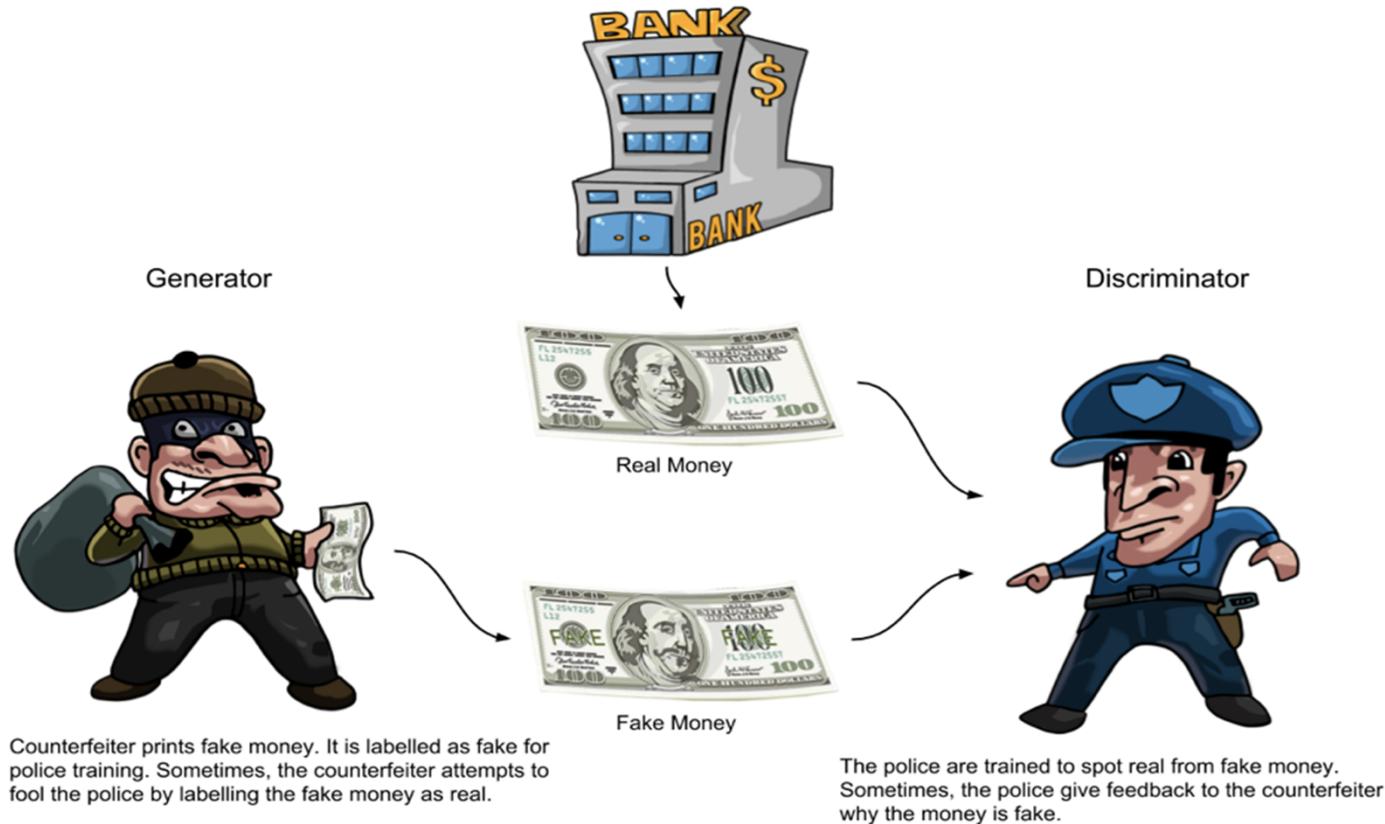
脊椎骨折
Probability(0.97)

Learning Problem

- 數值對影像
 - Text
 - Numerical →
 - Images
- Neural Networks
(Deep Learning)
- Text
 - Numerical
 - Images

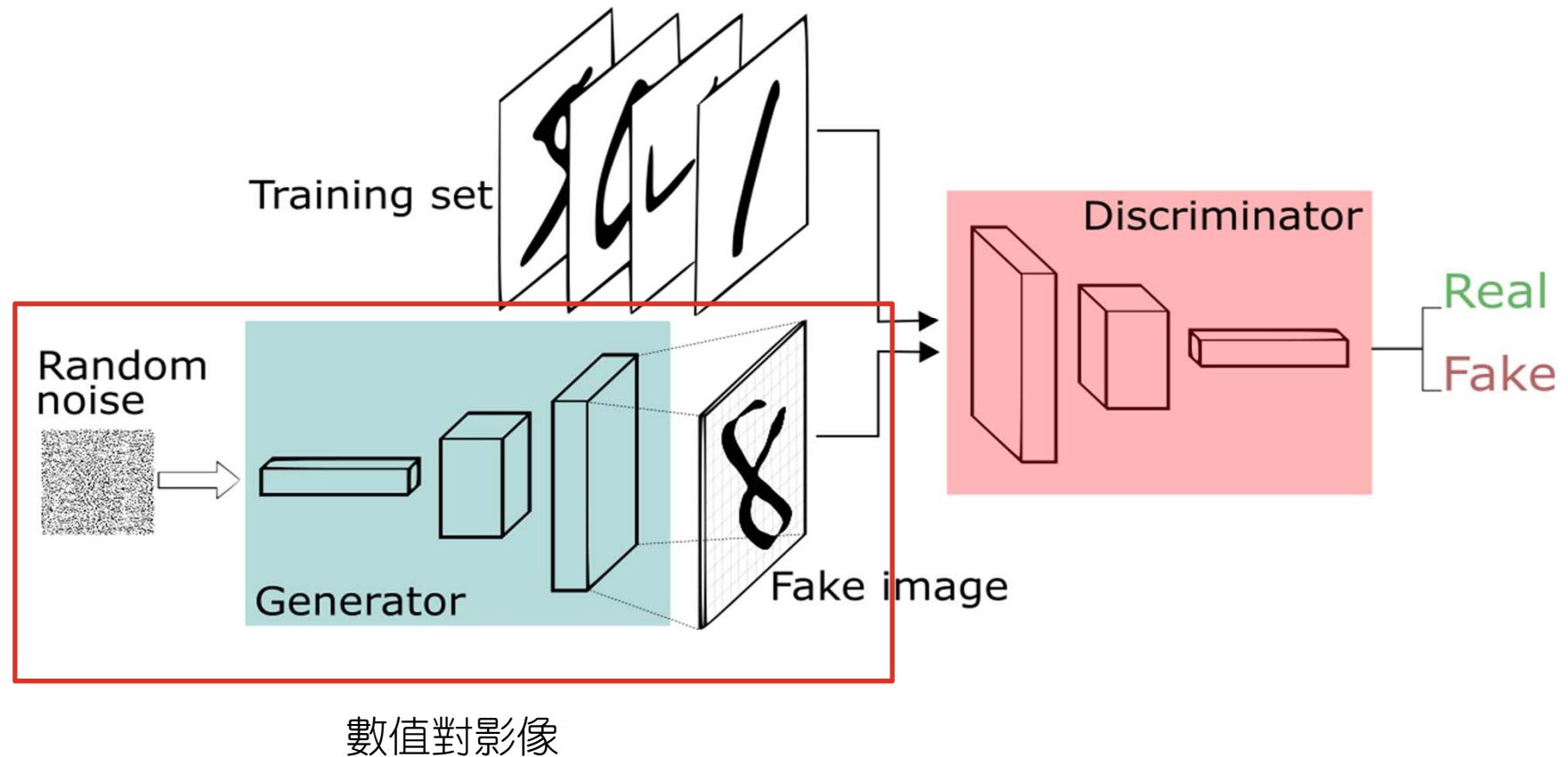
GAN Concept

- Introduced by Ian Goodfellow in 2014

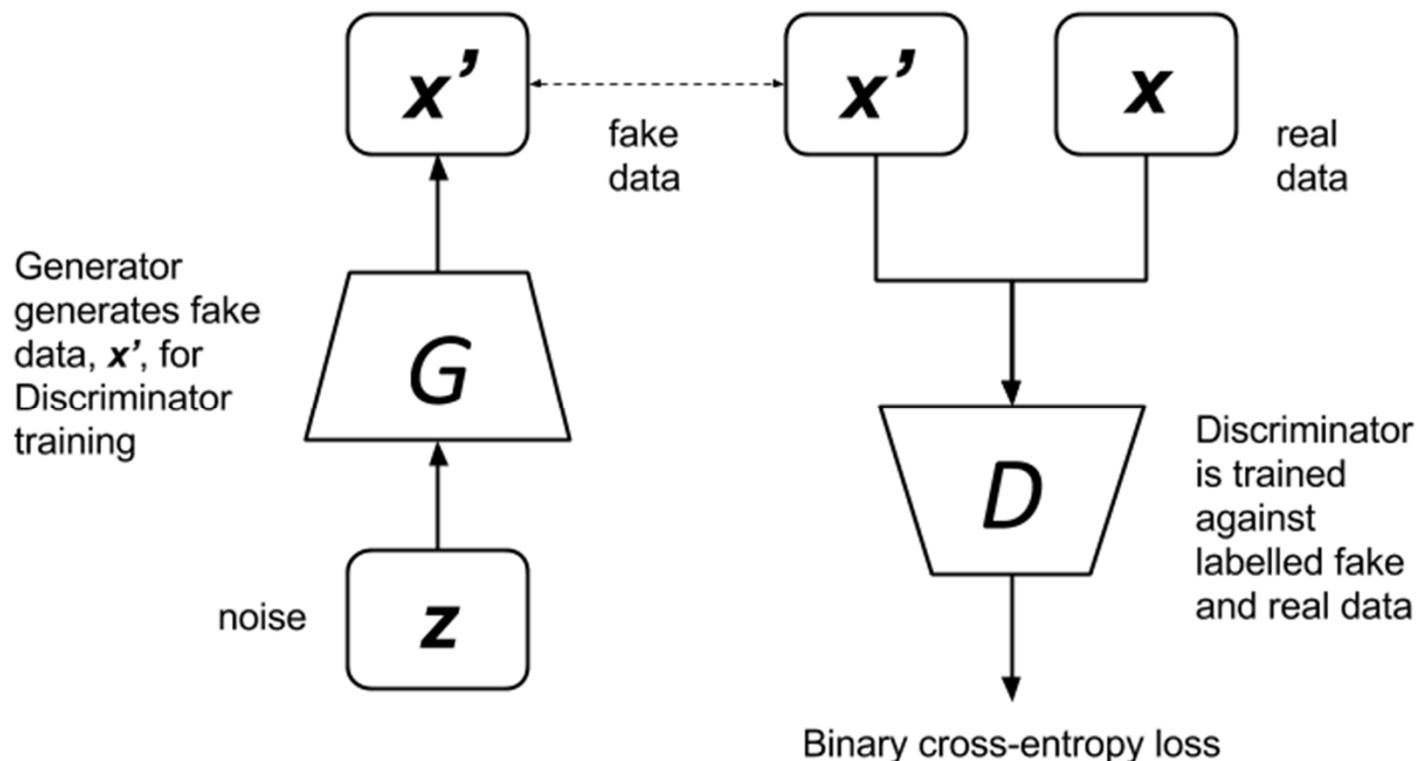


Packt, Advanced Deep Learning with Keras

GAN Concept

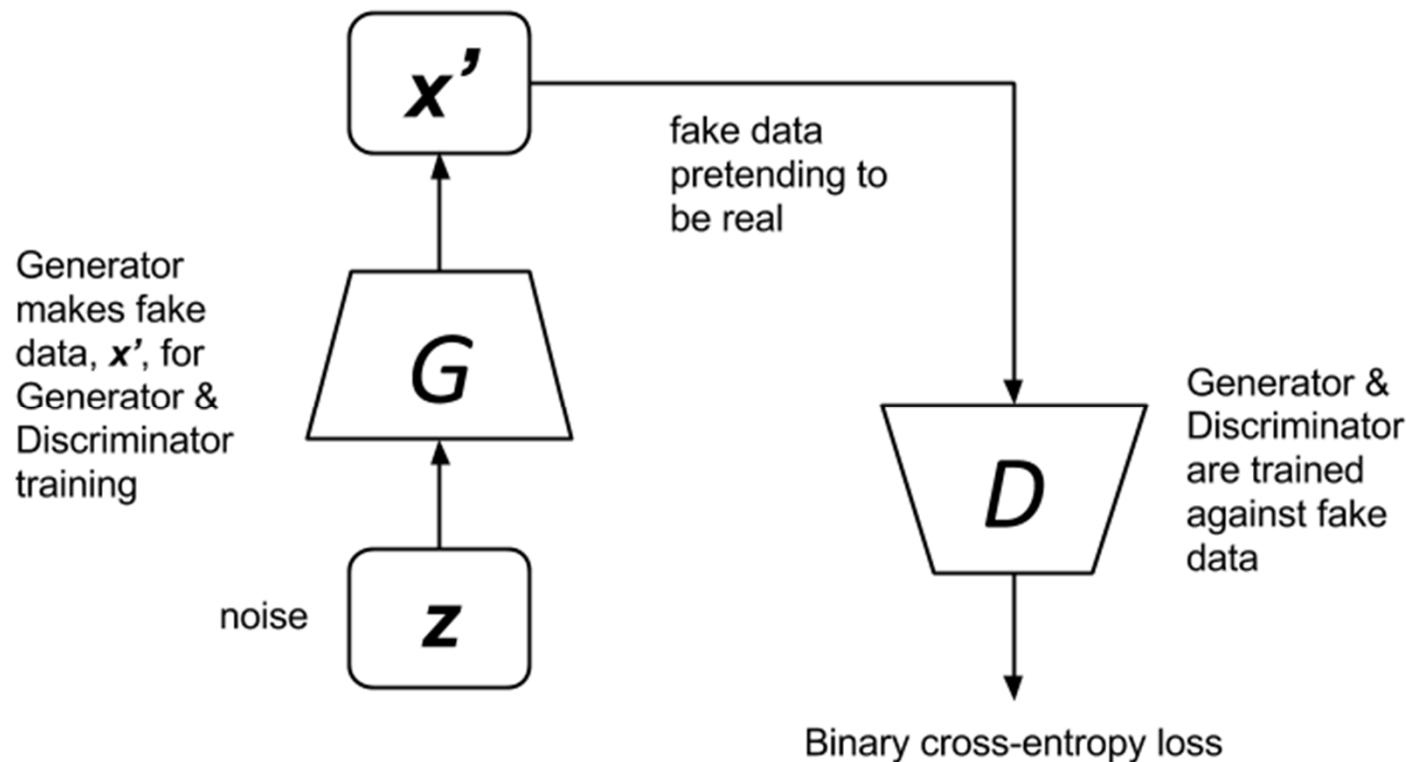


Discriminator Training



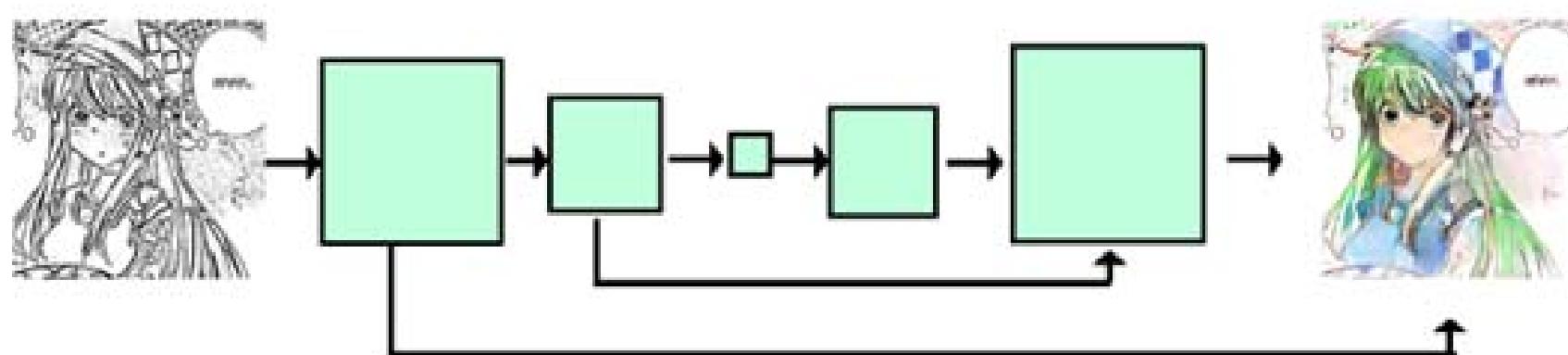
Packt, Advanced Deep Learning with Keras

Generator Training



DCGAN

- Deep + Convolutional
- Transposed Convolution Operation
(Deconvolution Layer)



<http://www.hackcha.cn/?p=360>

Conditional GAN

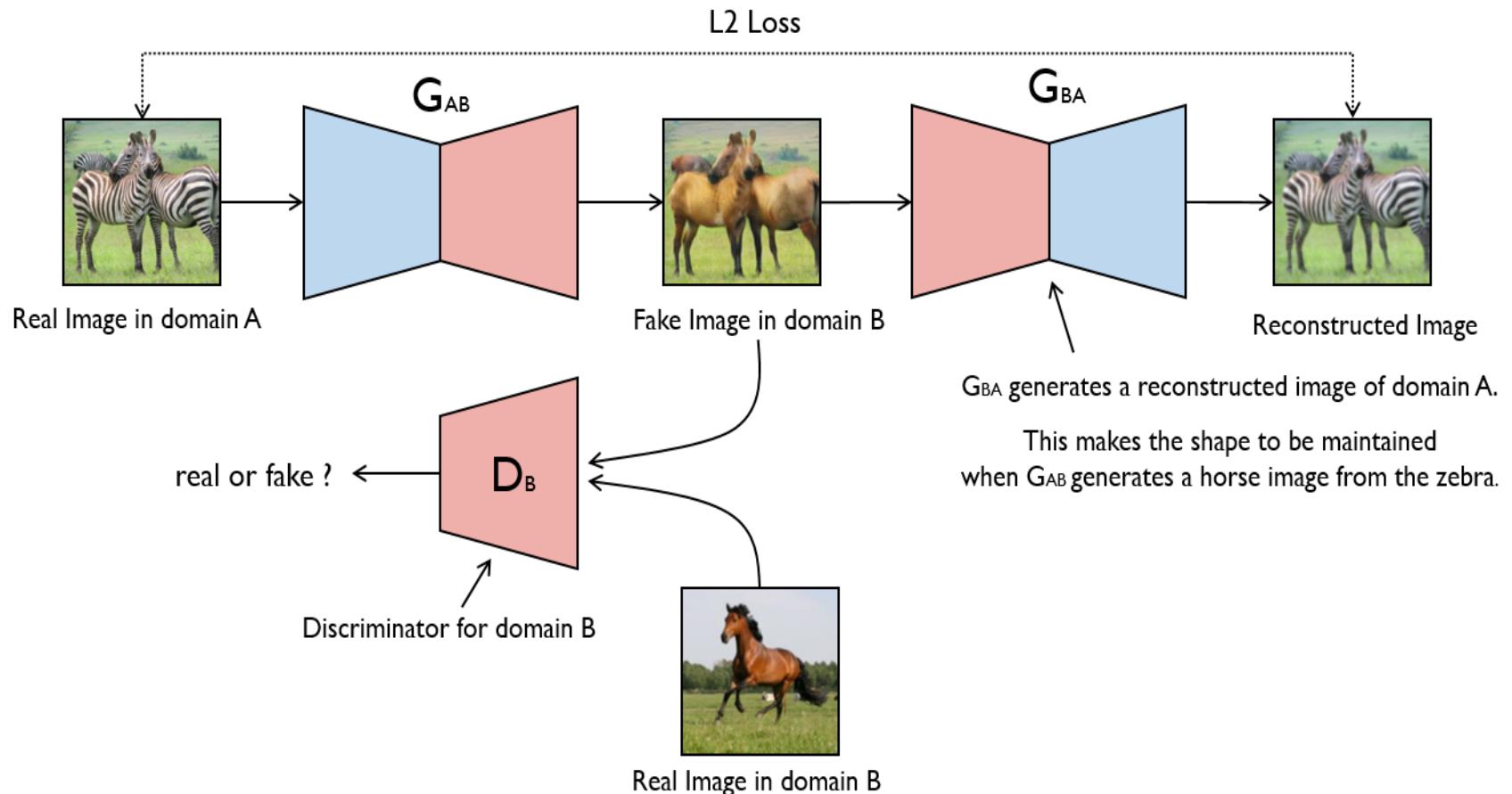
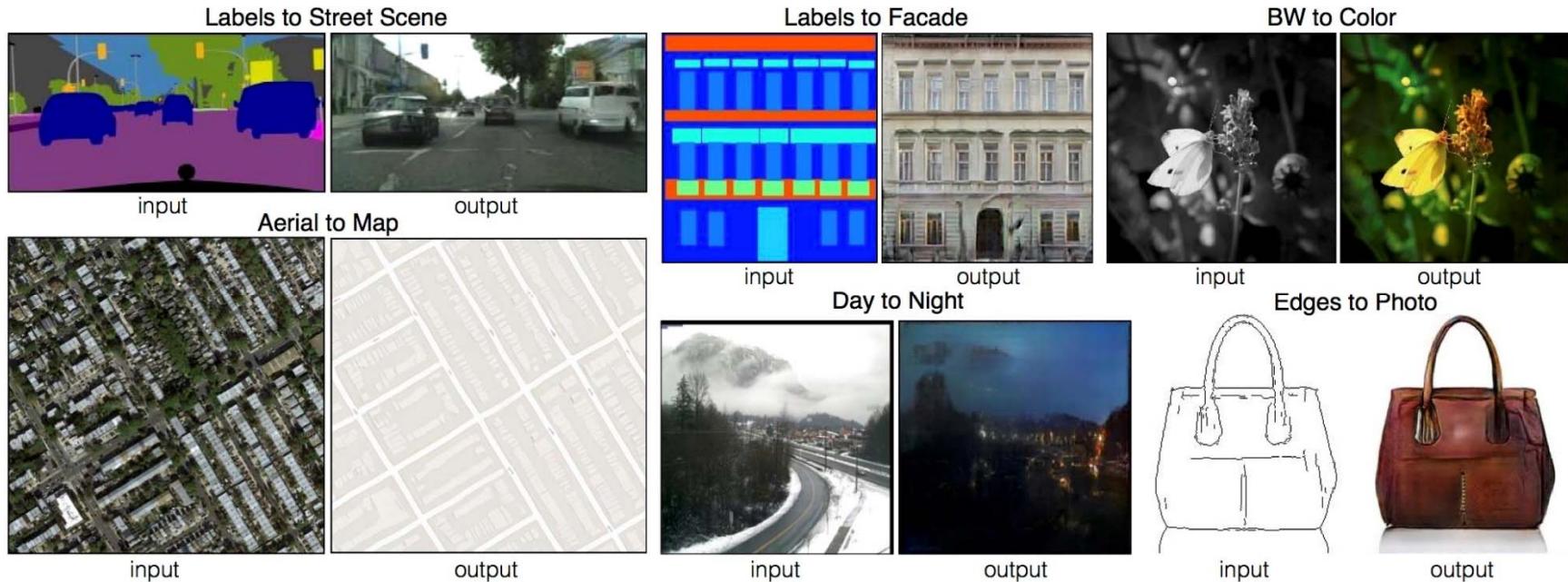


Image to Image Pix2Pix



Isola et al., Image-to-Image Translation with Conditional Adversarial Nets, 2016.

Super Resolution



Figure 2: From left to right: bicubic interpolation, deep residual network optimized for MSE, deep residual generative adversarial network optimized for a loss more sensitive to human perception, original HR image. Corresponding PSNR and SSIM are shown in brackets. [4× upscaling]

Source: Photo-Realistic Single Image Super-Resolution Using a Generative Adversarial Network, (Zhu et al., 2016)

Deep Fake



<https://twitter.com/i/status/986257991799222272>

Deep Nude

- DeepNude

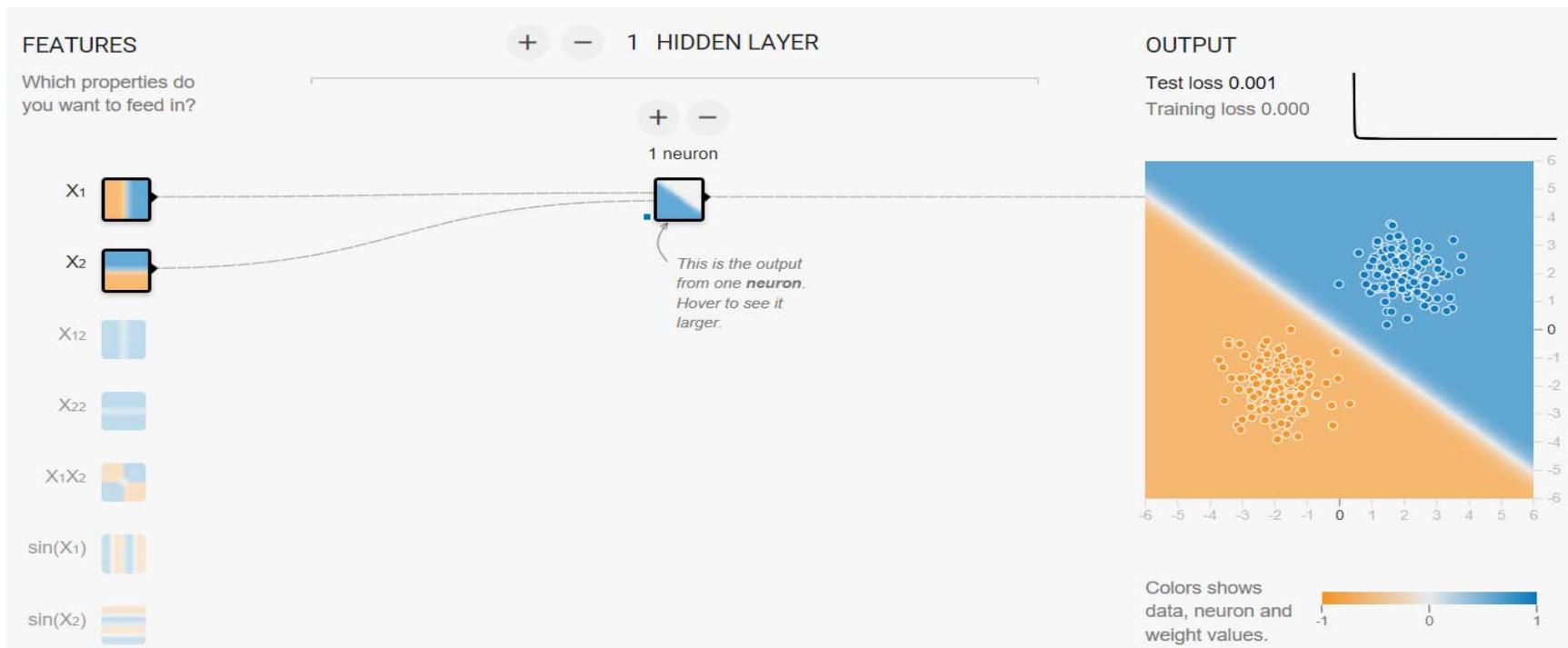


<https://www.moonlol.com/deepnude-app-6311.html>

線上機器學習範例介紹

Neural Network

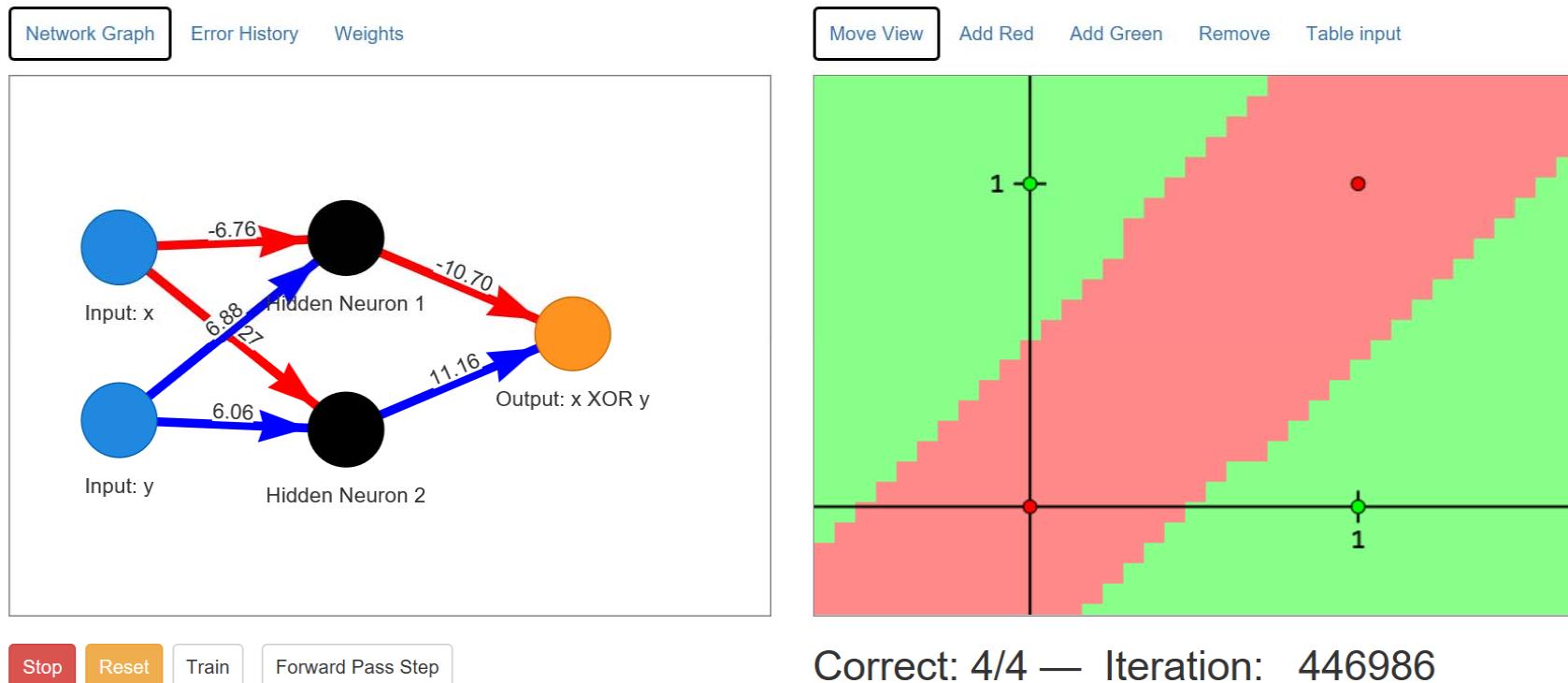
• Linearly Problem



<https://playground.tensorflow.org/>

Neural Network demo

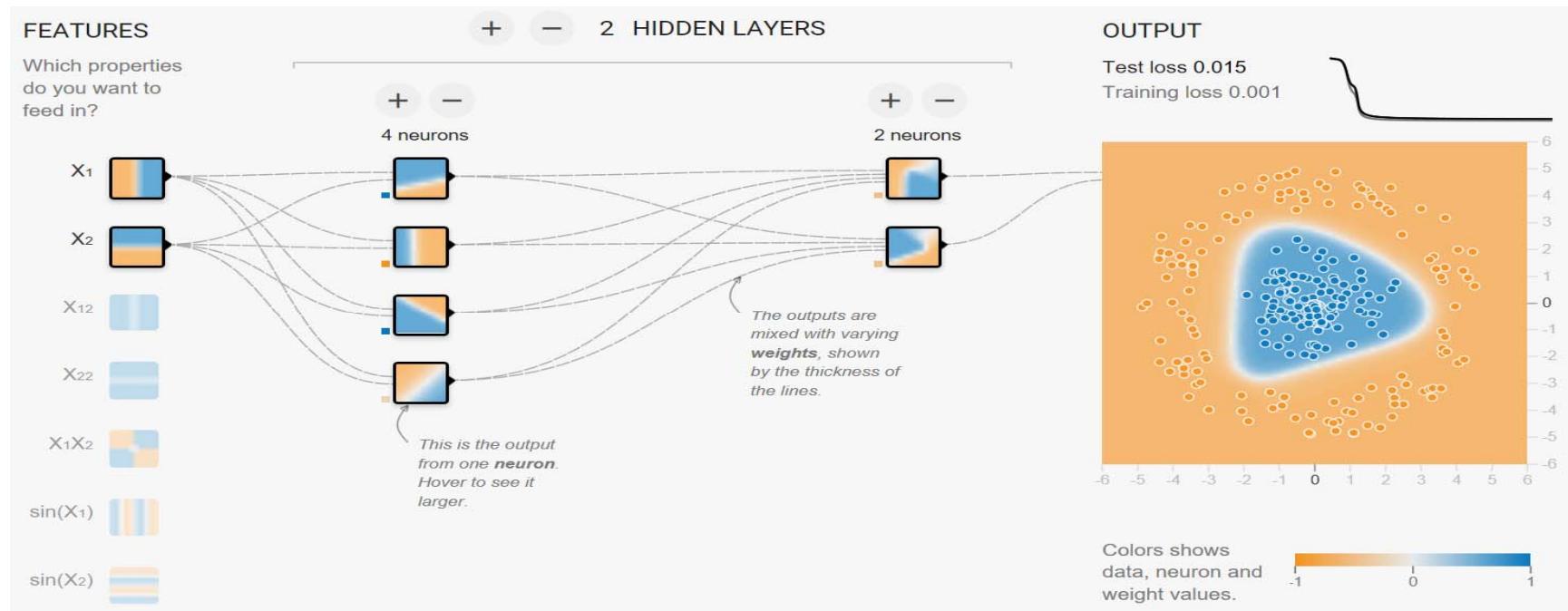
- Nonlinear model



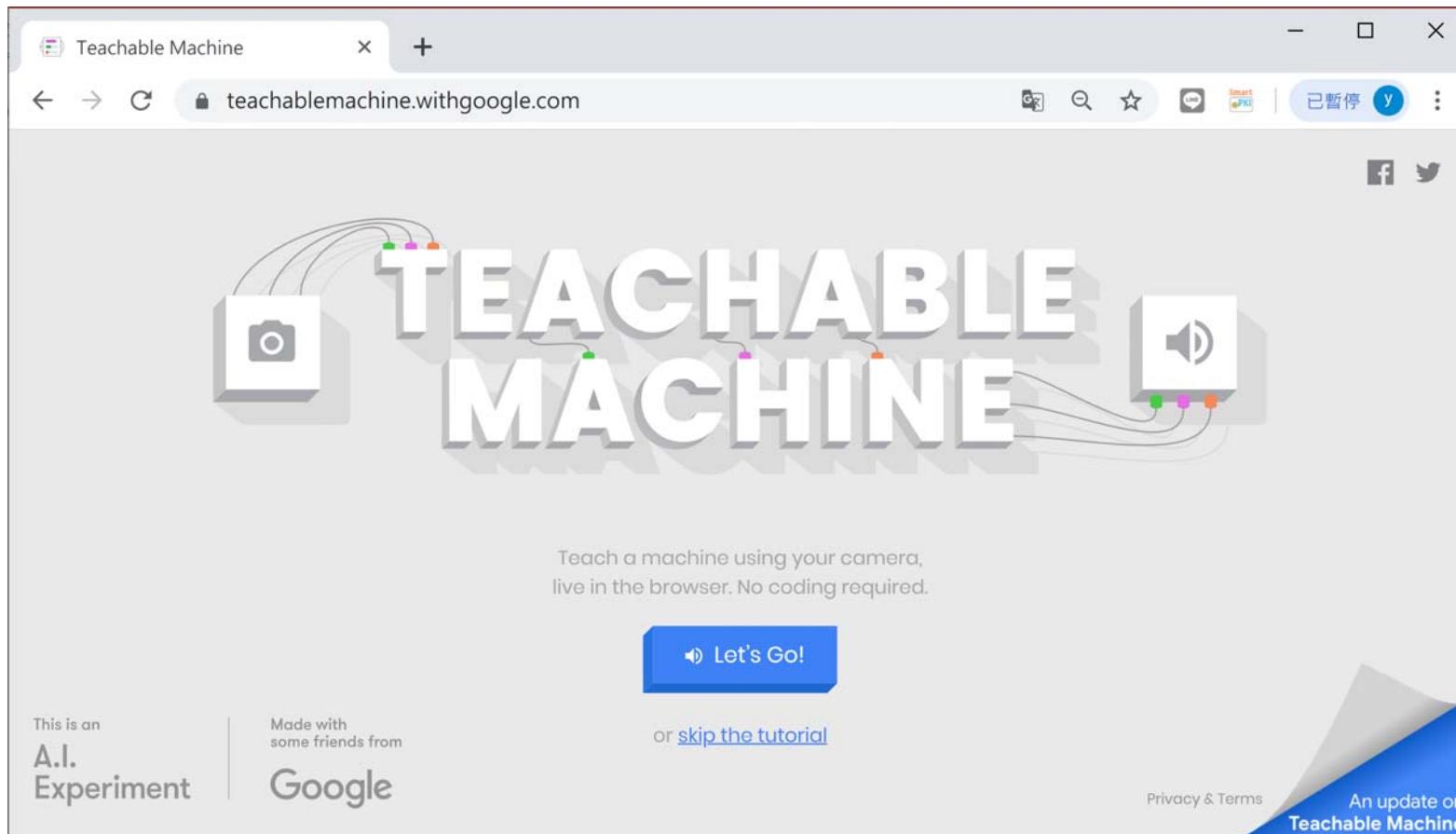
<https://lecture-demo.ira.uka.de/neural-network-demo/>

Neural Network

- Nonlinear model



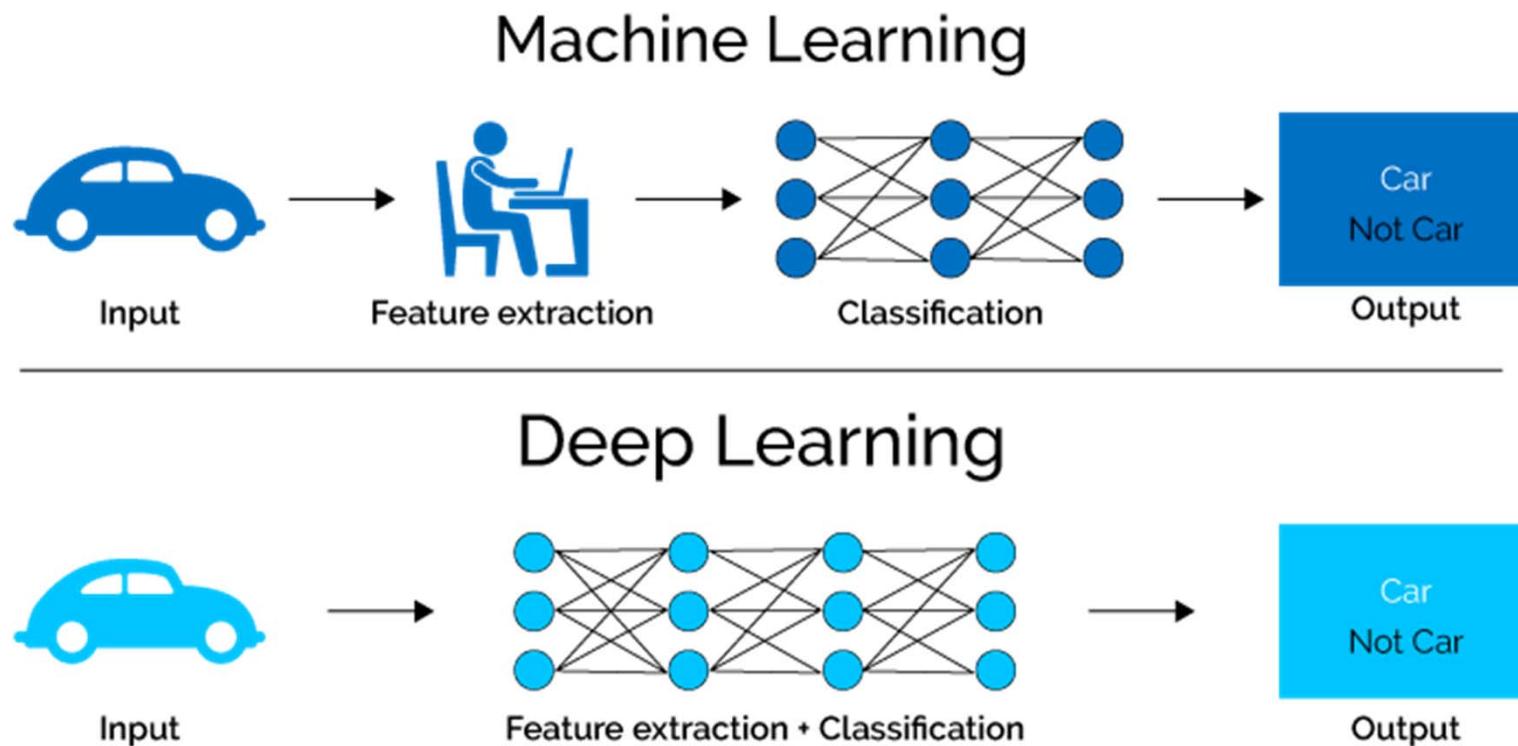
Teachable Machine



<https://teachablemachine.withgoogle.com/>

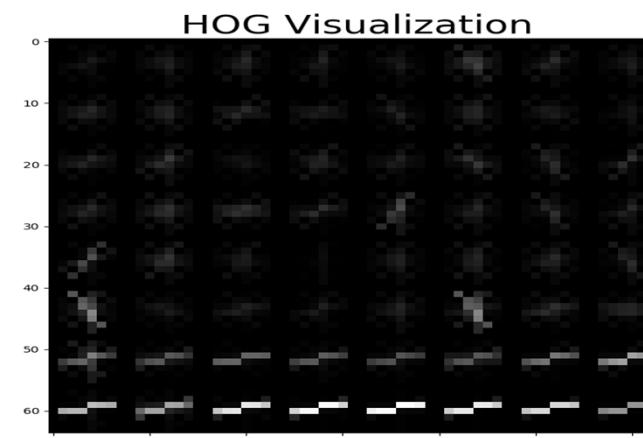
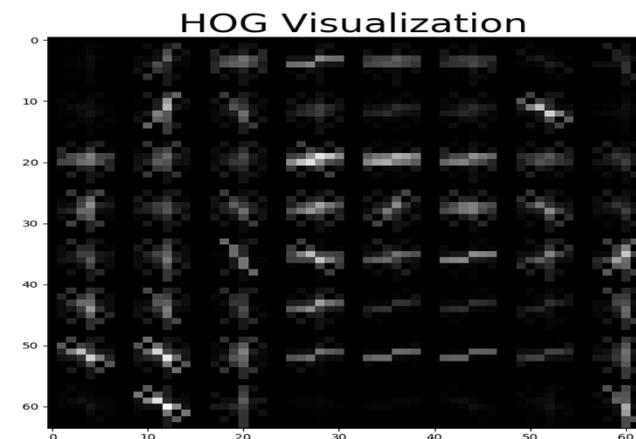
特徵映射

Simple NN vs. DL

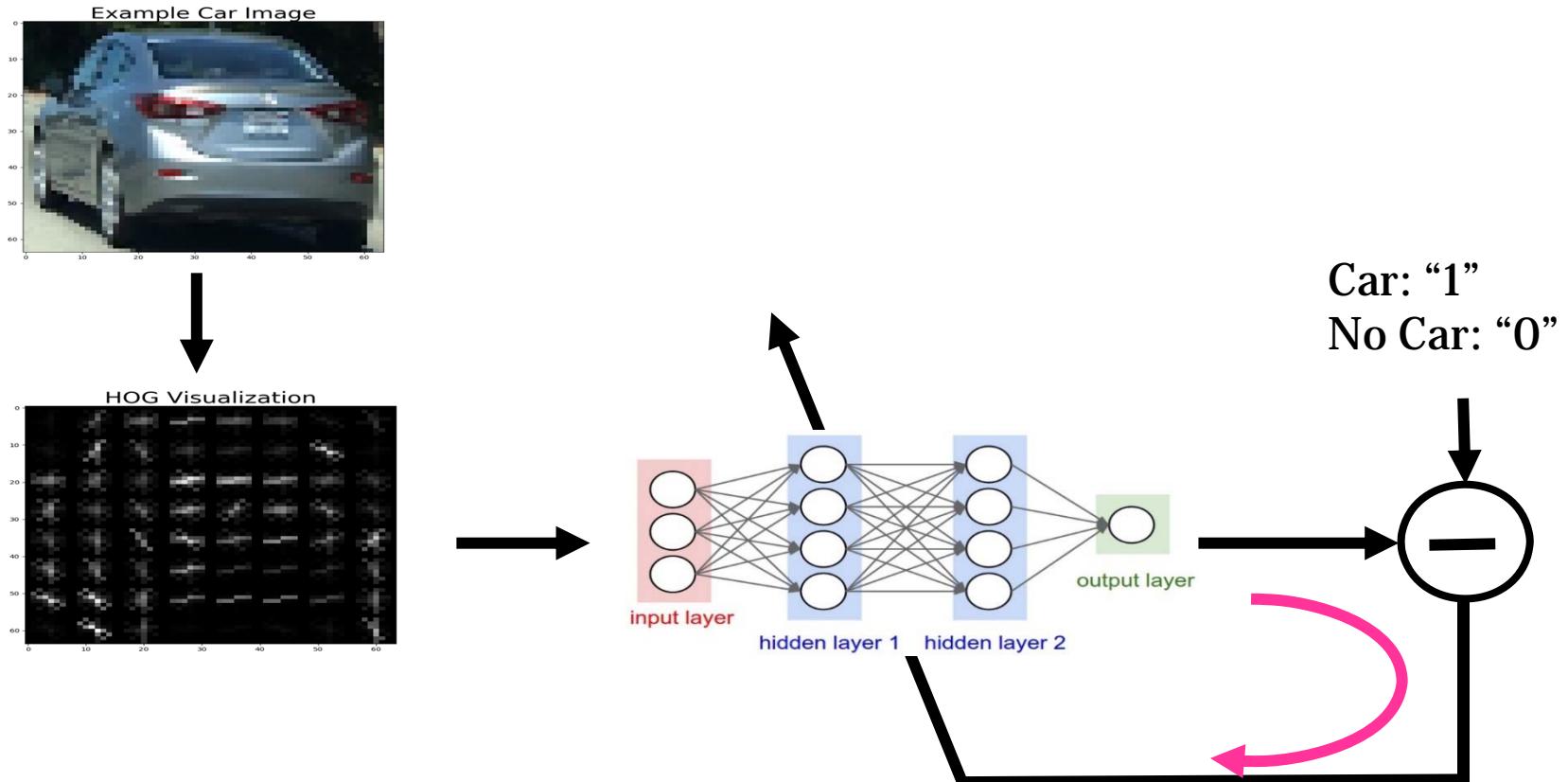


<https://towardsdatascience.com/parallel-and-distributed-deep-learning-a-survey-97137ff94e4c>

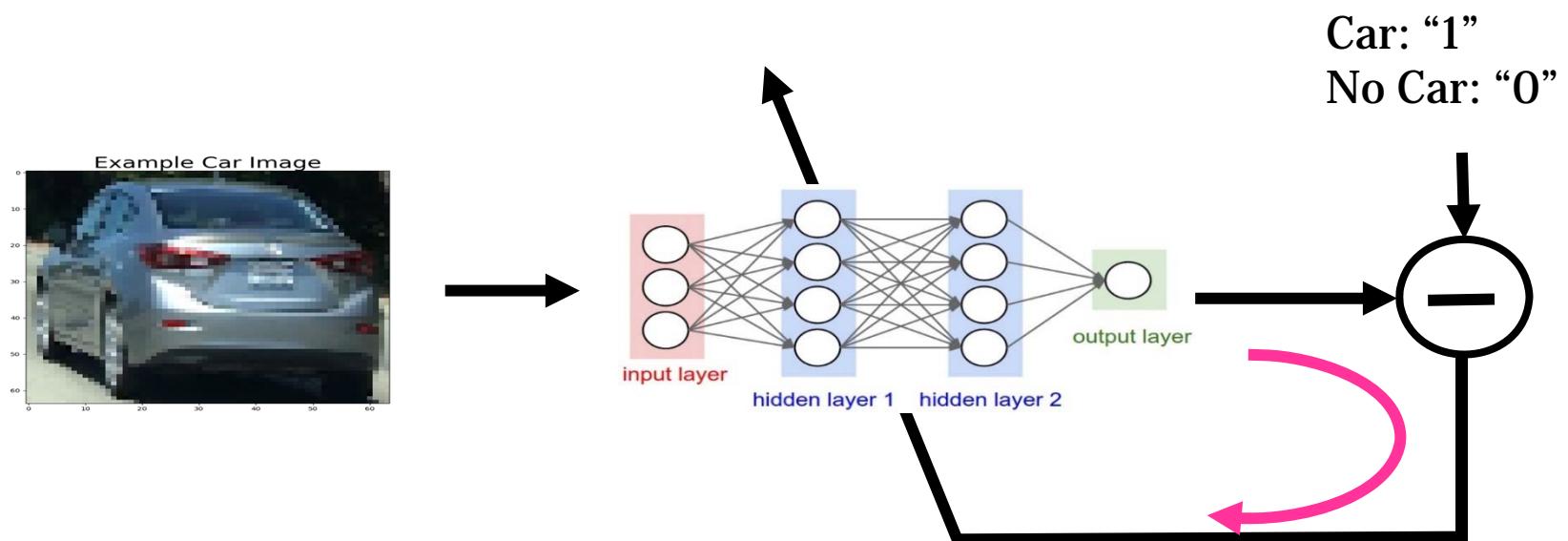
Feature Extraction



Simple NN



Deep Learning

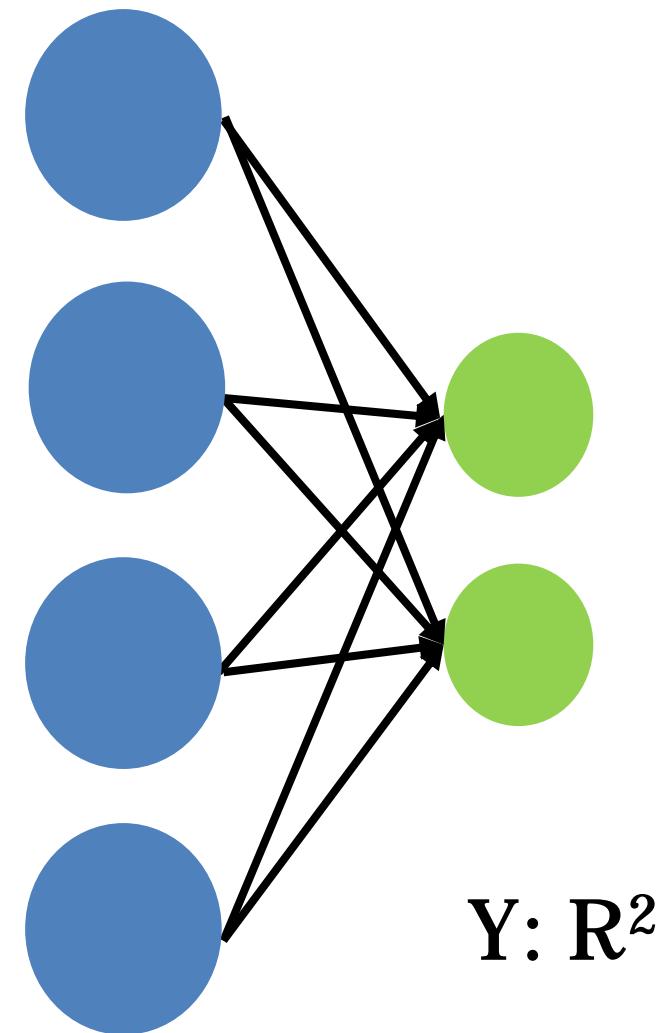


Feature Map

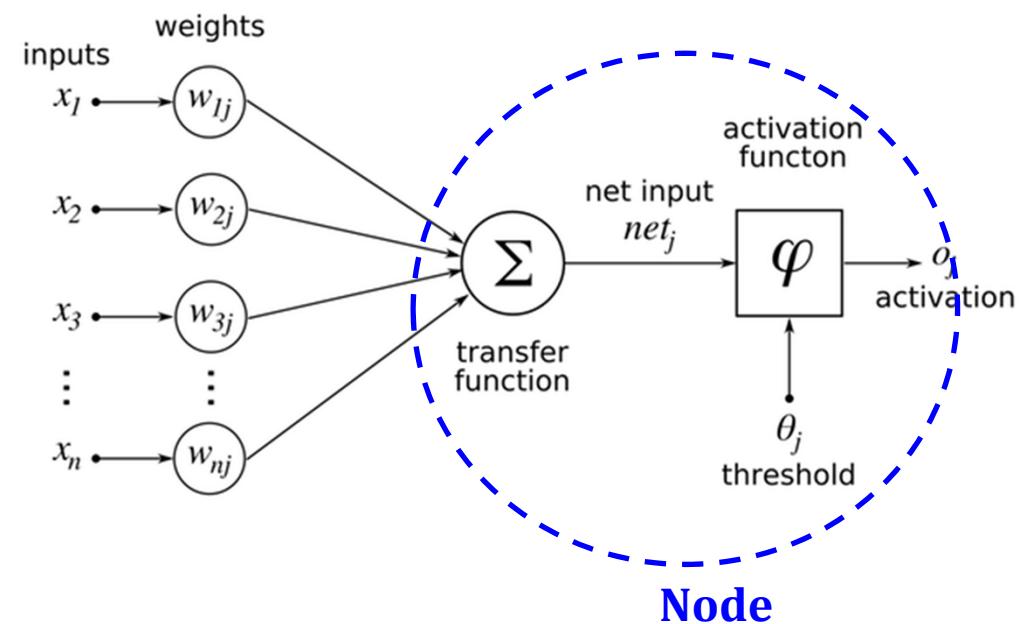
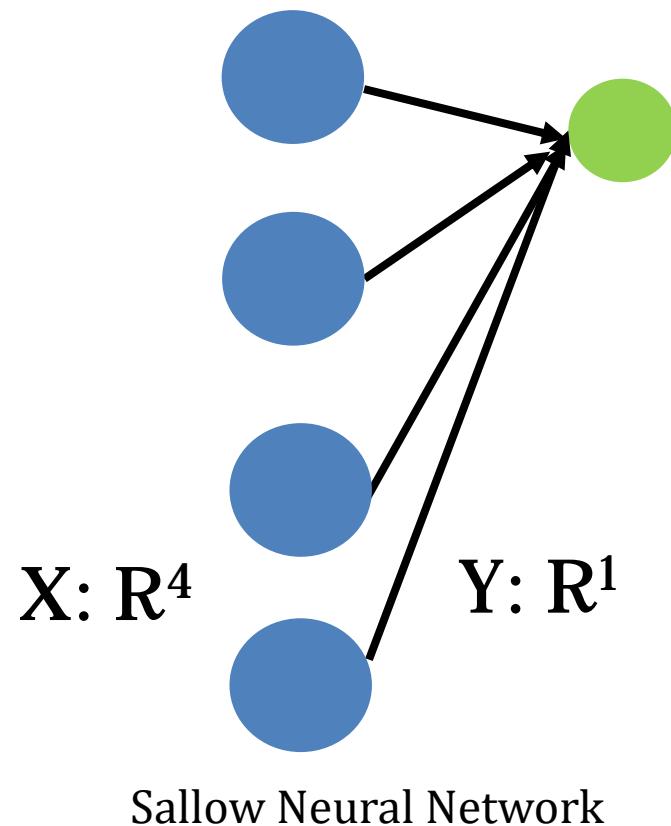
- Matrix
- Mapping
- Nonlinear
- Connected
- Dropout
- Normalization
- ...

$$Y = AX$$

$X: \mathbb{R}^4$



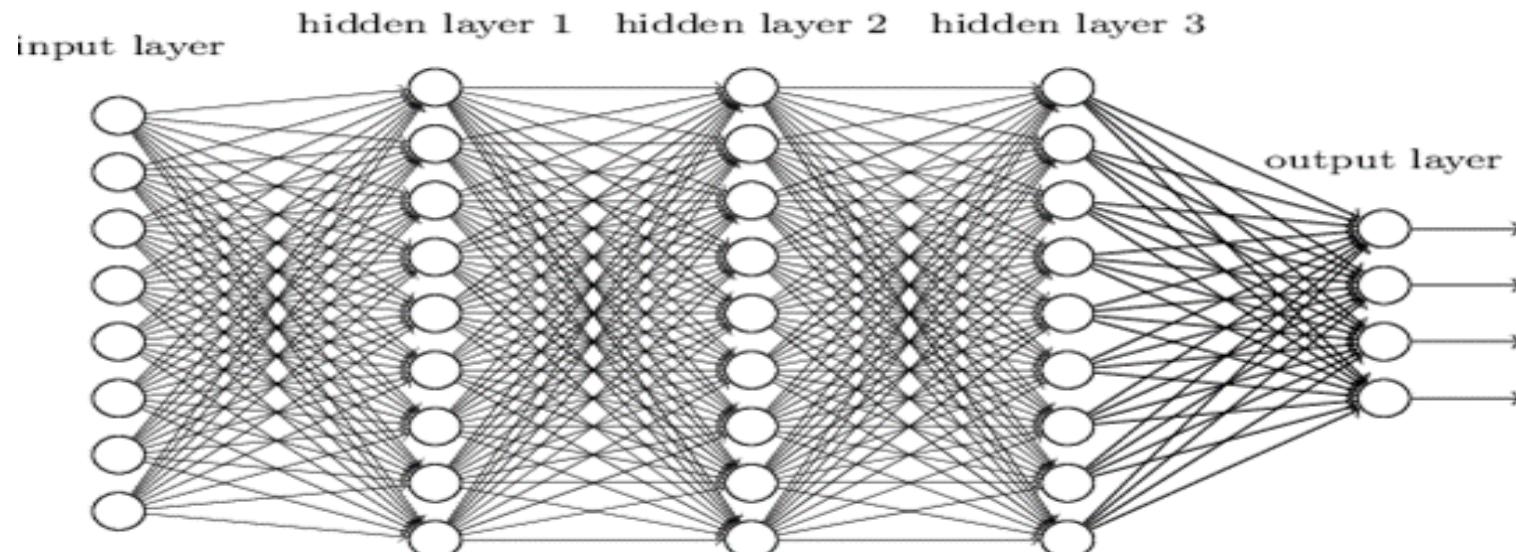
Feature Map



Shallow Neural Network

Deep Feature Map

- 深度學習模型 (Model)



醫學專題實作

UCI Breast Cancer

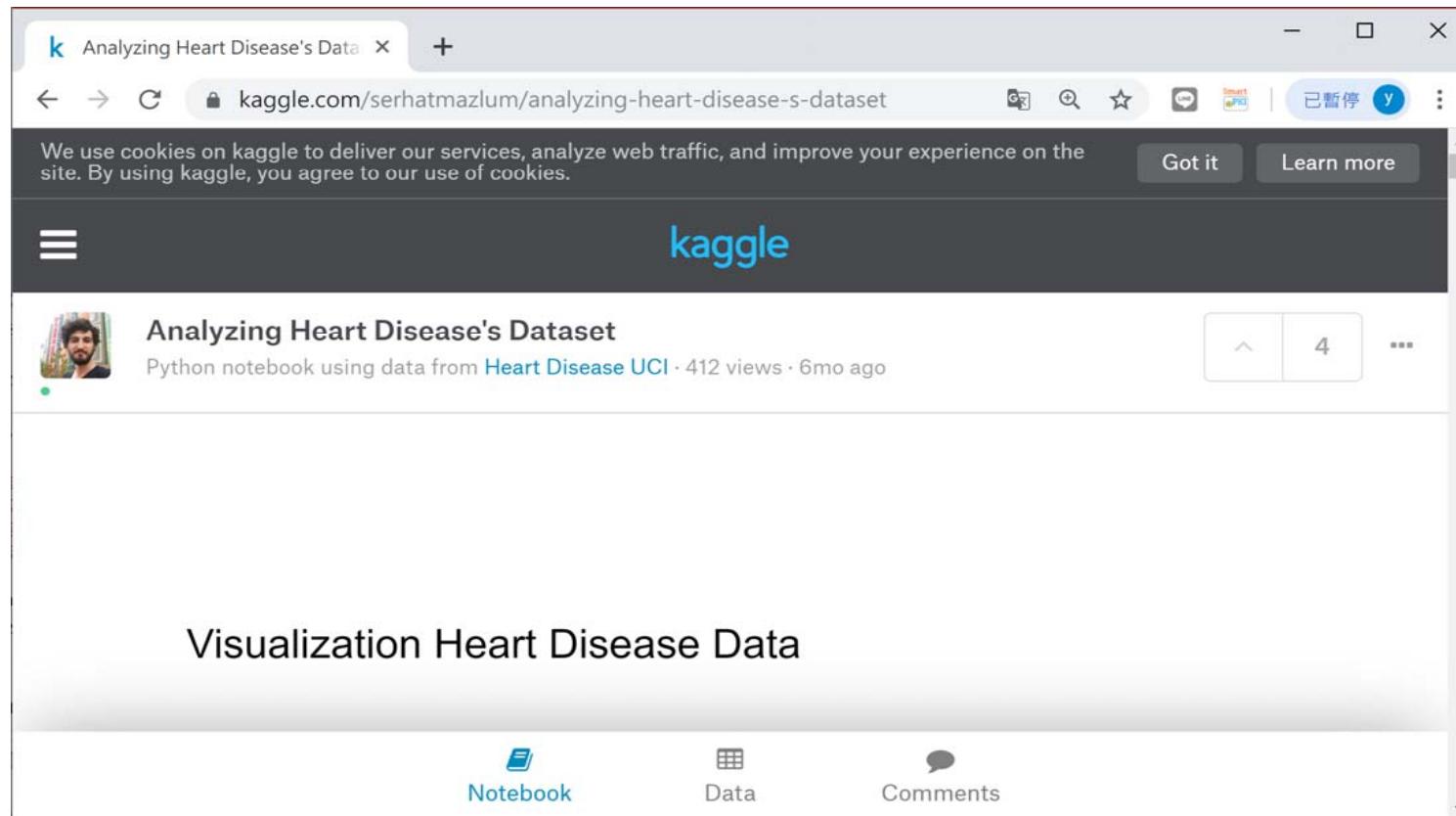
- Associated tasks: Classification
- Number of instances: 569
- Number of attributes: 30 (mean, standard error, worst)
 - ~~id~~
 - radius
 - texture
 - perimeter
 - area
 - smoothness
 - compactness
 - concavity
 - concave points
 - symmetry
 - fractal dimension (10 different characteristics of the digitized cell nuclei)
- Class: B(benign)/M(malignant)

Breast Cancer

The screenshot shows a web browser window with the URL [kaggle.com/buddhiniw/breast-cancer-prediction](https://www.kaggle.com/buddhiniw/breast-cancer-prediction). The page displays a Python notebook titled "Breast cancer prediction" by a user named buddhiniw. The notebook uses data from the "Breast Cancer Wisconsin (Diagnostic) Data Set". It has 27,274 views and was posted 3 years ago. The notebook is categorized under "healthcare". The interface includes a navigation bar with "kaggle" and a sidebar with a profile picture and the notebook title. Below the notebook details, there is a section titled "Using the Wisconsin breast cancer diagnostic data set for" followed by three buttons: "Notebook", "Data", and "Comments". A "Got it" button and a "Learn more" link are visible at the top of the page.

<https://www.kaggle.com/buddhiniw/breast-cancer-prediction>

Heart Disease



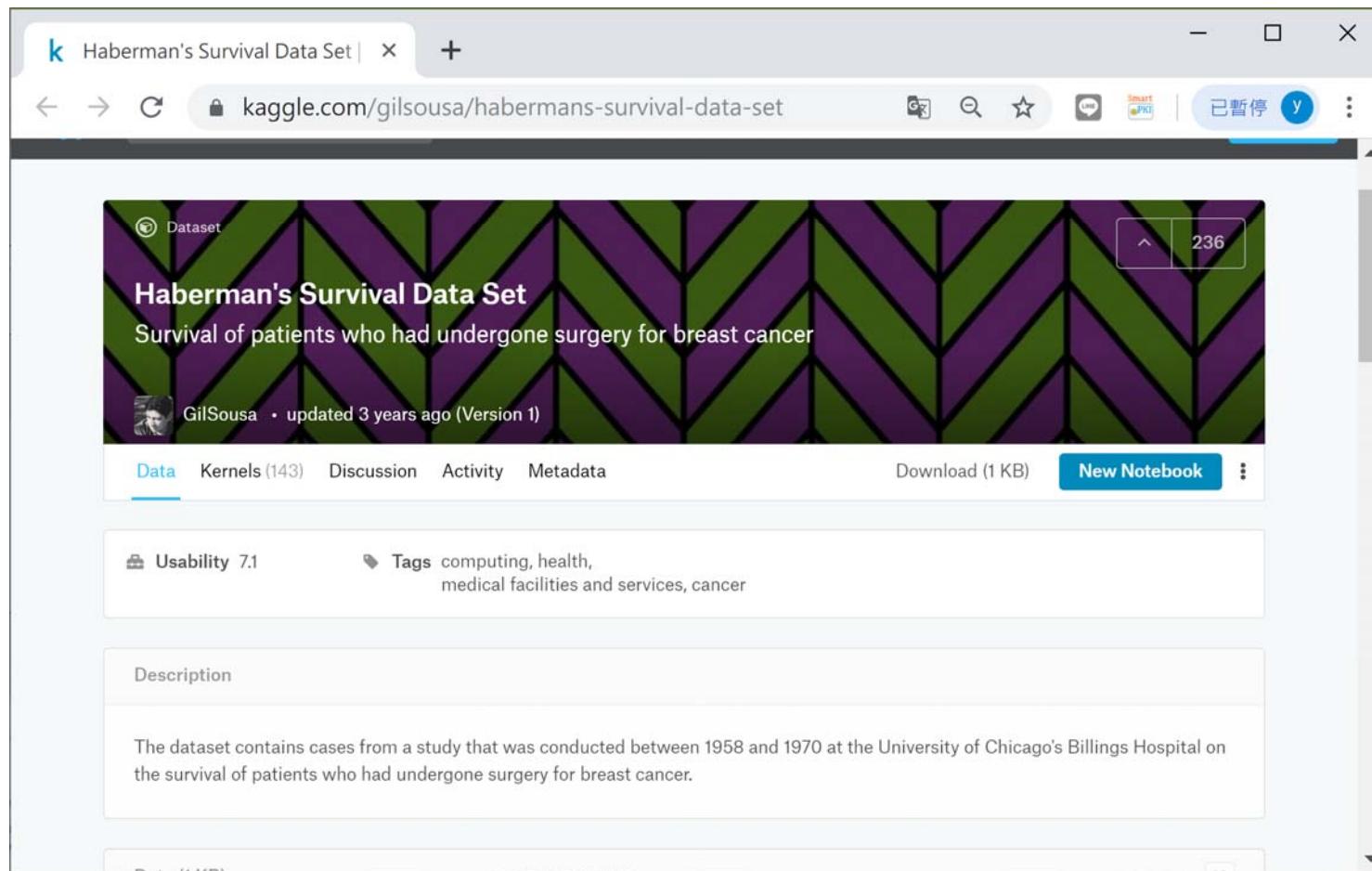
<https://www.kaggle.com/serhatmazlum/analyzing-heart-disease-s-dataset>

Cervical Cancer Risk

The screenshot shows a web browser window displaying a Kaggle dataset page. The title of the page is "Cervical Cancer Risk Classification". The page features a grid of microscopic images showing tissue samples, labeled as "Tumor tissues" and "Non-tumor tissues". Below the images, the text reads: "prediction of cancer indicators; Please download; run kernel & upvote". A user profile "Gokagglers" is shown, indicating the dataset was updated 2 years ago (Version 6). The dataset has a rating of 8.2 for Usability, is licensed under "Other (specified in description)", and includes tags for healthcare, cancer, women's health, reproductive health, and human genetics. At the bottom, there is a note: "Cervical Cancer Risk Factors for Biopsy: This Dataset is Obtained from UCI Repository and kindly acknowledged!".

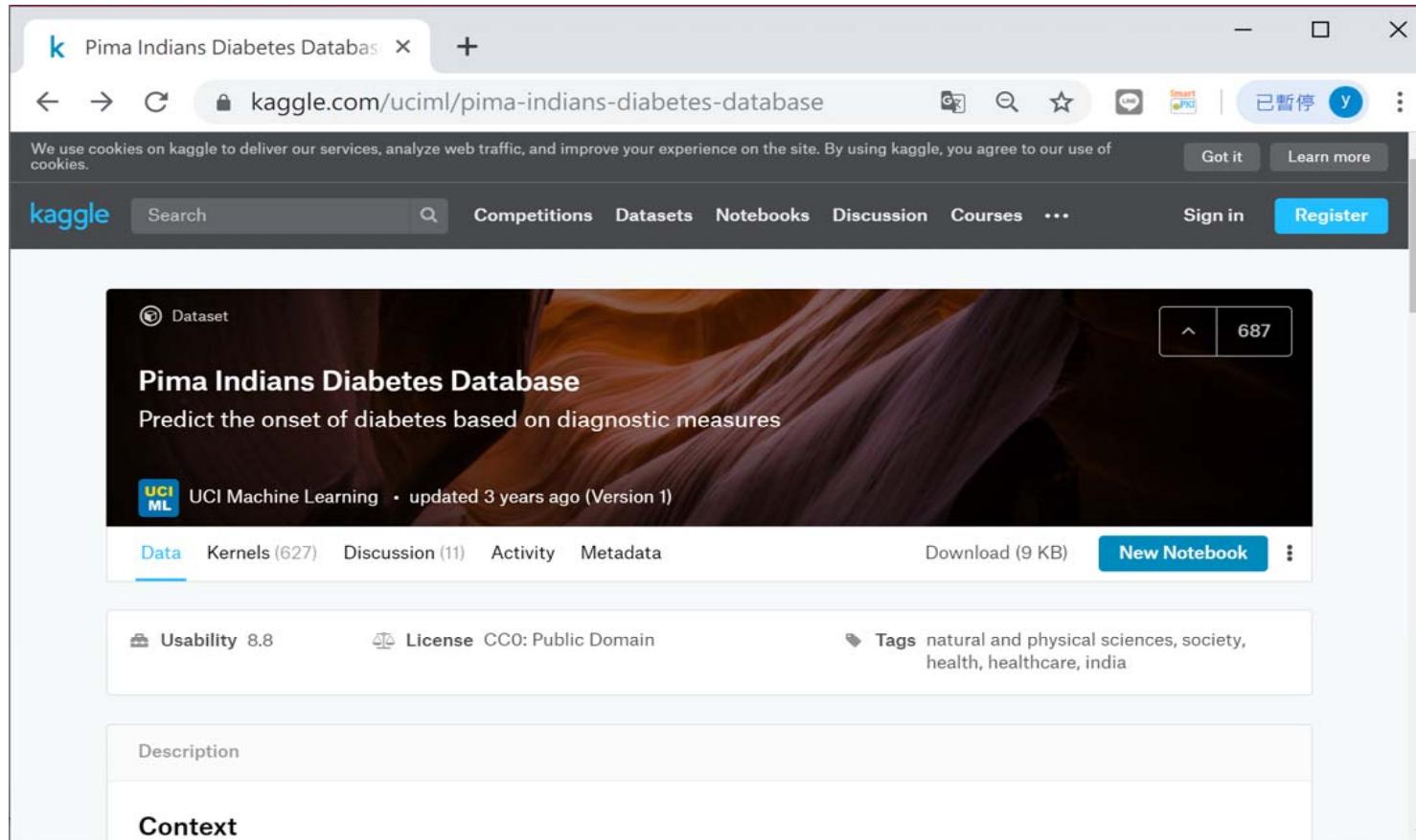
<https://www.kaggle.com/loveall/cervical-cancer-risk-classification>

Survival Data Set



<https://www.kaggle.com/gilsousa/habermans-survival-data-set>

Diabetes Database



<https://www.kaggle.com/buddhiniw/breast-cancer-prediction>

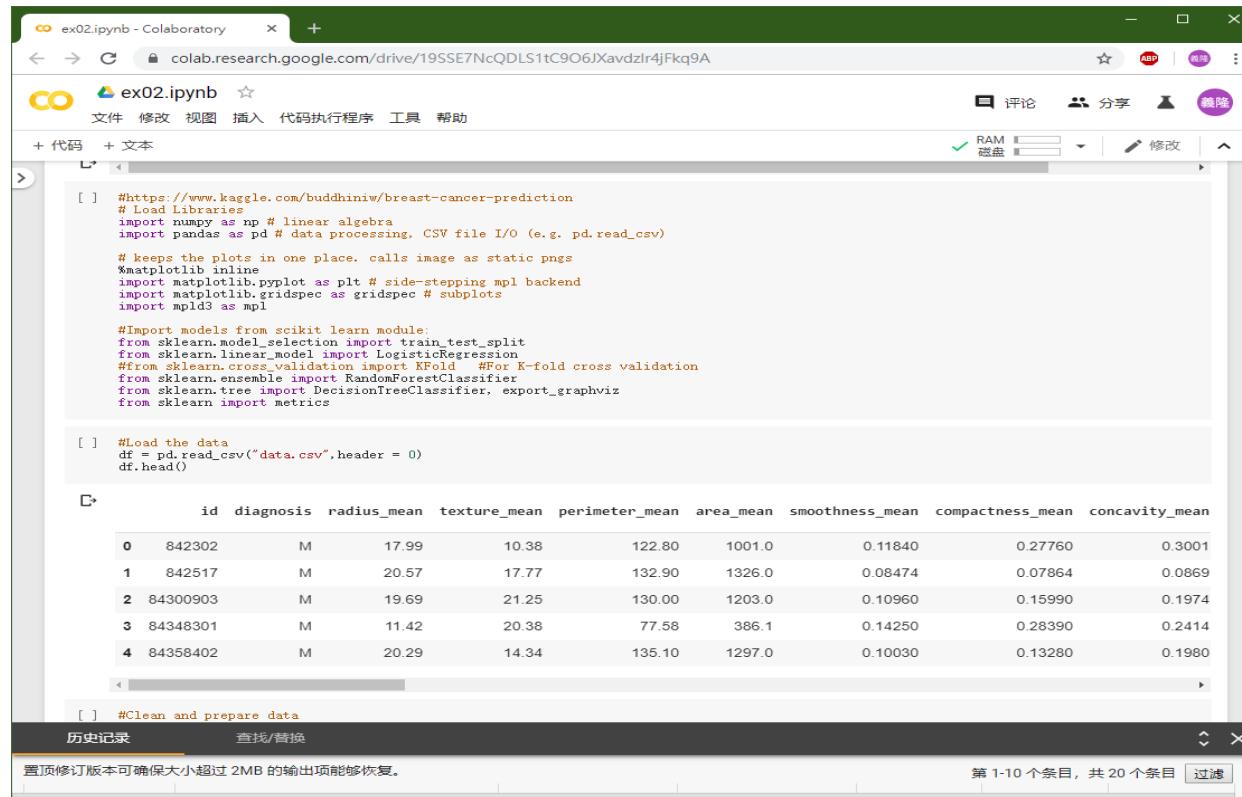
課後提問

- 快問快答

The screenshot shows a Kahoot! game created by 'yihlon' titled '機器學習課程'. The game has 10 questions and is set to expire in 20 seconds. The first question asks: '本課程補助的政府單位是哪一個?' The second question asks: '本系列課程人才學習路徑是哪一個?' The third question asks: '本計畫人才培育包含那些課程?(複選)' The fourth question asks: '本課程主軸包含那些?(複選)'. The Kahoot! interface includes a sidebar with player statistics and a 'Create' button.

課後練習一

- 使用Colab載入GitHub資料集



The screenshot shows a Google Colab notebook titled "ex02.ipynb". The code cell contains Python code for data analysis, including imports from scikit-learn and pandas, and a head() command to preview the dataset. The output cell displays the first five rows of the breast cancer dataset, which includes columns for ID, diagnosis, and various measurements.

	id	diagnosis	radius_mean	texture_mean	perimeter_mean	area_mean	smoothness_mean	compactness_mean	concavity_mean
0	842302	M	17.99	10.38	122.80	1001.0	0.11840	0.27760	0.3001
1	842517	M	20.57	17.77	132.90	1326.0	0.08474	0.07864	0.0869
2	84300903	M	19.69	21.25	130.00	1203.0	0.10960	0.15990	0.1974
3	84348301	M	11.42	20.38	77.58	386.1	0.14250	0.28390	0.2414
4	84358402	M	20.29	14.34	135.10	1297.0	0.10030	0.13280	0.1980