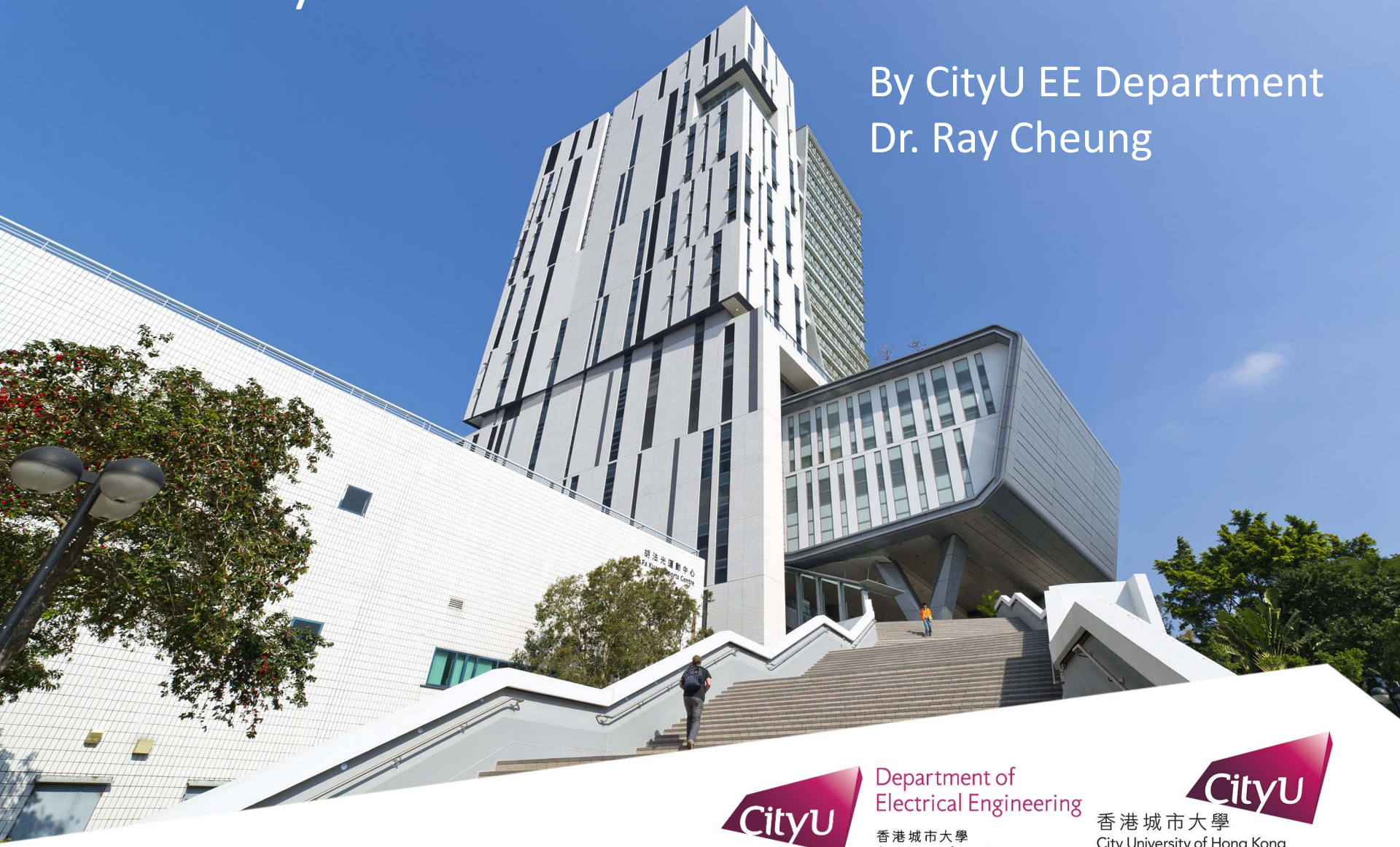
Deep Learning Workshop for Secondary School Students



By CityU EE Department
Dr. Ray Cheung

CityU Department of Electrical Engineering
香港城市大學 City University of Hong Kong
CityU 香港城市大學 City University of Hong Kong

Building a Pokemon classifier with **TensorFlow**, **Keras** and **Colab**

CityU
Department of Electrical Engineering
香港城市大學
City University of Hong Kong

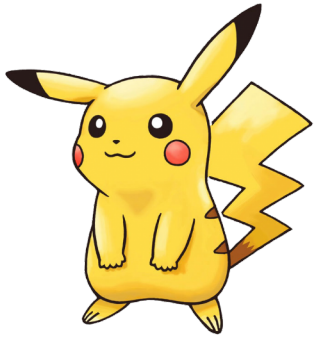
Outline

- Introduction to this workshop
  - Special thanks to the arrangement of the CityU Provost Office
  - Special thanks to all the Principals and Teachers who promoted this event
- Basic Concept
- Hands-on coding
- QA Session with the inputs from each of you
- Coding optimization
- Student sharing – Noel
- Conduct a post-event survey
- Polling!

Office of the Provost
香港城市大學
City University of Hong Kong

Department of Electrical Engineering
香港城市大學
City University of Hong Kong

5 types of Pokemon to be classified



比卡超
Pikachu

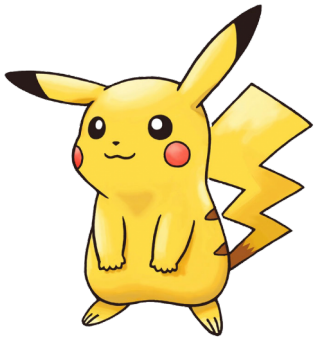
小火龍
Charmander

車厘龜
Squirtle

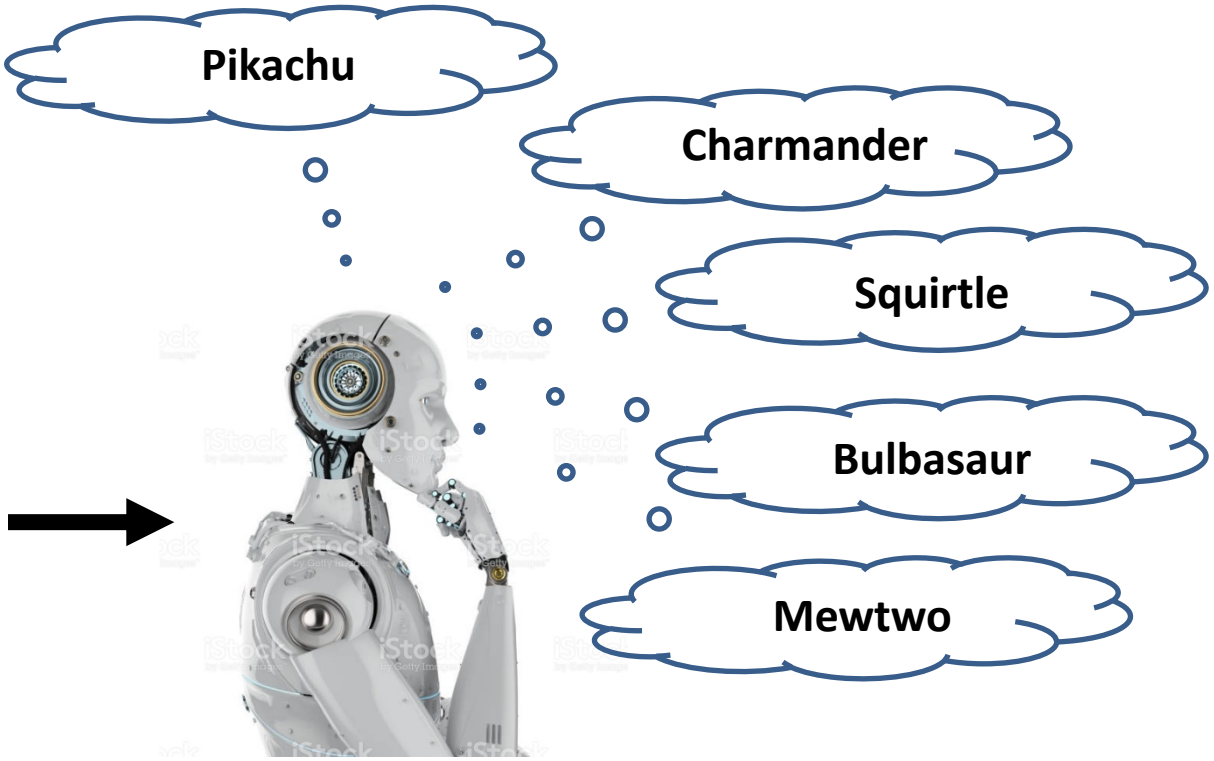
奇異種子
Bulbasaur

超夢夢
Mewtwo

Which class does this image belong to?

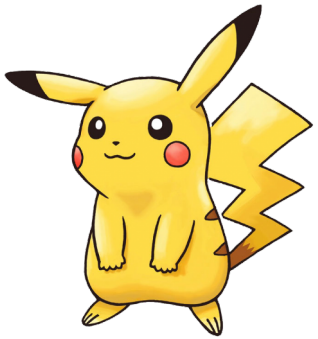


Input image

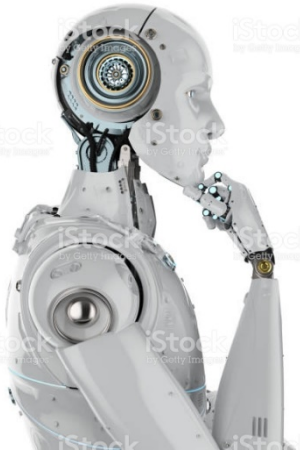


Machine learning classifier

Which class does this image belong to?



Input image



Machine learning classifier

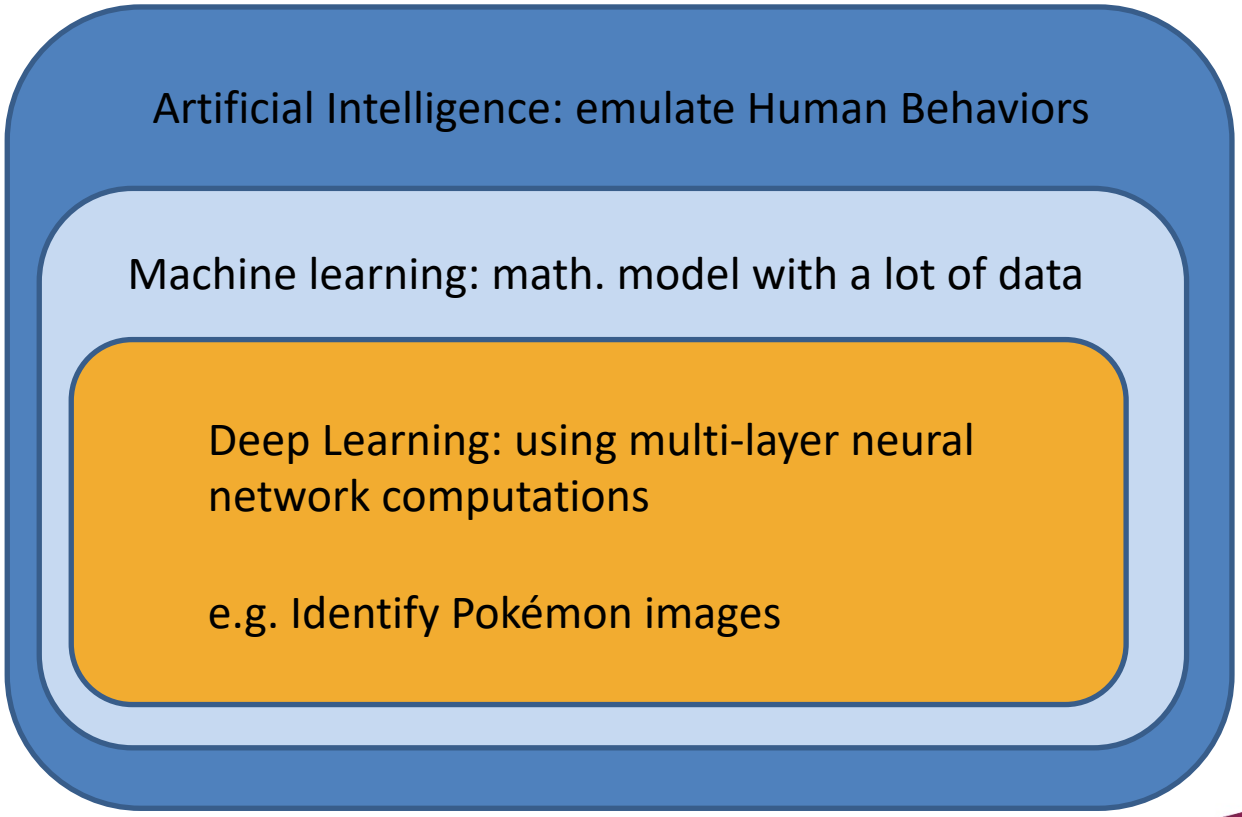
Input image:

	Probability
bulbasaur	0.006850
charmander	0.003913
mewtwo	0.000013
pikachu	0.979008
squirtle	0.010216

CityU
Department of Electrical Engineering
香港城市大學
City University of Hong Kong

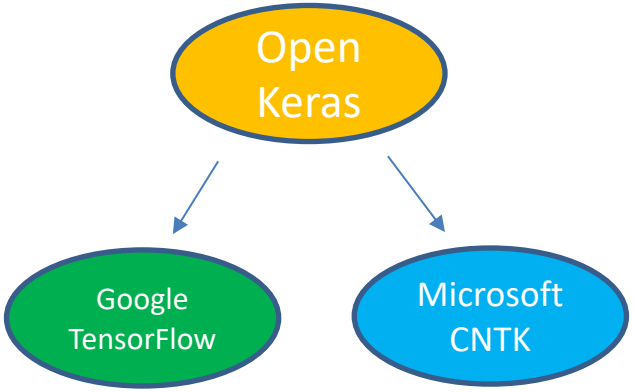
AI, Machine Learning, Deep Learning

Intelligence: an ability to perceive or infer information, to retain it as a knowledge



TensorFlow, Keras and Colab

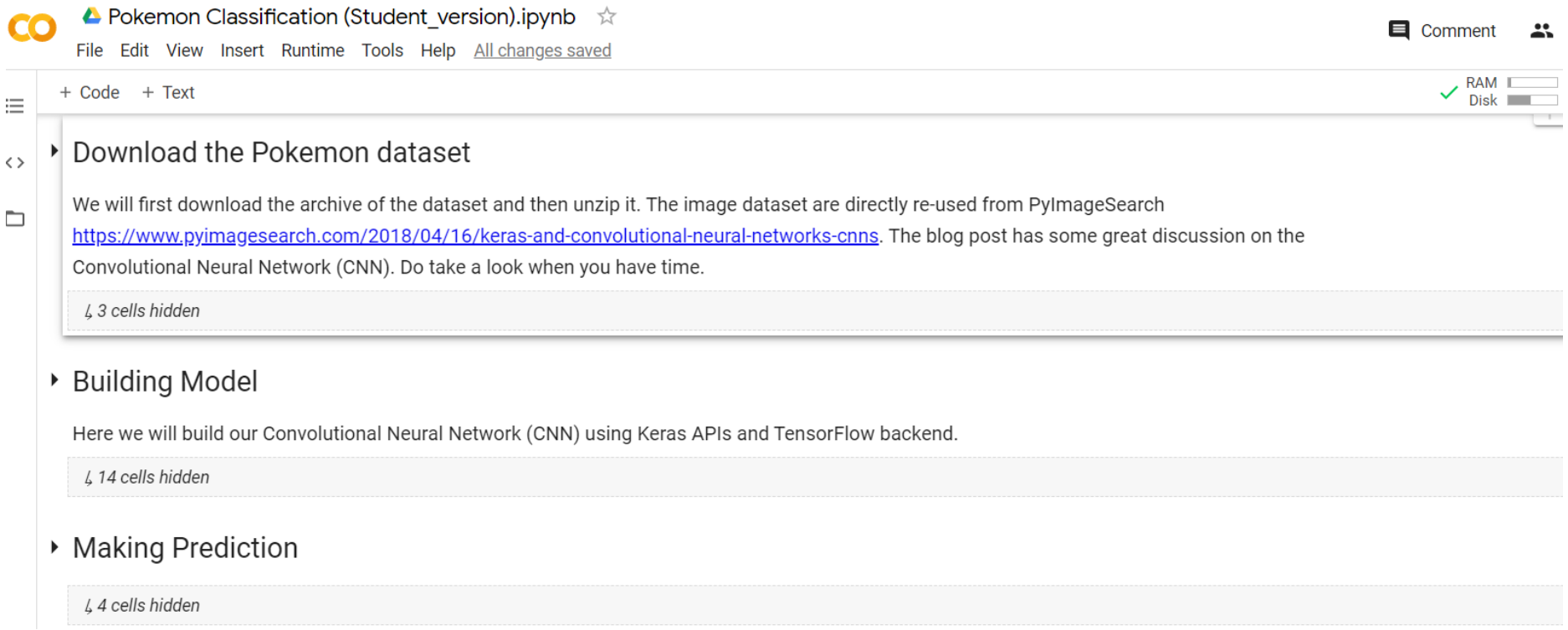
- TensorFlow
  - Open Source Machine Learning library
- Keras
  - High Level API
- Colaboratory(Colab)
  - Free Jupyter notebook environment with free GPU runtime
  - CPU: Bicycle
  - GPU: Car
  - TPU: Rocket



TensorFlow, Keras and Colab

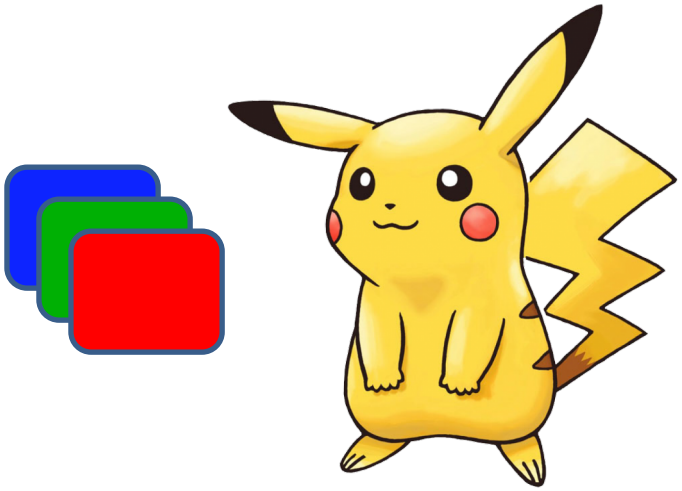
1. Data collection ← most of the work
2. Defining your model ← few lines of code
3. Model training ← one line
4. Model evaluation ← one line
5. Prediction ← one line

Coding Environment



How do computers “see”?

What you see



What your computer see

88	126	145	85	123	142	85	123	142	86	124
86	125	142	84	123	140	83	122	139	85	124
85	124	141	82	121	138	82	121	138	84	123
82	119	135	80	117	133	80	117	133	85	122
78	114	128	77	113	127	79	115	129	84	120
79	115	129	78	114	128	80	116	130	83	119
82	118	130	81	117	129	81	117	129	82	118
83	117	129	82	116	128	82	116	128	82	116
79	113	123	79	113	123	80	114	124	81	115
76	108	119	76	108	119	77	109	120	80	112
76	109	118	76	109	118	77	110	119	79	112

CityU
Department of Electrical Engineering
香港城市大學
City University of Hong Kong

Extracting features from images

- We look for lines, edges and shapes to learn the concept of a dog
- These are the features we want to extract

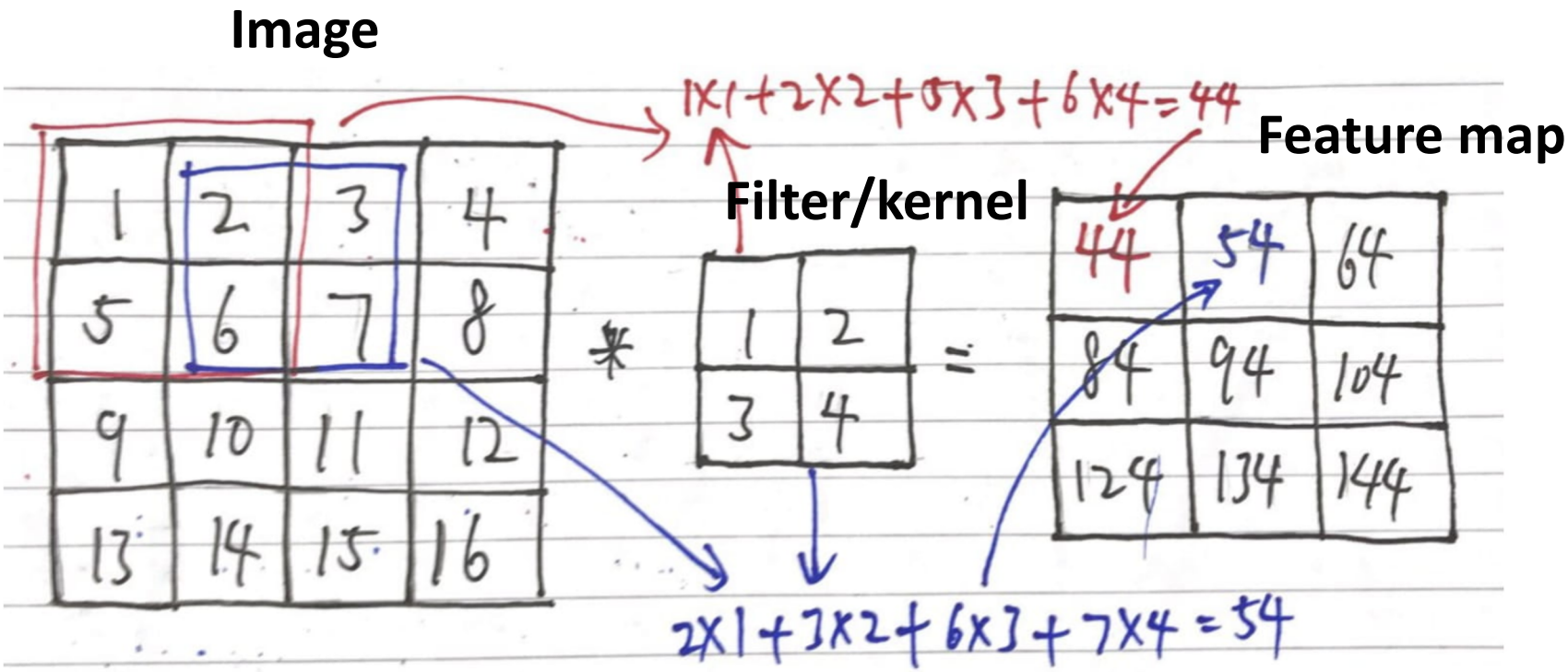
Image

Lines, Edges, Shapes (features)

Concept of a dog

Convolution – detecting edges from images

- The math operation “convolution” can be used to detect edges/extract features from an image



Convolution – detecting edges from images

- These filters can be used to detect horizontal lines, vertical lines, and edges respectively

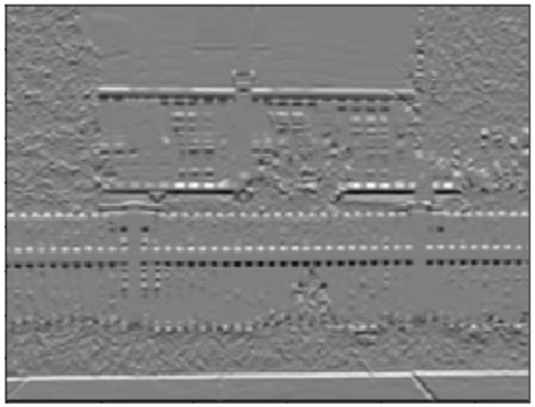
$$\begin{bmatrix} 1 & 1 & 1 \\ 0 & 0 & 0 \\ -1 & -1 & -1 \end{bmatrix} \quad \begin{bmatrix} 1 & 0 & -1 \\ 1 & 0 & -1 \\ 1 & 0 & -1 \end{bmatrix} \quad \begin{bmatrix} 0 & -1 & 0 \\ -1 & 4 & -1 \\ 0 & -1 & 0 \end{bmatrix}$$

Horizontal line filter | **Vertical line filter** | **Laplacian filter (edge detection)**

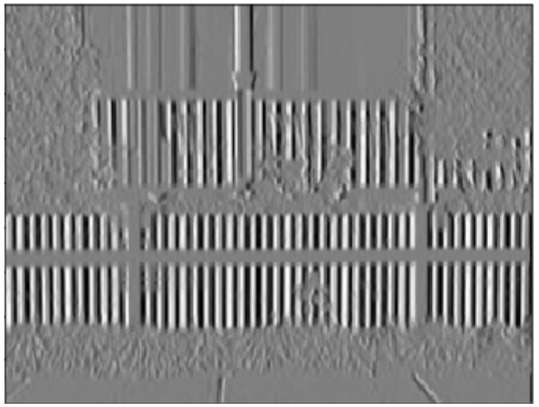
Convolution – detecting edges from images

An image after taking the convolution with…

Horizontal line filter



Vertical line filter



Laplacian filter (edge detection)

Department of Electrical Engineering
香港城市大學
City University of Hong Kong

Image Processing – Lena Sobel

$$Edge\_Gradient\ (G) = \sqrt{G_x^2 + G_y^2}$$

$$Angle\ (\theta) = \tan^{-1}\left(\frac{G_y}{G_x}\right)$$

All about Mathematics

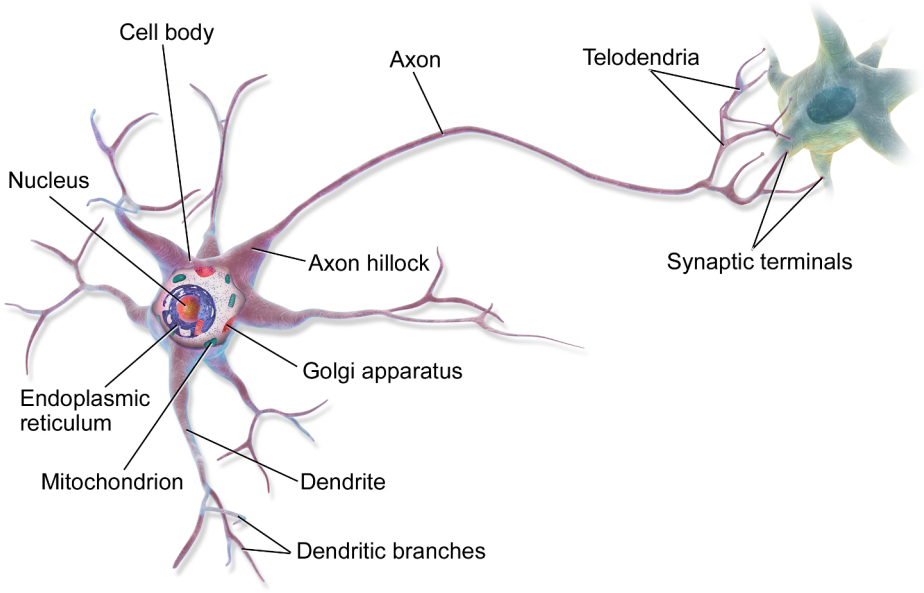
Department of Electrical Engineering
香港城市大學
City University of Hong Kong

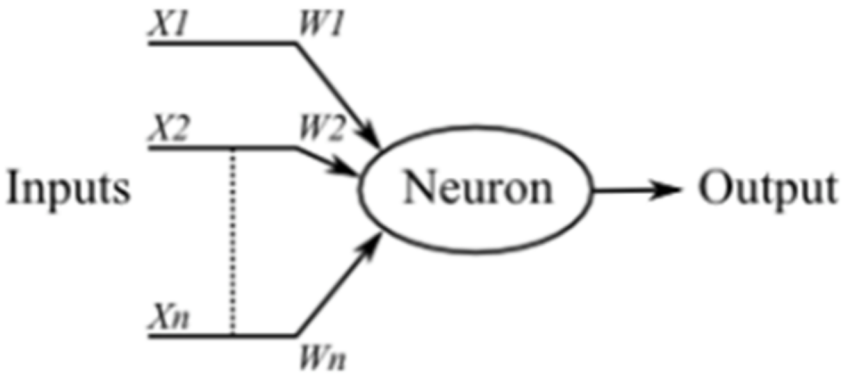
Now I have the features, what's next?

Department of Electrical Engineering
香港城市大學
City University of Hong Kong

Modelling the brain – artificial neural network

A biological neuron

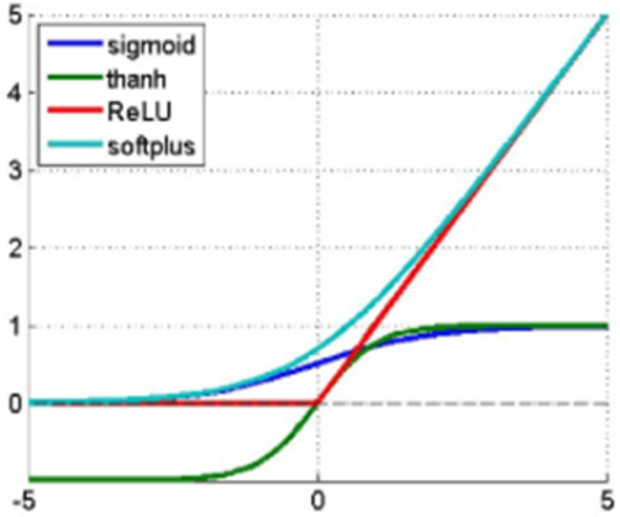




$$output = g(\vec{w} \cdot \vec{x} + w_0)$$

Activation Function – Adding Non-Linearity

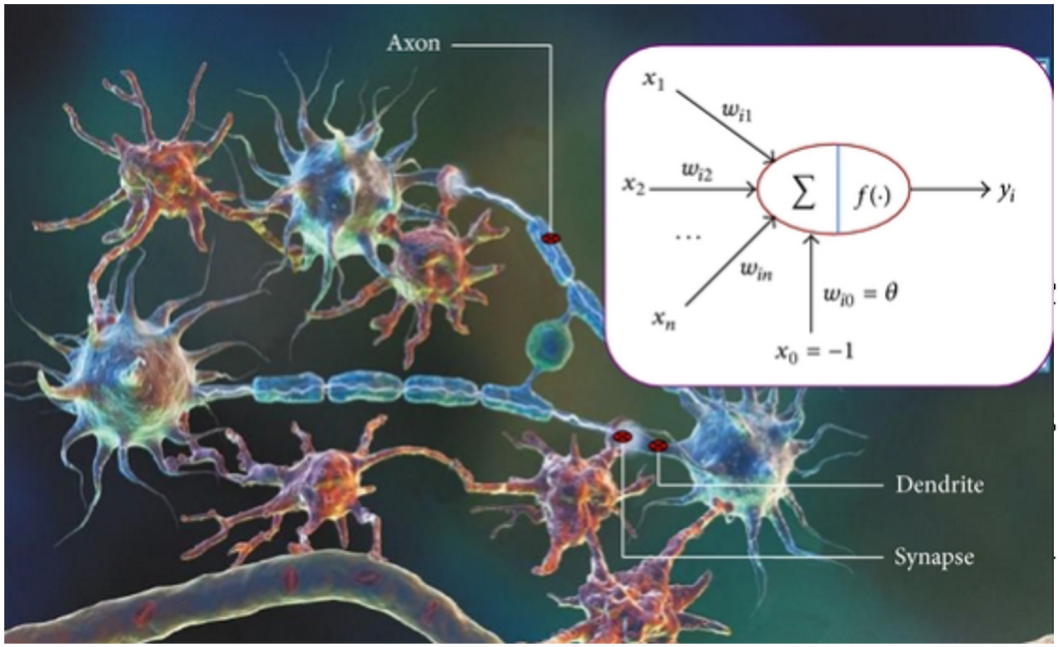
	Propagation
Sigmoid	$y_s = \frac{1}{1+e^{-x_s}}$
Tanh	$y_s = \tanh(x_s)$
ReLu	$y_s = \max(0, x_s)$

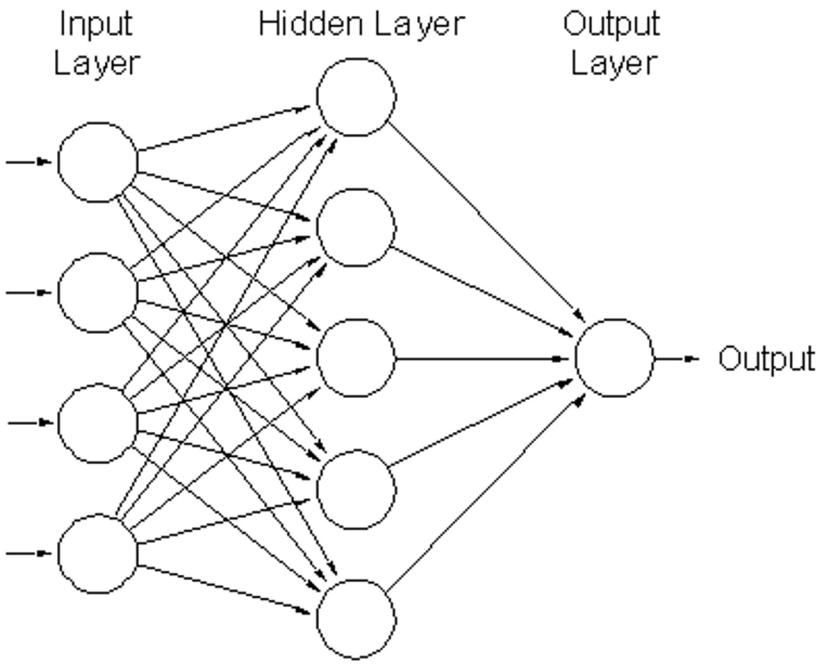


Full list of common activation functions: https://keras.io/activations/

Modelling the brain – artificial neural network

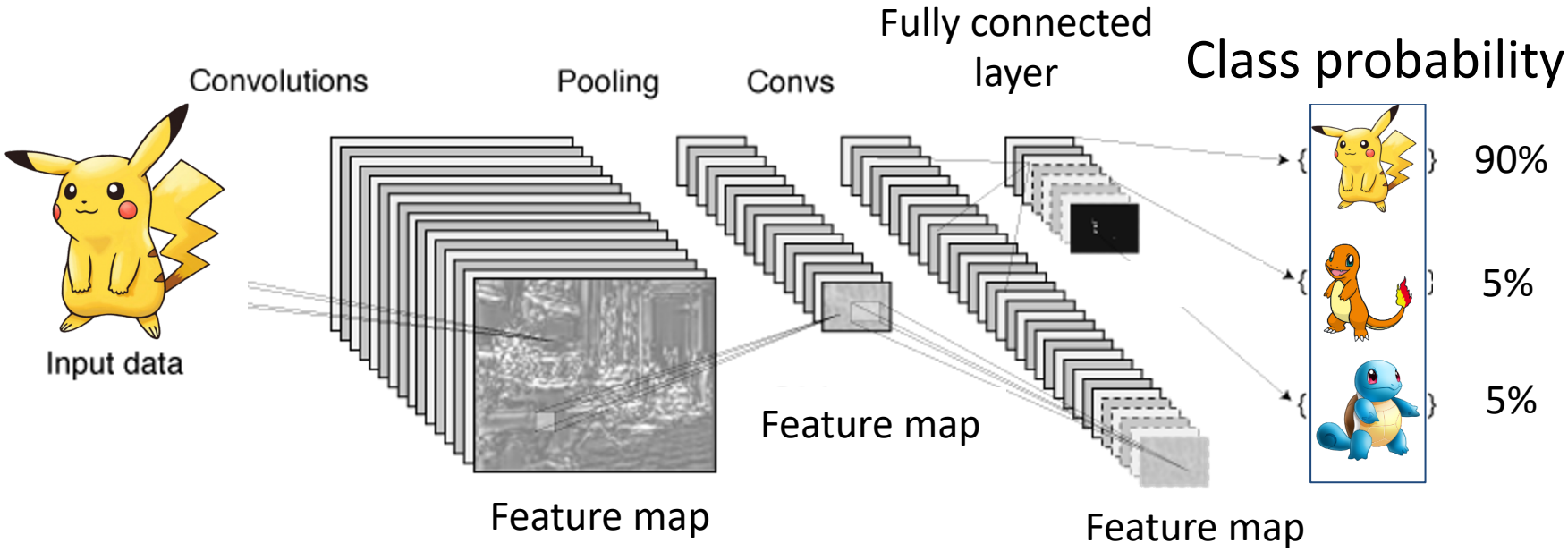
- Putting many neurons together, we have an artificial neural network
- Aka: deep neural network, fully connected neural network, connectionist system, multilayer perceptron etc



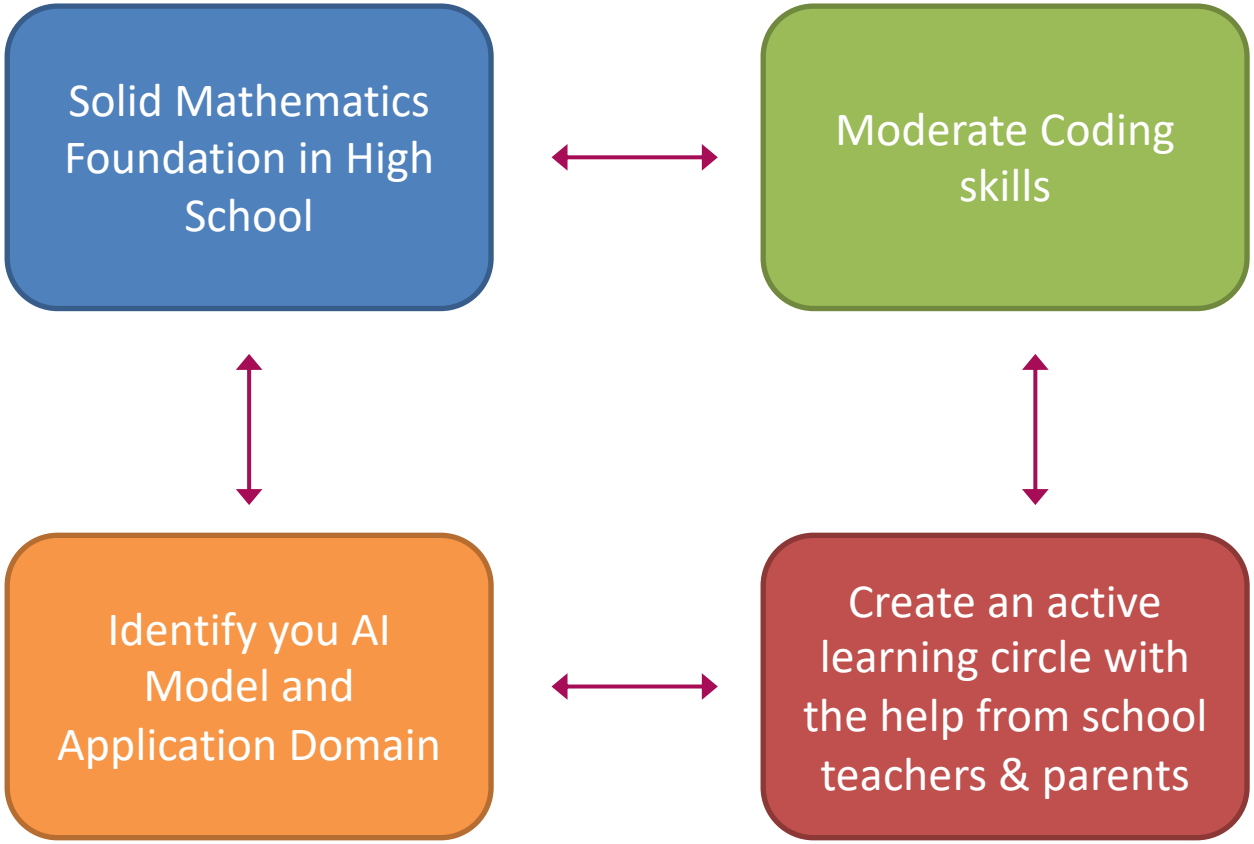


Learning the filters by convolutional neural network

- Instead of handcrafting the filters, they can be learned by the convolutional neural network



General Advice

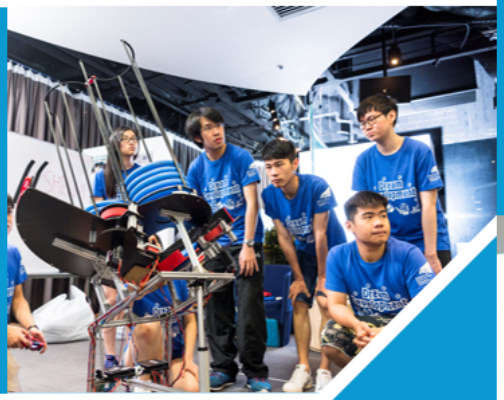


Past workshops

How to adopt new tech in STEM?

5G Lab Visit

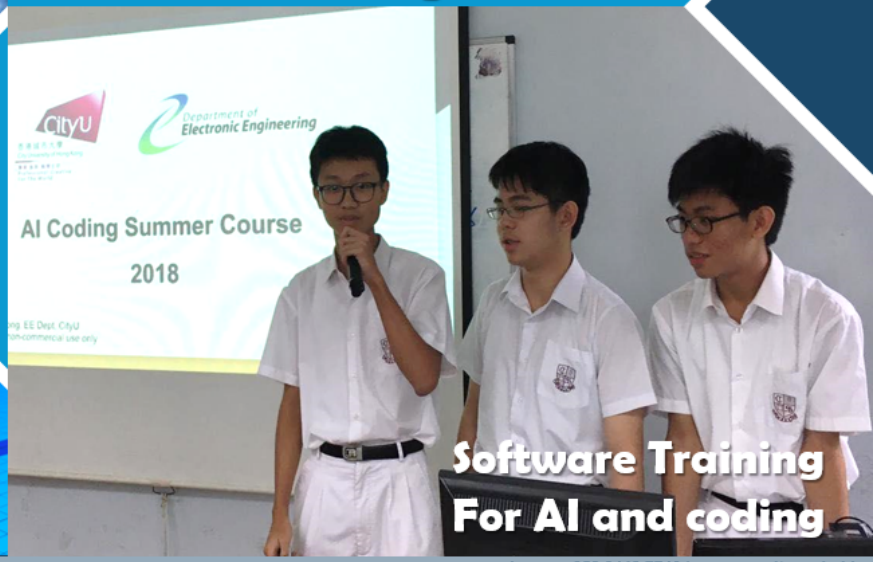
Product Design



IoT Lab Training

CityU EE provides hardware and software complete training to support secondary school students.

Robotics Hardware Training



Software Training For AI and coding

phone : +852 3442 7740 | www.ee.cityu.edu.hk

CityU
Department of Electrical Engineering
香港城市大學
City University of Hong Kong

Office of Education Development and Gateway Education
香港城市大學 City University of Hong Kong

Department of Electrical Engineering
香港城市大學 City University of Hong Kong

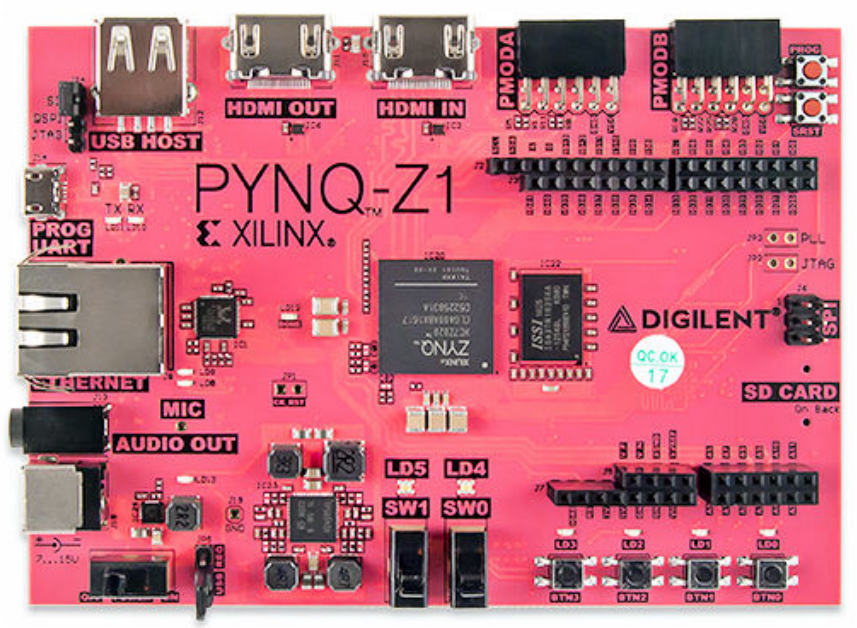
LEARNING CODING AND AI PROGRAM 2019

Learn to Code for AI !
Oct to Dec, every Sat (except exam period), 2pm-5pm

Briefing Session: 27/9 (Friday), 5pm, LT-11, Yeung

WORKSHOP CONTENT:

1. BASIC PYTHON
2. ADVANCED PYTHON
3. MACHINE LEARNING WITH PYTHON
4. DEEP LEARNING WITH PYTHON
5. HARDWARE ACCELERATION WITH PYTHON



REGISTER NOW!

STUDENTS FROM ALL MAJORS ARE WELCOMED!

Contact person: John Wong (Whatsapp: 6485 4147, Email: tljewong@cityu.edu.hk)
Remark: This program is supported by CityU Teaching & Learning Fund

Department of Electrical Engineering
香港城市大學 City University of Hong Kong

Hands-on coding!

What's Next?

JS1205 Department of Electrical Engineering

Department of Electrical Engineering
香港城市大學
City University of Hong Kong

(Options: BEng Computer and Data Engineering,
BEng Electronic and Electrical Engineering*, BEng Information Engineering)

Our Majors

- Common first year
- Students choose a major after one year of study
- Majors offered:
  - BEng in Computer and Data Engineering (CDE) 工學士(電子計算機及數據工程學)
  - BEng in Electronic and Electrical Engineering (EEE) 工學士(電子及電機工程學)*
  - BEng in Information Engineering (INFE) 工學士(資訊工程學)

* *Change of major title from "Electronic and Communication Engineering" to "Electronic and Electrical Engineering" is subject to approval of the University.*

Program Highlights

CDE - Computer Applications

- Digital Systems 數碼系統
- Computer and Embedded Systems 電腦及嵌入式系統
- Security Systems 保安系統
- Data Center and Cloud Computing 數據中心及雲端運算
- Big Data and Multimedia 大數據及多媒體科技

EEE- Electronic and Electrical Systems

- Wireless Communications & Data Technology 無線通訊及大數據技術
- Terahertz & Optical Technologies 太赫茲及光學科技
- Photonics, Electronics and Sensors 光電子、電子及感應器
- Smart Control & Power Systems 智能管理及能源系統
- Bioelectronics and Bioinformatics 生物電子和生物信息技術

INFE - Computer Network and System

- Networking and Telecommunications 網絡與通訊
- Algorithms and Software 算法與軟件
- Cybersecurity and Forensics 網絡安全與鑑證
- Artificial Intelligence and Big Data 人工智能與大數據
- Signal and Image Processing 訊號與影像處理

1) Principal Nomination Scheme

2) AI Workshop for High School Students

3) EE International students summer course

4) Face Recognition workshop for High School Students

5) Others upcoming

https://www.ee.cityu.edu.hk/home/

Department of Electrical Engineering
香港城市大學
City University of Hong Kong

https://www.ee.cityu.edu.hk/home/doc/programme/CityU_EE-V3.0.pdf

CityU Department of Electrical Engineering
香港城市大學
City University of Hong Kong

Acknowledgements

- Prof. Stella Pang – Head, Department of EE
- Kinni Mew – CityU EE Alumni, GDG Developer
- John Wong – Research Assistant, Department of EE
- Credit to PyImageSearch for the dataset

(https://www.pyimagesearch.com/2018/04/09/how-to-quickly-build-a-deep-learning-image-dataset/)

專業 創新 胸懷全球
Professional · Creative For The World

Department of Electrical Engineering
香港城市大學
City University of Hong Kong