

# MATLAB在AI領域的最新發展與未來趨勢： 如何將AI融入大學教學

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# Agenda

- 1. AI與MATLAB的連結
- 2. 零基礎如何開始在MATLAB使用AI
- 3. MATLAB中的AI國內外產業界應用
- 4. 未來趨勢：AI在大學教學中的應用



# AI與MATLAB的連結

# MathWorks

## North America

United States

### Headquarters

Natick, MA USA

## Europe

Finland  
France  
Germany  
Ireland  
Italy  
Netherlands  
Spain  
Sweden  
Switzerland  
UK

## Asia-Pacific

Australia  
China  
India  
Japan  
Korea

**Distributors  
serving 20+  
countries**

We are Terasoft  
(鈦思科技)  
TW Distributor



員工  
6000人以上

在全球有33個辦公室



銷售額  
超過10億美元

銷售有60%來自美國之外



私有公司

自成立以來持續盈利

85%: 擁有學士學位  
58%: 擁有碩士學位  
15%: 擁有博士學位

>50%: 開發者

## 【MathWorks的使命與信念】

**Accelerating the pace of engineering and science**

~ 在工程與科學領域，加速發現、創新與開發



# MathWorks

全球有數百萬工程師和科學家使用MATLAB和Simulink



用戶數  
超過400萬人

在超過185個國家使用



公司  
超過100,000間

包括企業、研究機構、大學和政府



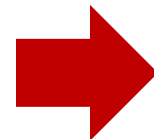
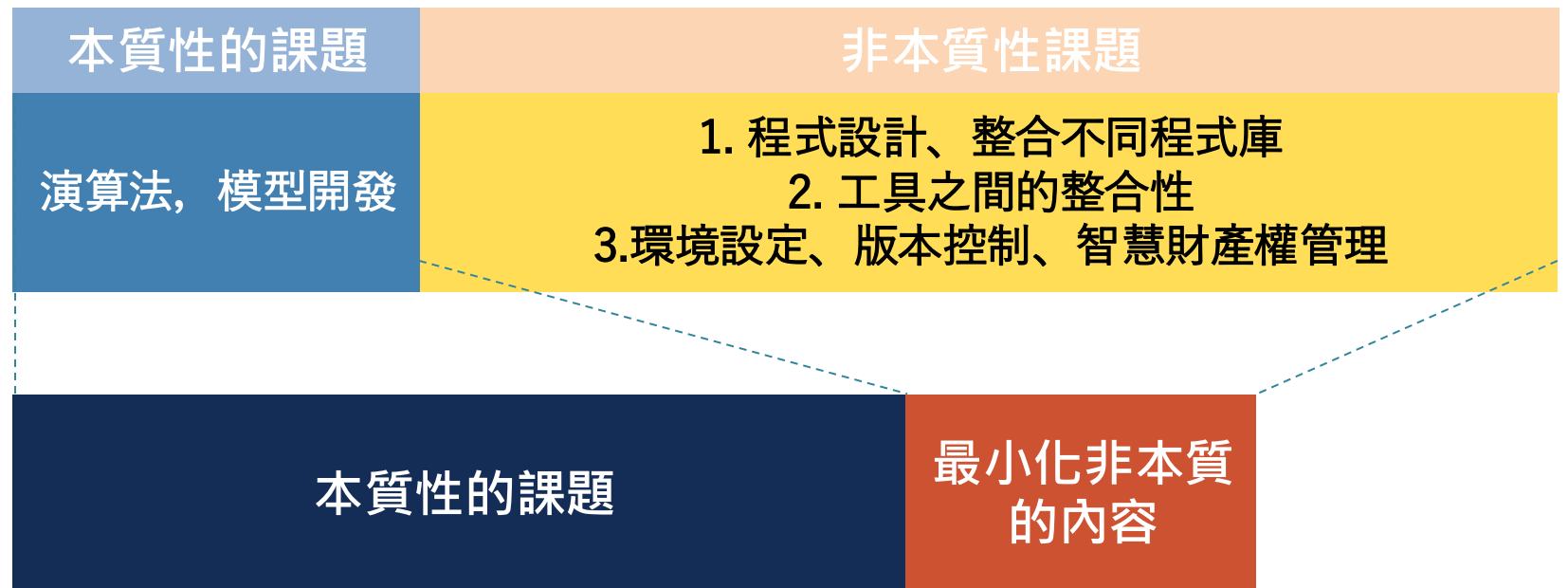
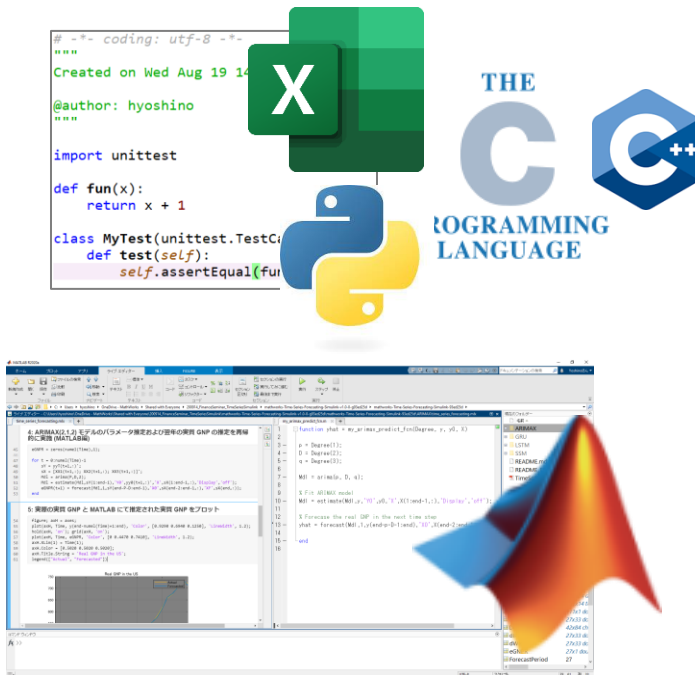
世界前十的汽車和航空企業都使用  
MATLAB和Simulink

( 資料來源：OICA 2017全球汽車生產，PwC 2018年航空與國防年度報告 )

# MATLAB 的存在意義與使命

## ■ “Accelerating the pace of engineering and science”

➤ 提供環境，讓研究者/開發工程師能專注於本質性的課題（研究、開發）。

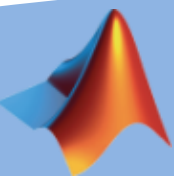


- ✓ 縮短分析時間
- ✓ 提高效率（快速嘗試與實現新想法）
- ✓ 提升品質（擴大驗證範圍與工作規模）

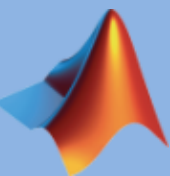
# 初心者門檻

- 程式語言
- IDE(介面)
- 函式庫
- 輸出整合方式

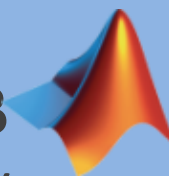
- MATALB



- MATLAB



- MATLAB  
Toolbox(100+)

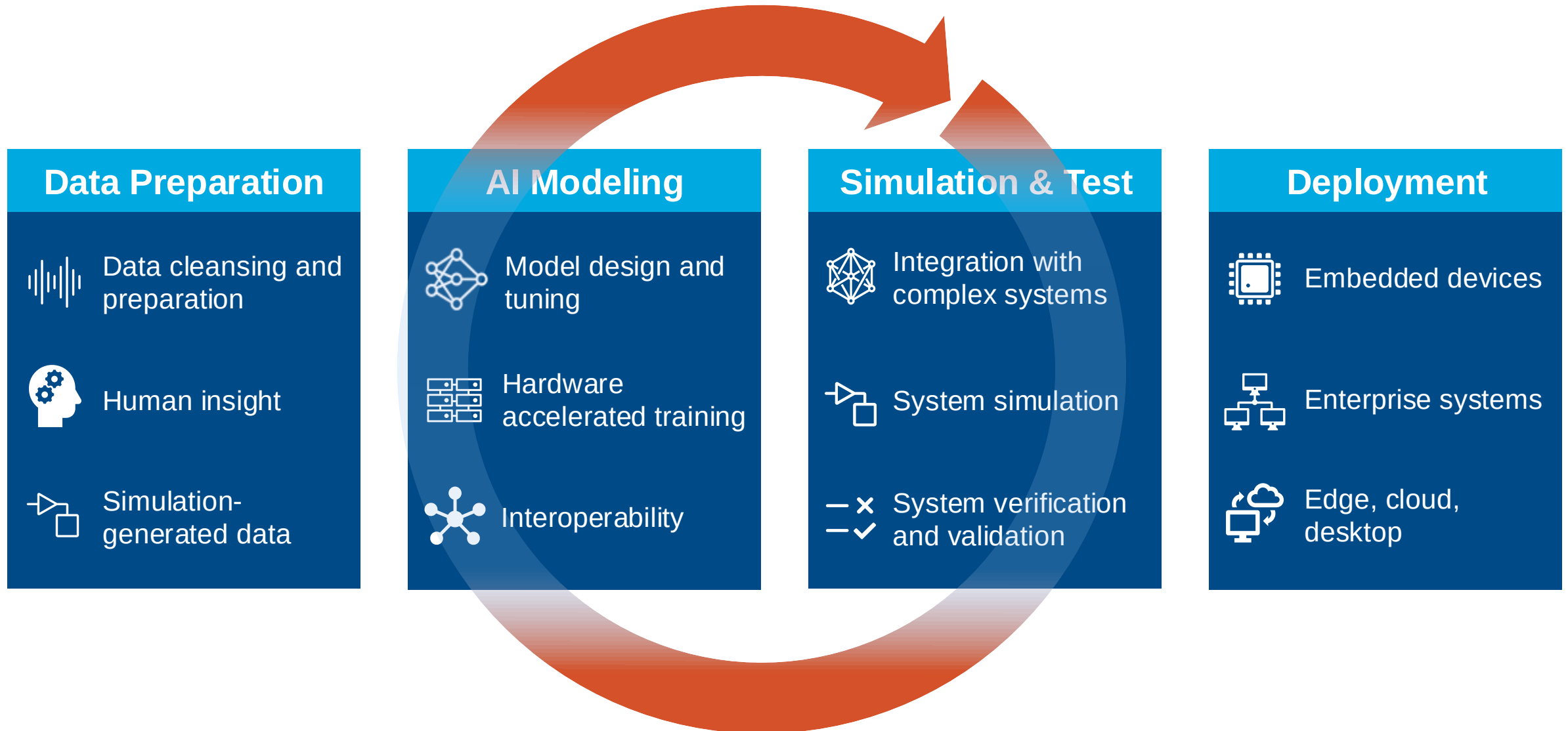


- MATLAB Coder  
■ MATLAB Compiler



1. 環境建立快速(下載後安裝1小時內建立好教學環境)
2. 版本獨立且向下支援(一年兩個版本，舊版的Code大部分可在新版執行)
3. 跨領域應用函式庫暢通(不用擔心兩個函式庫支援不同版本程式語言，導致整合困難)

# AI-driven system design





# Evolution of AI in MATLAB and Simulink

## Up to 2019

### Toolboxes

- Statistics and Machine Learning Toolbox
- Deep Learning Toolbox
- Text Analytics Toolbox
- Reinforcement Learning Toolbox
- Predictive Maintenance Toolbox

### Apps

- Classification Learner
- Regression Learner
- Diagnostic Feature Designer
- Image Labeler
- Deep Network Designer
- Video Labeler
- Signal Labeler

### AutoML

- Feature Selection

### Code Generation

- GPU Coder
- MATLAB Coder

### Interoperability

- TensorFlow-Keras Importer
- ONNX Support

## 2020 - 2022

### Accessibility

- Deep Learning Model Hub

### Apps / Live Tasks

- Experiment Manager, Lidar Labeler
- Reinforcement Learning Designer
- Clustering and dimensionality reduction Live Task

### AutoML

- Automated model selection/tuning
- Automated Feature Engineering

### Compression and Code Generation

- Quantization, Taylor Pruning
- Deep Learning HDL Coder
- TensorFlow Lite

### Explainability

- LIME/Shapley

### Interoperability

- TensorFlow Model Importer, Exporter
- PyTorch importer

### Machine Learning

- Incremental Learning, Boosted Ensembles
- Anomaly Detection, Drift Detection

### Model-Based Design

- Image Classification & Model Prediction
- Recurrent Neural Networks
- Object Detectors & Predict Blocks

## 2023 - 2024

### Compression

- Taylor, Projection Pruning

### Deep Learning

- Transformers
- L-BFGS solver
- Flexible end-to-end neural network workflow

### Explainability

- Fairness in Machine Learning
- Visualization with D-RISE

### Generative AI

- AI chat playground
- Connectors to OpenAI APIs

### Interoperability

- Co-execution blocks in Simulink

### Machine Learning

- Direct Forecasting with Regression
- Incremental Anomaly Detection
- Machine Learning in System Identification Models

### Verification

- Out of distribution detection (OOD) & code generation support
- Robustness

# Get Started with Domain Specific Examples

Examples are how engineers and scientists learn to apply AI to build [Deep Learning Applications](#) & [Machine Learning Applications](#)

- Computer Vision (Image & Video)
- Signal Processing
- Text
- Audio
- Controls (including Reinforcement Learning)
- Predictive Maintenance
- Autonomous Navigation
- Communications
- System Design (Simulink)
- Wireless
- Biotech & Pharmaceutical
- Finance
- Energy Production
- Manufacturing
- **Over 500+ examples!**

## Statistics and Machine Learning Applications

Apply statistics and machine learning methods to industry-specific workflows

Statistics and Machine Learning Toolbox™ provides tools to describe, analyze, and model data. Apply these tools, in combination with other MATLAB® toolboxes, to perform industry-specific workflows. Some of the application areas include:

- **Aerospace** — Explore radar and other signals, detect anomalies, and build predictive models.
- **Biotechnology and Pharmaceutical** — Analyze clinical data, and perform modeling and simulation for drug discovery and development.
- **Communications and Signal Processing** — Classify audio and other signals, and model wireless devices and integrated circuits.
- **Energy Production**
- **Industrial Automation** — Extend deep learning workflows with computer vision, image processing, automated driving, signals, audio, text analytics, and computational finance
- **Medical Devices** — applications while
- **Quantitative Finance** — risk, and fraud det

## Aerospace

**Radar Target Classification**  
Classify radar returns

## Biotechnology and Pharmaceutical

**High-Throughput Sequencing**  
**Gene Expression Profiling**  
This example shows:

## Applications

Extend deep learning workflows with computer vision, image processing, automated driving, signals, audio, text analytics, and computational finance

Use Deep Learning Toolbox™ to incorporate deep learning in computer vision, image processing, automated driving, signal processing, audio, text analytics, and computational finance applications.

## Categories

### Image Processing and Computer Vision

Extend deep learning workflows with image processing, computer vision, medical imaging, lidar, and automated driving applications

### Signal Processing, Audio, and Wireless

Extend deep learning workflows with signal processing, audio processing, wireless communications, and radar processing applications

### Autonomous and Control Systems

Extend deep learning workflows with reinforcement learning, predictive maintenance, and autonomous navigation applications

### Text Analytics and Computational Finance

Extend deep learning workflows with text analytics and computational finance applications

R2023b



$$F = G \frac{m_1 m_2}{d^2}$$

$$\phi(x) = \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$

$$i\hbar \frac{\partial}{\partial t} \psi = \hat{H} \psi$$

$$dS \geq 0$$

$$E = mc^2$$

$$F - E + V = 2$$

$$\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$$

$$\frac{df}{dt} = \lim_{h \rightarrow 0} \frac{f(t+h) - f(t)}{h}$$

# 零基礎如何開始在MATLAB使用AI



<https://pse.is/aimap>

MATLAB入門(中文)  
MATLAB Onramp

MATLAB核心技巧  
Core MATLAB Skills

打造MATLAB  
專業能力  
Build MATLAB  
Proficiency

進階MATLAB技巧  
Advanced MATLAB Programming Skills

## MATLAB數值處理影像、訊號課程

影像處理入門  
Image Processing Onramp

訊號處理入門  
Signal Processing Onramp

最佳化入門  
Optimization Onramp

統計入門  
Statistics Onramp

曲線擬合入門  
Curve Fitting Onramp

影像處理進階  
Image Processing with MATLAB

訊號處理進階  
Signal Processing with MATLAB

數值處理進階  
Data Analysis with MATLAB

深度學習  
影像基礎

IPCV  
實驗室

深度學習  
影像進階

視覺檢測  
(AOI)實驗室

人工智慧主題實驗室  
技術文章/影片/程式碼下載

## MATLAB AI課程

深度學習入門(中文)  
Deep Learning Onramp

機器學習入門  
Machine Learning Onramp

強化學習入門  
Reinforcement Learning Onramp

使用MATLAB進行深度學習(進階)  
Deep Learning with MATLAB

使用MATLAB進行機器學習(進階)  
Machine Learning with MATLAB

深度學習  
數值處理

MATLAB  
整合部署

深度學習  
架構擴充

MATLAB與  
Python整合

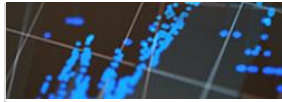
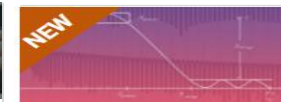
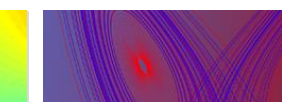


# 如何從零開始建立AI – 基礎線上課程(56堂線上課程)

## Getting Started

|                                                                                                              |                                                                                                                                     |                                                                                                                            |                                                                                                                       |                                                                                                                              |                                                                                                                         |                                                                                                                        |                                                                                                                                 |
|--------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|
|  FREE<br>MATLAB<br>Onramp   |  FREE<br>Deep Learning<br>Onramp                   |  FREE<br>Reinforcement<br>Learning Onramp |  FREE<br>Machine Learning<br>Onramp |  FREE<br>Image Processing<br>Onramp       |  FREE<br>Signal Processing<br>Onramp |  NEW FREE<br>Optimization<br>Onramp |  NEW<br>Wireless<br>Communications<br>Onramp |
|  FREE<br>Simulink<br>Onramp |  FREE<br>Control Design<br>Onramp with<br>Simulink |  FREE<br>Stateflow Onramp                 |  FREE<br>Simscape Onramp            |  NEW FREE<br>Circuit Simulation<br>Onramp |  NEW<br>Computer Vision<br>Onramp    |                                                                                                                        |                                                                                                                                 |

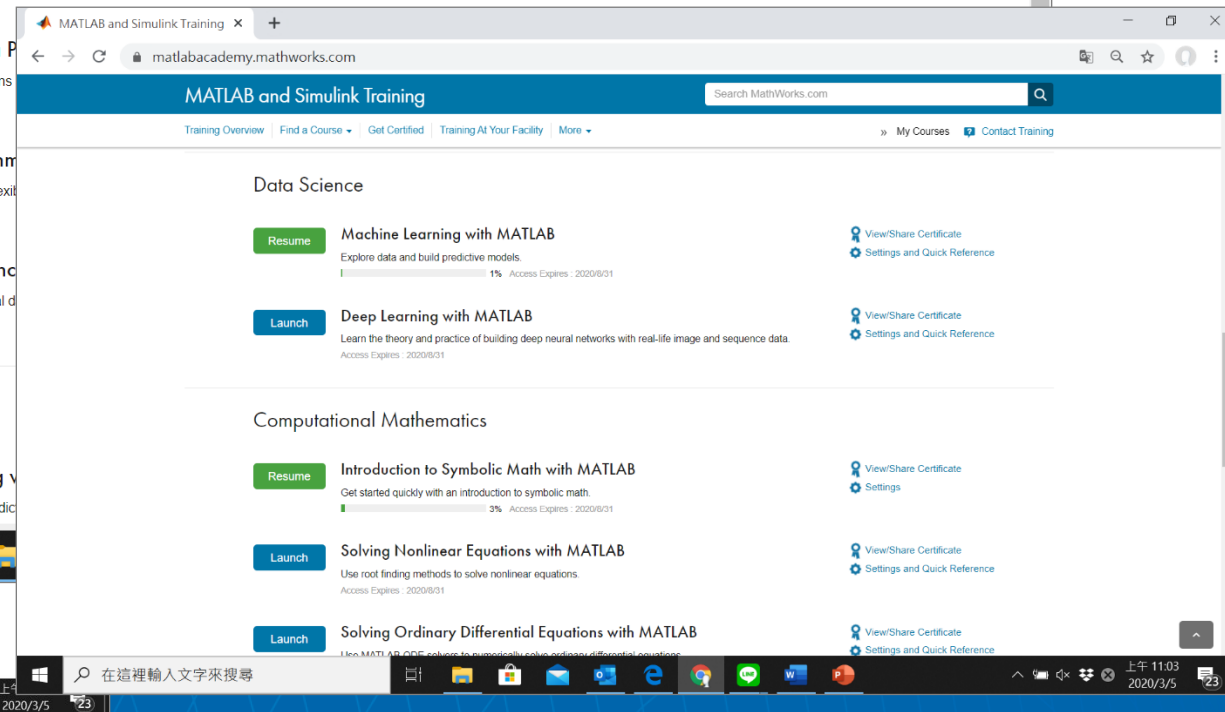
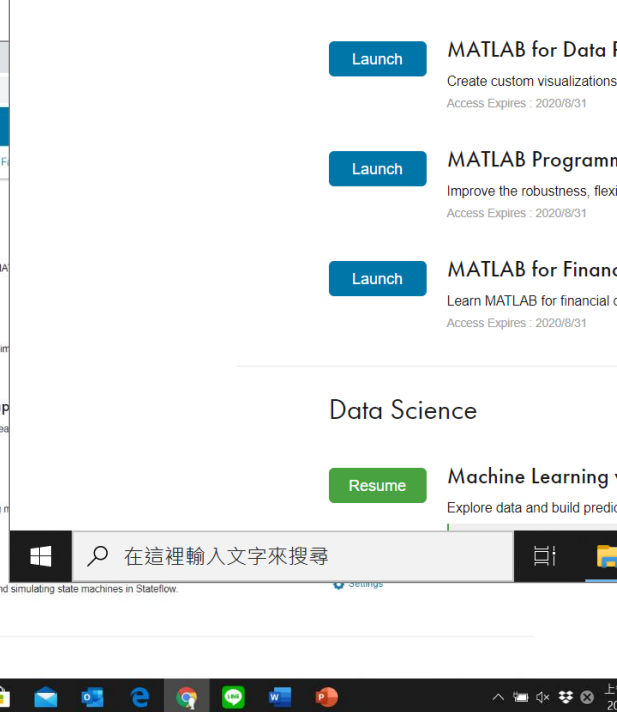
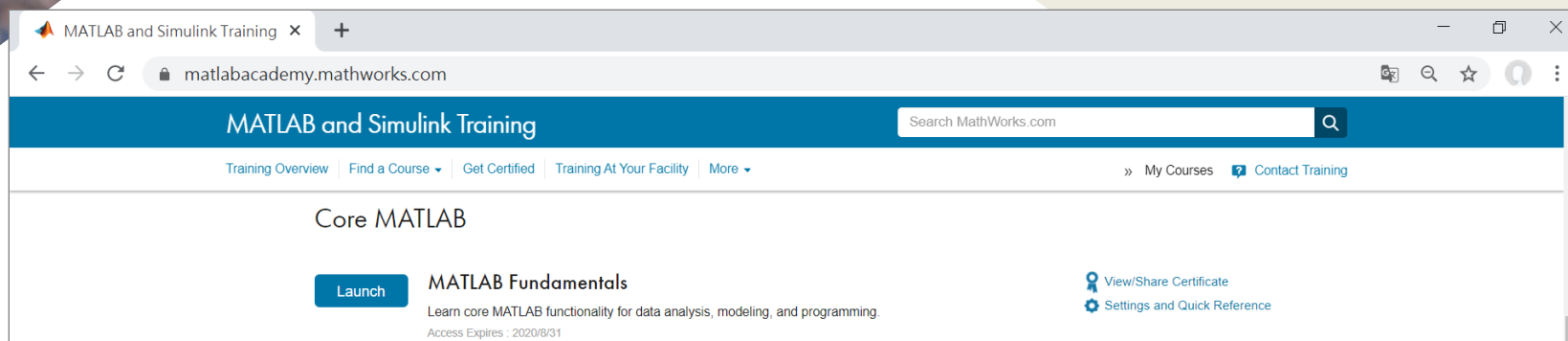
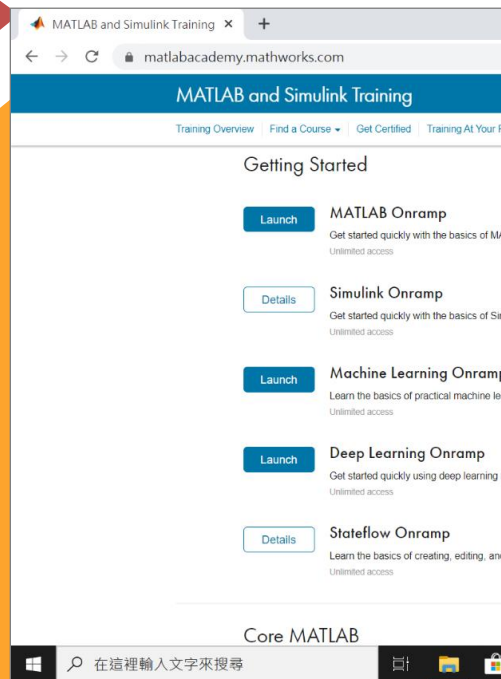
## MATLAB

|                                                                                                                     |                                                                                                                                         |                                                                                                                            |                                                                                                                            |                                                                                                                                                |                                                                                                                                                     |                                                                                                                                         |
|---------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| <br>MATLAB<br>Fundamentals         | <br>MATLAB for Data<br>Processing and<br>Visualization | <br>MATLAB<br>Programming<br>Techniques   |  NEW<br>Signal Processing<br>with MATLAB | <br>Solving Nonlinear<br>Equations with<br>MATLAB           | <br>Solving Ordinary<br>Differential<br>Equations with<br>MATLAB | <br>Introduction to<br>Linear Algebra with<br>MATLAB |
| <br>Deep Learning with<br>MATLAB | <br>Machine Learning<br>with MATLAB                  |  NEW<br>Image Processing<br>with MATLAB |                                                                                                                            | <br>Introduction to<br>Statistical Methods<br>with MATLAB | <br>Introduction to<br>Symbolic Math with<br>MATLAB            |                                                                                                                                         |

## Computational Mathematics



# 線上課程



# MATLAB Online Course Overview

- 隨時隨地學習：透過網絡瀏覽器或軟體中存取
- 邊做邊學：在 MATLAB 和 Simulink 中完成任務。
- 立即收到反饋跟踪進度並分享完成證書



← MY COURSES **MATLAB Fundamentals** (2% complete)

4.3 Creating Evenly-Spaced Vectors: (4/8) Use Colon Operator and Linspace

Task 1

Task 2

Task 3

**TASK**  
Create a variable named `x` that contains the row vector shown below.

3 5 7 9 11

Hint | See Solution | Reset  
Course Quick Reference

Submit Next task

**Test Results: Correct!**

- ✓ Is `x` defined correctly?
- ✓ Does script not contain square brackets?

HOME LIVE EDITOR VIEW

Text **B I U M** Code

EvenlySpacedVectors.mlx \* x +

at a time.

Task 1

1 `x = 5:15`

Task 2

2 `x = linspace(5,15,13)`

Task 3

3 `x = 3:2:11`

# 如何從零開始建立AI – 進階專案課程

- AI自學地圖：[MATLAB AI Map](#)

## MATLAB AI\_Map

MATLAB AI Self Learning Map

### AI Version Update

- [AI Update](#)

### Deep Learning for Image

- [Image Classification](#)
- [Object Detection](#)
- [Semantic Segmentation](#)
- [Instance Segmentation](#)
- [Anomaly Detection](#)
- [Text Detection & OCR & Barcode](#)
- [Deep Tracking and Pose Estimation](#)

### Deep Learning for Other

- [Numerical & Signal & Audio](#)
- [Large Language Model](#)
- [Exten](#)

### MATLAB AI Integration

- [Integration with Python](#)
- [Integration with Software\(Compiler & Compiler SDK\)](#)
- [Integration with Hardware\(GPU,ARM,FPGA\)](#)

### No Code & Low Code APPs

- [MATLAB Image APPs:](#)
- [MATLAB AI APPs:](#)
- [Customized APPs](#)

### Deep Learning Code Project

- [DL\\_Basic\\_Classificaiton](#)
- [DL\\_Advanced\\_RabbitDetect](#)
- [DL\\_Exten](#)
- [DL\\_Num](#)
- [DL\\_LLM](#)
- [\[@RL\\_Lab\]](#)
- [Python\\_MATLAB\\_Intergation](#)
- [GPU\\_Coder](#)



# 如何從零開始建立AI – 進階專案課程(7個主題程式碼)

- 深度學習影像基礎：[DL Basic Classificaiton](#)
- 深度學習影像進階：[DL Advanced RabbitDetect](#)
- 深度學習擴展：[DL Exten](#)
- 深度學習數值：[DL Num](#)
- 深度學習大語言模型：[DL LLM](#)(原廠)

## Deep Learning Classification

Built on 2022/02 by Fred Liu

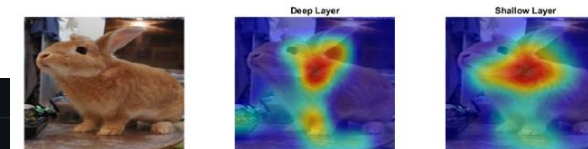
Major update 2022/5/2, update 2023.05.17, update to 2024a 2024/09/10 [Youtube Link](#)

版本:MATALB: 2022a ~ 最新版本

需要工具箱: Deeplearning, Image Processing, Computer Vision, Parallel Computing

需要支援包: Resnet18

[Deep Learning Toolbox Model for ResNet-18 Network](#)



## RabbitDetect

Built on 2022/02 by Fred Liu

Major update 2023.05.17

New update 2023.12.07(YOLOX,SOLOv2)

[Youtube Link](#)

版本:MATALB: update to 2023b,minimum version 2022a.

需要工具箱: Deeplearning, Image Processing, Computer Vision, Parallel Computing

需要支援包: YOLOv3,YOLOv4 Package & pretrain model Package

[Computer Vision Toolbox Model for YOLO v3 Object Detection](#)

[Computer Vision Toolbox Model for YOLO v4 Object Detection](#)

YOLOX:

[Computer Vision Toolbox Automated Visual Inspection Library](#)

MASK-RCNN

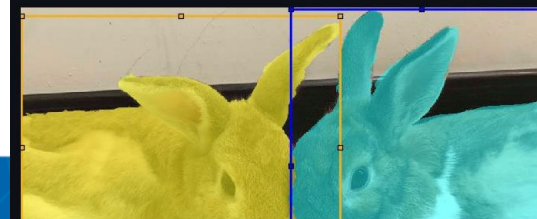
[Computer Vision Toolbox Model for Mask R-CNN Instance Segmentation](#)

SOLOv2

[Computer Vision Toolbox Model for SOLOv2 Instance Segmentation](#)

首先請閱讀setup\_readme.m (First to read setup\_readme)

因為內建資料庫資料較少，因此在訓練一些模型上效果可能較差，範例提供整體流程，但實作請換較大型的資料庫使用。 Due to the limited amount of data in the built-in database, the performance of some models may be poorer during training. The example provides the overall process, but for implementation, it is recommended to use a larger database.

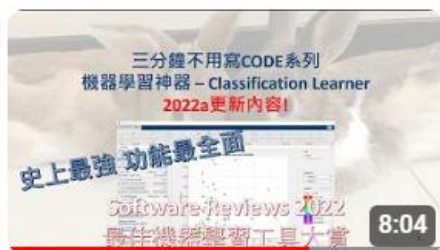


# 如何從零開始建立AI – 進階專案課程(115部操作影片)

Low Code AI ▶ 全部播放



2022a更新！深度學習(Deep Network Designer) - MATLAB



2022a更新！機器學習(Classification Learner) - MATLAB



強化學習(Reinforcement Learning) - MATLAB三分鐘不用寫CODE系列



強化學習(Reinforcement Learning) - MATLAB三分鐘不用寫CODE系列



深度學習超參數搜索(Experiment Manager) - MATLAB



2022a更新！深度學習(Deep Network Designer) - MATLAB



2022a更新！機器學習(Classification Learner) - MATLAB



醫學影像標記工具(Medical Image Labeler) - MATLAB

Deep Learning ▶ 全部播放



MATLAB深度學習之十五：深度學習數值DL\_Num



MATLAB中使用LLM，在ChatGPT詢問MATLAB



MATLAB深度學習之十三：LLMs with MATLAB



MATLAB 2024a AI更新介紹

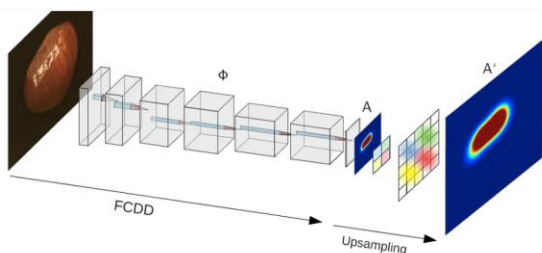


MATLAB深度學習之八(6)RabbitDetect實例分割篇...

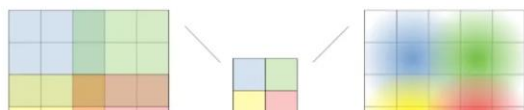
1. Low Code APP 主題操作影片
2. 三分鐘不用寫Code系列
3. Image / Deep Learning 操作影片
4. MATLAB Integration
5. 持續更新中 . . .

# 如何從零開始建立AI – 進階專案課程(文章教學)

- 1. 每個版本AI的更新介紹(2023b~最新版)
- 2. MATALB 實現整合系列(跟Python,C++,C#做整合)
- 3. MATALB 轉Code系列(MATLAB Code轉 C/C++, CUDA, RTL)
- 4. 主題實驗室(AOI\_Lab, IPCV\_Lab)
- 5. 演算法介紹



利用此方法可以僅使用到少數的負面樣本(異常樣本)，就能訓練出穩健的模型，而且訓練時間短，不需要太多正常樣本與以及少量異常的樣本即可，並且使用合成的異常樣本也很有效，並且在尺寸的縮放上效果也很好。



## 載入資料與資料分割(Load Data & Splits Dataset)

```
dsPCB = imageDatastore(datadir,IncludeSubfolders=true,LabelSource="foldernames");  
summary(dsPCB.Labels)
```

```
Anomaly    100  
Normal    1005
```

## 分割成訓練、驗證，與測試資料集

```
[dsTrain,dsVal,dsTest] = splitAnomalyData(dsPCB,"Anomaly");
```

Splitting anomaly dataset

\* Finalizing... Done.

\* Number of files and proportions per class in all the datasets:

|         | Input    |          | Train    |       | Validation |         | Test     |         |
|---------|----------|----------|----------|-------|------------|---------|----------|---------|
|         | NumFiles | Ratio    | NumFiles | Ratio | NumFiles   | Ratio   | NumFiles | Ratio   |
| Anomaly | 100      | 0.090498 | 0        | 0     | 34         | 0.25373 | 66       | 0.24627 |
| Normal  | 1005     | 0.9095   | 703      | 1     | 100        | 0.74627 | 202      | 0.75373 |

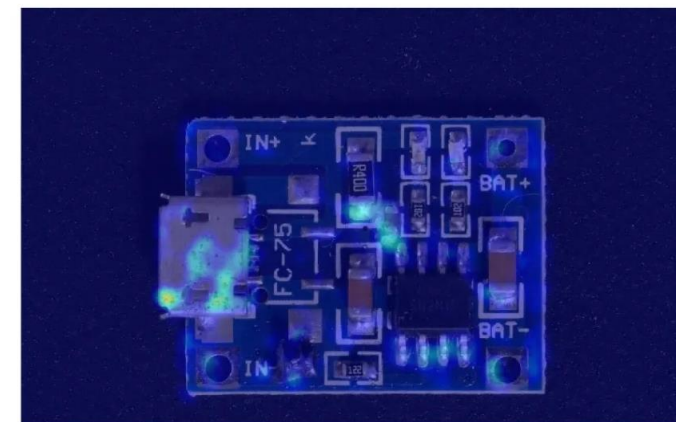
資料載入與資料分割

splitAnomalyData是2023a新出的function，這點要注意一下，但流程就會是將資料放入imageDatastore中，再利用splitAnomalyData切割出訓練資料、驗證資料，與測試資料，透過此方法可以節省掉很多資料分割的時間。

## 測試影像

載入單張影像進行異常檢測測試

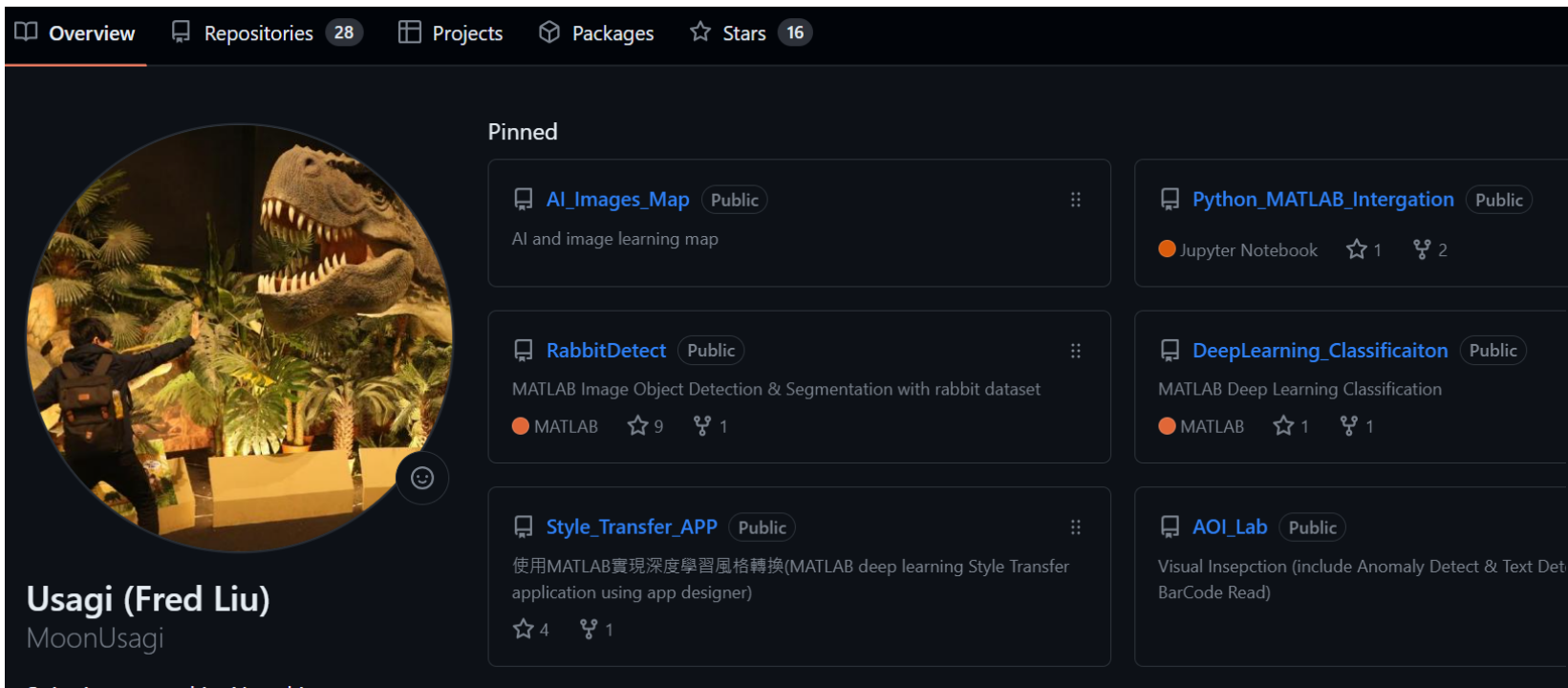
```
AnomalyImage = imread("D:\Fred\WATLAB_Project(myself)\AnomalyDetection\VisA_20220922\VisA_20220922\pcb4\data\Images\Anomaly\026.JPG");  
displayRange = [0,162];  
map2 = anomalyMap(detector,AnomalyImage);  
image2 = (anomalyMapOverlay(AnomalyImage,map2,MapRange=displayRange,Blend="equal"));  
figure,imshow(image2)
```



測試結果



# 自學資源



The screenshot shows a GitHub profile for 'Usagi (Fred Liu)' with the username 'MoonUsagi'. The profile has 28 repositories and 16 stars. The pinned repositories are:

- AI\_Images\_Map** (Public): AI and image learning map
- RabbitDetect** (Public): MATLAB Image Object Detection & Segmentation with rabbit dataset (MATLAB, 9 stars, 1 fork)
- Style\_Transfer\_APP** (Public): 使用MATLAB實現深度學習風格轉換(MATLAB deep learning Style Transfer application using app designer) (4 stars, 1 fork)
- Python\_MATLAB\_Intergation** (Public): Jupyter Notebook (1 star, 2 forks)
- DeepLearning\_Classificaiton** (Public): MATLAB Deep Learning Classification (MATLAB, 1 star, 1 fork)
- AOI\_Lab** (Public): Visual Insepction (include Anomaly Detect & Text Det BarCode Read)



## AI\_Images\_Map

AI and image learning map

### Deep Learning

- Image Classification
- Object Detection
- Semantic Segmentation
- Instance Segmentation
- Text Detection & OCR & Barcode
- Anomaly Detection

### MATLAB Integration

- Integration with Python
- Integration with Software(Compiler & Compiler SDK)
- Integration with Hardware(GPU,ARM,FPGA)

### MATLAB APPs

- MATLAB Image APPs:
- MATLAB Deep Learning APPs:
- Customized APPs

Linktree : [linktr.ee/FredLiu](https://linktr.ee/FredLiu)

GitHub : [MoonUsagi](https://github.com/MoonUsagi)

YouTube : [Fred玩MATLAB](https://www.youtube.com/channel/UC8w8w8w8w8w8w8w8w8w8w8w) 搜尋 : @FredMATLAB

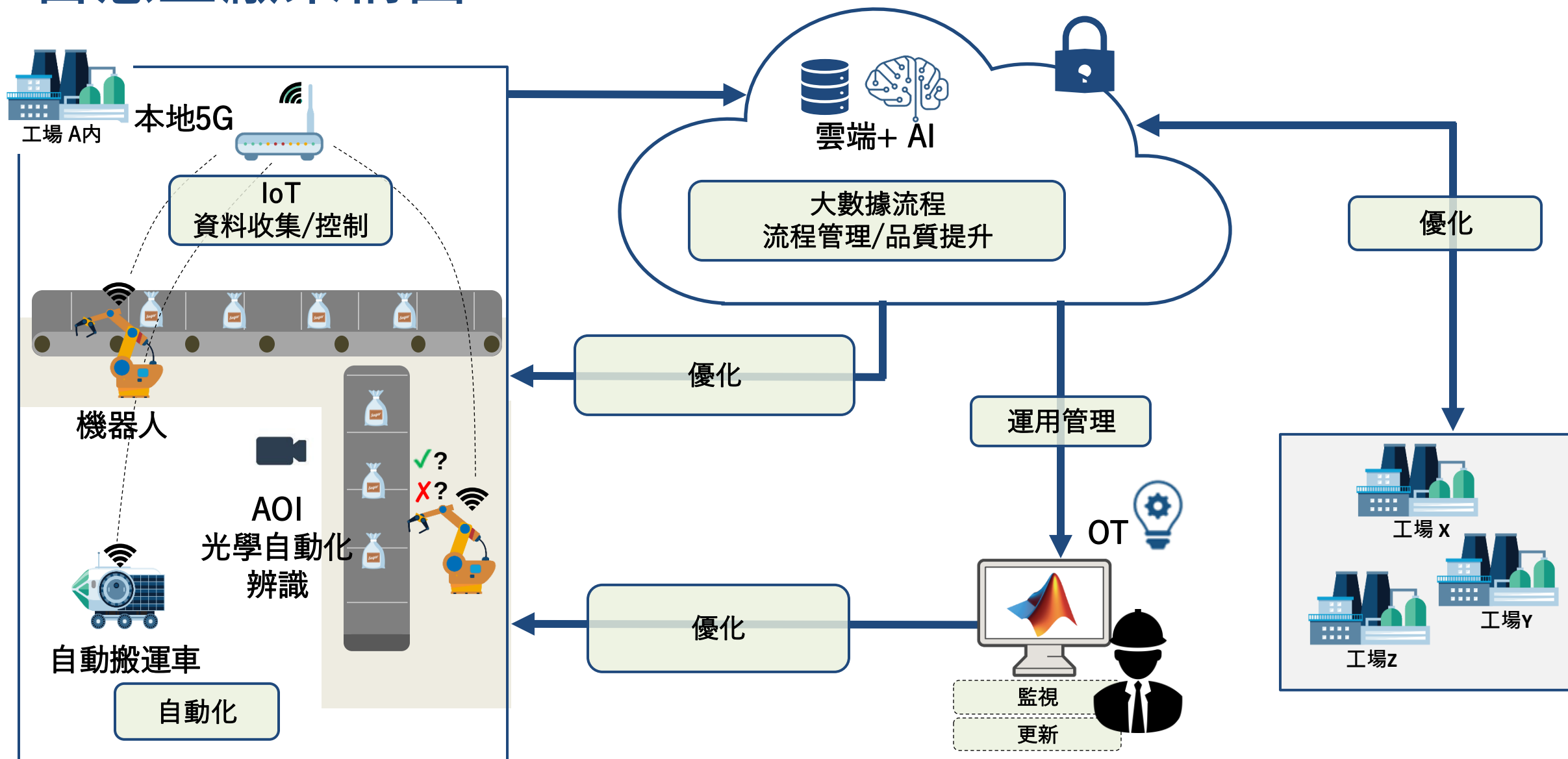
Medium : [@FredLiu](https://medium.com/@FredLiu)





## MATLAB中的AI國內外產業界應用

# 智慧工廠架構圖



# Factories now – Status quo

The “trusted” methods, but will continue to increase burden on workers

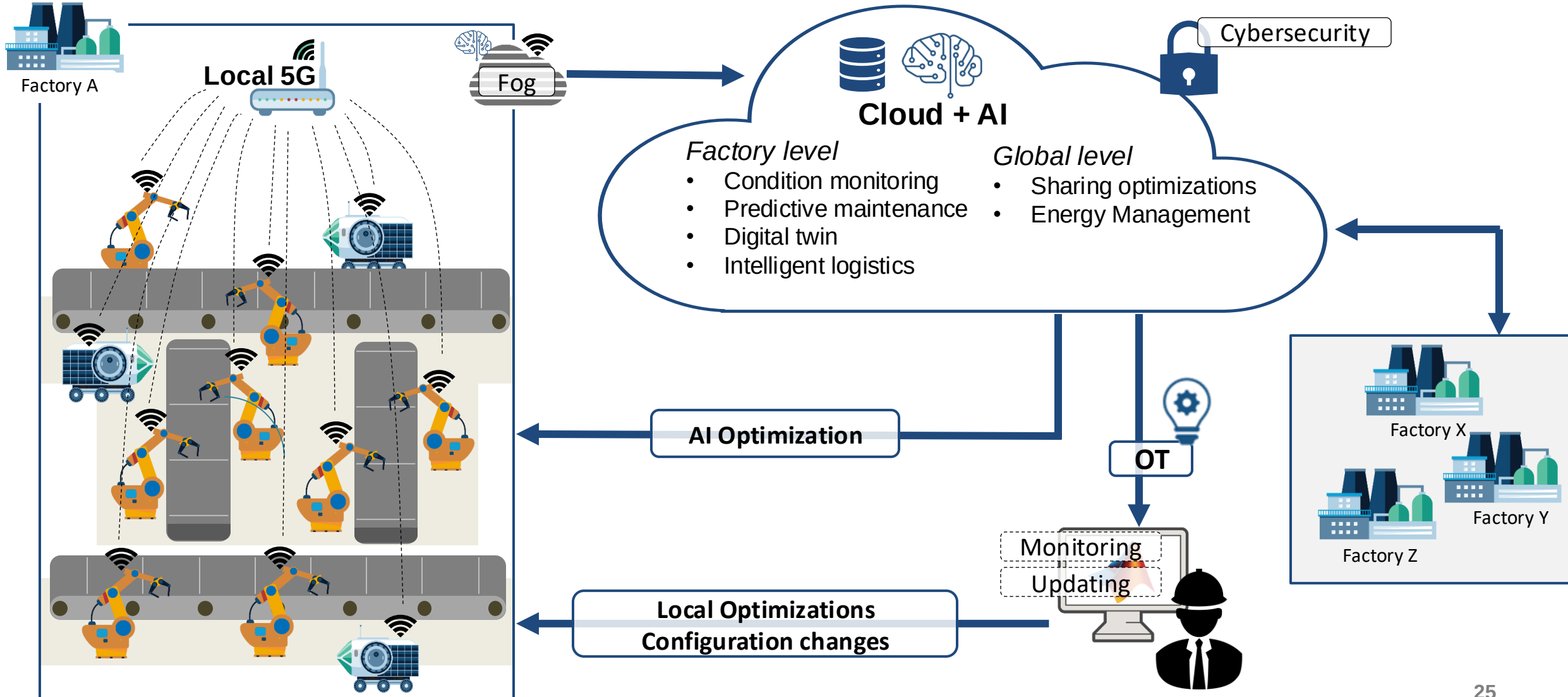
- 系統
  - 固定位置的機器人
    - 可靠但佔用空間大
- 技術
  - 任務自動化
    - 配置更改困難
    - 不適合動態環境
  - 手動編程
    - 耗時的運動規劃
- 連接性
  - 狀態監測
    - 大數據未能有效利用
- 基礎設施
  - 空間分離
    - 為了人員安全而浪費空間



# Factories now – Frontrunners

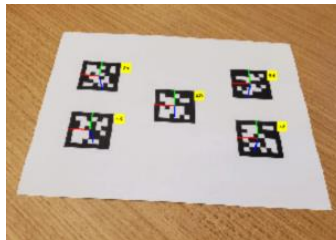
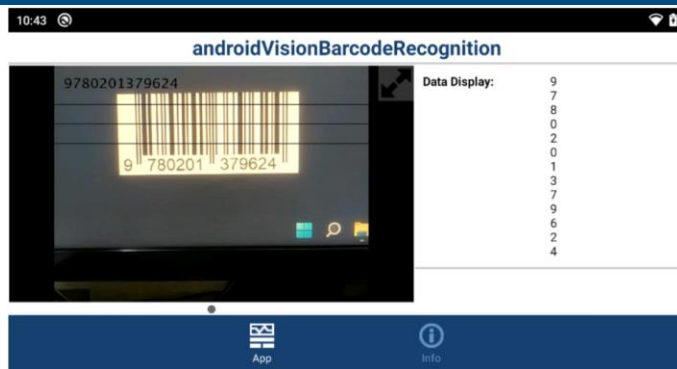
- System
  - **Autonomous systems:** Collaborative robots, AMR/AGV
    - Adaptive robots that work in dynamic environments with humans
    - Saves space and easily reconfigurable
  - AR Picking
    - Humans using AR for guided picking
- Technology
  - **Semi-autonomous technologies**
    - AI and **deep learning** utilization (inspection, sorting, etc.)
  - Visualization / AR / VR
    - Maintenance, training
- Connectivity
  - **Digital twin**
    - Offline teaching, optimization of sequential actions
  - Intelligent logistics
    - Efficient operation of autonomous systems
  - **Predictive Maintenance**
    - Using data to pre-empt failures and reduce downtime
- Infrastructure
  - Cloud computing
    - Factory-level data aggregation, analysis, utilization
  - Energy Management
    - Optimization to meet factory needs
  - OT (Operational Technology)
    - Single factory level monitoring, optimization

# Factories in 5 years – Holistic optimization with Industrial IoT



# 智慧工廠 – Barcode/OCR/Seven-Segment Digits

## Barcode detect



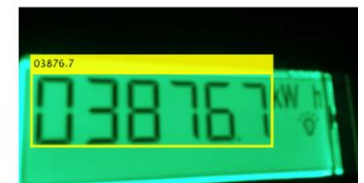
## OCR

THE QUICK BROWN FOX JUMPS  
OVER THE LAZY DOG.

劉 方 傑 Fred Liu

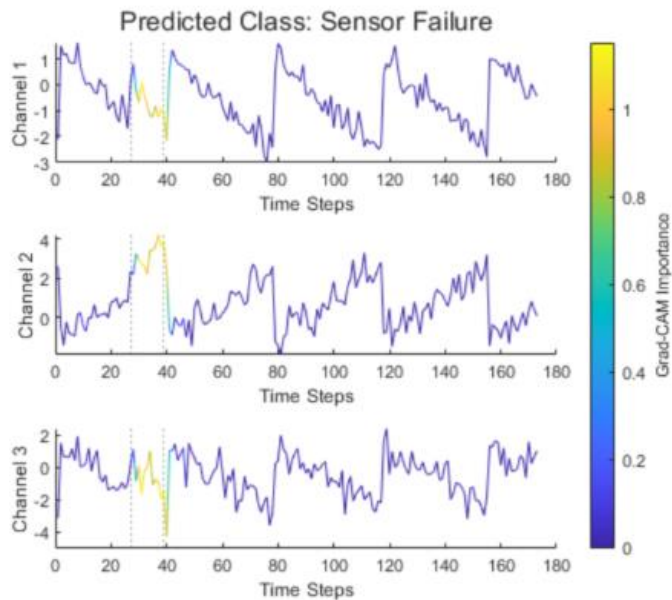
工程 部  
工程師  
工程師  
Engineering Dept.  
Application Engineer

## Seven-Segment Digits

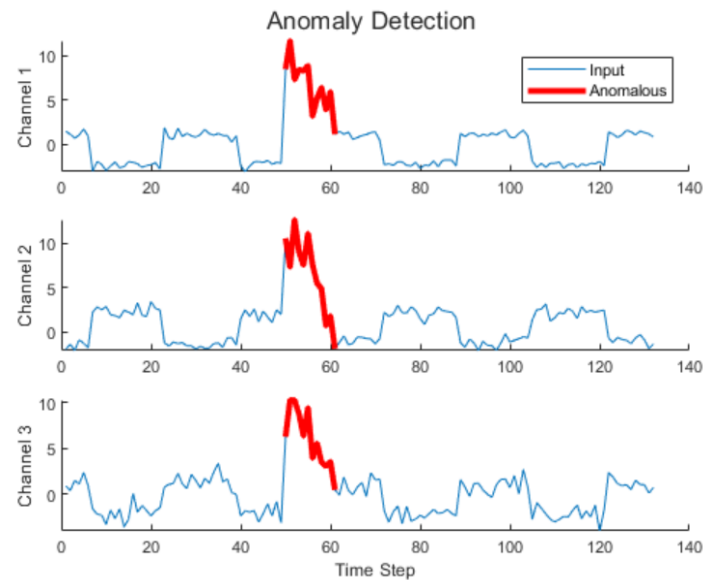


# 智慧工廠 – 訊號異常偵測，特徵可視化

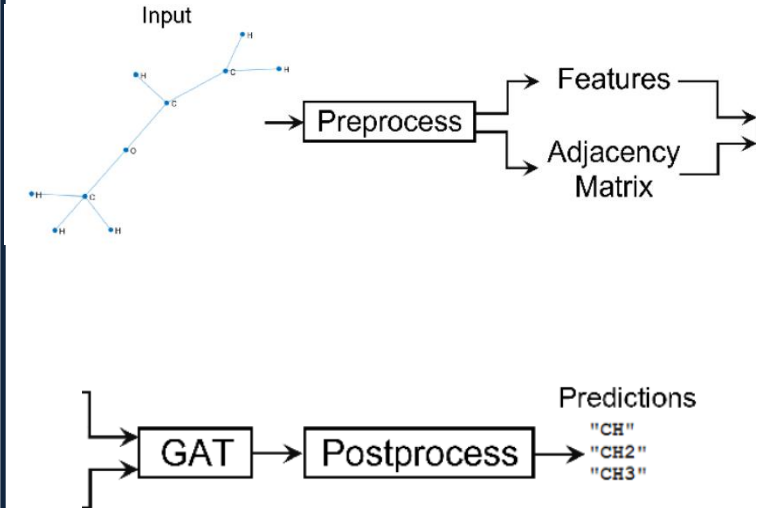
## Classify Using Grad-CAM



## Anomaly Detection



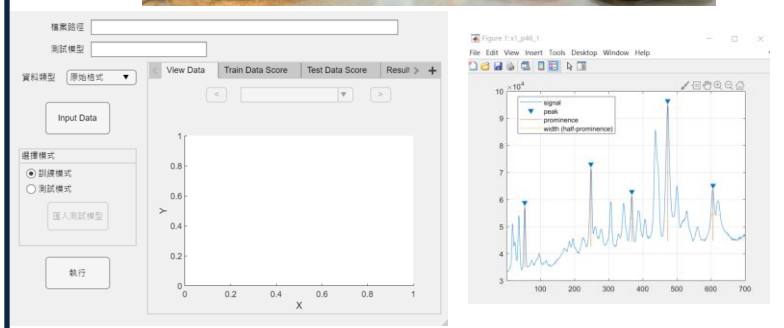
## Graph Classification



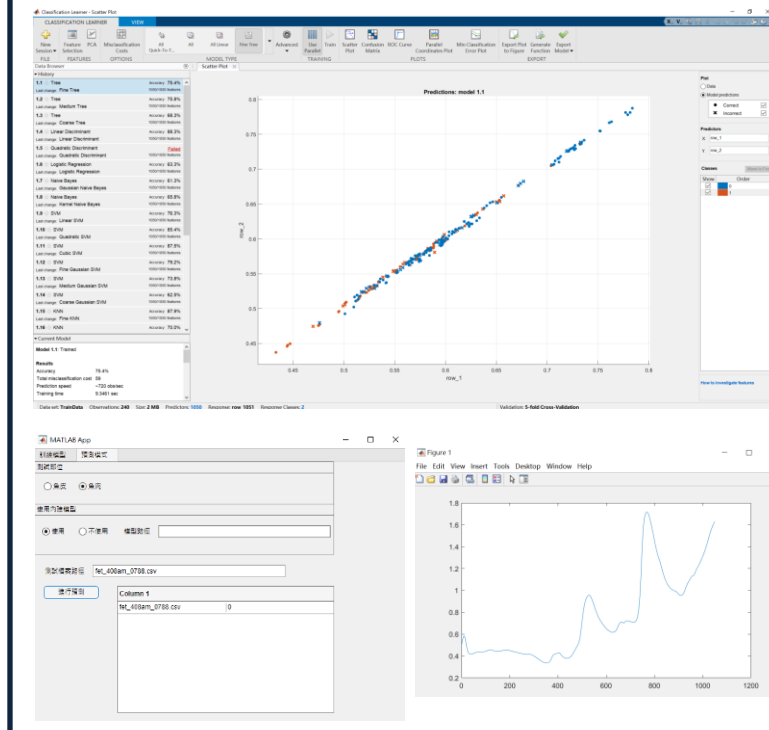


# AI分析訊號光譜

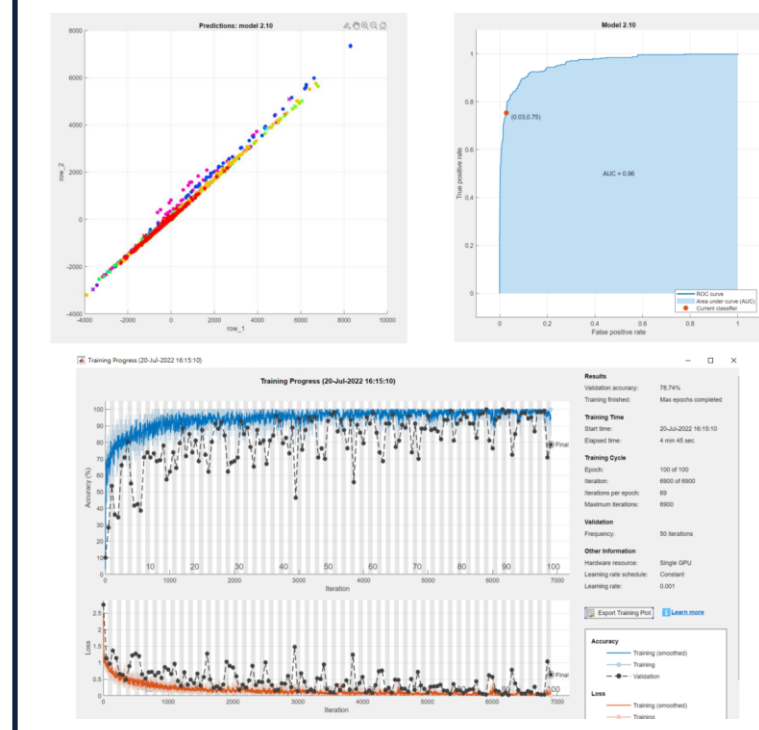
## 農藥光譜分析



## 肉質光譜分析

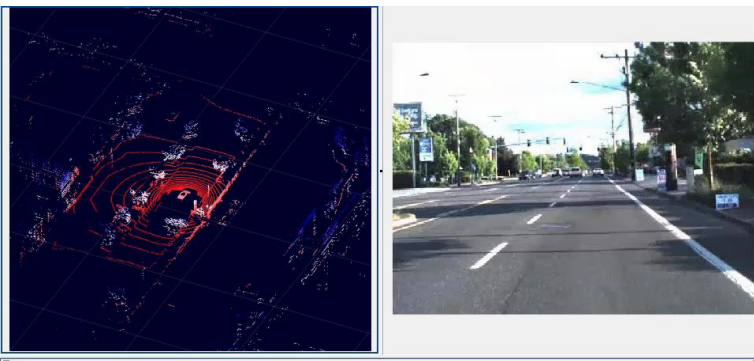


## 材質化合物&藥材分析

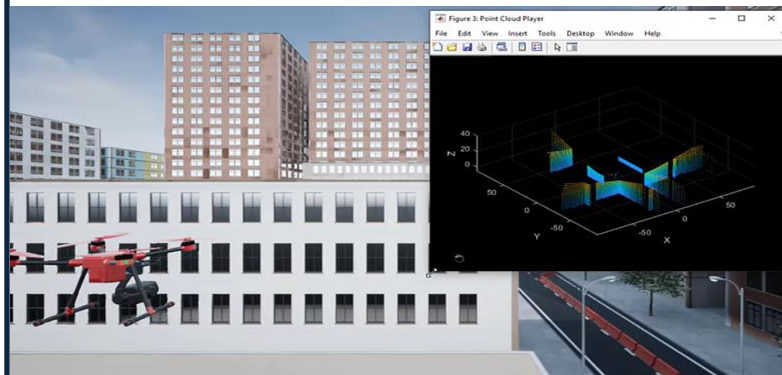


# 光達應用

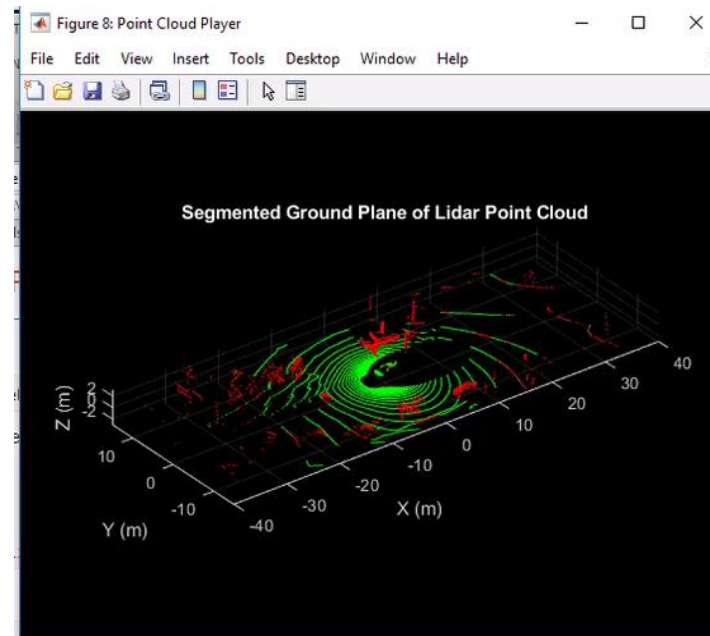
## 自駕車場景應用



## 無人機場景應用

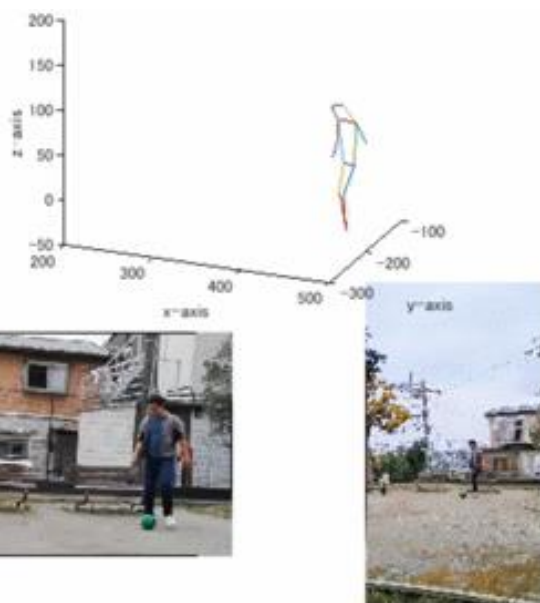
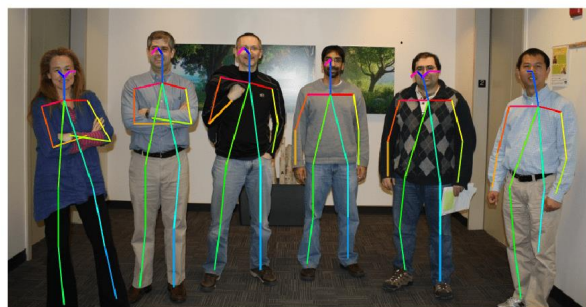


## 工廠環境檢測&異物偵測



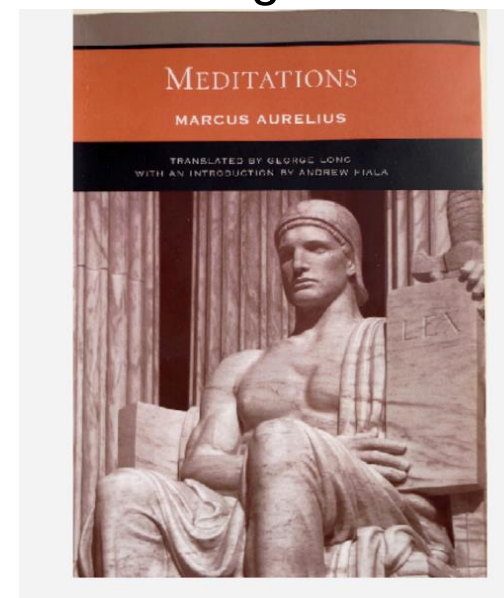
# 人體姿態與文字深度學習

## 2D/3D人體姿態偵測與辨識

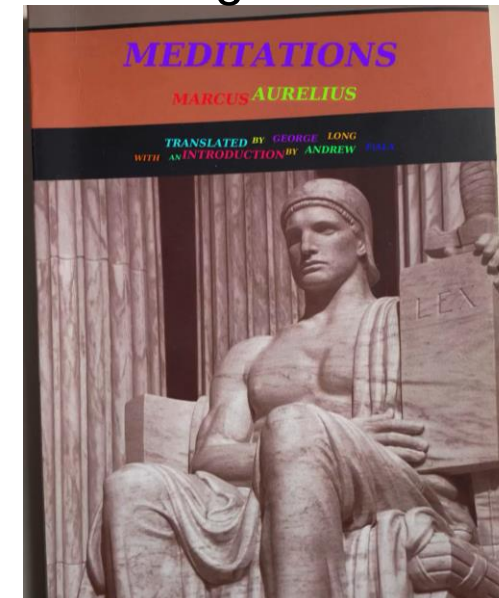


## 使用深度學習取代傳統ISP流程

Original

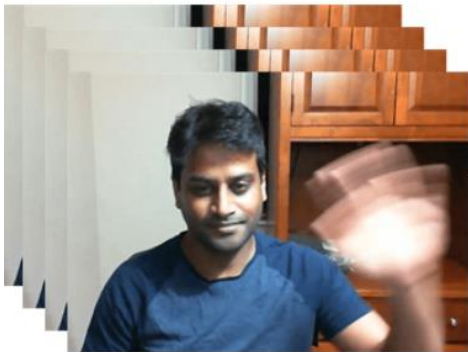
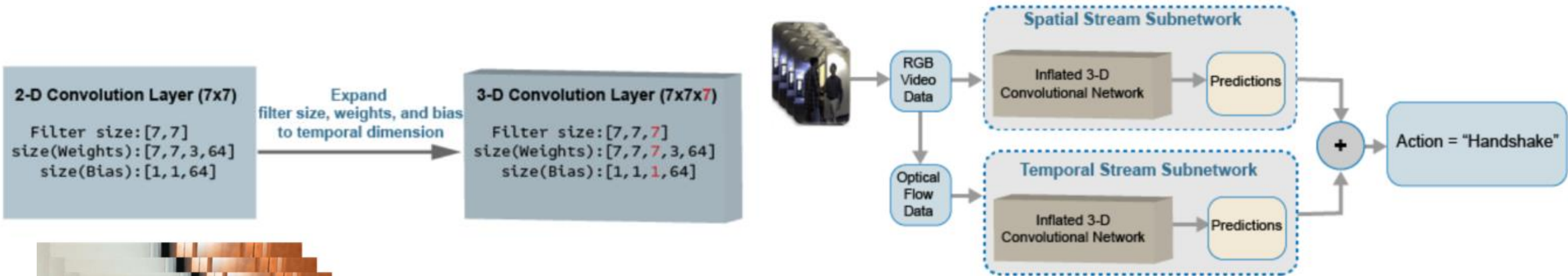


Augmented



# 影片深度學習

## 影片行為分類



Video

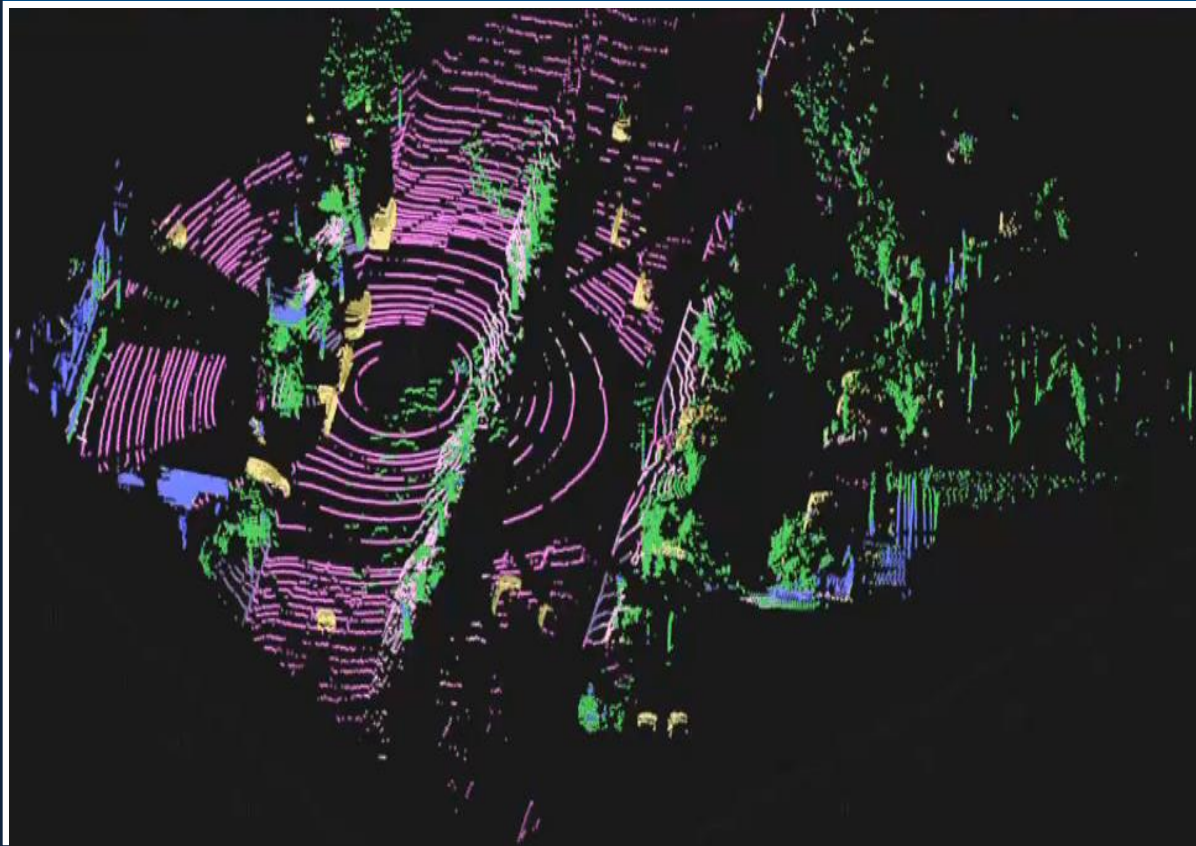


| Network     | Inputs                    | Size(MB) | Classifications (Human Actions) | Description                                                                   |
|-------------|---------------------------|----------|---------------------------------|-------------------------------------------------------------------------------|
| SlowFast    | Video                     | 124      | 400                             | Faster convergence than Inflated-3D                                           |
| R(2+1)D     | Video                     | 112      | 400                             | Faster convergence than Inflated-3D                                           |
| Inflated-3D | Video & Optical Flow data | 91       | 400                             | Accuracy of the classifier improves when combining optical flow and RGB data. |

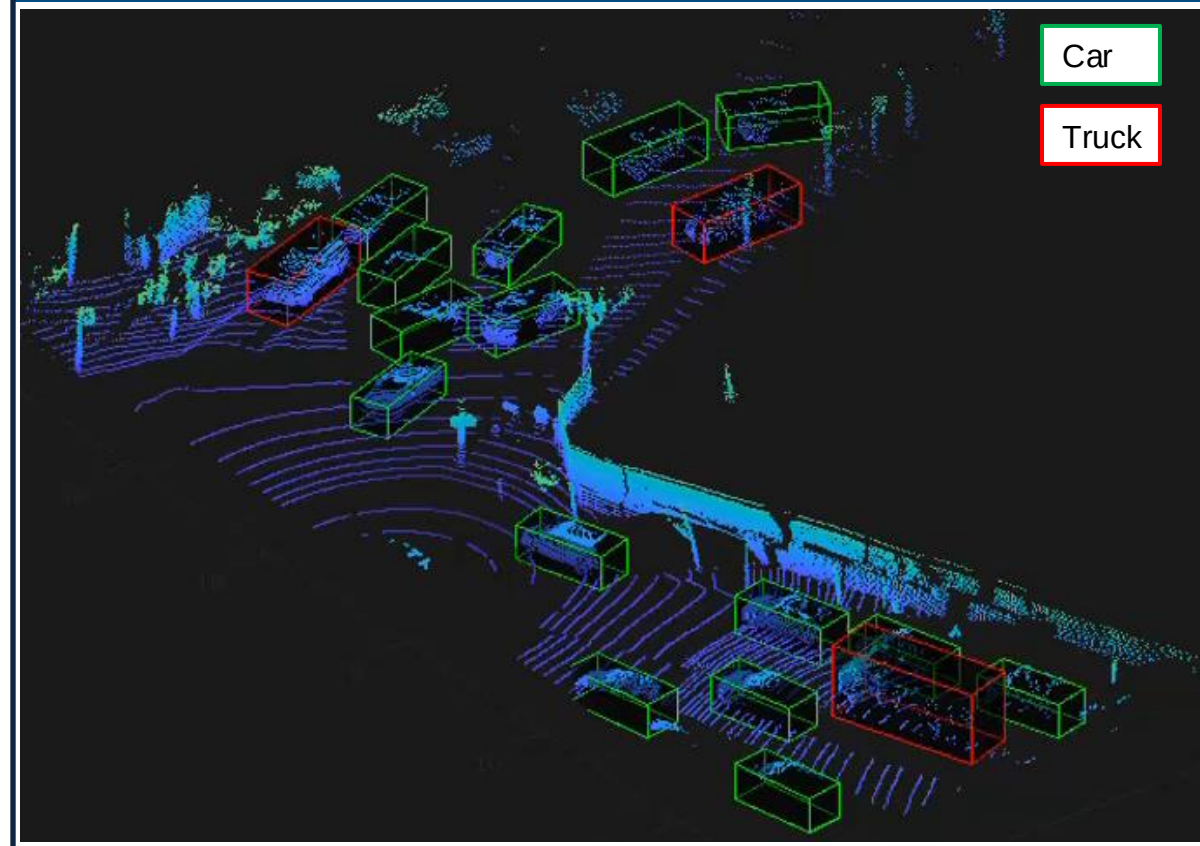


# 光達點雲深度學習

點雲語意分割(SqueezeSegv2)

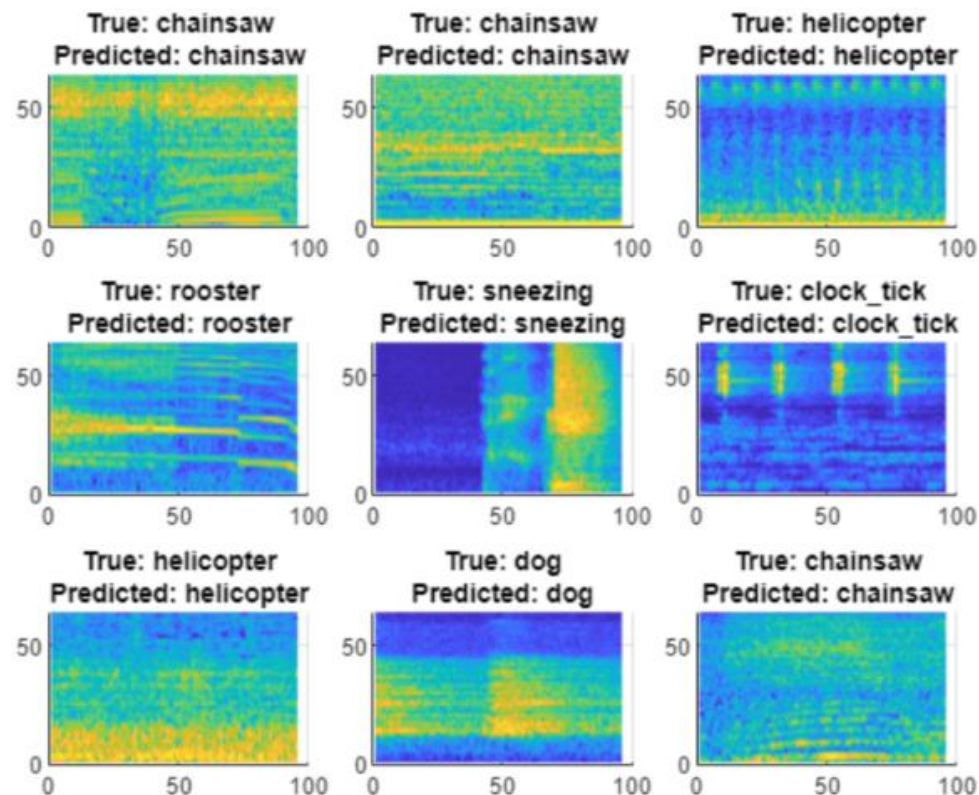


點雲物件辨識(PointPillars)

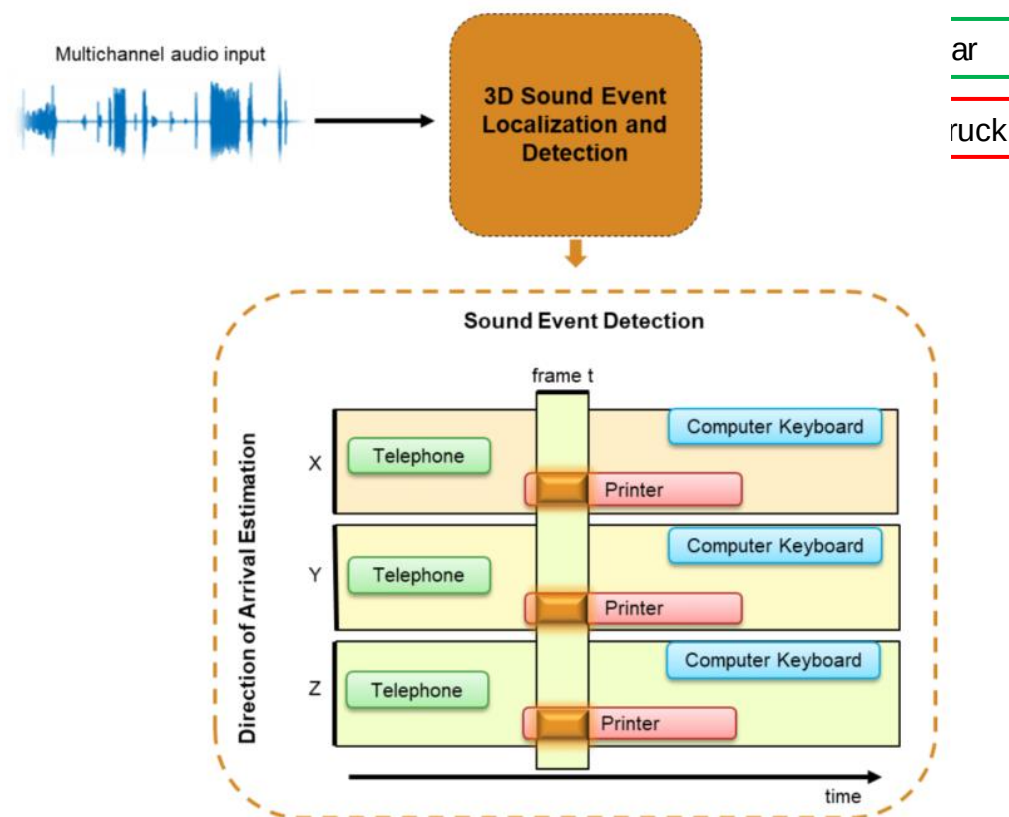


# 音訊深度學習

## 音訊分類



## 3D音訊位置與辨識(SELD)





# 雷達(SAR)深度學習

## 雷達分類

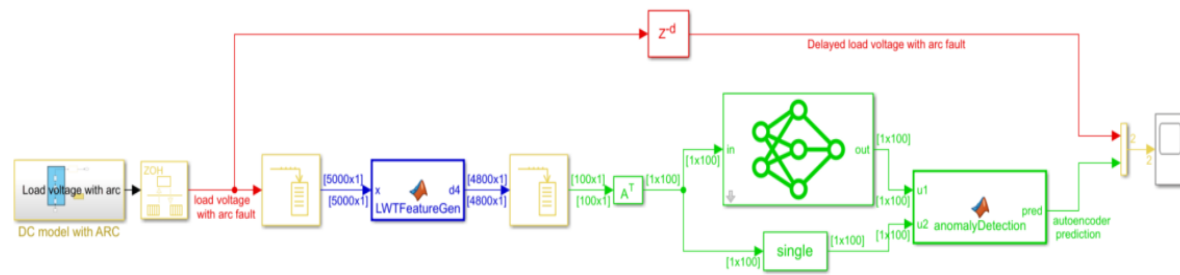
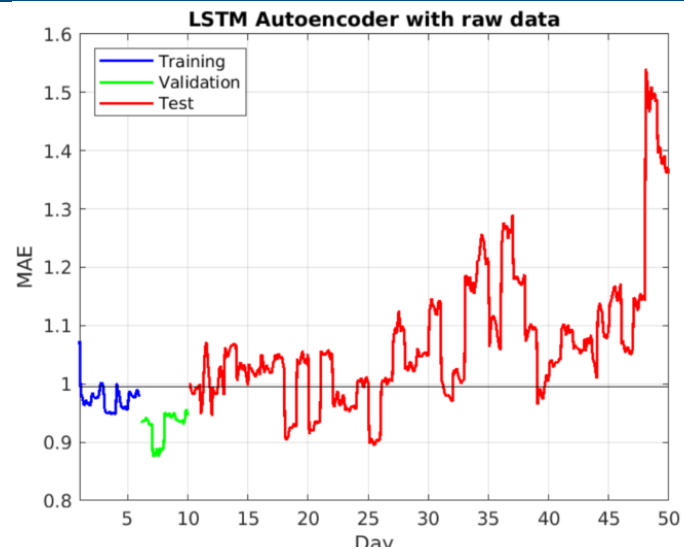
| BTR-60 | 2S1     | BRDM-2   | D7    | SLICY | ZIL131            | BRDM <sub>2</sub> | SLICY             | ZSU <sub>23_4</sub> |
|--------|---------|----------|-------|-------|-------------------|-------------------|-------------------|---------------------|
|        |         |          |       |       |                   |                   |                   |                     |
| T62    | ZIL 131 | ZSU-23/4 | SLICY | SLICY | BRDM <sub>2</sub> | SLICY             | BRDM <sub>2</sub> | SLICY               |
|        |         |          |       |       |                   |                   |                   |                     |

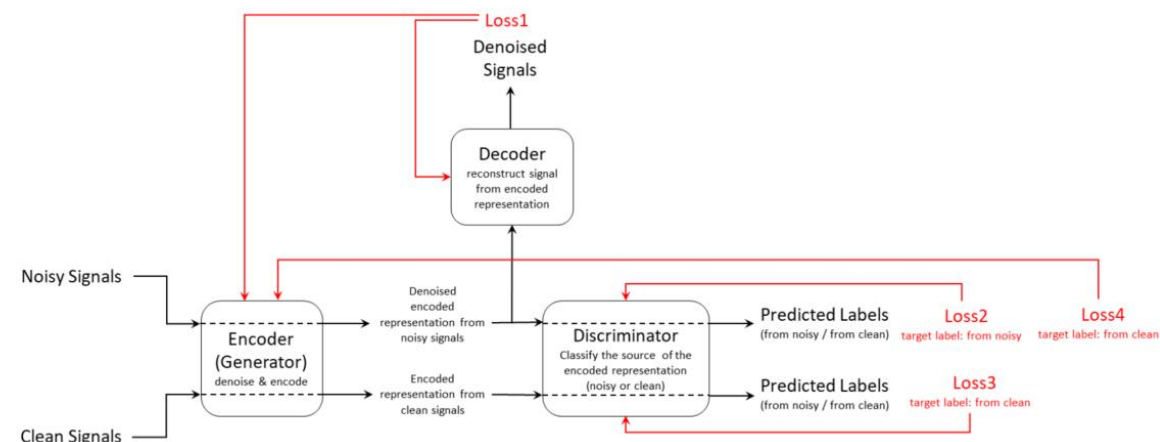
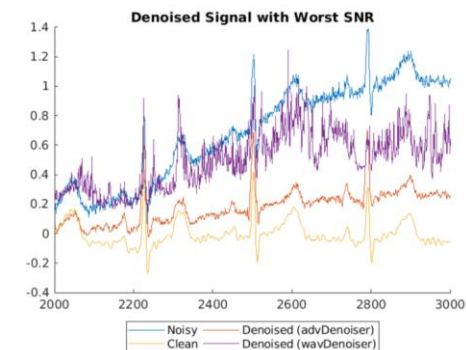
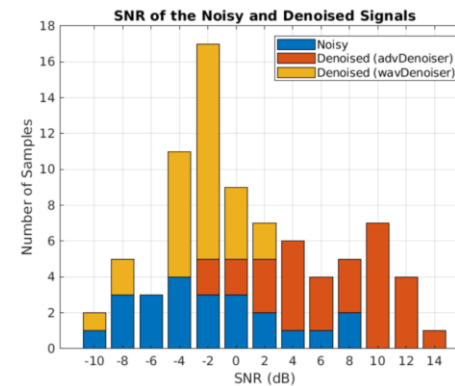
|     |                   |                   |        |       |
|-----|-------------------|-------------------|--------|-------|
| 2S1 | SLICY             | 2S1               | ZIL131 | T62   |
|     |                   |                   |        |       |
| 2S1 | BRDM <sub>2</sub> | BTR <sub>60</sub> | ZIL131 | SLICY |
|     |                   |                   |        |       |

# 訊號深度學習

## 小波異常偵測使用自動編碼器



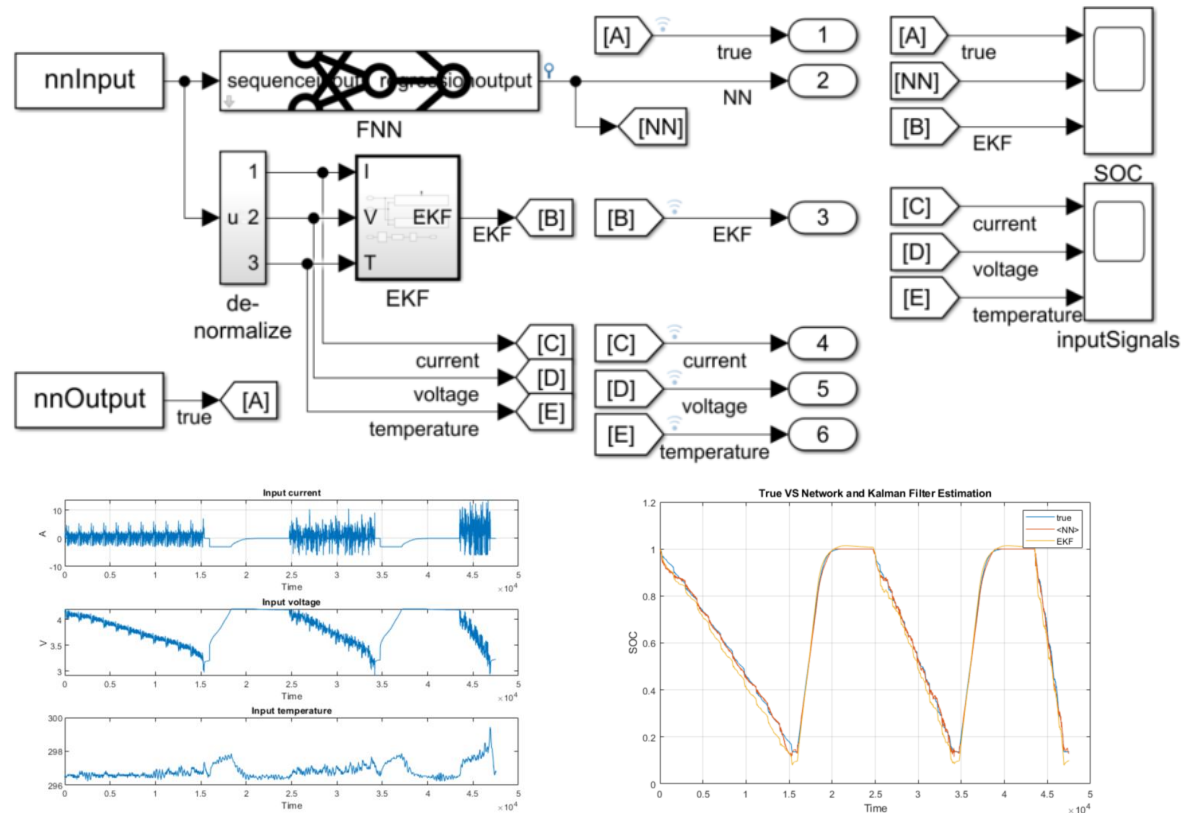
## 對抗學習降噪模型



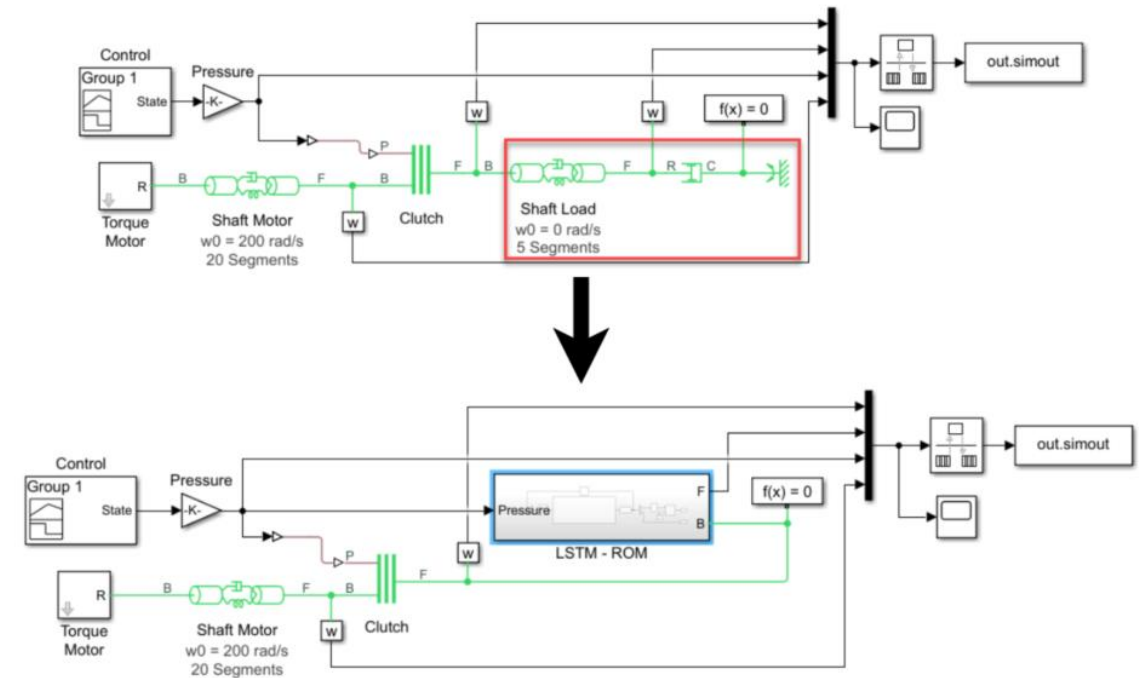


# Simulink深度學習

## 電池電量狀態預估

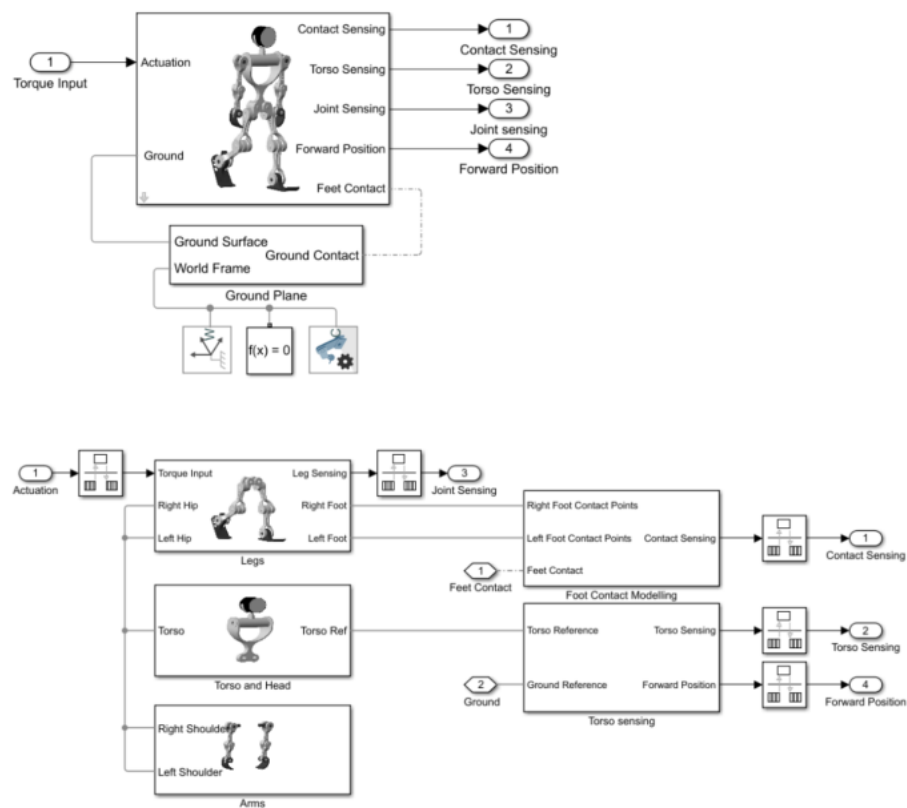


## 物理系統建模使用LSTM

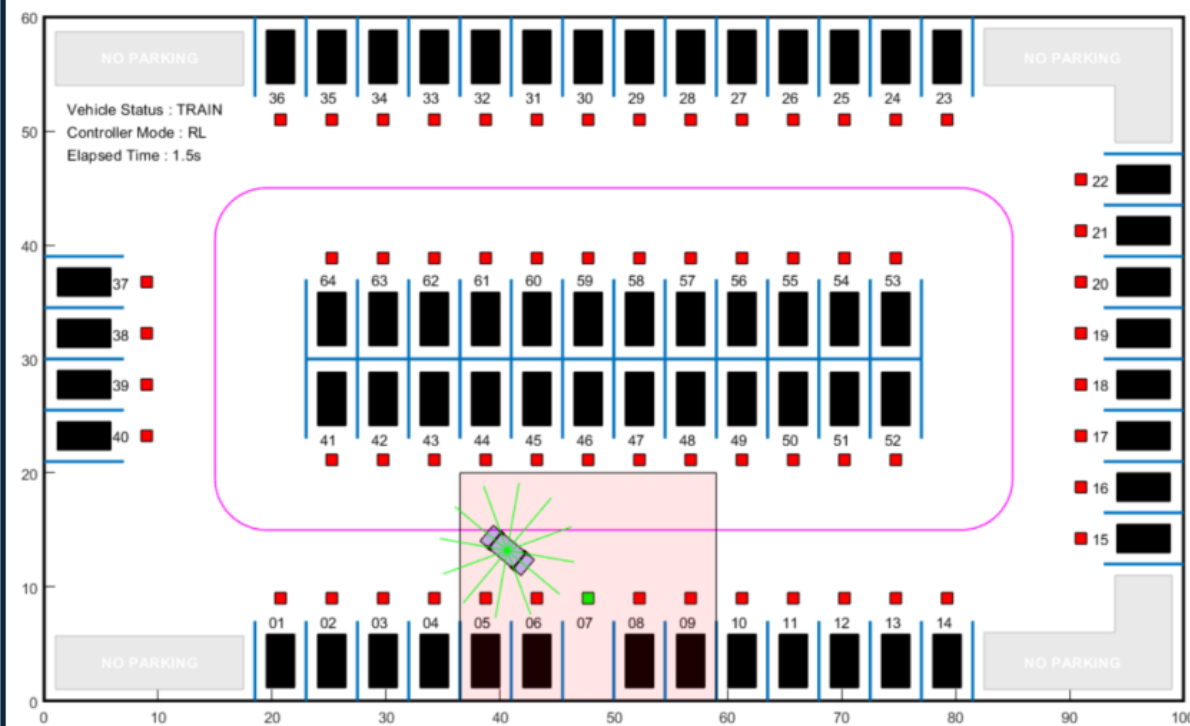


# 控制強化學習

## 強化學習 – 機器人行走



## 強化學習 - 停車路徑



# Low Code Design AI

## Data Preparation

 Data cleansing and preparation

 Human insight

 Simulation-generated data

## AI Modeling

 Model design and tuning

 Hardware accelerated training

 Interoperability

## Simulation & Test

 Integration with complex systems

 System simulation

 System verification and validation

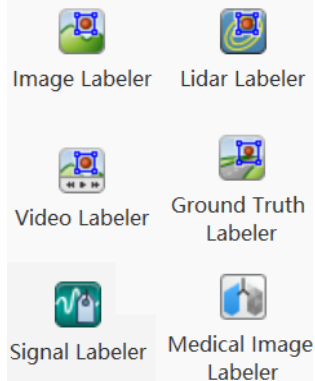
## Deployment

 Embedded devices

 Enterprise systems

 Edge, cloud, desktop

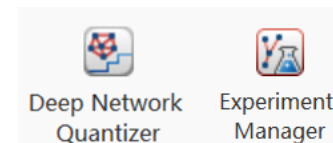
### Labeler APP



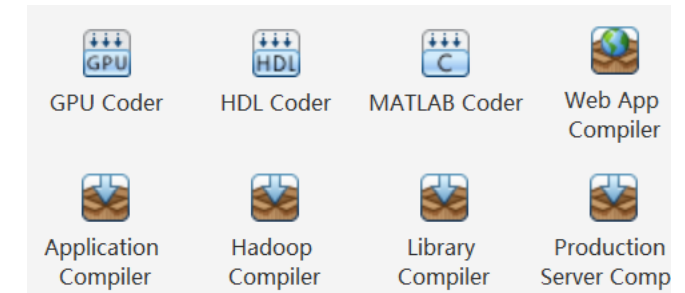
### AI Modeling APP



### AI Simulation APP



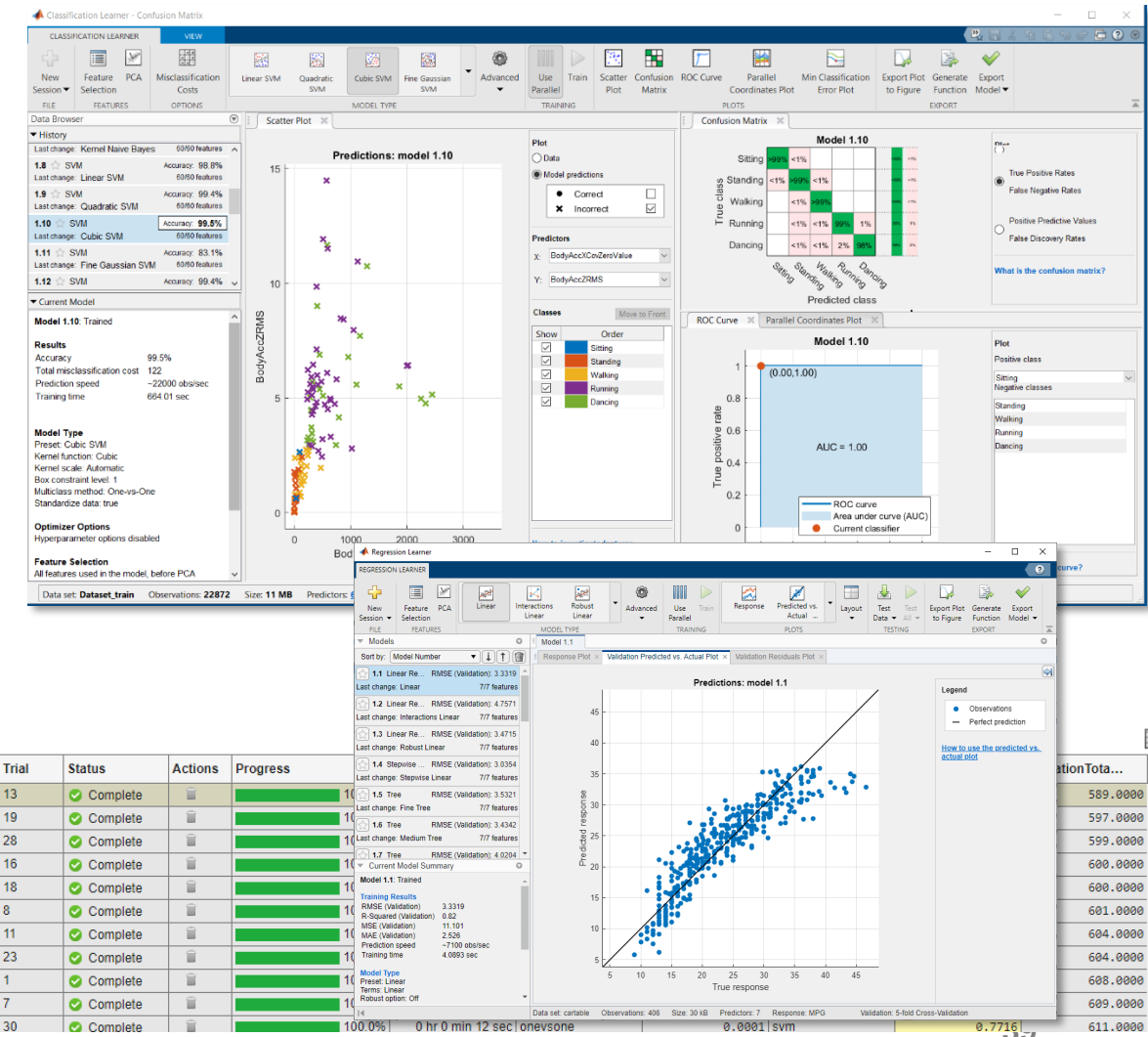
### Deployment APP



# No Code可視化，快速AI機器學習模型建立

- 一鍵執行三十多種的模型訓練
- 匯入後可透過特徵提取排名特徵強度
- 模型的各種輸出可視化呈現

|                                                                           |        |
|---------------------------------------------------------------------------|--------|
| Optimizable models that train hyperparameters using Bayesian Optimization | R2019b |
| Added “shallow” neural nets                                               | R2021a |
| Kernel linear models and optimized neural nets                            | R2021b |
| Feature ranking                                                           | R2022a |
| Train/Validation/Test split                                               | R2022a |
| Partial dependence plots, Model comparison table                          | R2022b |
| Export trained models to Experiment Manager                               | R2023a |
| Efficiently-trained linear multi-class models                             | R2023a |
| Model size in comparison table                                            | R2023a |
| Optimizable efficient linear models                                       | R2023b |
| Interpret models with LIME and Shapley explanations, graphs and tables    | R2023b |

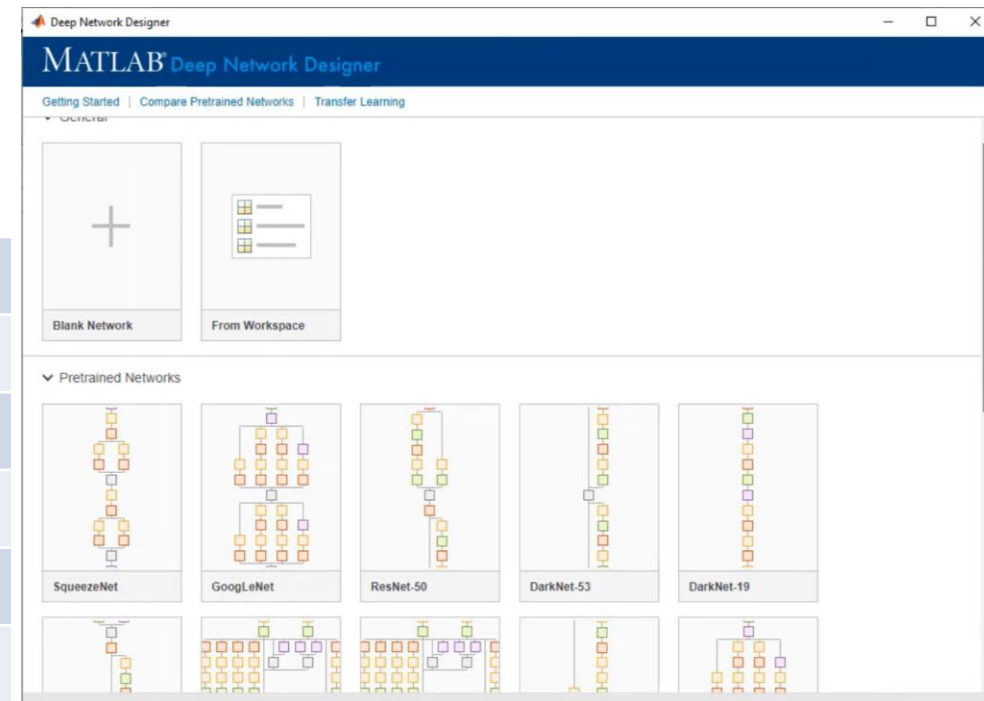




# Deep Network Designer: No Code可視化，快速AI深度學習模型建立

- 自定義編輯網路，自動分析網路架構
- 自由拖拉模塊，與匯入自定義層
- 內建資料擴充與可視化資料
- 訓練網路，並且可視化訓練流程與參數

|                                                  |        |
|--------------------------------------------------|--------|
| Initial release                                  | R2018b |
| Automatically generate code                      | R2019a |
| Import Data & Train Networks                     | R2020a |
| Import pretrained networks                       | R2020b |
| Timeseries support                               | R2020b |
| Export to Simulink                               | R2021b |
| Create experiments for Experiment Manager        | R2022a |
| Import networks from PyTorch and TensorFlow      | R2023b |
| Access network analysis results programmatically | R2024a |



Deep Network Designer app to build, visualize, and edit deep learning networks

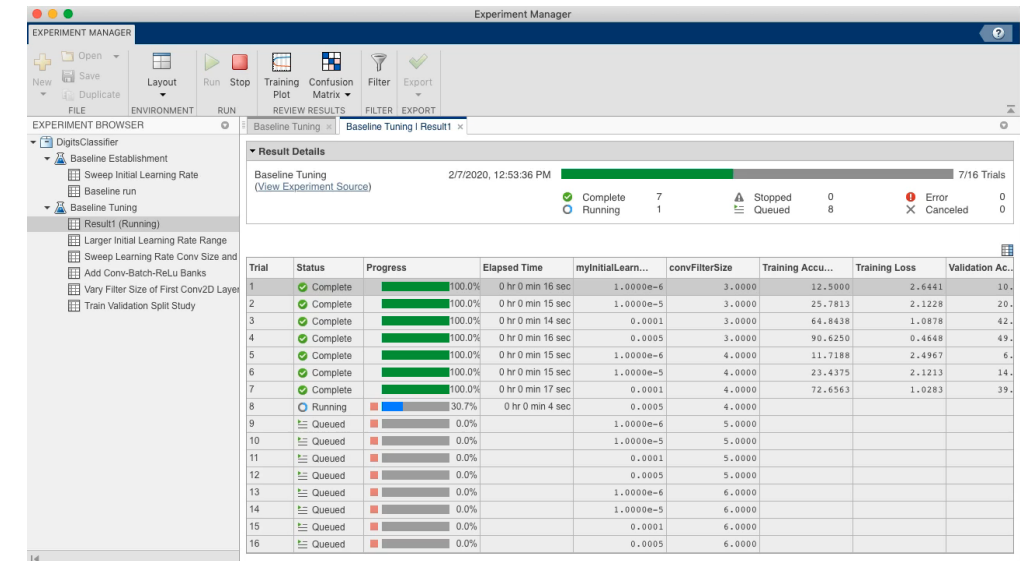
# Find the Optimal Network Using Experiments

Design and run experiments to train and compare [deep learning](#) and [machine learning](#) models under multiple initial conditions.

- Sweep through a range of hyperparameter values
- Compare the results of using different data sets
- Test different deep network architectures and machine learning models

## Experiment Manager App (since 2020a)

|                                                                                      |        |
|--------------------------------------------------------------------------------------|--------|
| Train networks in parallel                                                           | R2020b |
| Bayesian optimization                                                                | R2021a |
| Custom Training Experiments                                                          | R2021a |
| MATLAB online support                                                                | R2021b |
| Offload experiments as batch jobs                                                    | R2022a |
| Export to Experiment Manager from regression learner and classification learner apps | R2023a |
| Delete multiple experiments and results                                              | R2023b |
| Available in MATLAB                                                                  | R2023b |

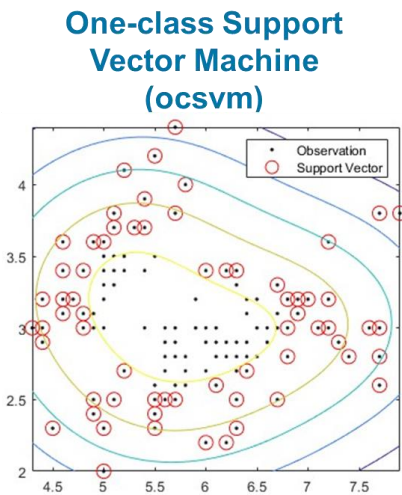


Experiment Manager app to manage multiple deep learning experiments, analyze and compare results and code

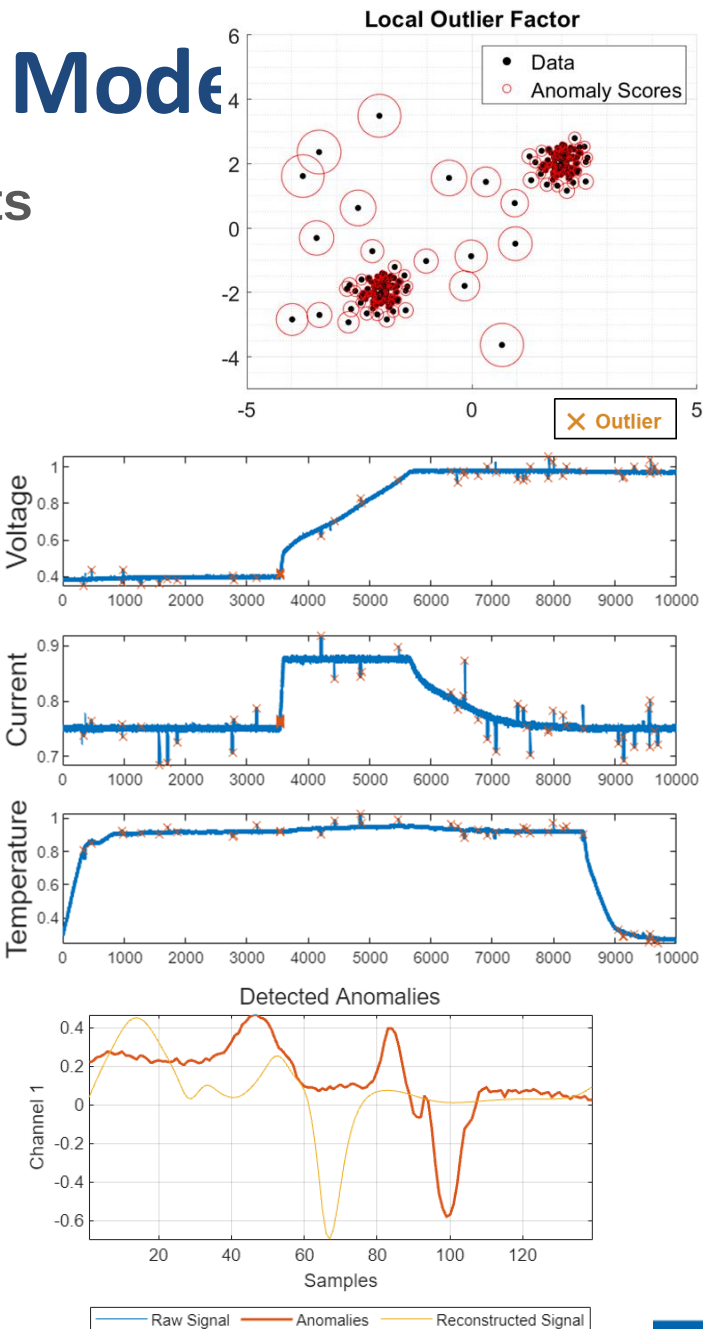
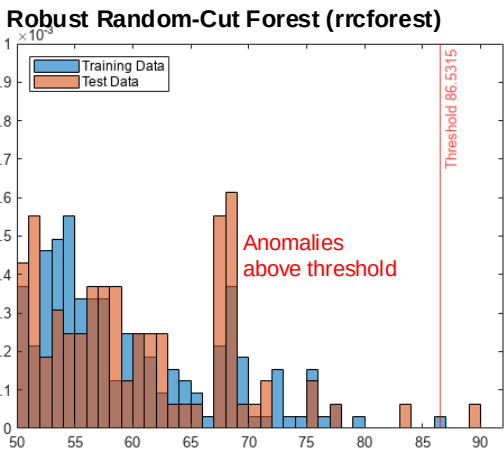
# Detect Anomalies using Machine Learning Models

Train models using normal data, use models to detect outlier points

|                                                                                                |        |
|------------------------------------------------------------------------------------------------|--------|
| Isolation forest models for anomaly detection                                                  | R2019b |
| Local outlier factor calculation                                                               | R2022b |
| Efficient one-class support vector machine (SVM) models using primal solver                    | R2022b |
| Robust random-cut forest anomaly detection model                                               | R2023a |
| Incremental anomaly detection                                                                  | R2023b |
| deepSignalAnomalyDetector<br><i>Signal Processing Toolbox</i>                                  | R2023a |
| New examples on detecting anomalies, denoising signals, extracting features, and label signals | R2024a |



\*Faster than fitsvm() on large datasets due to primal solver.



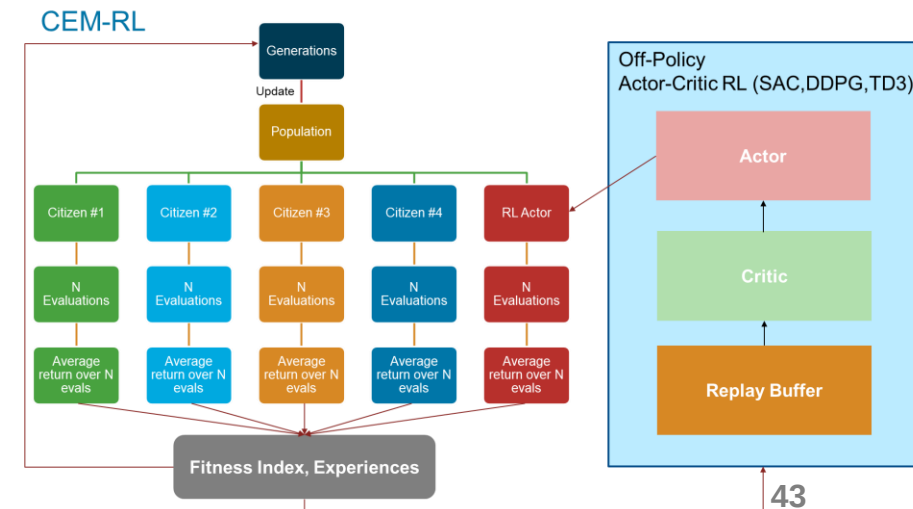
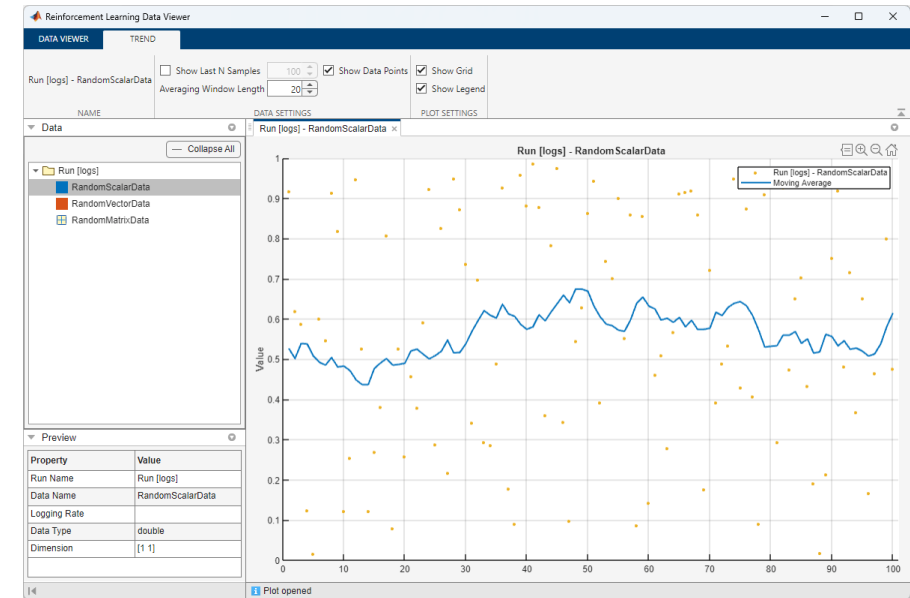
# What's New in Reinforcement Learning

## Ease of use

- Input normalization (**R2024a**)
  - ▣ Normalize inputs of actors and critics for more stable training
- Reinforcement Learning Data Viewer (**R2023a**)
  - Visualize logged data with this new interactive tool

## Algorithms

- Improved training algorithms (**R2024a**)
  - Improve training results using updated algorithms for DQN, DDPG, TD3, SAC, PPO, and TRPO
- Evolutionary reinforcement learning (**R2024a**)
  - Train agents in series or in parallel using evolutionary strategies for increased computational efficiency
- Multi-agent reinforcement learning (**R2023b**)
  - Train multiple agents in a MATLAB environment





# Leverage Application Specific Reference Examples

## AI Modeling



Model design and tuning



Hardware accelerated training

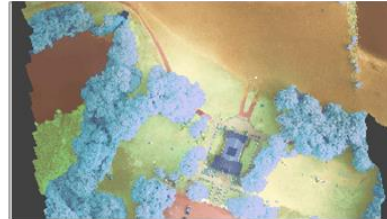


Interoperability



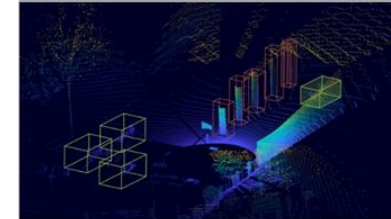
### Predictive Maintenance

Anomaly Detection and Condition Monitoring



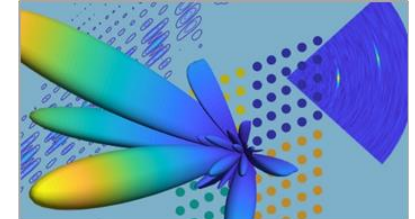
### Geospatial Analysis

Hyperspectral Image Classification



### Lidar

3-D Point Cloud Object Detection



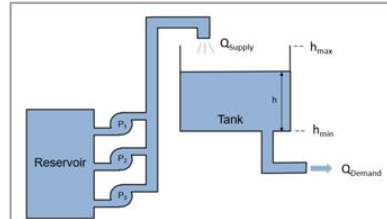
### Radar

Waveform Classification



### Wireless Comms

Data Synthesis for 5G Channel Estimation



### Controls Systems

PID Tuning & System Scheduling



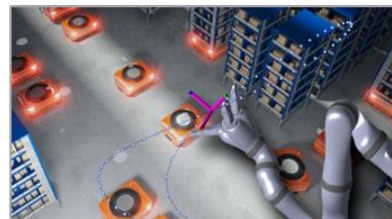
### Computational Finance

Trading & Risk Management



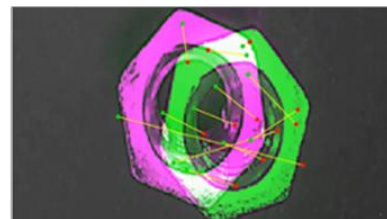
### Automated Driving

Pedestrian & Vehicle Detection



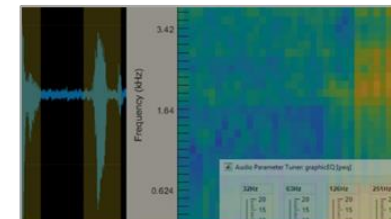
### Robotics

Path Planning & Process Optimization



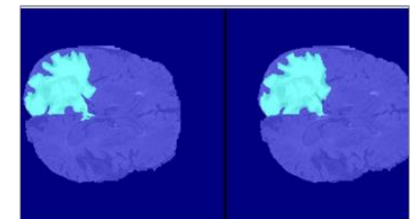
### Visual Inspection

Defect Detection



### Audio

Speech Recognition

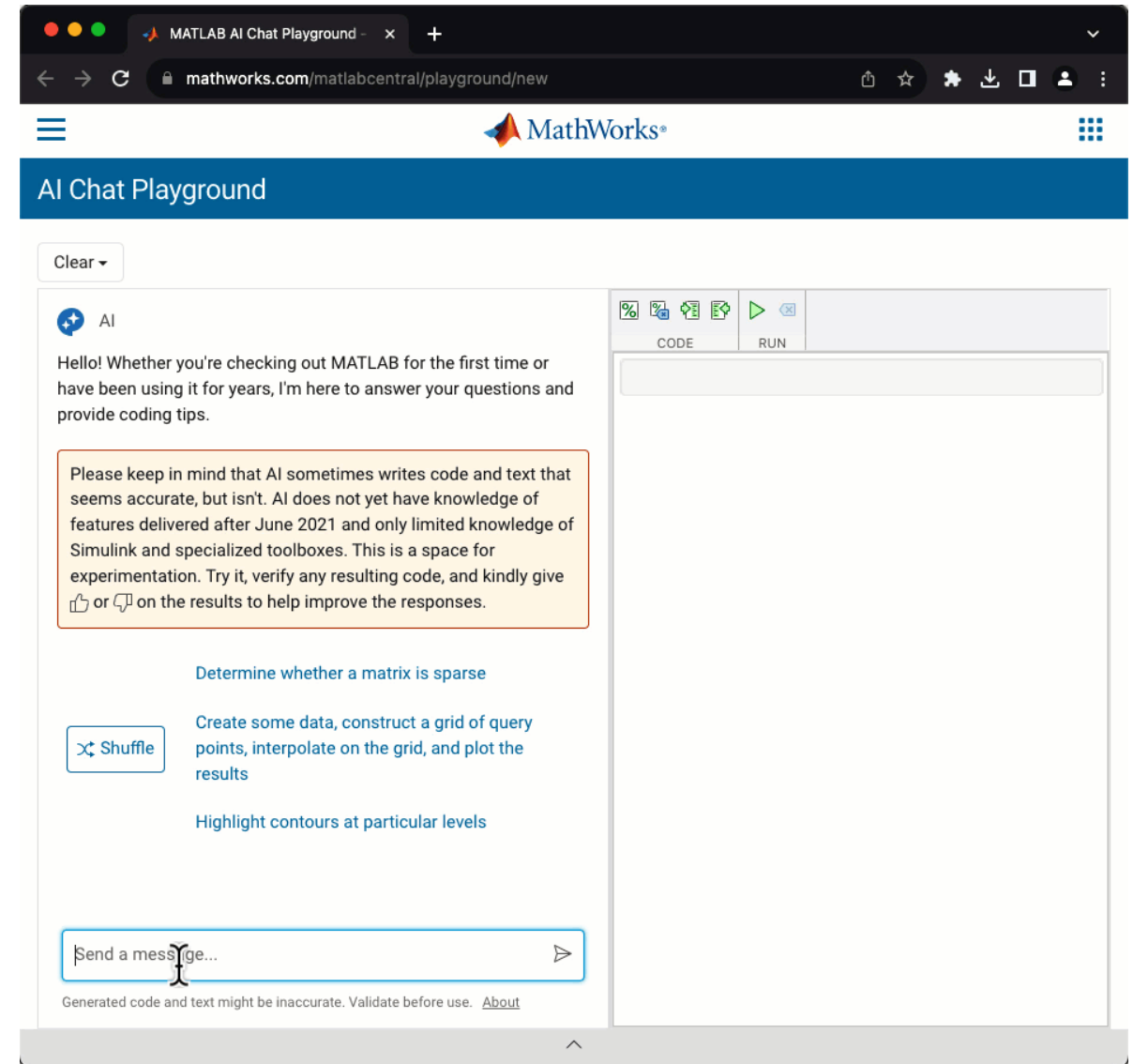


### Medical Imaging

Tumor Detection

# MATLAB AI Chat Playground

- Experiment with an AI assistant alongside MATLAB
- Generate first-draft MATLAB code or ask questions
- Powered by the ChatGPT API's
- Learn more in [this blog post](https://www.mathworks.com/matlabcentral/playground/)





# MATLAB

作者：mathworks.com 地球儀圖示

Discover MATLAB® with the official MATLAB GPT by MathWorks.  
Learn about valuable resources, save time building with MATLAB,  
get answers, and stay up to date with the latest features.

 Create an  
animation of  
a sine wave

 What are the  
latest features  
of MATLAB?

 Smooth a  
noisy dataset

 How do I  
get MATLAB?

 傳訊息給 MATLAB



# Co-execute with Open-Source Frameworks

Co-execution enables users to combine MATLAB, Simulink and with TensorFlow or PyTorch for parts of the AI workflow

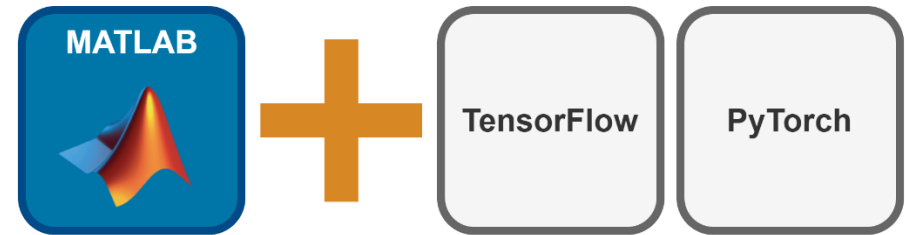
Import and Export models through:

Co-execution Examples (GitHub)

R2022b

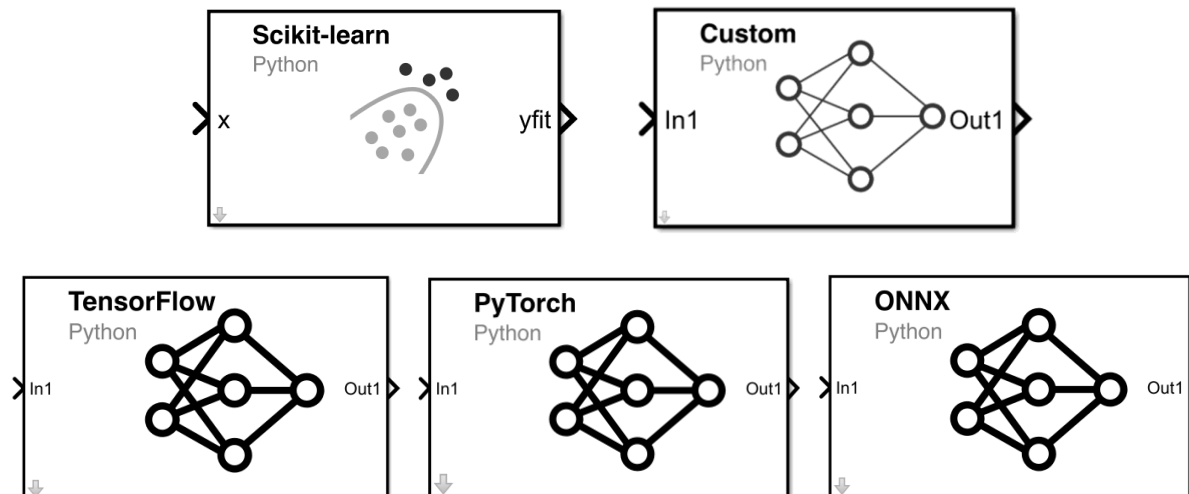
Execute Python models in Simulink

R2024a



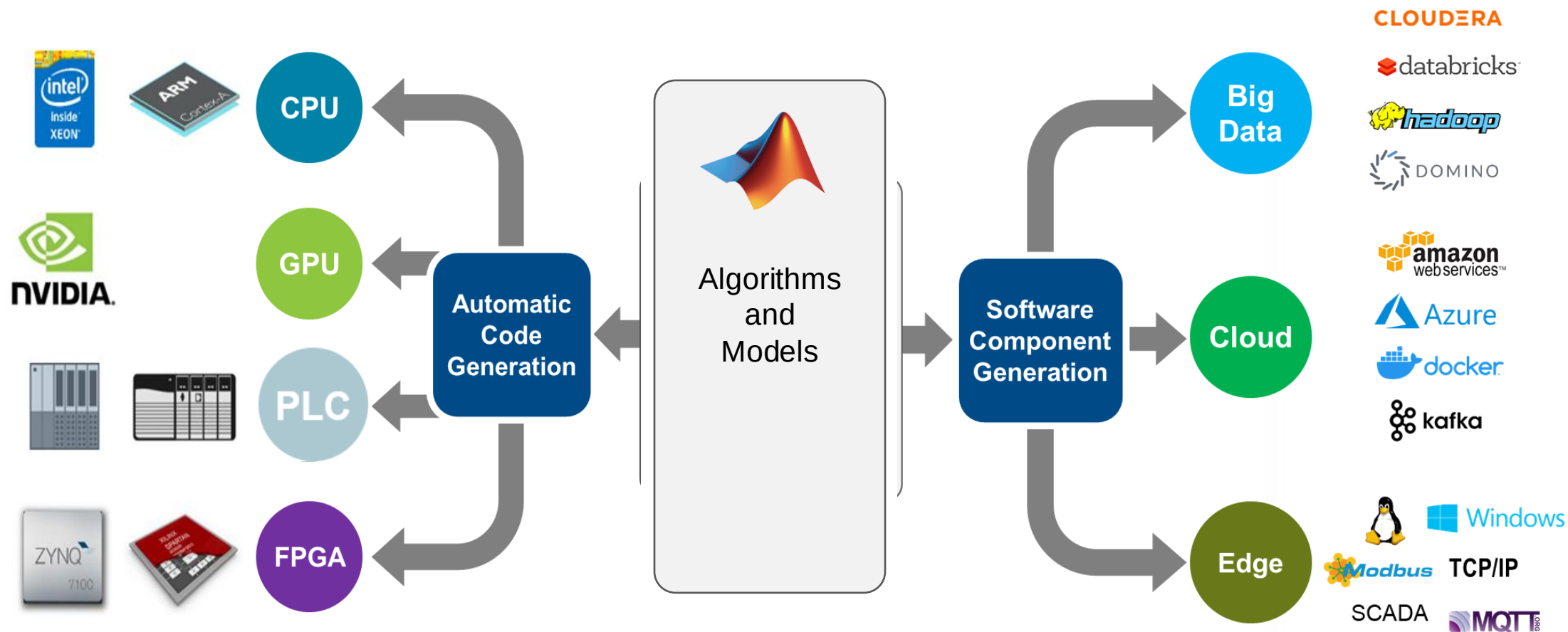
[Image Classification in MATLAB Using TensorFlow](#)

[Hyperparameter Tuning in MATLAB using Experiment Manager & TensorFlow](#)





# 部署到企業基礎設施或嵌入式系統



# MATLAB 線上作業評分系統(MATLAB Grader)

Solution 1: 4 of 5 tests passed (80%)

Submitted on 20 Nov 2018 | ID: 10161219 | Size: 63

Test Results



```
1 syms g x; % insert variable
2 g=piecewise(x<=0, x^2, 0<x<1, x, x>=1, 1+x^2); % insert conditions and values
3
4 % evaluate the function at different points a=g(-2); b=g(0.5); c=g(2)
5 a=subs(g, x, -2)
6 b=subs(g, x, 0.5)
7 c=subs(g, x, 2)
```

Fix This Solution

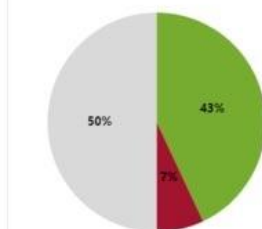
My Solutions



Back to Problem  
Learner Status Learner Solutions

Status Summary

564 Learners have accessed the problem.



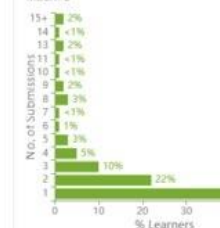
Solved: 43% (240)  
Not solved: 7% (41)  
No solutions submitted: 50% (283)

Solved:

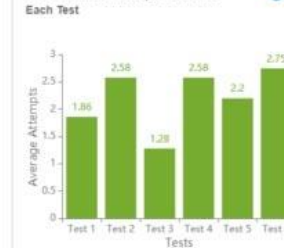
240 Learners have solved the problem.

Submissions Required to Solve the Problem

Mean: 3



Ave. Submissions Required to Pass Each Test



0% (20%)

20% (20%)

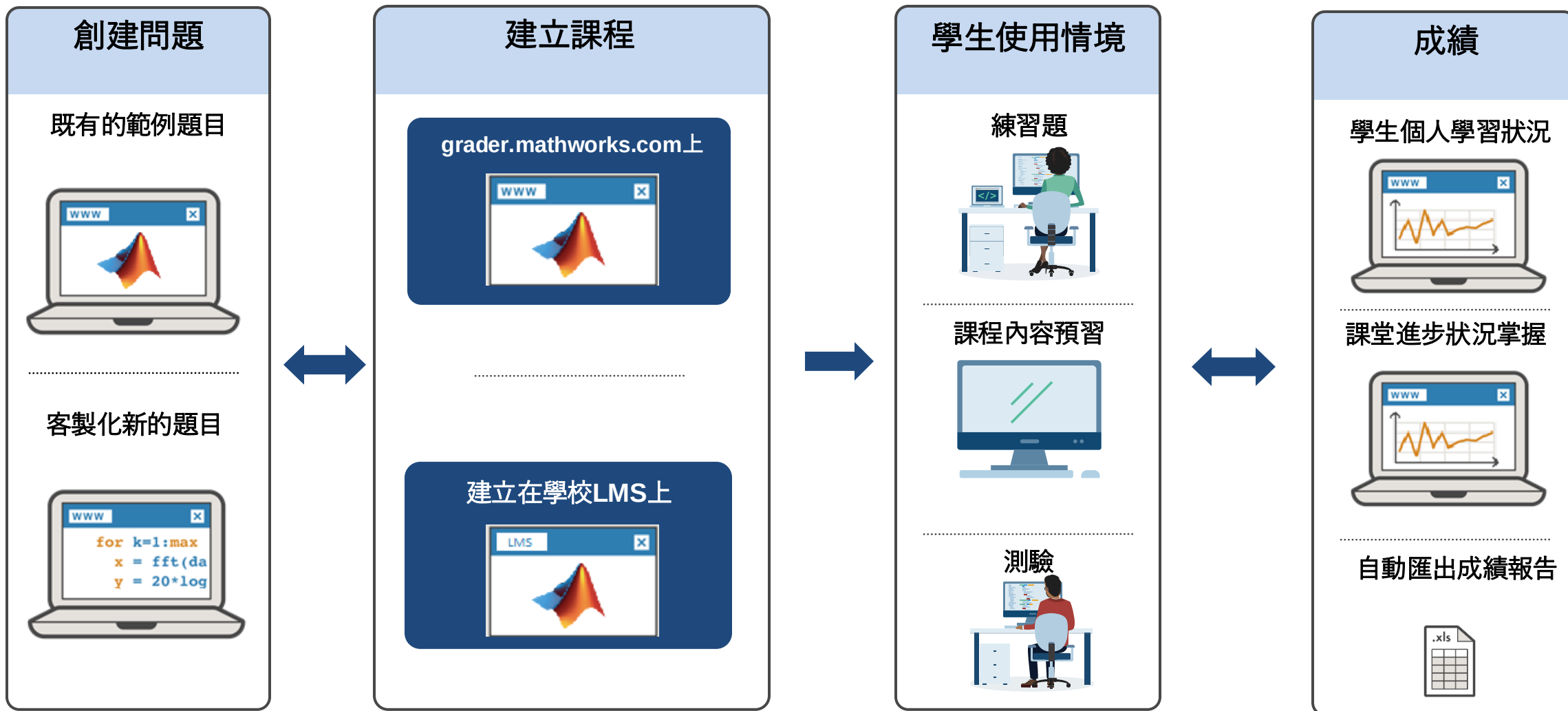
20% (20%)

20% (20%)

20% (20%)

Total: 80%

# MATLAB Grader 使用流程



# 將傳統作業轉換為自動評分系統

HomeToolsAssignment\_v2.pdf x ? Sign In



1 / 344.6%

...

## INTRODUCTION TO PROGRAMMING WITH MATLAB

### Assignment 1: Convergent Series

**Background**

In mathematics, a series is the sum of the terms of an infinite sequence of numbers. A series is convergent if the sequence of its partial sums tends to a limit, that means that the partial sums become closer and closer to a given number when the number of their terms increases.

For more details, please refer to the [Wikipedia entry on Convergent Series](#).

**Problem 1b: Estimating the value of Pi using Leibniz Series - Due 9/1**

One of the methods to estimate the value of  $\pi$  is to use the Leibniz series expansion to a reasonably large number of terms and use the expression below to estimate the value of  $\pi$ .

$$\frac{\pi}{4} \approx 1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \dots + \frac{(-1)^{n+1}}{2n-1} = \sum_{k=1}^n \frac{(-1)^{k+1}}{2k-1}$$

LaTeX: `\pi/4 \approx 1 - 1/3 + 1/5 + ... = \sum_{k=1}^n (-1)^{k+1} / (2k-1)`

Using this expression, write a script to estimate the value of  $\pi$  using  $N$  terms. Your code should include the following variables:

```
N % Number of terms used in the series expansion
estPi % Value of  $\pi$  estimated using 'N' terms in the series.
```

Determine a value of  $N$  that ensures that the estimated value of  $\pi$  is within 0.1% of the actual value. Start with 10 terms, and increase or decrease the number appropriately to adjust the estimate. You can use the Learner Template code provided below to develop your solution.

**Learner Template**

```
nTerms = ; % Number of terms to be used in the series expansion
% <Enter your code here>

estPi = ; % Estimated value of Pi for 'N' values.
```

Check to ensure that:

- the code does NOT use the variable 'pi' available in MATLAB.
- the output is numerically accurate for the number of series terms used.

**Test Suite 1:** Is MATLAB's built-in variable 'pi' being invoked in your code?

**Feedback:** The variable 'pi' available in MATLAB is being used in your code. Please retain only your estimated value of  $\pi$  under the variable name 'estPi'.

**Test Suite 2:** Is the estimated value of 'pi' acceptably accurate?

**Feedback:** Your estimated value doesn't fall within 0.1% of the expected value of  $\pi$ .



MATLAB GraderJeff Alderson

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Untitled Problem

Back to Add Problem | Introduction to Programming

Close

> Vector Creation (Leibniz series terms)

hide details...

Copy

Consider the Leibniz series:

$$1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \frac{1}{9} - \dots$$

Write a script to generate a vector of the first twenty terms of this series. Assign the vector of series terms to a row vector variable named **LeibnizTerms**.

Solve this problem using vectorized code (i.e. do not use a loop in your solution.)

Files Referenced

None

Problem Type

Script

Code

Reference SolutionLearner Template

1 k = 0:19;  
2 LeibnizTerms= (-1).^k ./ (2 \* k + 1);

Assessment

> Test 1

Does variable LeibnizTerms have the correct values?

LeibnizTerms = Reference Solution?



# MATLAB Grader使用範例

## 問題

20200708 Webinar MATLAB Grader サンプルコース > 課題 1 >

### 3元連立方程式を解く

Edit Actions

以下の3元連立方程式を解け。(MATLABにはバックスラッシュ演算子がありますが、それはここでは使ってはいけません)

$$\begin{cases} 5x - 4y + 6z = 8 \\ 7x - 6y + 10z = 14 \\ 4x + 9y + 7z = 74 \end{cases}$$

## Script

Reset MATLAB Documentation

```
1 A = [5 -4 6; 7 -6 10; 4 9 7];
2 b = [8; 14; 74];
3
4 X = A\b;
5 x = X(1)
6 y = X(2)
7 z = X(3)
```

## 學生回答

Run Script

## Assessment:

Run Pretest

Submit

Pretest results are not submitted for grading. To run all the tests and submit the results for grading, click Submit.

> ✓ xは正しく計算されているか (Pretest)

> ✓ yは正しく計算されているか (Pretest)

> ✓ zは正しく計算されているか (Pretest)

> ✗ バックスラッシュは使われているか (Pretest)

The submission must not contain the backslash operator: \

## 即時回饋

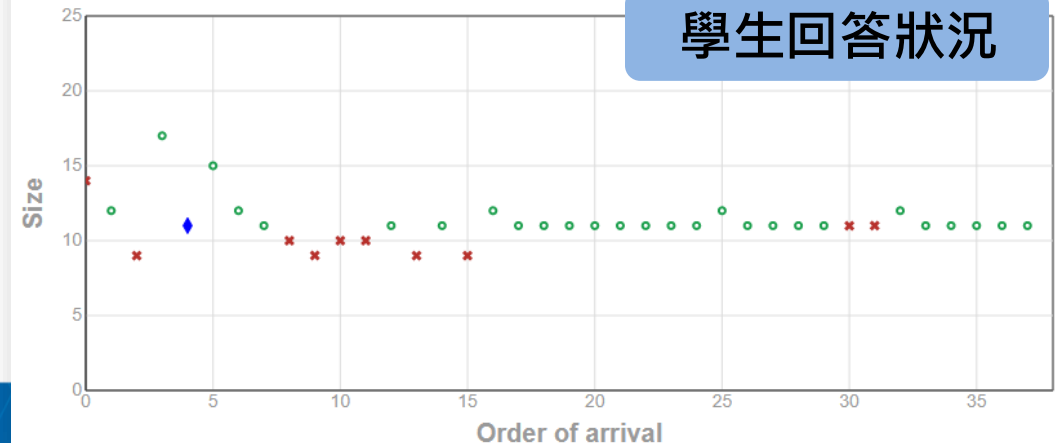
## Learner Analytics

Class Overview Learner Solutions

Map View

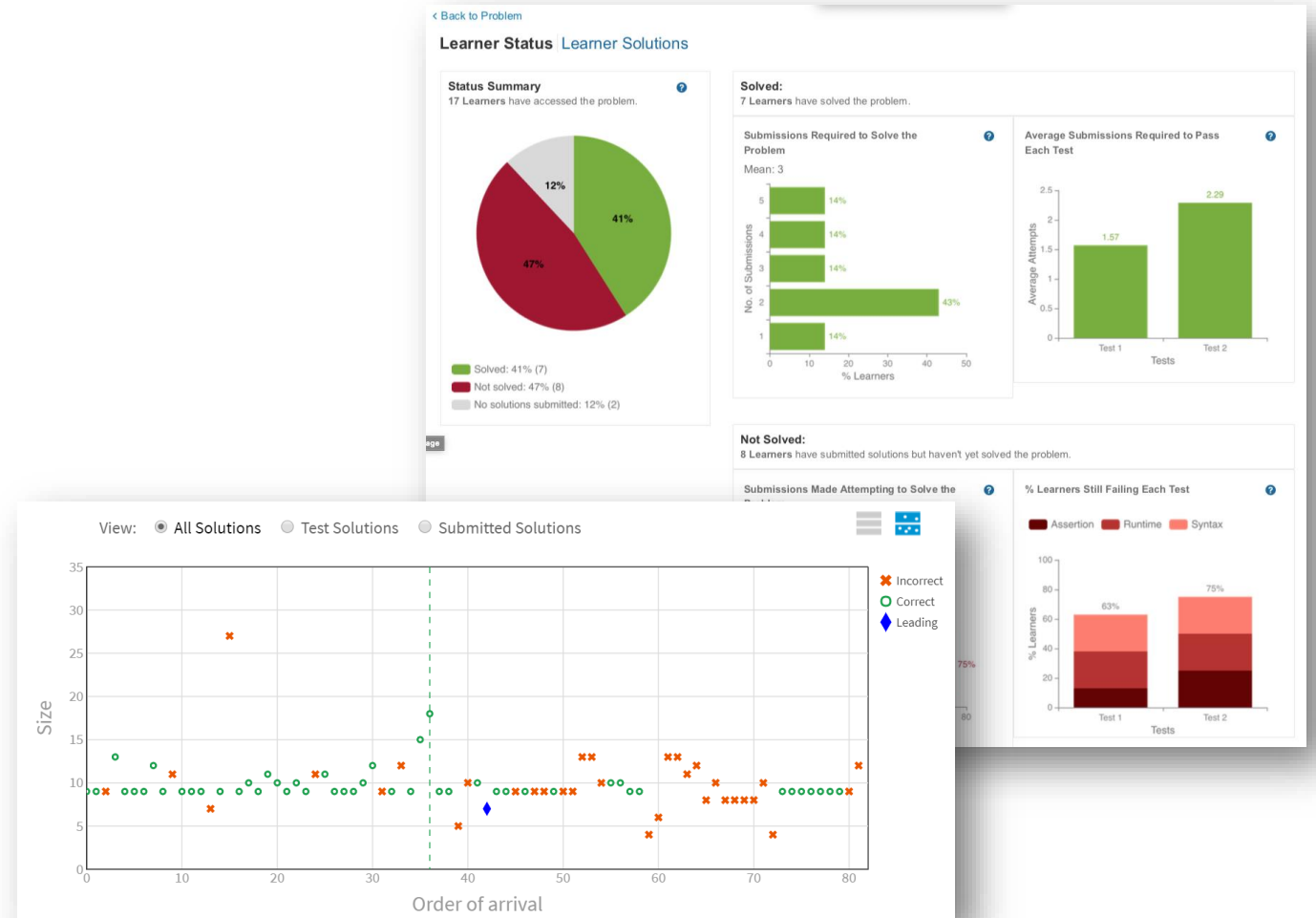
List View

Search by last name, code or solution



# MATLAB Graderの機能 –成績管理

- 自動對學生的答案進行評分
  - 答對比率分析
  - 解答的即時反饋
- 成績分析
  - 個別學生答題狀況分析
  - 整體學生答題狀況分析
  - 教師/助教可以查看分數



# LMS(學習管理系統)結合

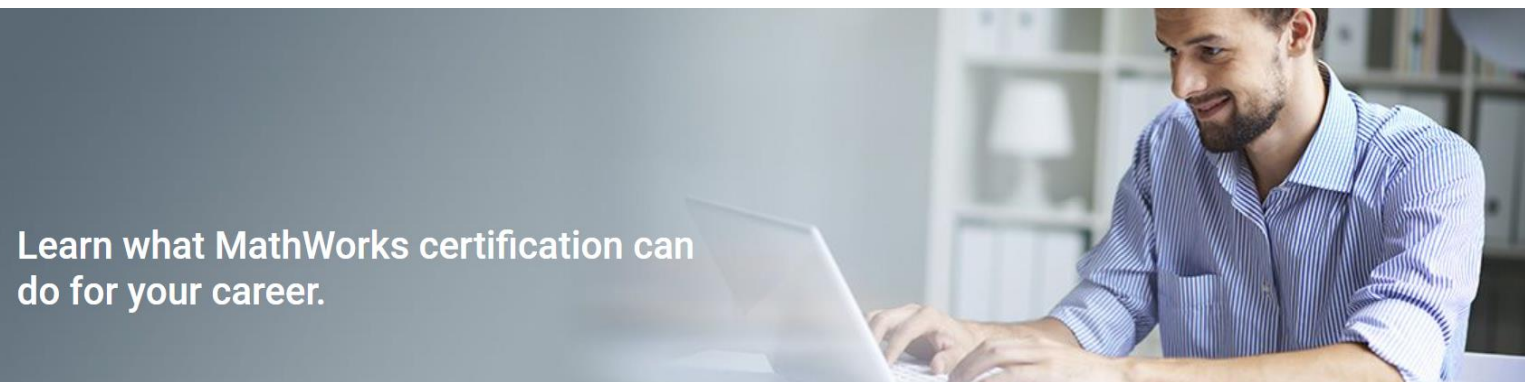
- 集成和管理學習材料、作業、成績等。
- 通過連接 MATLAB Grader 和 LMS 彙整成績。



# MATLAB證照

證明你的MATLAB專業，提高組織的生產力

- 分為Certified MATLAB Associate 或 Certified MATLAB Professional證照  
Certified MATLAB Associate 為選擇題，僅需1.5小時即可完成測驗



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A promotional graphic for MATLAB certification. At the top, it features the MathWorks logo and the text 'MathWorks 認證計畫'. Below this, the main headline reads '取得MATLAB®證照 展現程式競爭力'. A QR code is displayed with the URL 'https://bit.ly/3Bv6CyM'. The graphic includes several callout boxes with icons and text: '自行選擇考試方式 (現場/線上)', '提供備考資源', '證明你的MATLAB專業', and '提高組織的生產力'. A central illustration shows hands typing on a laptop. Below this, a banner says '馬上報考MATLAB證照'. The bottom section, titled '報名僅需四步驟', lists four steps: 1. 建立帳號, 2. 選擇考試地點, 3. 選擇考試日期、時間, and 4. 付款、完成報名. The footer contains the Terasoft logo and tagline 'Accelerating your Research &amp; Development', along with MathWorks and MATLAB logos.



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