

講題：人工智能應用與數學原理



Dr. Ray Cheung
Associate Professor

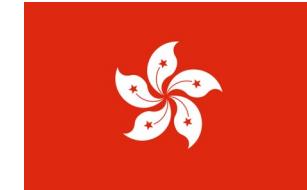


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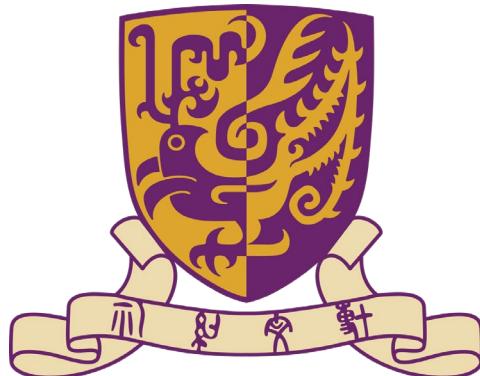
大綱內容

- AI Pokemon示範
- 人工智能應用 - 中學生作品
- 人工智能的數學應用
- 從 K12 到大學學習機會

我在香港的學習之路



- HKCEE
 - Mathematics, Additional Mathematics
 - Physics, Chemistry, Biology, Computer Studies
- HKAL
 - Pure Mathematics, Applied Mathematics, Physics, Chemistry
- CUHK
 - BEng in Computer Engineering
 - MPhil in Computing Science & Engineering
- Imperial College London
 - PhD in Computing
 - Visiting Scholar, Stanford University
- Post-Doctoral
 - UCLA, EEE
- Research Fellow
 - Princeton University, EEE
- CityU University of Hong Kong since 2010
 - Associate Professor, EE Department
 - CDE / ECE / IE / Microelectronics Engineering – 200+ Students per year

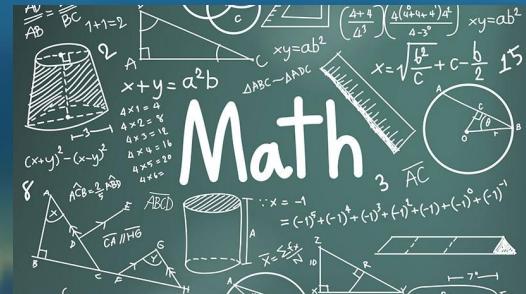
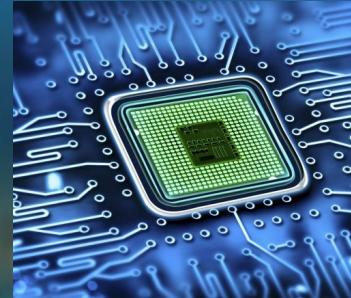
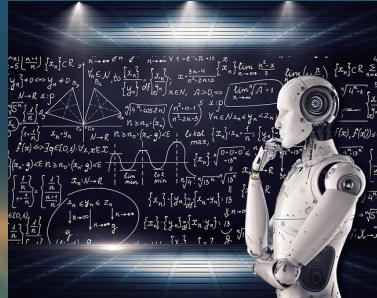


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無處不在的 STEM





Building a Pokemon classifier with TensorFlow, Keras and Colab

5 types of Pokemon to be classified



比卡超
Pikachu



小火龍
Charmander



車厘龜
Squirtle

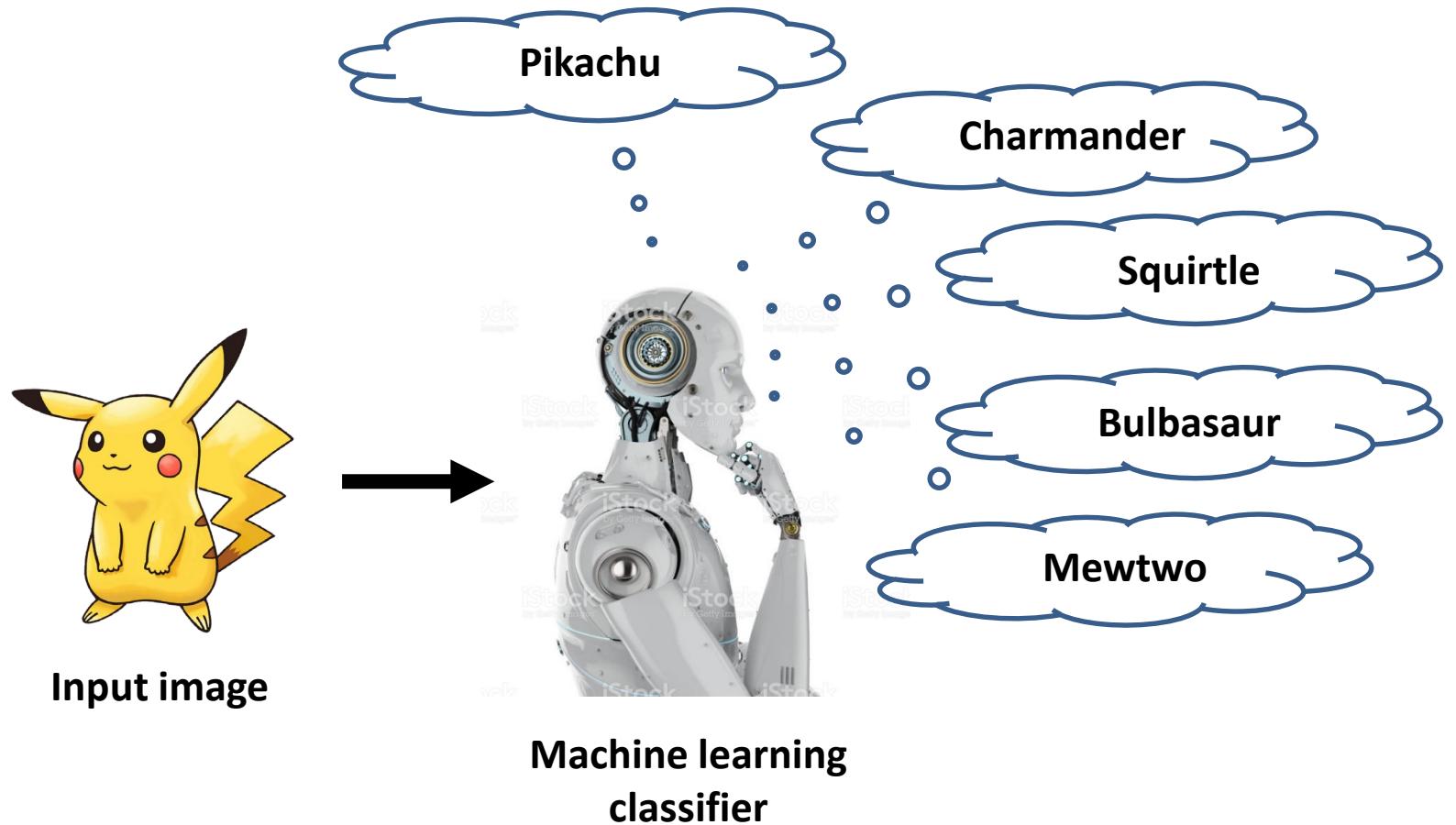


奇異種子
Bulbasaur



超夢夢
Mewtwo

Which class does this image belong to?



TensorFlow, Keras and Colab

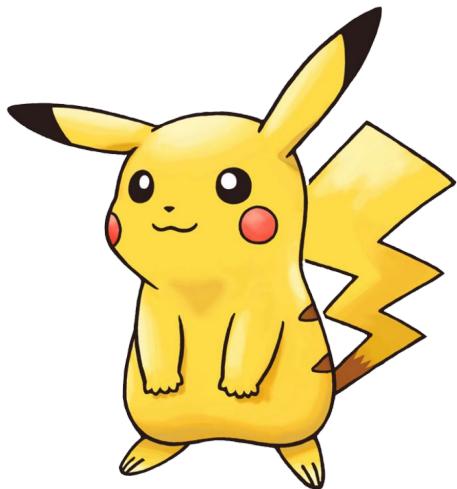
- TensorFlow
 - Open Source Machine Learning library
- Keras
 - High Level API
- Colaboratory(Colab)
 - Free Jupyter notebook environment with free GPU runtime
 - CPU: Bicycle
 - GPU: Car
 - TPU: Rocket

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

How do computers “see”?

What you see

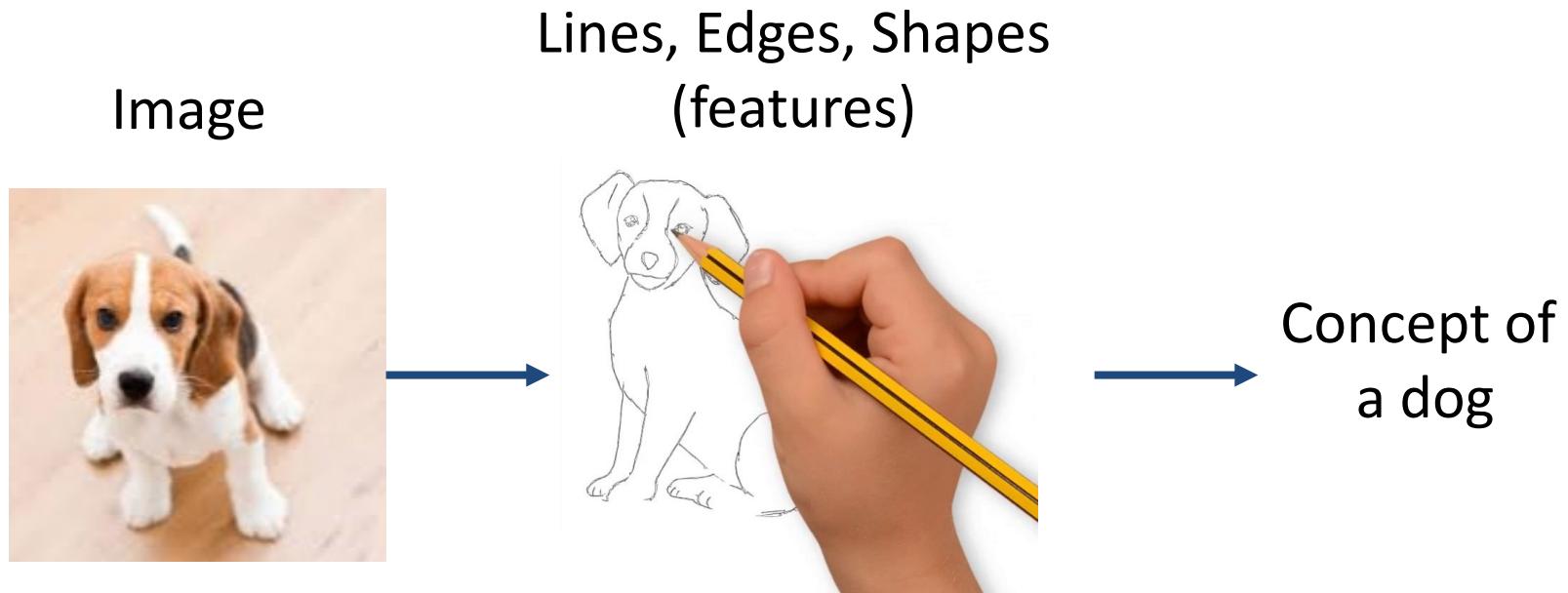


What your computer see

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

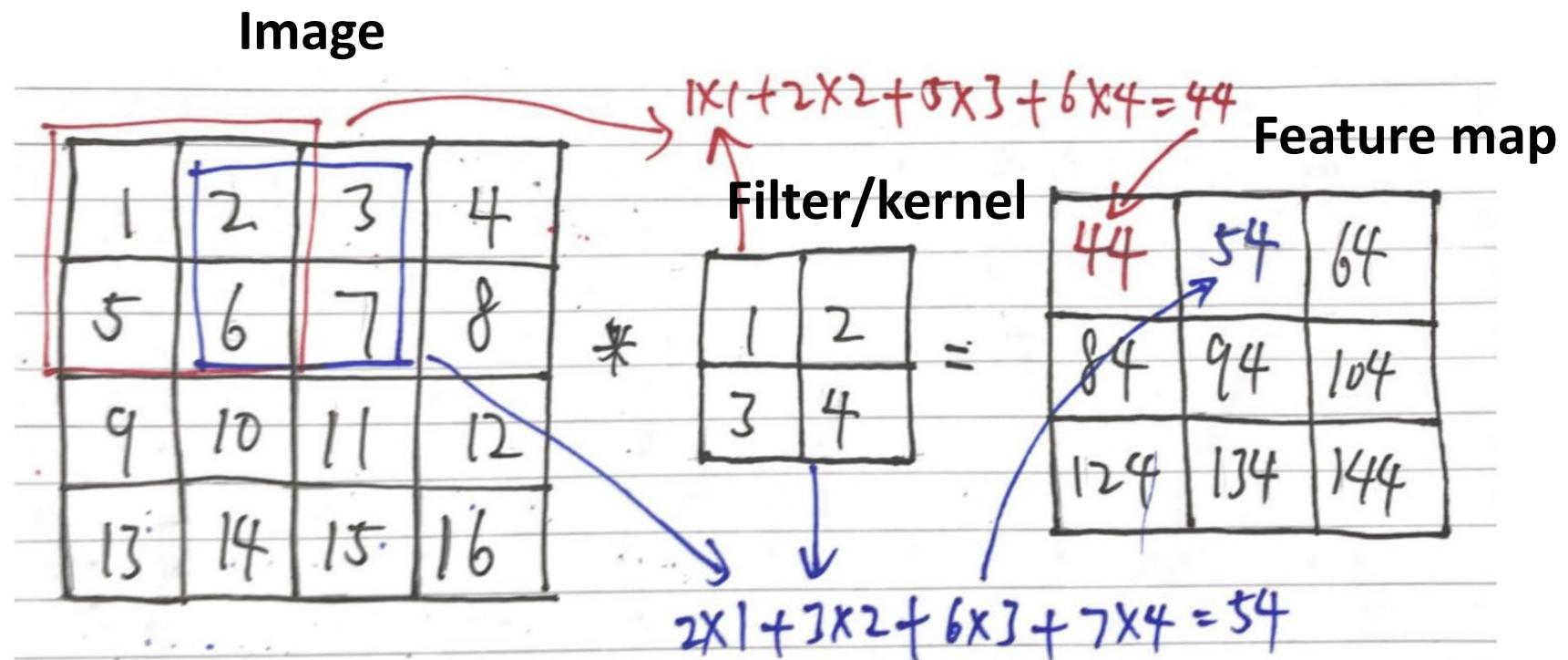
Extracting features from images

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



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

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

Horizontal line filter

Vertical line filter

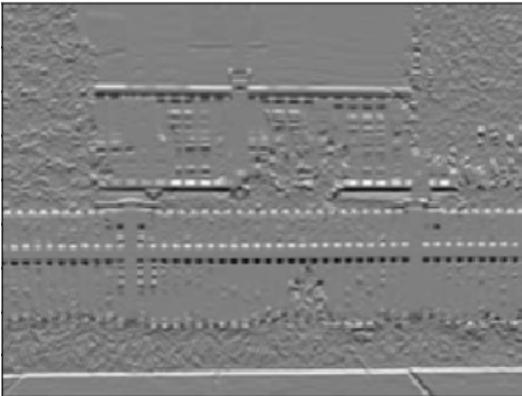
Laplacian filter
(edge detection)



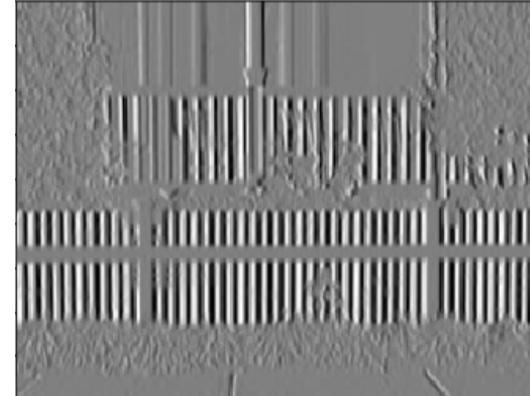
Convolution – detecting edges from images

An image after taking
the convolution with...

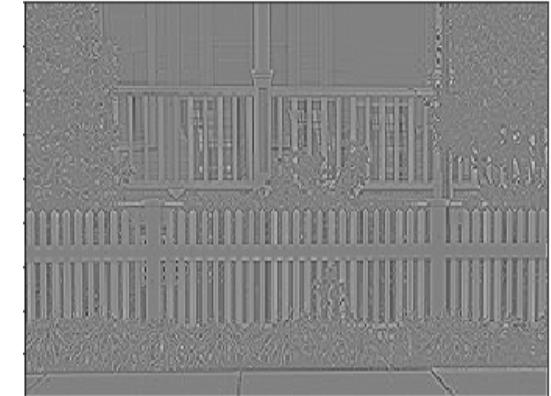
Horizontal line filter



Vertical line filter



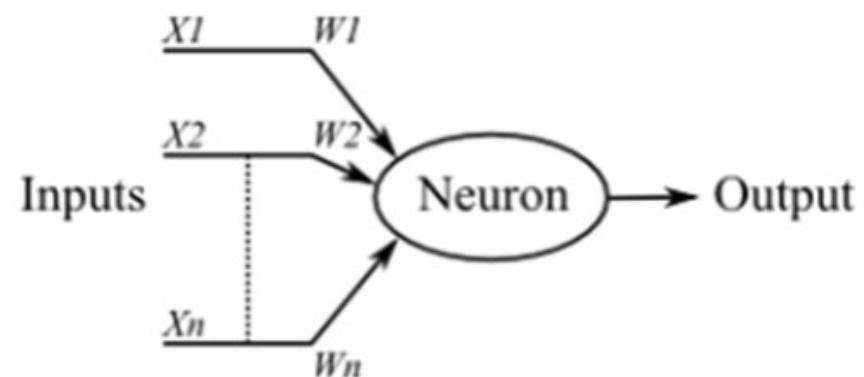
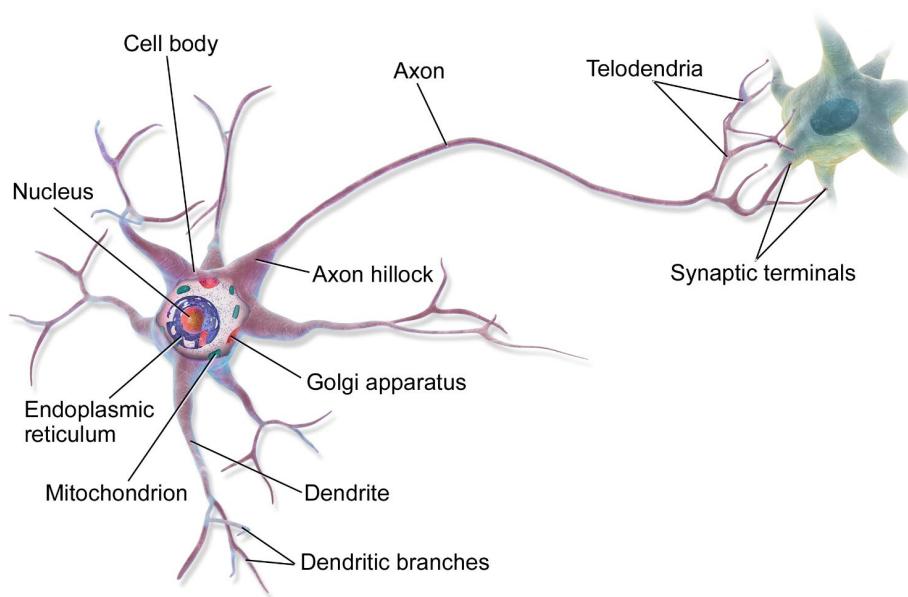
Laplacian filter
(edge detection)



**Now I have the features,
what's next?**

Modelling the brain – artificial neural network

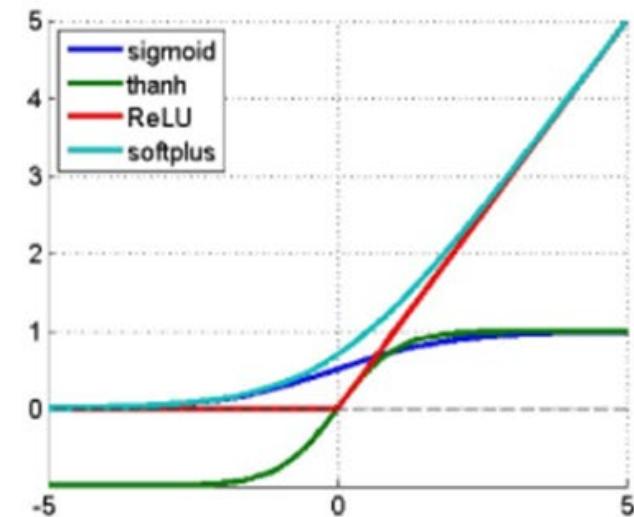
A biological neuron



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

Activation Function – Adding Non-Linearity

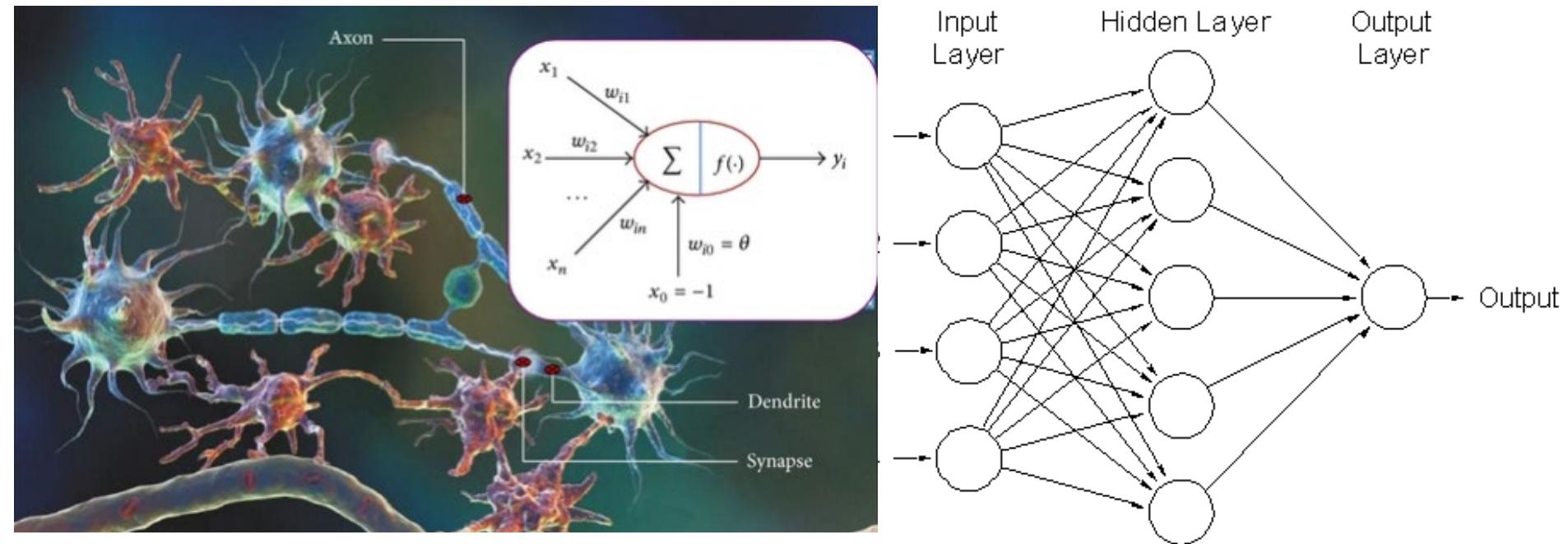
	Propagation
Sigmoid	$y_s = \frac{1}{1+e^{-x_s}}$
Tanh	$y_s = \tanh(x_s)$
ReLU	$y_s = \max(0, x_s)$



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

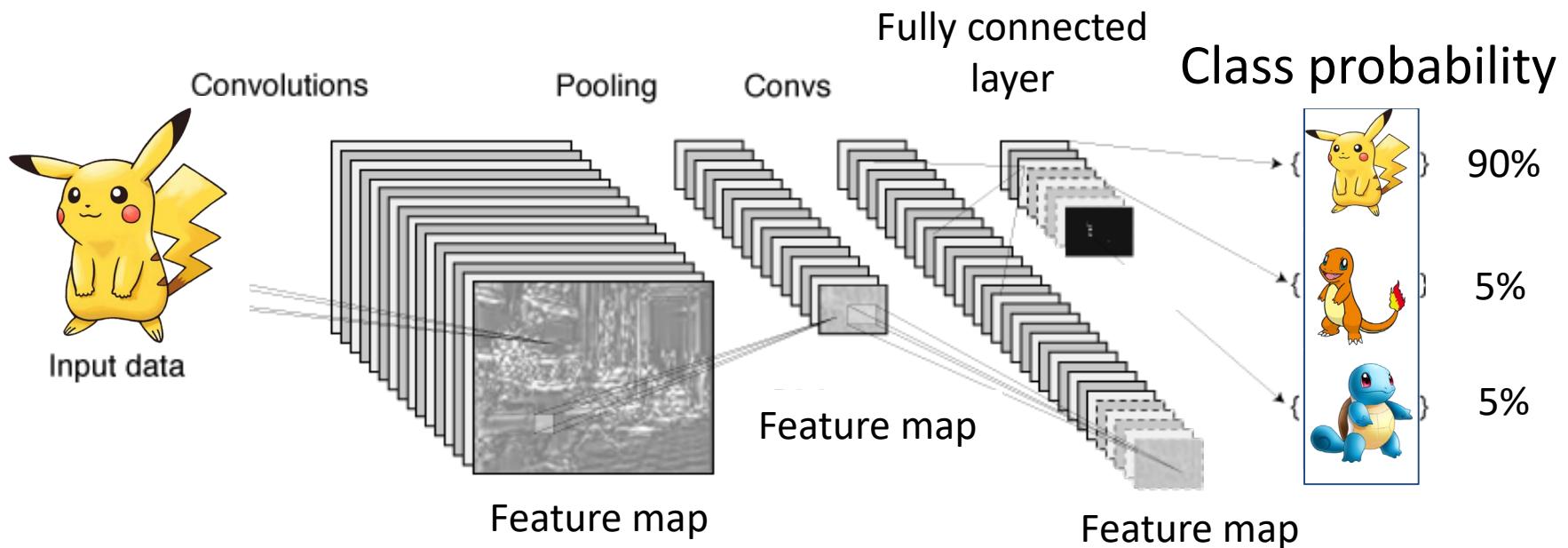
Modelling the brain – artificial neural network

- 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



Hands-on coding!



[https://drive.google.com/file/d/176yVWKgW02Gquq
AyMrTfIIcUTtycZXwF/view?usp=sharing](https://drive.google.com/file/d/176yVWKgW02GquqAyMrTfIIcUTtycZXwF/view?usp=sharing)



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AI Education in HK

一帶一路 佈局全球



8



94



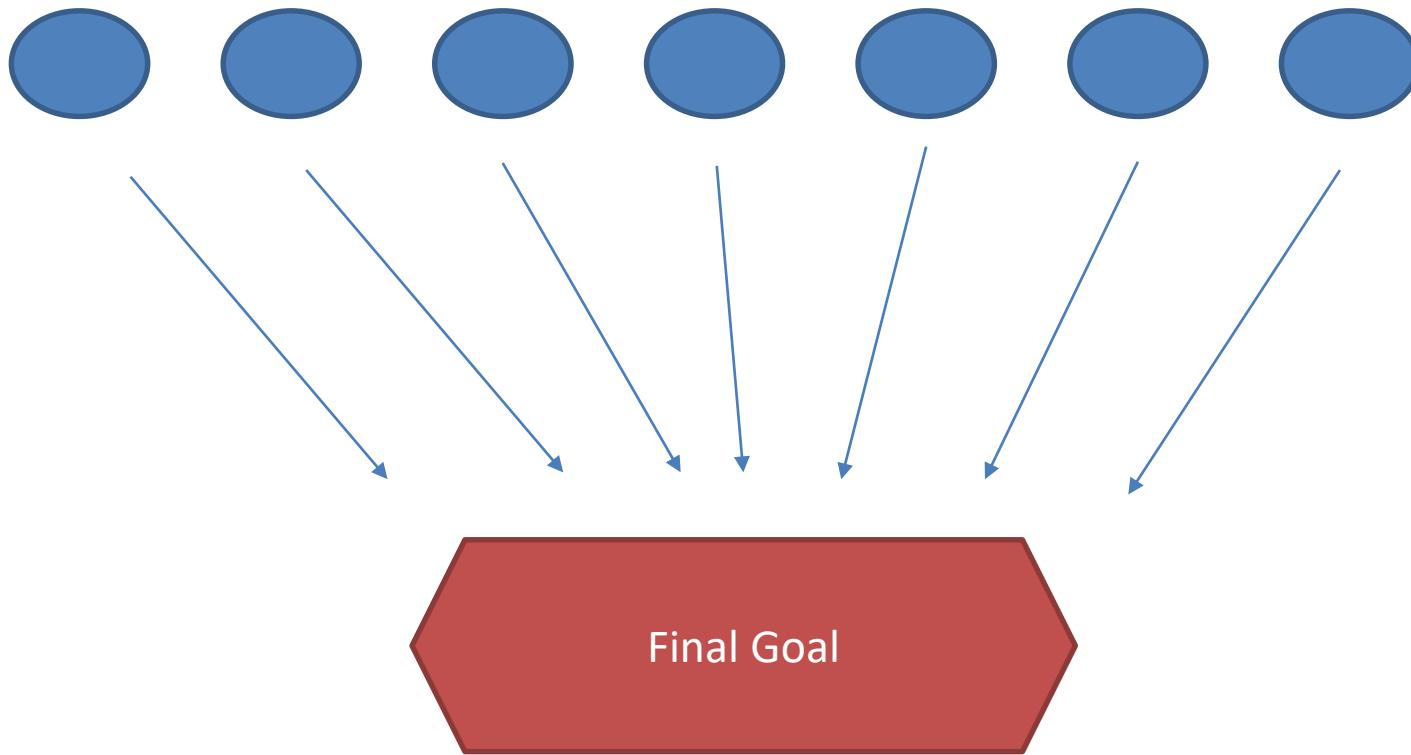
89

商湯
sense time

Many to One, One to Many

多對一，一對多

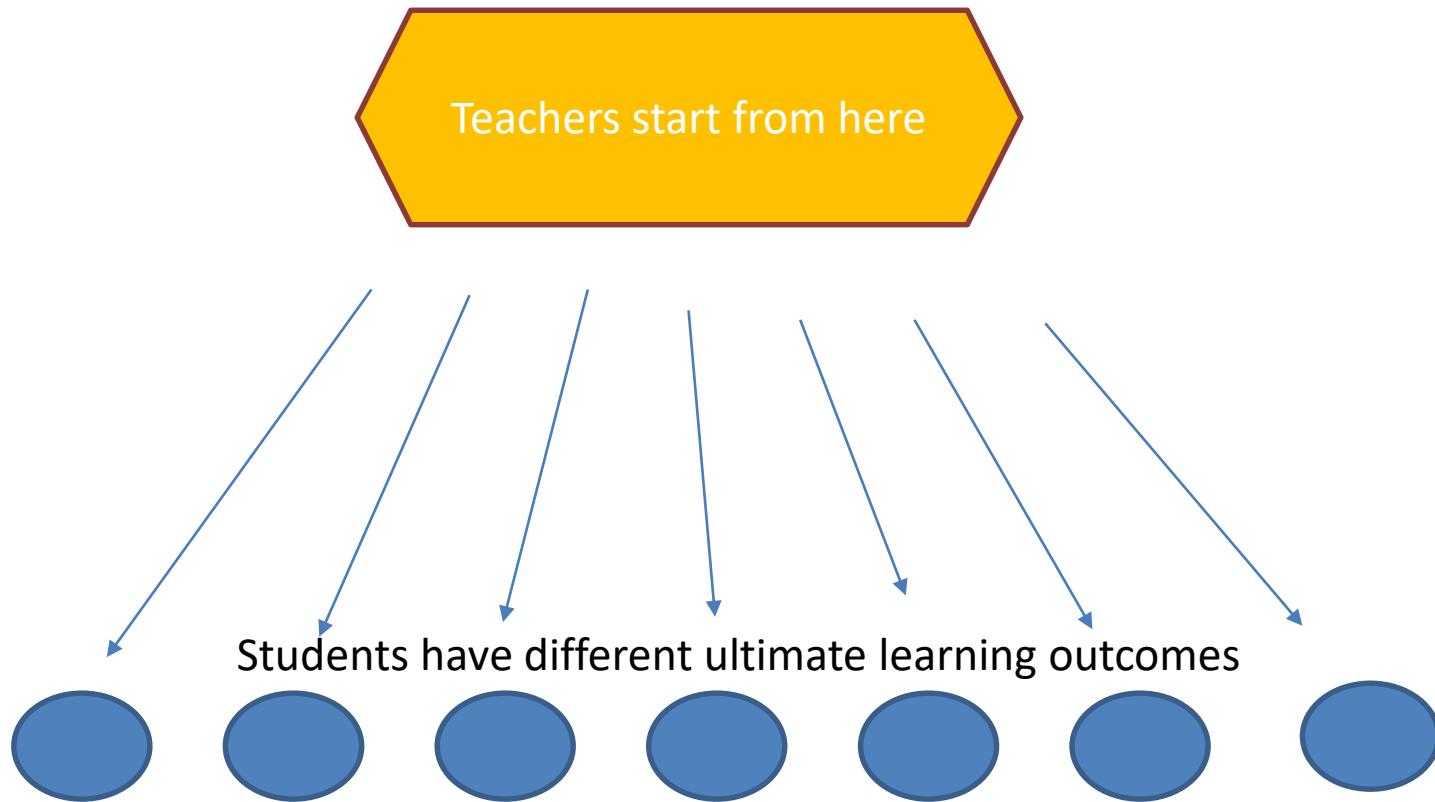
Students guided by teachers to achieve the same final goal.



Can Do vs. Really Understand?
可以做到與真正理解嗎？

Many to One, One to Many

多對一，一對多



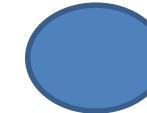
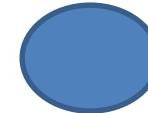
Learning how to face problems, trouble-shooting, design process, accept failure
學習如何面對問題，解決問題，設計過程，接受失敗

K12教育的基礎知識

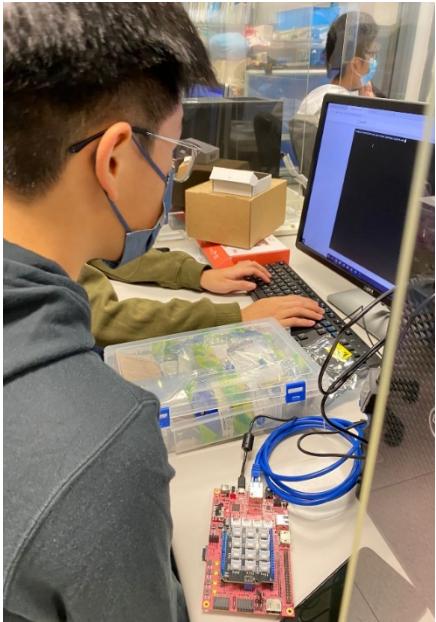
Maths, Literacy, Science,
Value, Learn how to
learn, ...

Flowchart / Abstraction
/ Algorithm / Data
Structure / Coding

Robots / VR / AR / 3D Printing / NFT / AI / Cloud / ... / Endless opportunities



人工智能應用 - 中學生作品

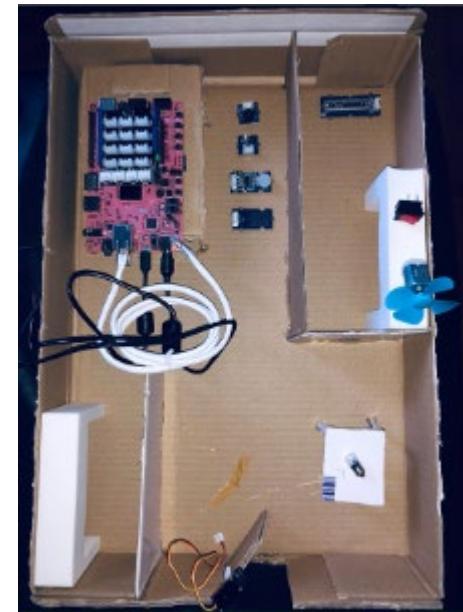
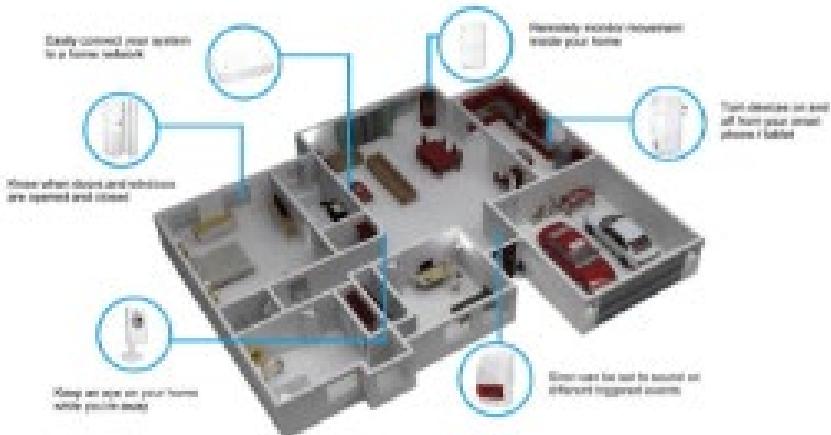


GEF 2021 project exhibition page:
<https://cityueegef.github.io/exhibition/>



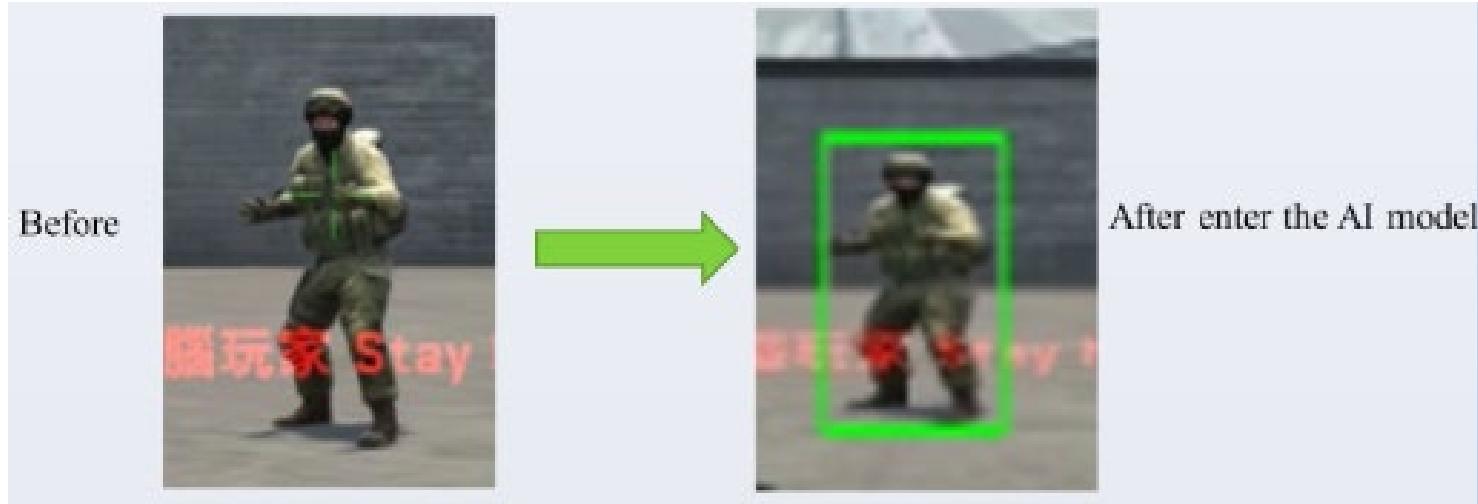
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AI Care for the Elderly



- Video demo:
<https://www.youtube.com/watch?v=wvADnTICfPQ>
- https://gorjoe.github.io/gef_p8_ACE/
- Source code:
https://github.com/gorjoe/gef_p8_ACE

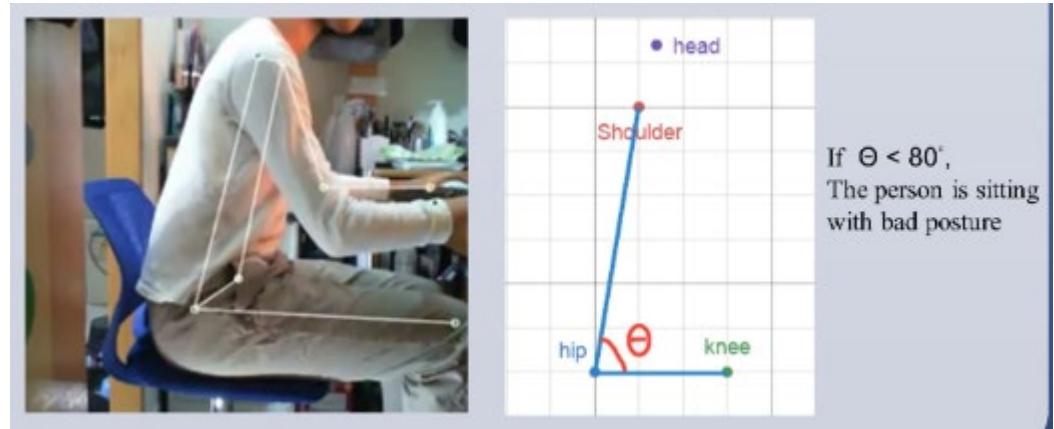
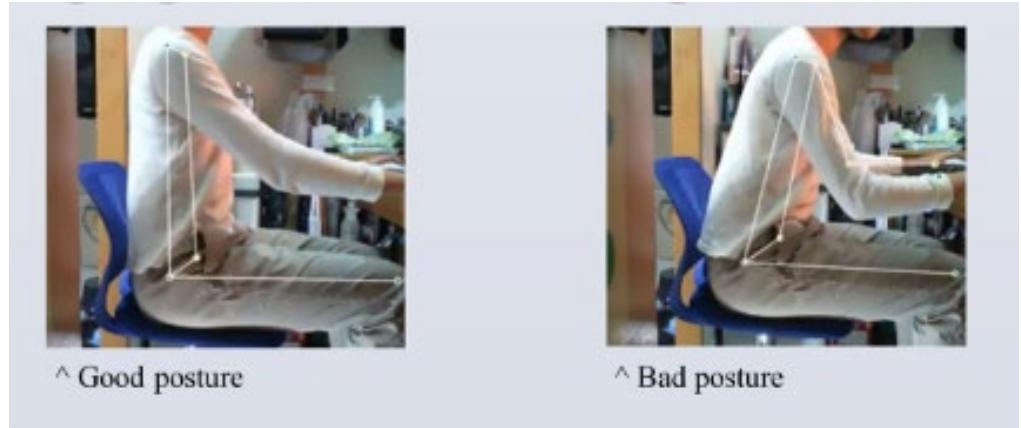
Game Character Detection



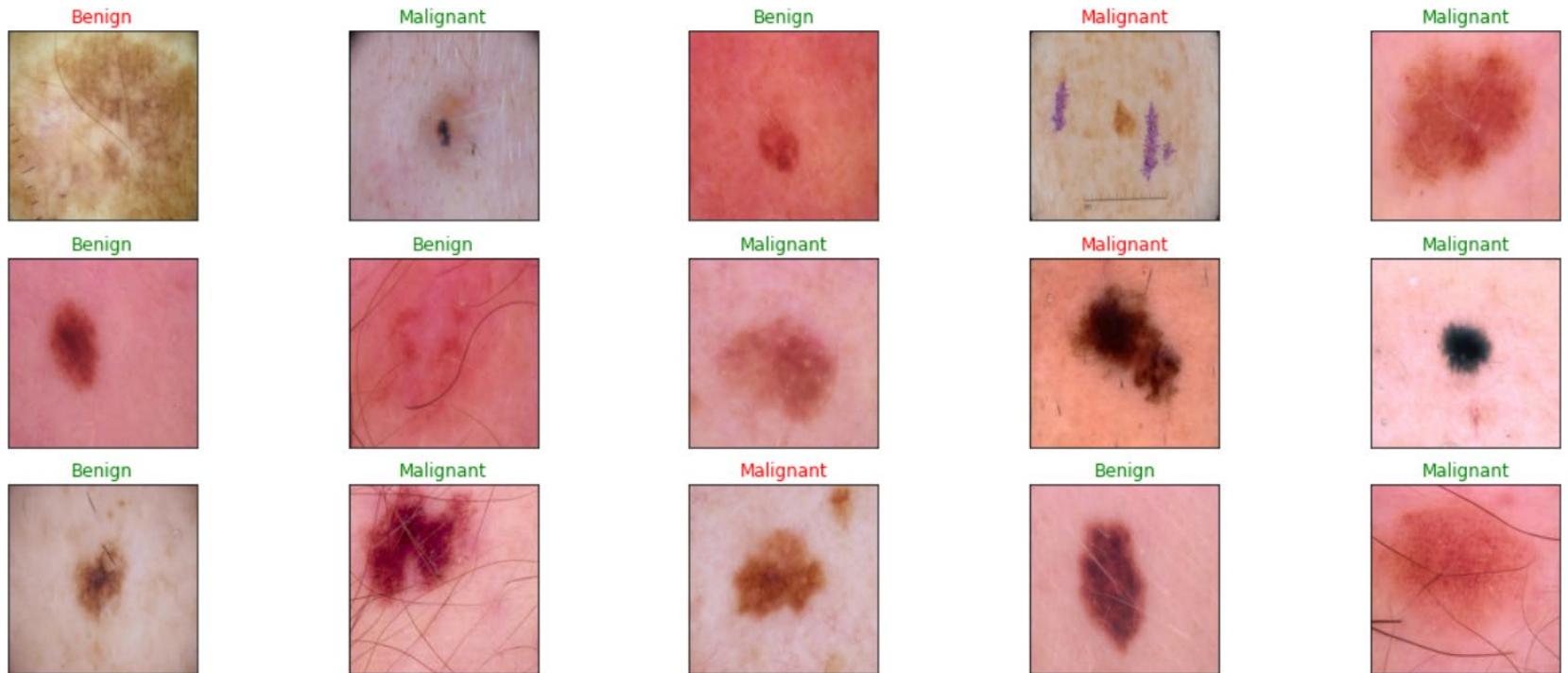
- Video demo:
https://www.youtube.com/watch?v=_JMfFlzSGPU
- Source code:
https://github.com/HellfireSam/valorant_aim_assist

AI Posture check

- Video demo:
<https://www.youtube.com/watch?v=v=V94WaBHLkEs>
- Source code:
<https://github.com/aswchlin/PostureCheck>



Skin Cancer Detection



- Video demo:
<https://www.youtube.com/watch?v=TJzRMHJYSN4>
- Source code:
<https://github.com/vichubrb/P02---Spotted-Skin-Cancer-Image-Recognition>



HKDSE Elective-Recommendation

- Video demo:

<https://www.youtube.com/watch?v=4eU7Cq4BHQ0>

- Source code:

<https://github.com/aurorachua/Elective-Recommendation-System>

```
new_description = pd.Series(input('Enter gender and grades separated by a space: '))
get_recommendations(new_description,descriptions)
```

Enter gender and grades separated by a space: F 60 50 60 50 30 30 30 50 50 30 60 30 50

	Student	Gender	CHI	EN	MA	HM	PHY	CHEM	BIO	LSO	...	EL	CH.1	CL	EC	GEO
363	HK0917	F	61.0	54.00	61.0	47.00	29.0	27.0	57.0	44.0	...	--	--	--	60.65	--
113	HK0315	F	51.0	47.00	45.0	35.00	28.0	27.0	41.0	47.0	...	--	--	--	--	27.72
271	HK0682	M	51.0	59.44	42.9	26.22	27.7	27.7	27.7	45.4	...	--	--	--	19.69	--
138	HK0369	M	57.0	51.00	60.0	44.00	48.0	29.0	47.0	45.0	...	--	--	--	--	--
333	HK0840	F	59.0	71.00	56.0	65.00	57.0	57.0	71.0	61.0	...	--	--	--	--	--

Language Pronunciation Accuracy Checker

How to say it?

Brewery

Start Recording

- Video demo:
<https://www.youtube.com/watch?v=29RpBgZeJU0>
- Source code:
https://github.com/InTheAirMC/lang_pronunciation_cityu

Sign Language Translator



- Video demo:
<https://www.youtube.com/watch?v=lgasdAOw6mOg>
- Source code:
https://github.com/LucasYam/P50_SignLanguageTranslator

Bitcoin Price Prediction



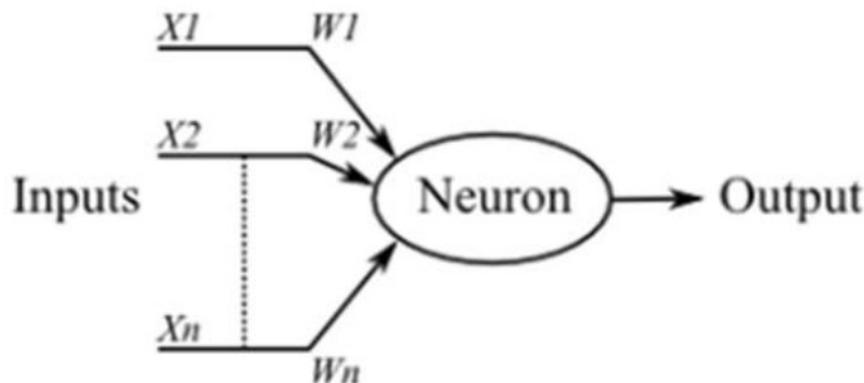
- Video demo:
<https://www.youtube.com/watch?v=CA3yEnpxk1w>
- Source code:
<https://github.com/Metrinox/Earning-Cryptocurrency-Using-Artificial-Intelligence-Algorithm>

date	symbol	open	high	low	close	Volume BTC	Volume USDT
2017-08-17 04-AM	BTC/USDT	16199.91	16199.91	4261.32	4308.83	44.5100	190952.85
2017-08-17 05-AM	BTC/USDT	4308.83	4328.69	4291.37	4315.32	23.2300	100304.82
2017-08-17 06-AM	BTC/USDT	4315.32	4345.45	4309.37	4324.35	7.2300	31282.31
2017-08-17 07-AM	BTC/USDT	4324.35	4349.99	4287.41	4349.99	4.4400	19241.06
2017-08-17 08-AM	BTC/USDT	4349.99	4377.85	4333.32	4360.69	0.9499	4139.70

人工智能的數學應用

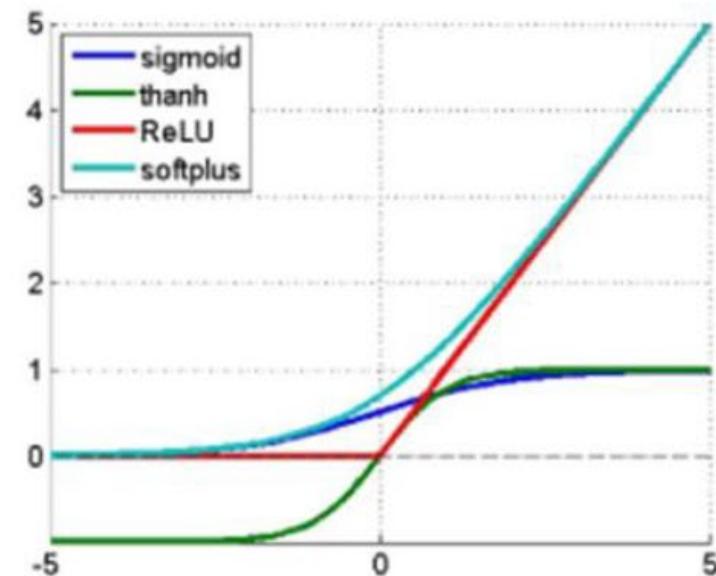
AI的數學應用 - 函數

- 人工神經元
- 激活函數
(activation function)



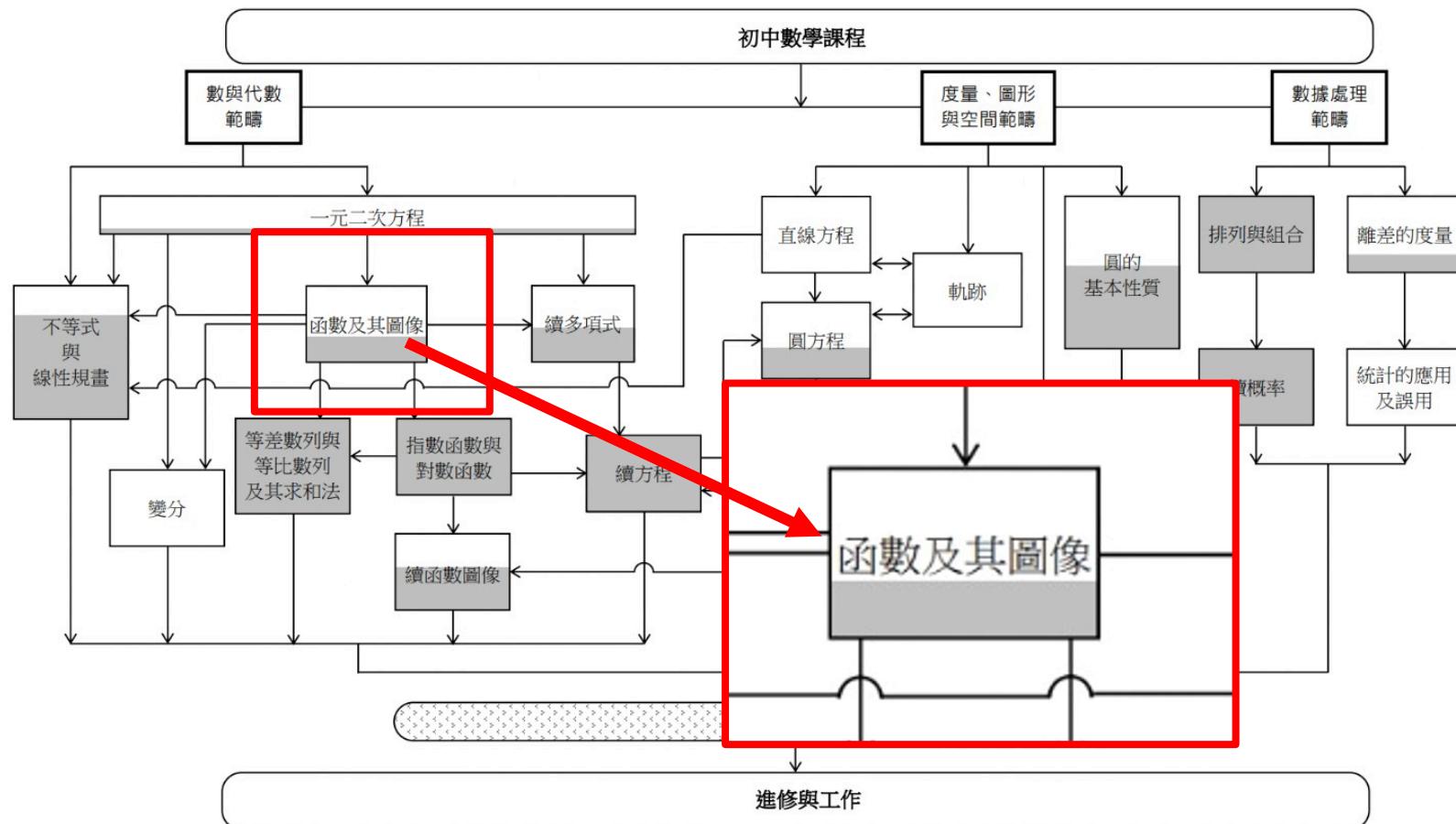
$$\text{output} = g(\mathbf{w} \cdot \mathbf{x} + w_0)$$

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



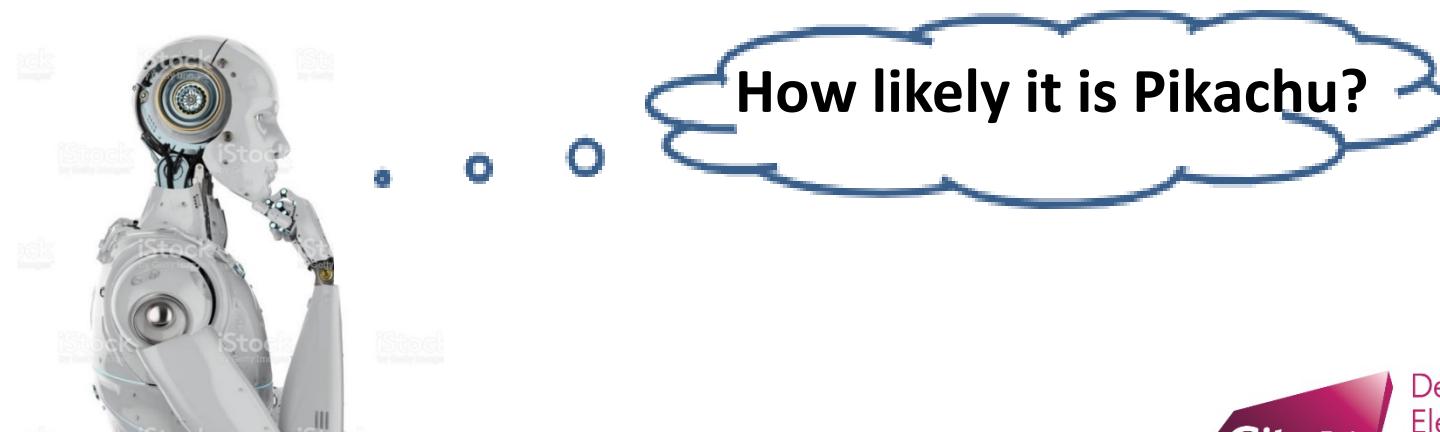
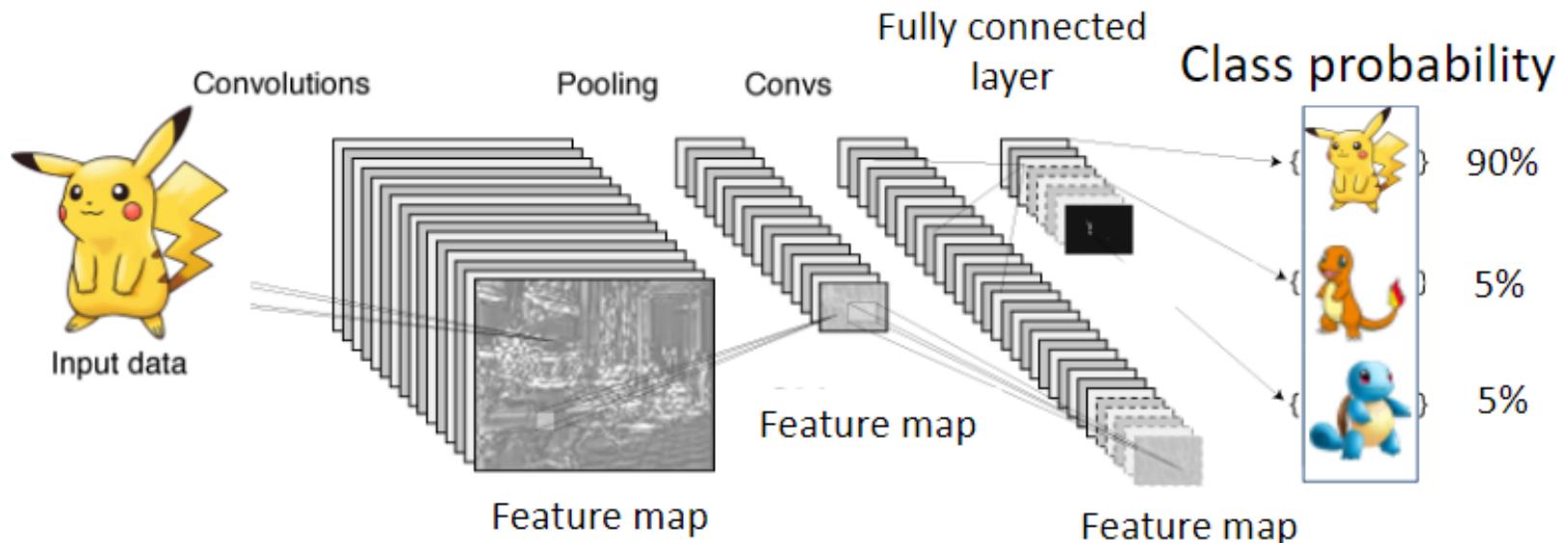
第三章 流程圖

流程圖：高中數學課程必修部分



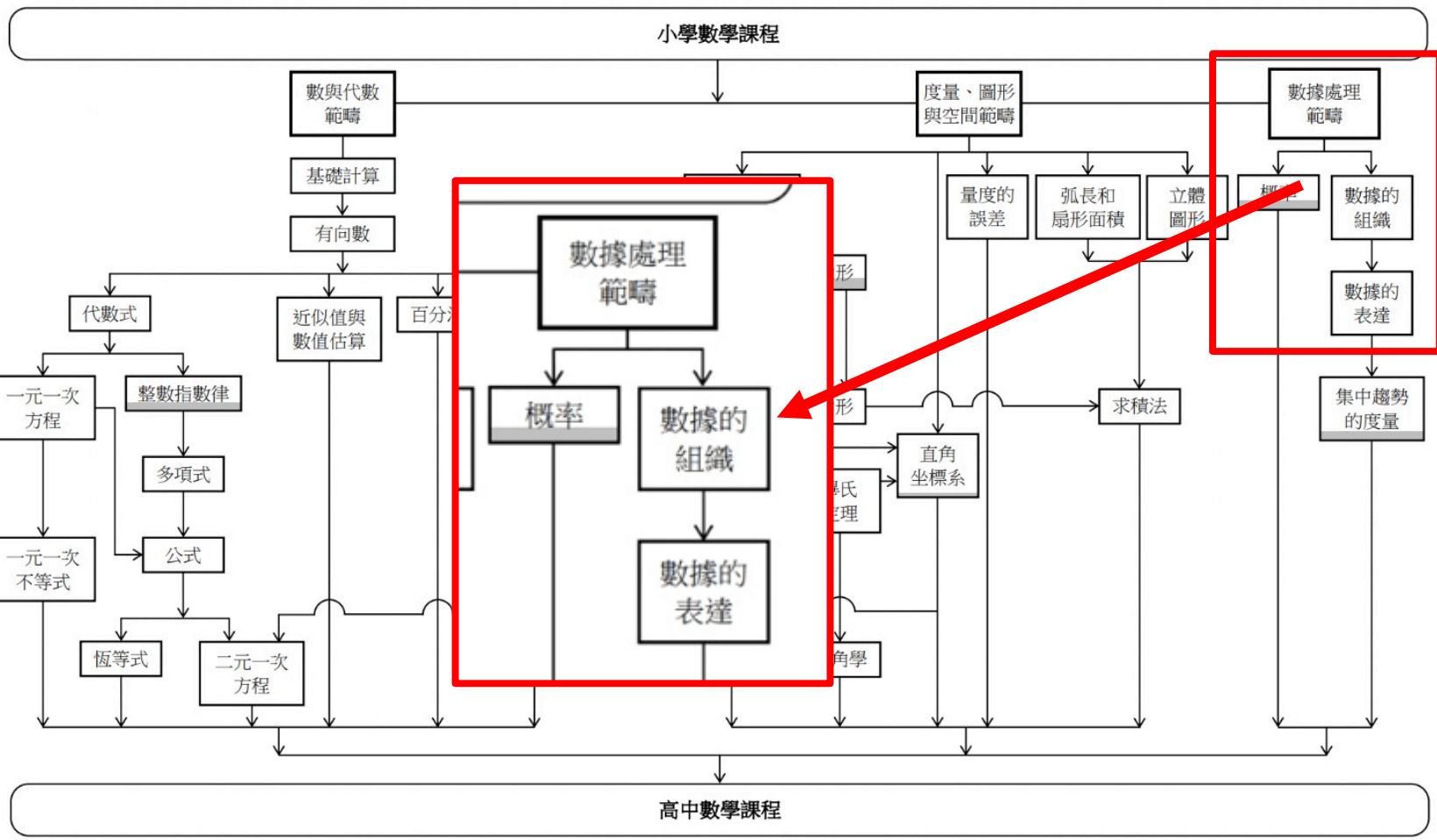
■ 表示非基礎課題。

AI的數學應用 – 概率



第三章 流程圖

流程圖：初中數學課程



表示非基礎課題。

AI的數學應用 - 微積分

- 機器學習 = 損失函數(loss function)最少化
- 優化問題 -> 微積分

jupyter NumPy_exercise(solution) Last Checkpoint: 22 minutes ago (autosaved)

File Edit View Insert Cell Kernel Widgets Help Trusted Python 3

Gradient Descent Algorithm (1st Order Optimization) [Optional Exercise]

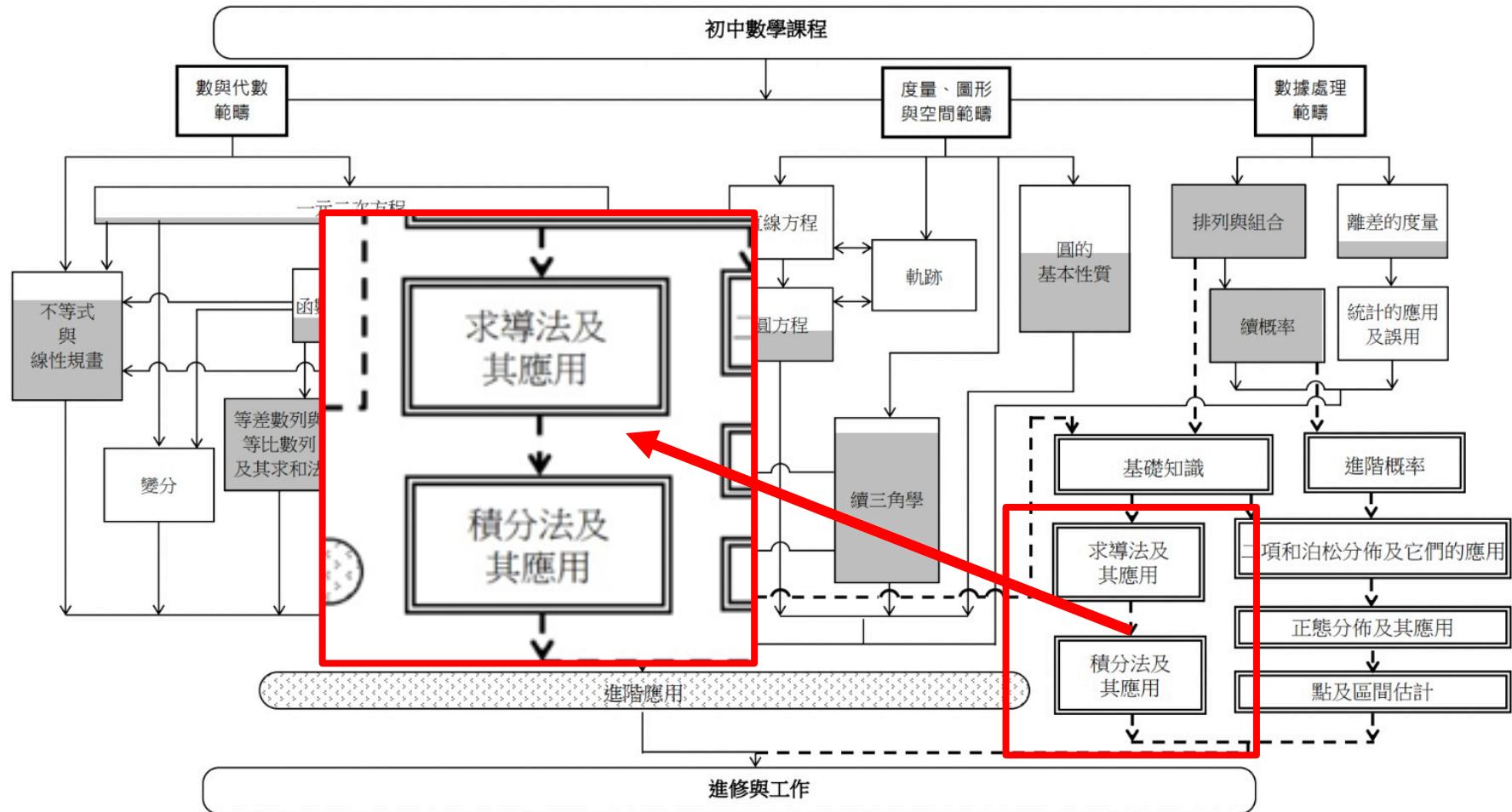
Gradient descent algorithm:

1. Initialize β by sampling from the standard normal distribution $\mathcal{N}(0, 1)$
2. At each iteration k , update the parameters β by this equation:
$$\beta_{k+1} = \beta_k - \alpha \nabla l(\beta_k)$$
where $\alpha \sim 10^{-1}$ is the step size
3. Stop the algorithm when $|l(\beta_{k+1}) - l(\beta_k)| <$ tolerance, we can use a small number, i.e. 10^{-7} , as our tolerance value

```
In [ ]: 1 beta = np.random.normal(0,1,2)
2
3 alpha = 3e-1
4 tol = 1e-7
5 delta = 1
6 k = 0
7
8 while np.abs(delta) >= tol:
9
10     y_hat = model(beta, x1)
11     g = -2*np.array([ np.mean(y-y_hat), np.mean(x*(y-y_hat)) ])
12
13     prev_loss = loss_func(beta, x1, y)
```



流程圖：高中數學課程必修部分與單元一（微積分與統計）



AI的數學應用 – 距離計算

- 人面識別 = 距離計算 (face distance)
- 歐幾里得距離 (Euclidean distance)

Face Distance: 0.69

Same person? (tolerance=0.60) : False

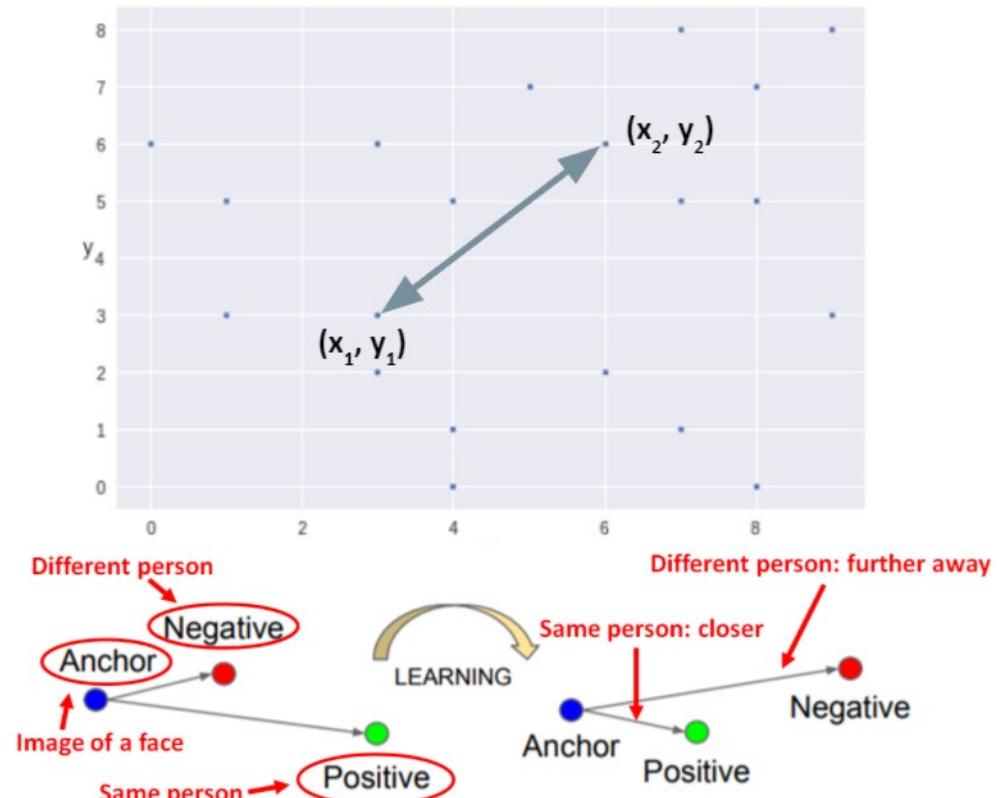
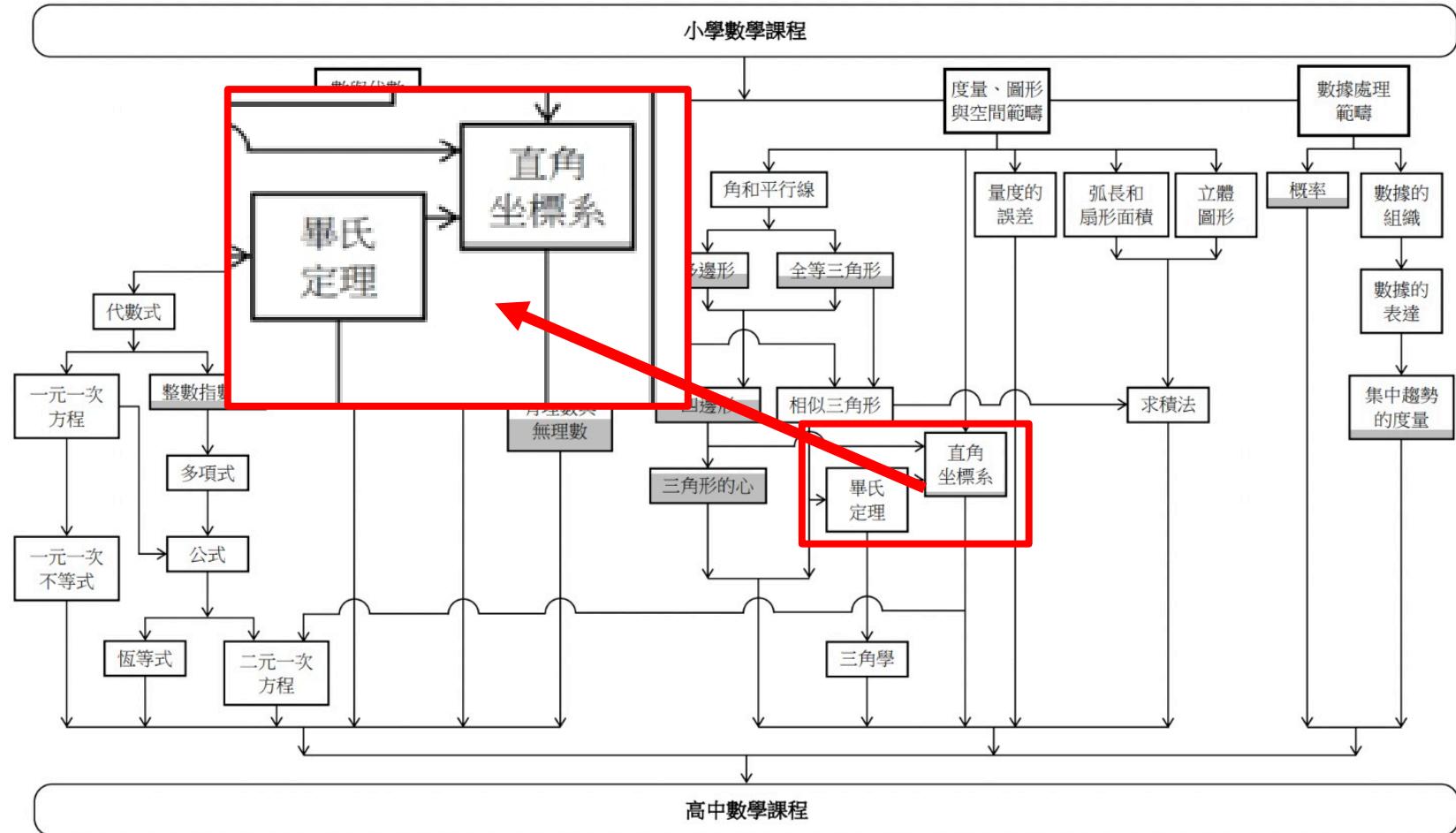


Figure 3. The **Triplet Loss** minimizes the distance between an *anchor* and a *positive*, both of which have the same identity, and maximizes the distance between the *anchor* and a *negative* of a different identity.

第三章 流程圖

流程圖：初中數學課程



表示非基礎課題。

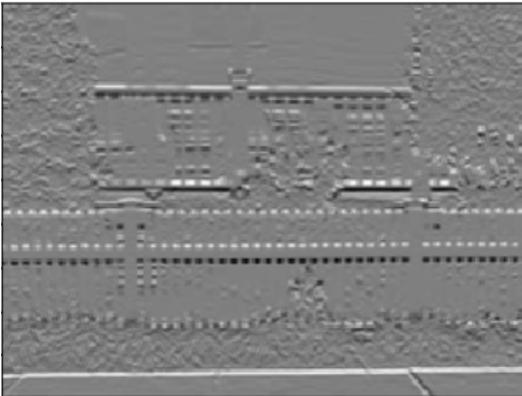
AI的數學應用 – 卷積

An image after taking
the convolution with...

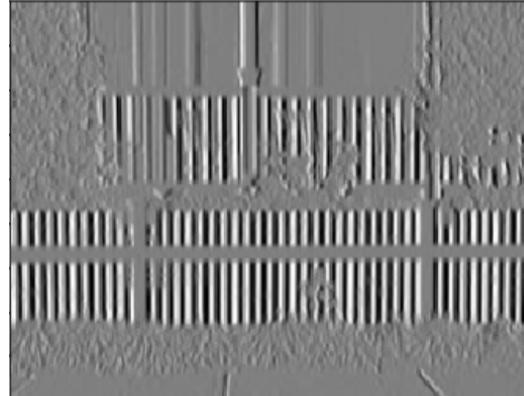


$$(f * g)[n] = \sum_{m=-\infty}^{\infty} f[m]g[n-m]$$

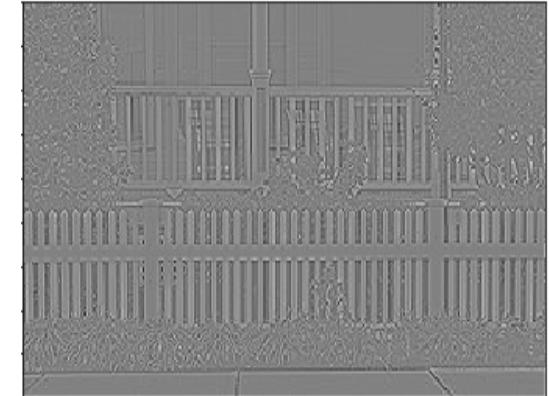
Horizontal line filter



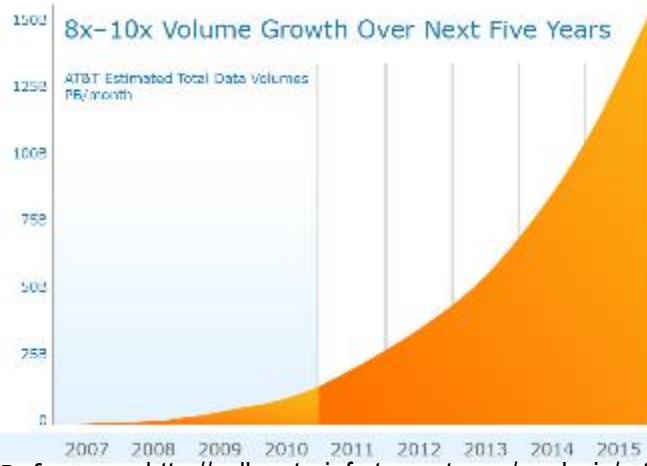
Vertical line filter



Laplacian filter
(edge detection)



AI的數學應用 - 張量計算



Data $[x_1][x_2]\cdots[x_N]$

Multidimensional data

$\mathcal{A} = (a_{i_1 i_2 \cdots i_N}) \in \mathbb{R}^{m_1 \times m_2 \times \cdots \times m_N}$

High-order tensor formulations

Example 1: Gene \times Condition \times Time

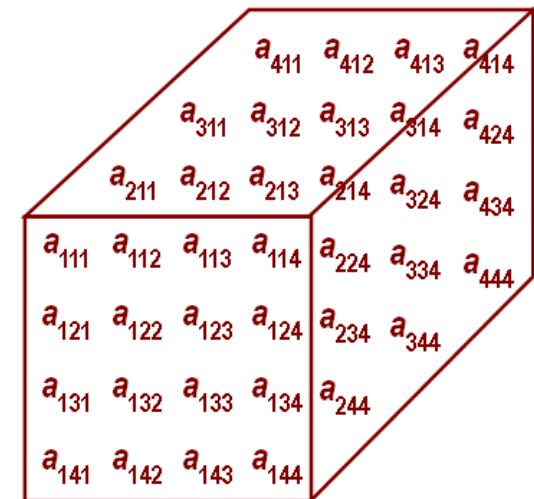
Example 2: Document \times Key word \times Region

Example 3: Speech \times Frequency \times Time

0, 1, ..., 9,
 $\frac{1}{2}, e, \pi,$
 a, b, c, x, y, \dots

$$\begin{bmatrix} a_1 \\ a_2 \\ a_3 \\ a_4 \end{bmatrix}$$

$$\begin{bmatrix} a_{11} & a_{12} & a_{13} & a_{14} \\ a_{21} & a_{22} & a_{23} & a_{24} \\ a_{31} & a_{32} & a_{33} & a_{34} \\ a_{41} & a_{42} & a_{43} & a_{44} \end{bmatrix}$$



Number



Vector



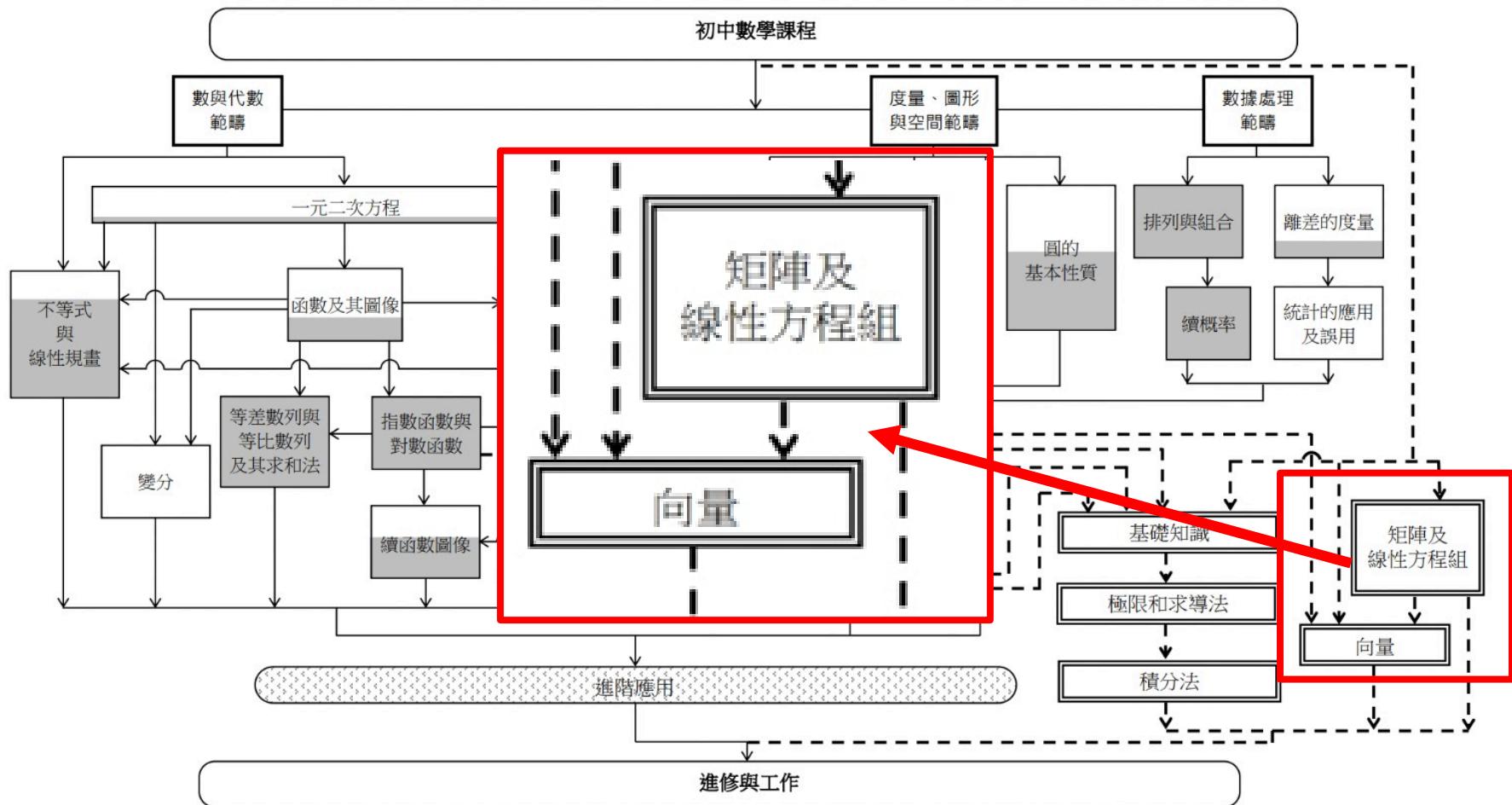
Matrix



???

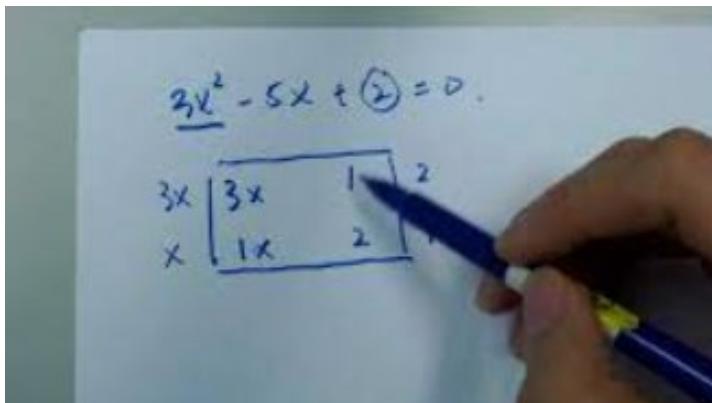
Tensor

流程圖：高中數學課程必修部分與單元二（代數與微積分）



人手運算 vs 電腦運算

- 1個變數 vs ~10萬個變數



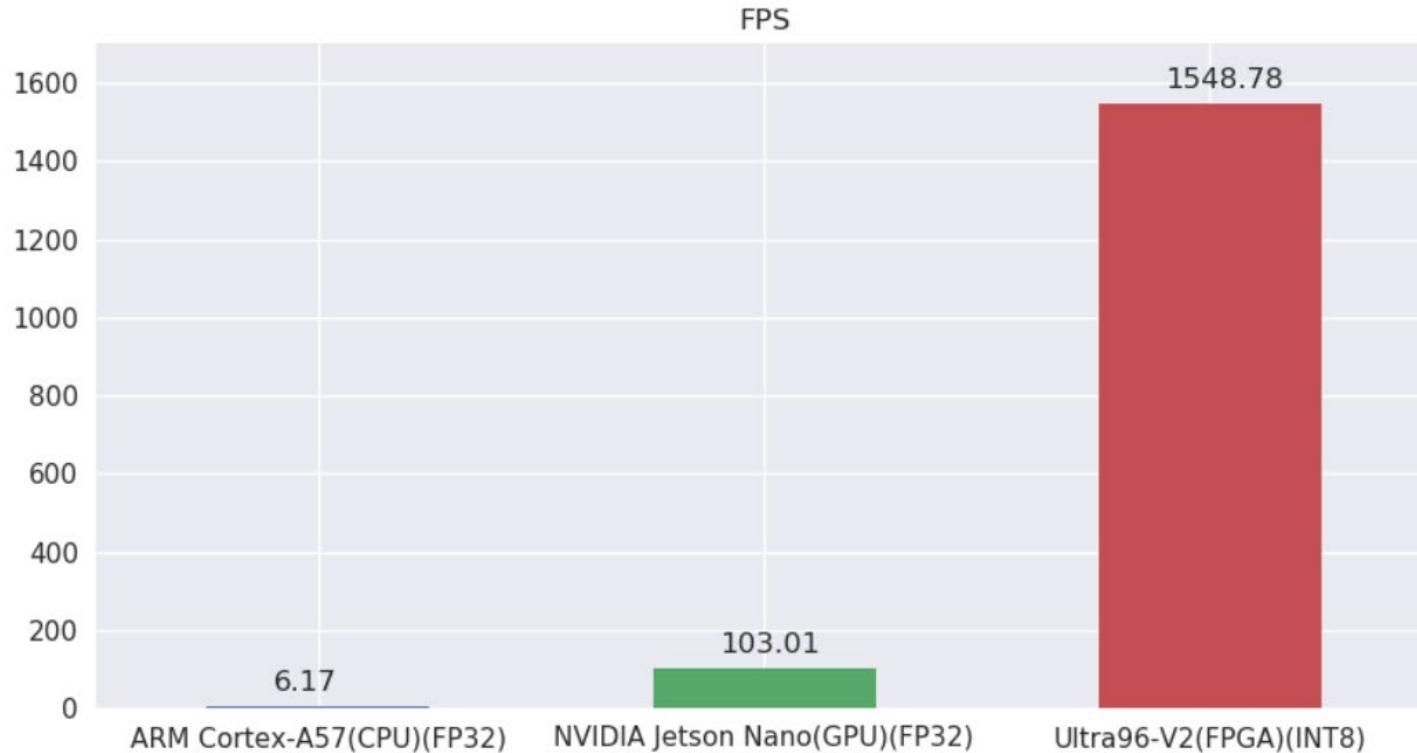
```
Model: "cnn_mnist_model"
Layer (type)          Output Shape       Param #
=====
input_1 (InputLayer)   [(None, 28, 28, 1)] 0
conv2d (Conv2D)        (None, 28, 28, 2)   20
max_pooling2d (MaxPooling2D) (None, 27, 27, 2) 0
flatten (Flatten)      (None, 1458)        0
dense (Dense)          (None, 100)         145900
dense_1 (Dense)        (None, 10)          1010
=====
Total params: 146,930
Trainable params: 146,930
Non-trainable params: 0
```

```
# Starting the training
history = model.fit(x_train, train_one_hot, epochs=epoch, batch_size = batch_size, valid
```

```
Epoch 1/100
420/420 [=====] - 4s 6ms/step - loss: 0.5555 - accuracy: 0.8173
Epoch 2/100
420/420 [=====] - 2s 6ms/step - loss: 0.3638 - accuracy: 0.8723
Epoch 3/100
420/420 [=====] - 2s 6ms/step - loss: 0.3278 - accuracy: 0.8829
```

AI運算 - FPGA硬件加速

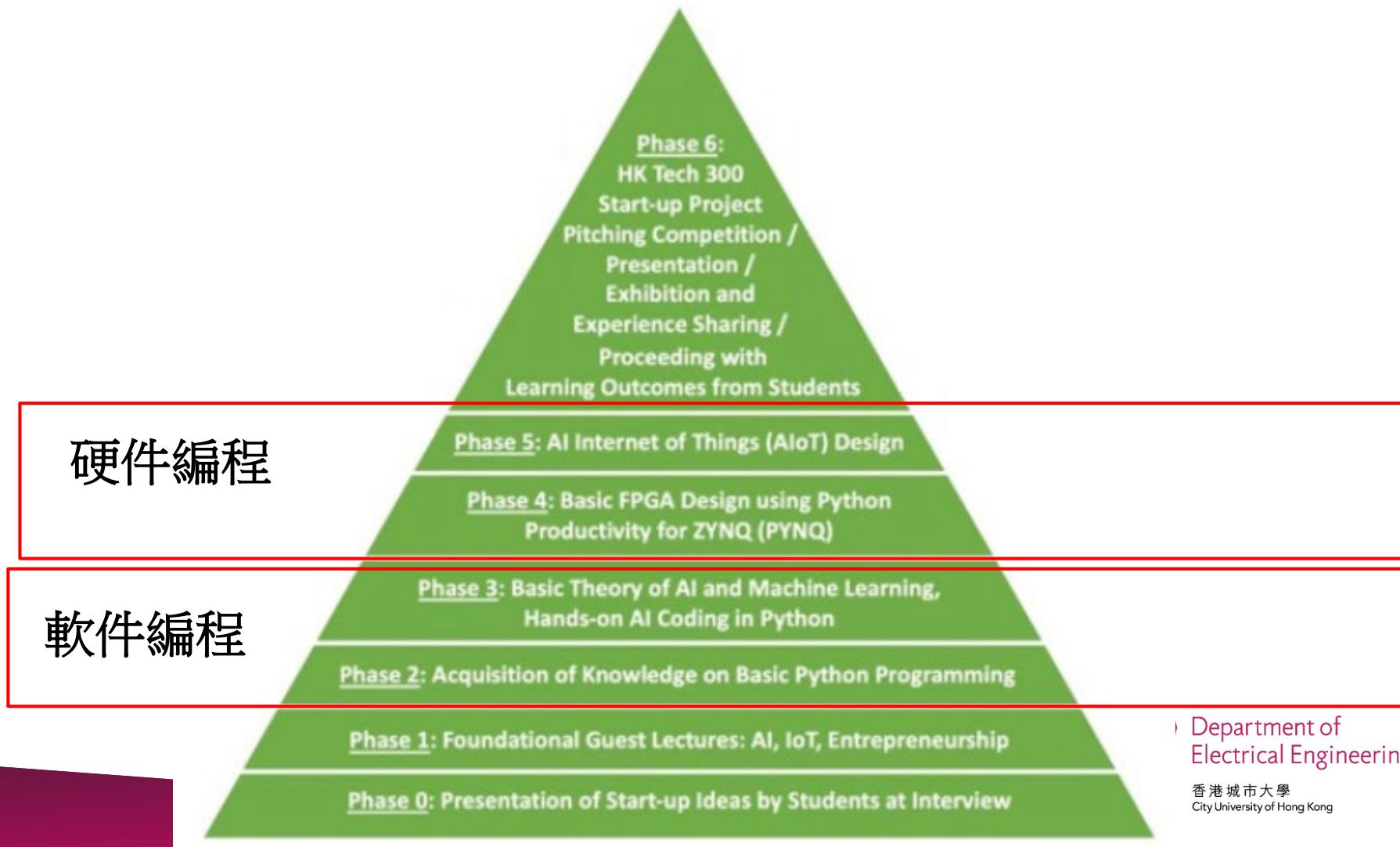
- ~15x speed up compared with GPU (FP32)
- ~250x speed up compared with CPU (FP32)



https://github.com/cityueegef/gef2020_aiot_exercise_notebooks/tree/main/vitis_ai_pynq_dpu/comparison



AIoT Coding, Engineering and Entrepreneurial (AIoT CE2) Skills Education for Gifted Students Programme



以學習AI提升學生對數學興趣



Exercise 3

- Recall the geometric interpretation of the dot product:
$$\frac{\mathbf{A} \cdot \mathbf{B}}{|\mathbf{A}| |\mathbf{B}|} = \cos \theta$$
- Verify that the angle between the vectors $\mathbf{A} = [0,1,2]$ and $\mathbf{B} = [3,0,0]$ is $\pi/2$ (90 degree)
- Hints:
 - Use `np.arccos(x)` to calculate $\cos^{-1} x$
 - Use `np.pi` to get the value of π

The desktop shows a PDF file open with the exercise questions, and a video conferencing application with multiple participants in a 'GEF - Class' session.

Gradient Descent Algorithm (1st Order Optimization) [Optional Exercise]

```
In [ ]: 1: beta = np.random.normal(0,1,2)
2:
3: alpha = 3e-1
4: tol = 1e-7
5: delta = 1
6: k = 0
7:
8: while np.abs(delta) >= tol:
9:
10:     y_hat = model(beta, x1)
11:     g = -2*np.array([ np.mean(y-y_hat), np.mean(x1*(y-y_hat)) ])
12:
13:     prev_loss = loss_func(beta, x1, y)
14:
```

The desktop shows a Jupyter Notebook with code for gradient descent and a video conferencing application with participants in a 'LI 1301' session.

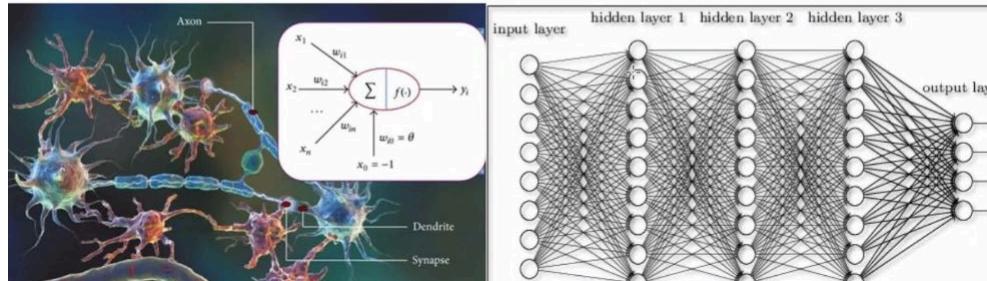


以學習AI提升學生對數學興趣



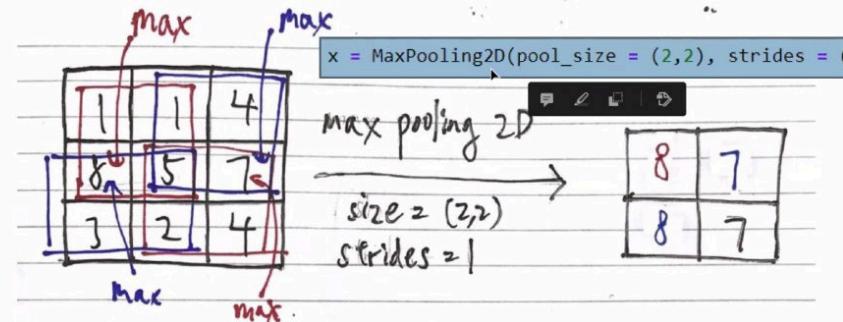
Deep Neural Network Model

- A hidden layer consists of a lot of neurons
- A deep neural network can have multiple hidden layers



Pooling Layer (Max Pooling)

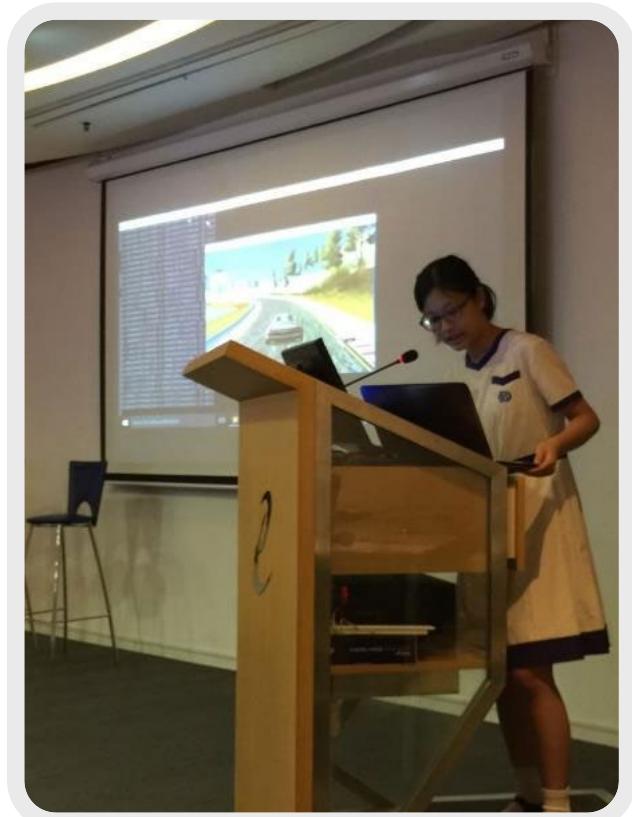
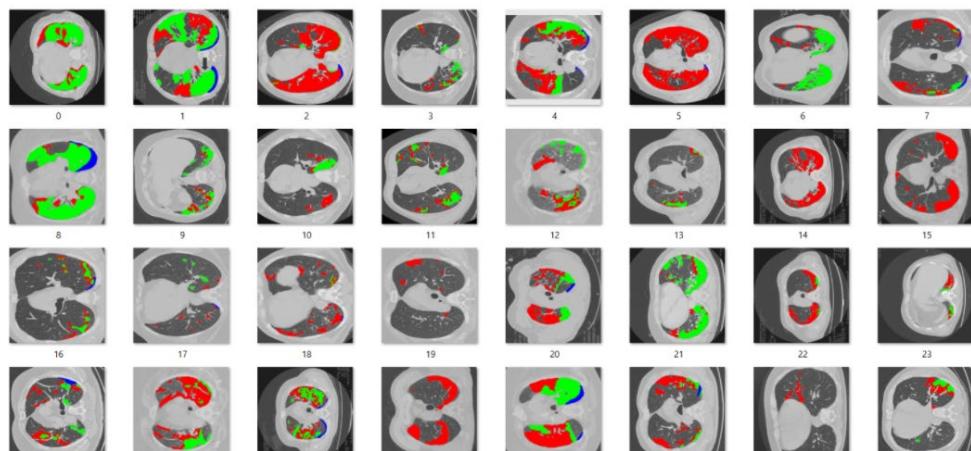
- Taking the max value inside the sliding window



University Intern Example

- Starting learning AI since Form 3
- Self-learning Python and Deep learning Framework
- Summer Internship at CityU Apps Lab

Corona-Net: Diagnosis and Segmentation of the Coronavirus Disease 2019



<https://github.com/chinglamchoi/Corona-Net>

Further Reading & Resources



The GNU Multiple Precision Arithmetic Library



Search gmplib.org



Page contents:

Documentation:	6.2.1 HTML 6.2.1 PDF
Download:	gmp-6.2.1.tar.gz Release notes NEW 2020-11-14
Development:	Developers' corner
GMPbench:	Results Download benchmark sources
Fun:	Compute billions of digits of π using GMP!
Security:	GMP server security policy

[What is GMP?](#)
[Function categories](#)
[Download](#)
[Reporting bugs](#)
[Mailing lists](#)
[Current release status](#)
[Future releases](#)

The GMP computers are maintained by a single person on a volunteer basis. The ongoing Intel CPU bug debacle with [Meltdown](#), [Spectre](#), [Foreshadow](#), [MDS](#), the jCC/cache-line bug, Fallout, LVI, Portsmash, etc, etc, and the [ME](#) backdoor is making the main GMP server far from as secure as we'd like it to be.

The system which runs this web server as well as mail server, mailing list server, firewall, etc, has an Intel E5-1650 v2 which is affected by most of the bugs/backdoors mentioned above. Please keep that in mind when using the resources here.

Please understand that we don't take security lightly, but that we effectively are DoS'ed by sloppy/malicious engineering.

Courses	Search	Khan Academy	Donate	Ray Cheung
MATH: PRE-K - 8TH GRADE	MATH: HIGH SCHOOL & COLLEGE	SCIENCE	ARTS & HUMANITIES	READING & LANGUAGE ARTS
Up to 2nd grade (Khan Kids)	Algebra 1	Middle school biology beta - NGSS	US history	Up to 2nd grade (Khan Kids)
2nd grade 59%	Geometry	Middle school Earth and space science beta - NGSS	AP®/College US History	2nd grade
3rd grade 12%	Algebra 2	Middle school physics - NGSS	US government and civics	3rd grade
4th grade 14%	Trigonometry	High school biology	AP®/College US Government & Politics	4th grade
5th grade	Precalculus	High school physics	World History Project - Origins to the Present	5th grade
6th grade	High school statistics	High school physics	World History Project - 1750 to the Present	6th grade
7th grade 1%	Statistics & probability	High school physics - NGSS	Art history	7th grade
8th grade	AP®/College Calculus AB	High school statistics	AP®/College Art History	8th grade
See all Math	AP®/College Calculus BC	AP®/College Statistics	Grammar 6%	9th grade
MATH: GET READY COURSES	AP®/College Statistics	Multivariable calculus	See all Arts & Humanities	See all Reading & Language Arts
Get ready for 3rd grade 67%	Differential equations	Differential equations	ECONOMICS	
Get ready for 4th grade 17%	Linear algebra	AP®/College Environmental Science	Macroeconomics	LIFE SKILLS
Get ready for 5th grade 18%	See all Math	AP®/College Physics 1	AP®/College Macroeconomics	Social & emotional learning (Khan Kids)
Get ready for 6th grade	TEST PREP	See all Science	Microeconomics	Careers
Get ready for 7th grade	SAT	COMPUTING	AP®/College	Personal finance
Get ready for 8th grade				



Math > High school geometry
 > Similarity > Solving
 modeling problems with
 similar & congruent triangles

- Geometry word problem: the golden ratio
- Geometry word problem: Earth & Moon radii
- Geometry word problem: a perfect pool shot

$$CD : BC = \varphi : 1$$

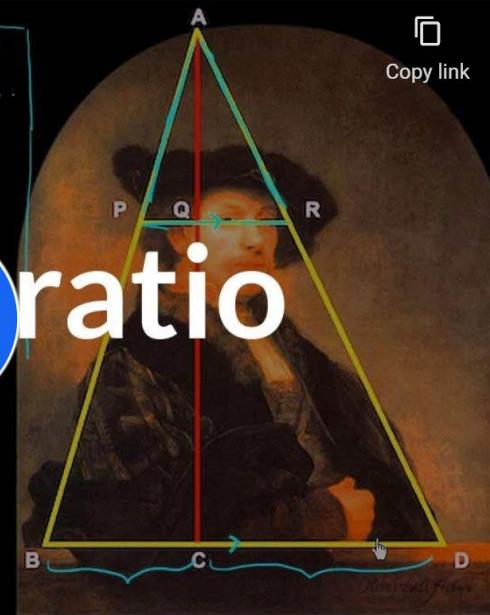
$$\overline{PR} \parallel \overline{BD}$$

$$AC : AQ = \varphi + 1 : 1$$

$$\frac{\text{Area of } \triangle ABD}{\text{Area of } \triangle ACP} = \frac{1}{\varphi}$$

Golden ratio

Copy link



Khan Academy

Geometry word problem: the golden ratio

[About](#)

[Transcript](#)

<https://www.khanacademy.org/math/geometry/hs-geo-similarity/hs-geo-similar-and-congruent-triangles-modeling/v/golden-ratio-to-find-radius-of-moon>

The dimensions of the earth and moon are in relationship to each other forming a Golden Triangle. Represented by φ , the Golden Ratio is the only number which has the mathematical property of its square being one more than itself:

$$\varphi + 1 = \varphi^2$$

$$1.61803... + 1 = 2.61803...$$

By applying the Pythagorean equation to this equation, a right triangle with sides φ , $\sqrt{\varphi}$, and 1 is constructed. As shown below, the radii of the earth and moon are in proportion to φ .

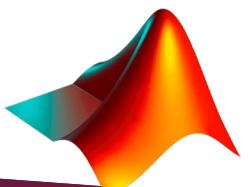
If the radius of the earth is 6371 km, then what is the radius of the moon?

Geometry word problem: Earth & Moon radii



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

MATLAB



MATLAB®

HOME PLOTS APPS

FILE

Current Folder

Command Window

```

New to MATLAB? Watch this Video, see Examples, or read Getting Started.
>> a/b
ans =
0.4000
>> a\b
ans =
2.5000
>> b
b =
5
>> a
a =
2
f2 >>

```

Workspace

Name	Min	Max
a	2	2
ans	2.50...	2.5000
b	5	5
x	12	12
y	766	766

Command History

```

today_test
clc
Today_Test
4/17/14, 2:07 PM
y=766
x=12
a=2
b=5
a*b
a/b
a\b
b
a

```

LIVE EDITOR

Inference with the trained network

Let's see how well the trained network performs on new data.

```

augTestSet = augmentedImage datastore(layers(1).InputSize,testSets);
predictedLabels = classify(myNet, augTestSet);
accuracy = mean(predictedLabels == testSets.Labels);

figure
confusionchart(testSets.Labels, predictedLabels, ...
    'RowSummary', 'row-normalized', 'ColumnSummary', 'column-normalized',
    'Title', "Confusion Matrix, Accuracy " + accuracy*100 + "%")

```

Let's take a look at a few example images.

```

imdx = 5;
img = readyIndex(augTestSet, imdx);

trueLabel = img.response;
[predLabel,scores] = classify(myNet,img);
idx = (predLabel == myNet.Layers(end).classes);

imageLabel(img, scores, predLabel, trueLabel, idx);

```

PLOTS

FIGURE

VIEW

HOME PLOTS APPS FIGURE VIEW

FILE

Current Folder

Editor - Untitled.m

```

1 r = (0:0.025:1)';
2 theta = pi*(-1:0.05:1);
3 z = r*exp(ji*theta);
4 w = z.^3;
5
6 surf(real(z),imag(z),real(w),imag(w))
7 xlabel('Real(z)')
8 ylabel('Imag(z)')
9 zlabel('Real(w)')
10 cb = colorbar;
11 cb.Label.String = 'Imag(w)';

```

Figures - Figure 1

Wolfram Mathematica®

CityU

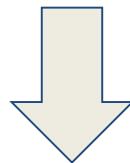
Department of Electrical Engineering

香港城市大學 City University of Hong Kong



Language Subjects

Language Subjects



Language

Language

Computing

National curriculum in England: framework for key stages 1 - 4

Computing is a core
subject in all 4 stages.

	Key stage 1	Key stage 2	Key stage 3	Key stage 4
Age	5-7	7-11	11-14	14-16
Year groups	1-2	3-6	7-9	10-11
Religious education	✓	✓	✓	✓
Sex and relationship education		✓	✓	

<https://www.gov.uk/government/publications/national-curriculum-in-england-framework-for-key-stages-1-to-4/the-national-curriculum-in-england-framework-for-key-stages-1-to-4>

	Key stage 1	Key stage 2	Key stage 3	Key stage 4
Age	5-7	7-11	11-14	14-16
Year groups	1-2	3-6	7-9	10-11
Core subjects				
English	✓	✓	✓	✓
Mathematics	✓	✓	✓	✓
Science	✓	✓	✓	✓
Foundation subjects				
Art and design	✓	✓	✓	
Citizenship			✓	✓
Computing	✓	✓	✓	✓
Design and technology	✓	✓	✓	
Languages		✓	✓	
Geography	✓	✓	✓	
History	✓	✓	✓	
Music	✓	✓	✓	
Physical education	✓	✓	✓	✓

From Thinking to Writing

- Assigning Meanings to Programs (1960)
 - From Set Theory
 - Mathematical statements
 - Flowchart
 - computer statements
 - Computer Execution

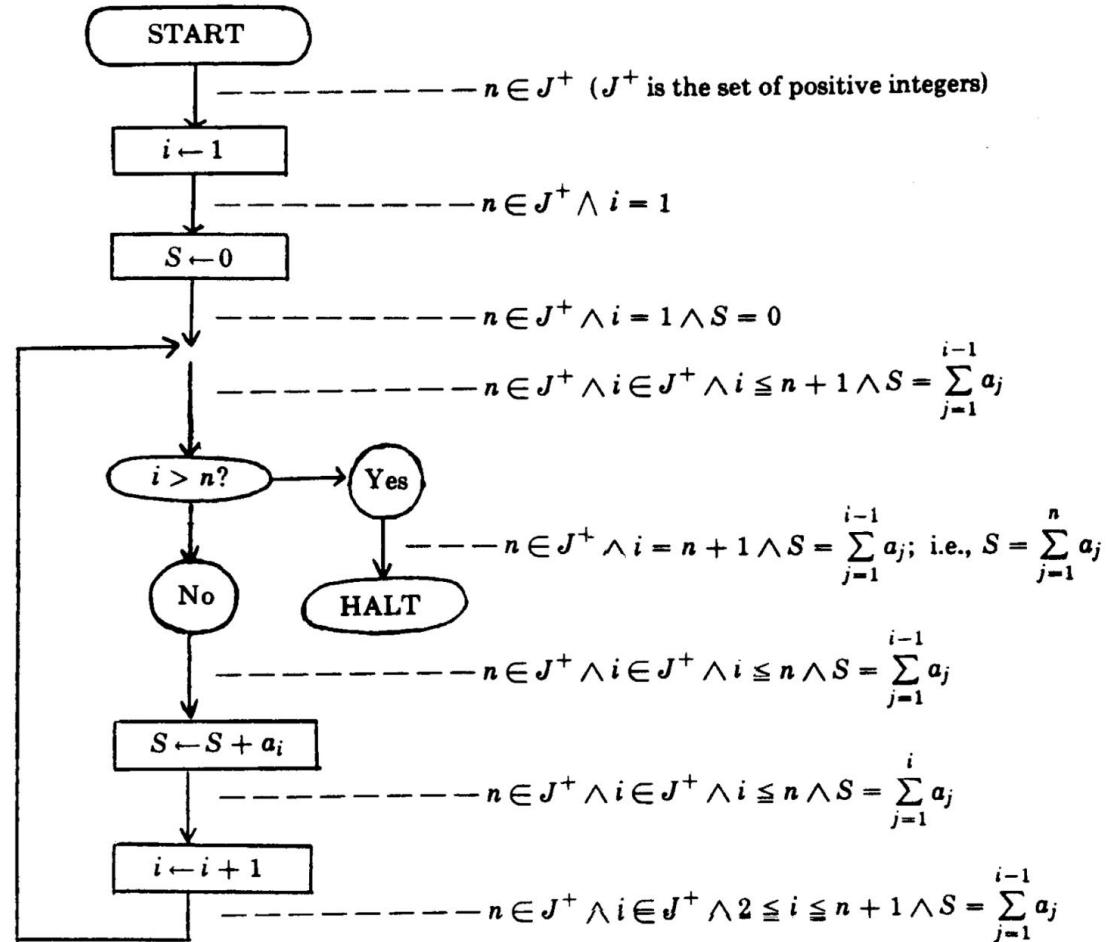


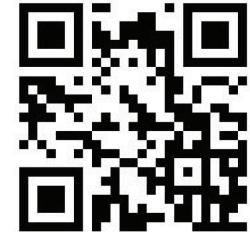
FIGURE 1. Flowchart of program to compute $S = \sum_{j=1}^n a_j$ ($n \geq 0$)



APPS LAB

香港城市大學
City University of Hong Kong

Swift Coding Club



Swift Coding Lab

Powered By CityU Apps Lab

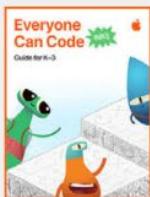
ELEMENTARY SCHOOL

MIDDLE SCHOOL

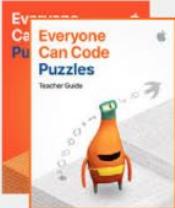
HIGH SCHOOL

HIGHER EDUCATION

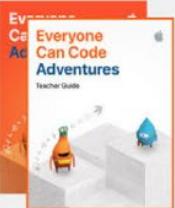
Apple Everyone Can Code



16 hours

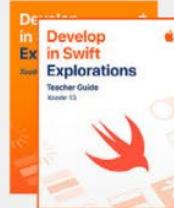


45 hours

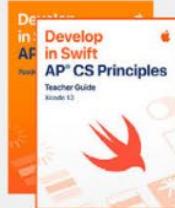


45 hours
iPad only

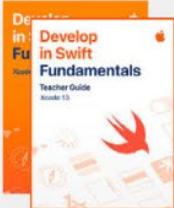
Apple Develop in Swift



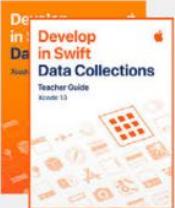
180 hours



180 hours



180 hours



180 hours



Swift Playgrounds on iPad and Mac



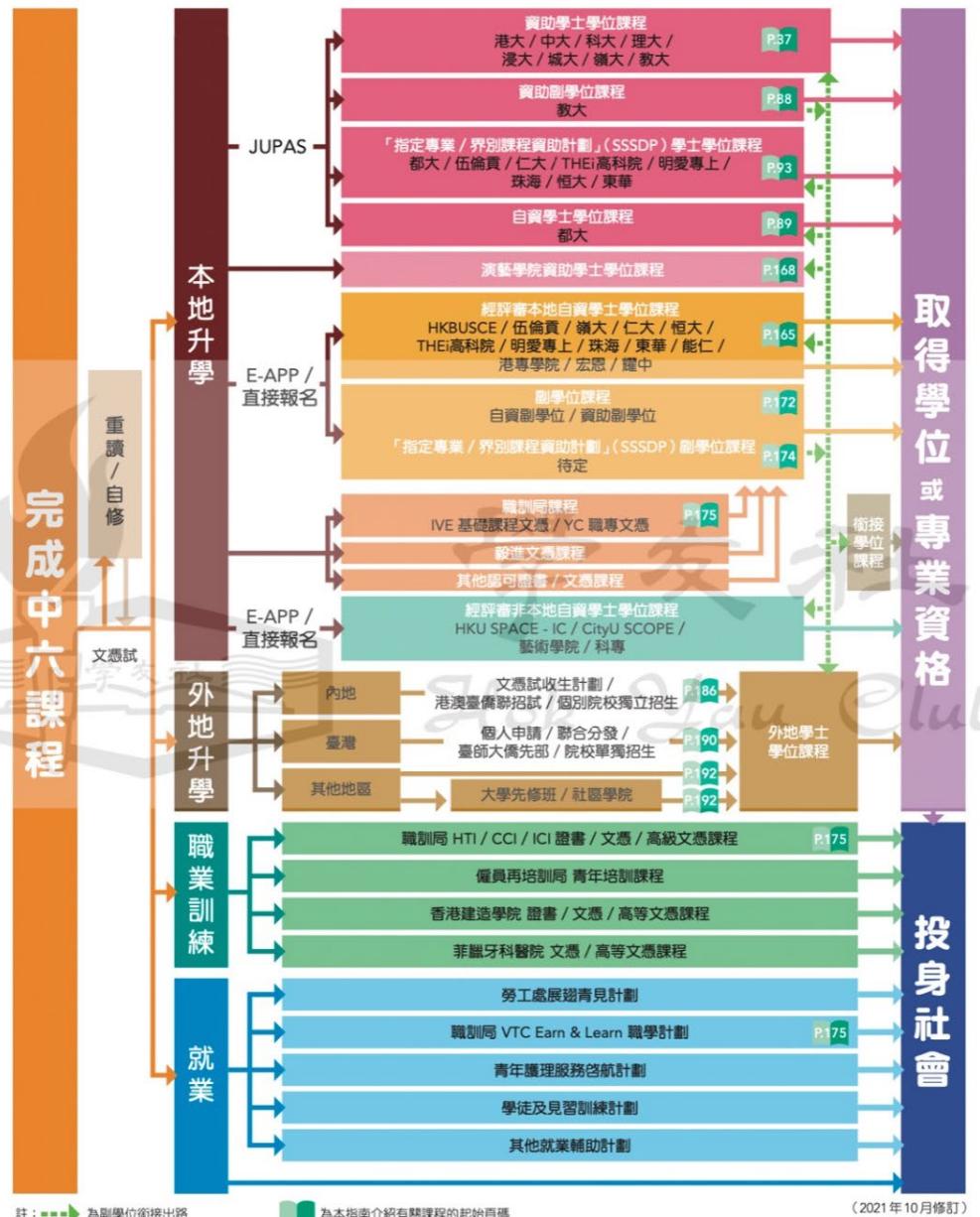
Xcode on Mac



高中畢業生出路圖

<https://student.hk/>

學友社學生輔導中心



My Profile

Associate Degree

Community College of City University (CCCU)

Programme: Associate of Engineering (AEng)

CGPA: 3.80/4.30

Bachelor's Degree (Advanced Standing II)

Department of Electrical Engineering, College of Engineering, City University of Hong Kong

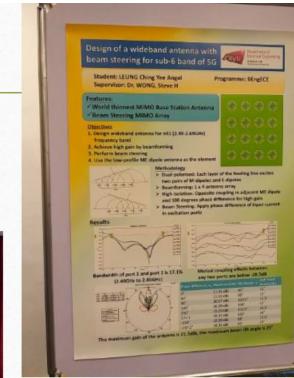
Programme: Bachelor of Engineering (BENGEGU2)

Major: Electronic and Communication Engineering (ECE)

Interest: 5G application and antenna design

Competitions

- Photography and Digital Art Competition
- Final Year Project Competition
- ASM Technology Award 2021



Final Year Project

Digital Empowerment For The Visually Impaired

Student Name: YU, Wing Yin

Student ID: 54413033

Supervisor: Dr CHEUNG, Ray C C

Assessor: Dr YUEN, Kelvin S Y



<https://www.ee.cityu.edu.hk/home/docs/EE-brochure-2021.pdf>

Electrical Engineering

with us every day and everywhere



Biomedical
diagnostics &
treatment



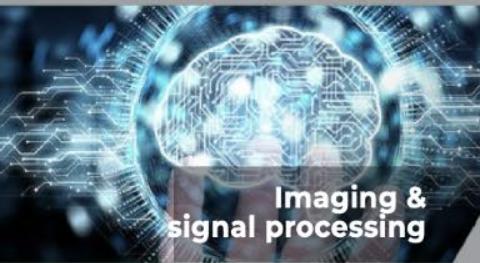
Control &
autonomous car



Computer, cell phone &
communication device



Big data &
artificial intelligence



Imaging &
signal processing



Sensor & tracking



Microelectronics

Big data

Computer &
mobile device

Communication
device

THz antenna

Electrical Engineering @ CityU
Undergraduate Admission
Graduate Admission
EE Multimedia Portal
Programmes for High School Students



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About JUPAS Participating-Institutions Programmes Offered Contact Information

ADMISSIONS SCORES OF THE 9 JUPAS PARTICIPATING-INSTITUTIONS

Home > Admissions Scores of The 9 JUPAS Participating-institutions

Admissions scores of the 9 JUPAS participating-institutions are applicable to **LOCAL JUPAS APPLICANTS** only.

2021
2020
2019
2018
2017
2016
2015
2014
2013
2012

Our Majors

Normative 4-year degree students will enter one of the following majors after one year of study:

BEng in Computer and Data Engineering 工學士(電子計算機及數據工程學)
BEng in Electronic and Electrical Engineering 工學士(電子及電機工程學)
BEng in Information Engineering 工學士(資訊工程學)
BEng in Microelectronics Engineering 工學士(微電子工程學)

Indicative Intake Target

Admission Route	Quota
Normative 4-year Degree and Advanced Standing I	180
Advanced Standing II	30

Admission Arrangements

+ JUPAS Hong Kong Diploma of Secondary Education (HKDSE) Applicants

+ Local Non-JUPAS Direct Applicants

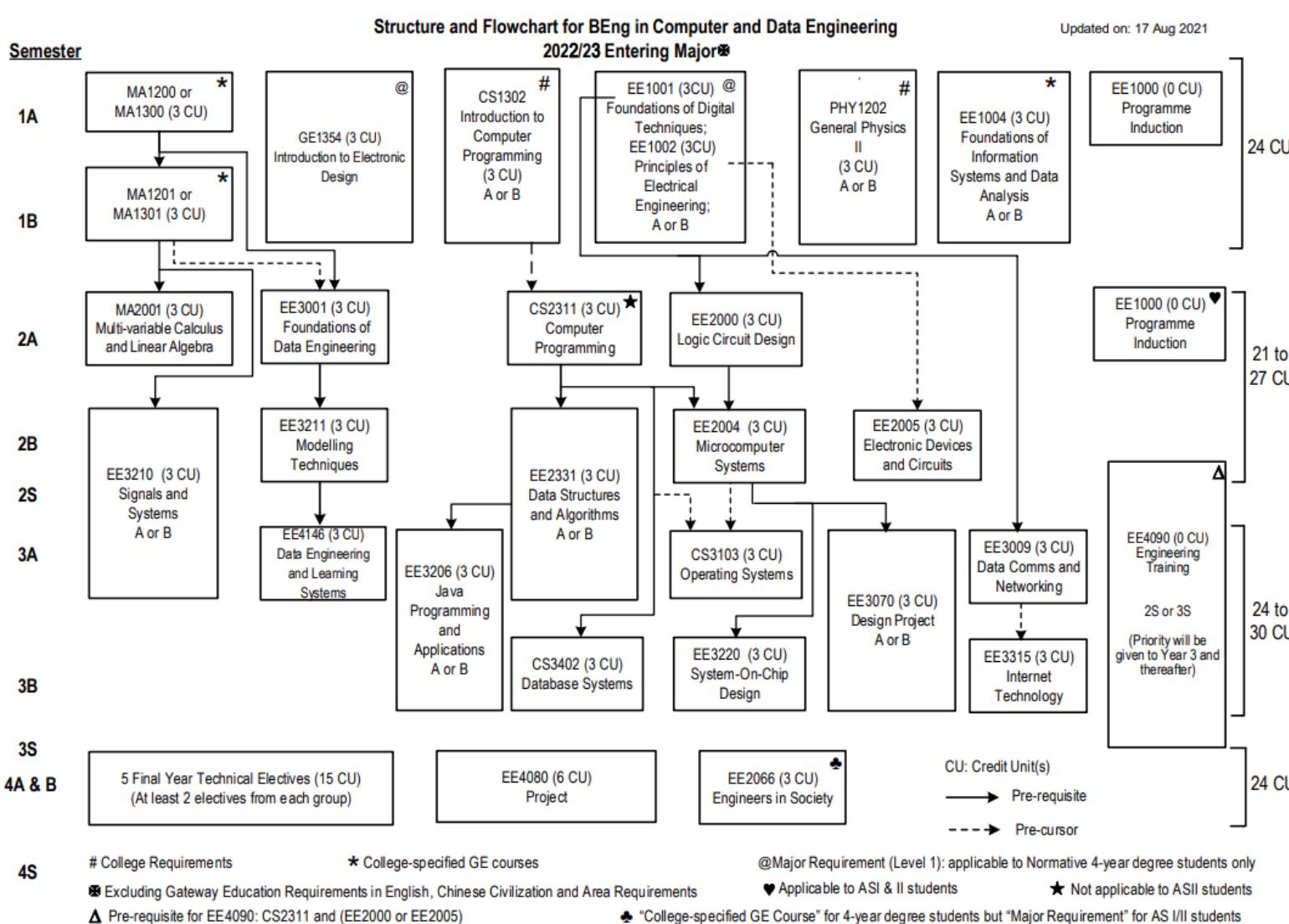
+ International Applicants

https://www.ee.cityu.edu.hk/prospective_students/undergraduate_admission/admission_information

<https://www.jupas.edu.hk/en/page/detail/3667/>

CityU EE Course: AIoT

- EE2004 - Microcomputer Systems
- EE2005 - Electronic Devices and Circuits
- EE2009 - Data Communications and Networking
- EE3220 – System-on-Chip Design
- EE3070 – Design Project



Our Program

JS1205 Department of Electrical Engineering

Options:

- *BEng Computer and Data Engineering*

(電子計算機及數據工程學工學士)

- *BEng in Electronic and Electrical Engineering*

(電子及電機工程學工學士)

- *BEng Information Engineering*

(資訊工程學工學士)

- *BEng in Microelectronics Engineering*

(微電子工程學工學士)

- **Common first year**

- **Students will enter a major after one year of study**

JUPAS Catalogue No.
JS1205

Department of Electrical Engineering

CityU
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

Options: BEng Computer and Data Engineering, BEng Electronic and Electrical Engineering, BEng Information Engineering, BEng Microelectronics Engineering^{A)}

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 (**EEL**)
工學士(電子及電機工程學)
 - BEng in Information Engineering (**INFE**)
工學士(資訊工程學)
 - BEng in Microelectronics Engineering (**MEE**)
工學士(微電子工程學)

*Subject to final approval in March 2022

CDE - Computer and Data Engineering

- Hardware and Software Design 電腦硬件及軟件設計
- Data Analytics and Security 數據分析及安全
- Cloud Computing Systems 雲端運算系統
- Machine Learning 機器學習
- Control and Internet of Things 機械控制與物聯網

EEL - Electronic and Electrical Engineering

- Wireless Communications and Data Technology 無線通訊及數據技術
- Terahertz and Optical Technologies 太赫茲及光學科技
- Photonic, Electronic and Sensor Devices 光電子及電子元件、感應器
- Smart Control and Power Systems 智能管理及能源系統
- Bioelectronics and Bioinformatics 生物電子及生物信息技術

INFE - Information Engineering

- Networking and Communications 網絡及通訊
- Algorithms and Optimisation 算法與優化
- Cybersecurity 網絡安全
- Artificial Intelligence 人工智能
- Signal Processing 訊號處理

MEE - Microelectronics Engineering

- Application-specific Integrated Circuits Design 專應用積體電路設計
- Nanotechnologies for High-performance Devices and Microsystems 用於高性能設備和微系統的納米技術
- New Designs and Materials for Integrated Circuits 積體電路新設計和材料
- Wireless and Optical Communications 無線及光學通訊
- Embedded System Design 嵌入式系統設計

Job Opportunities

Engineering companies, telecommunications, major utilities (CLP, PCCW)

- Engineer (Computer/Technical Support/ Telecommunication/Electronic/Electrical/Hardware)
- Scientific Consultant/Technologist

Banking & financial institutions, software and IT companies, government

- IT Specialist/Network Administrator
- Analyst/Programmer/Software Engineer
- Application Developer/Game Developer



Thank, you

Acknowledgements:

Invitation from Education Bureau, HKSAR

All the Principals & Teachers attended the sharing today

CityU EE Department, John Wong, GEF Team

EDB Gifted Education Fund, 100 Gifted Student members



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