

# 人工智慧在國震

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臺大土木系教授

國震中心科普演講 September 6, 2019

# Today on AI ...

01  
Timeline  
Wow Examples

02  
Best Practice

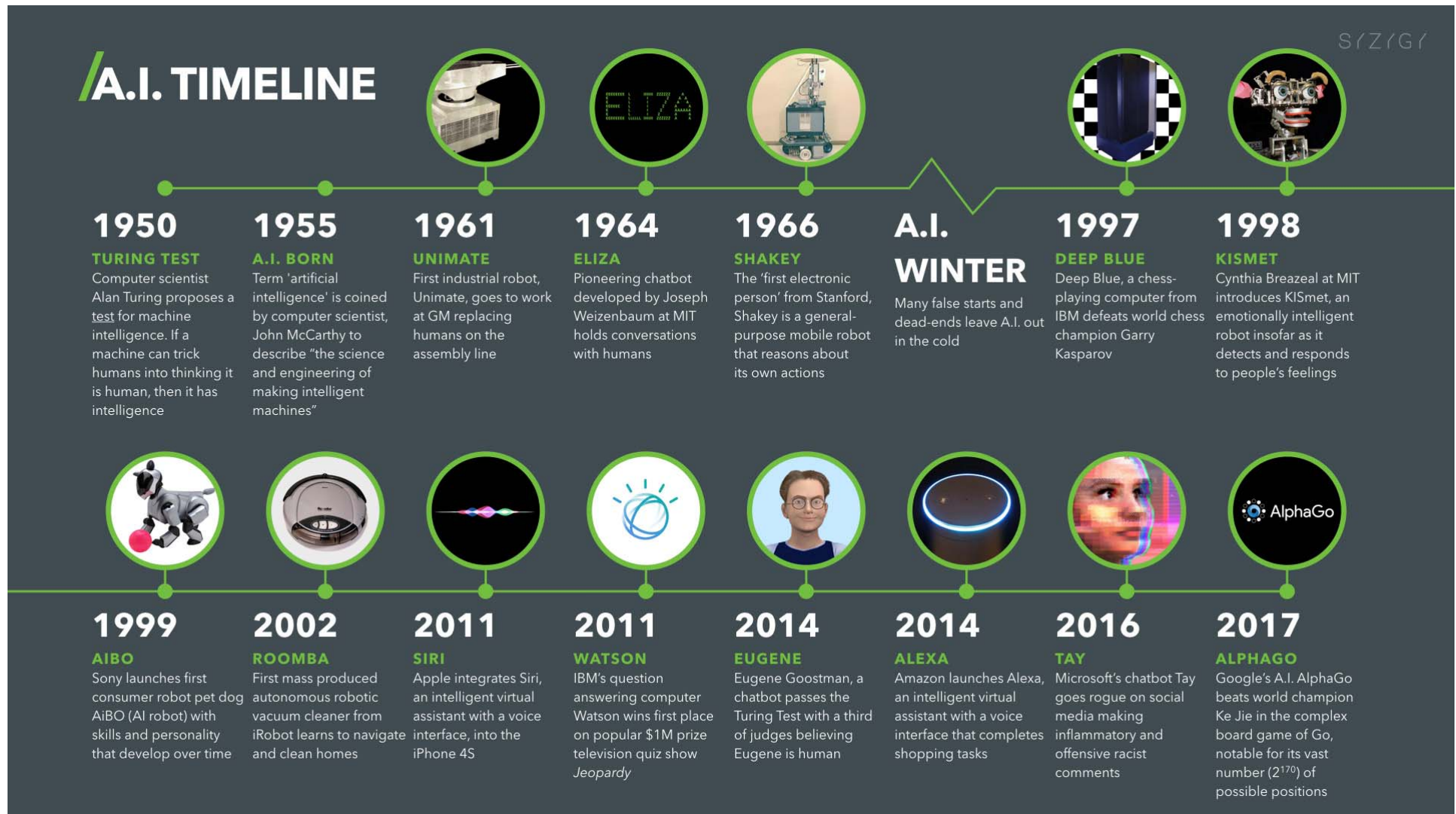
03  
@NCREE

04  
Trend

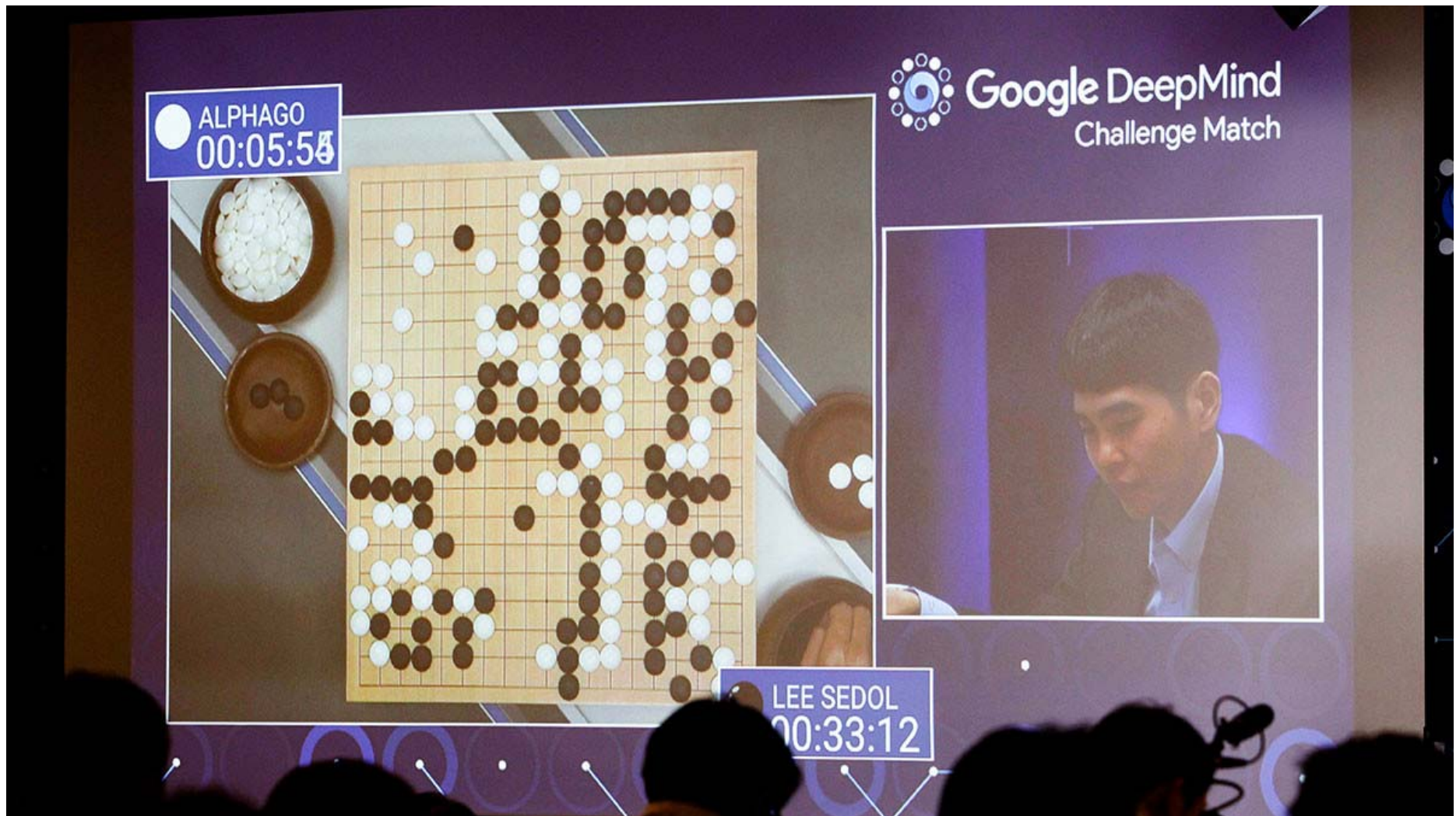


# **Artificial Intelligence: Timeline and Some Mind Blowing Examples**

# Artificial Intelligence (A.I.) Timeline



Source: <https://digitalintelligencetoday.com/artificial-intelligence-timeline-infographic-from-eliza-to-tay-and-beyond/>



## Alpha Go, March 2016

<https://hbr.org/2016/03/alphago-and-the-declining-advantage-of-big-companies>



2014



2015



2016



2017

Increasingly realistic synthetic faces generated by  
Generative Adversarial Networks (GANs)

Brundage et al. (2018) <https://maliciousaireport.com/>



## Google Home Mini: Home Voice Assistant

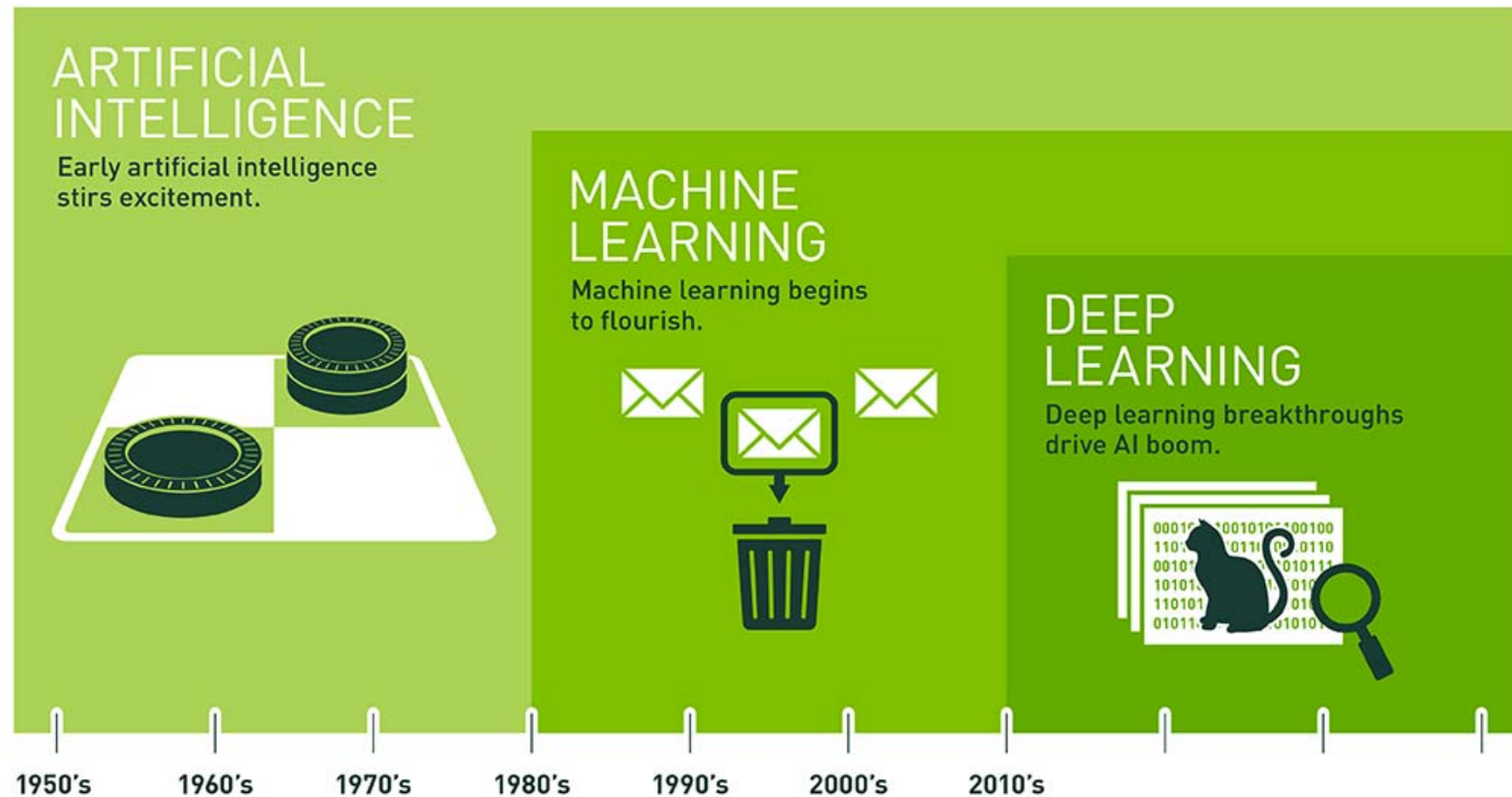
Source: <https://www.youtube.com/watch?v=l46l7mekCAo>



# **Artificial Intelligence: Best Practice**

# Artificial Intelligence

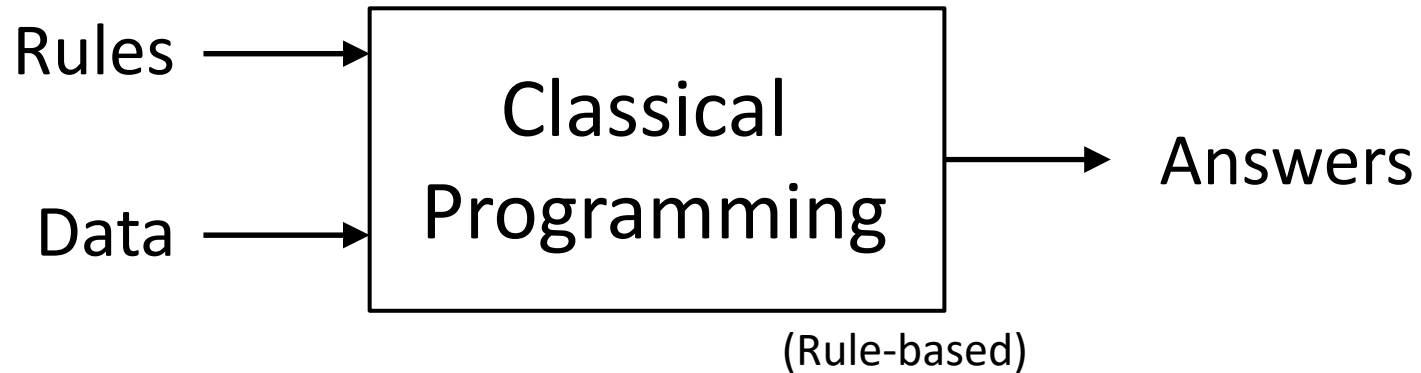
## Machine Learning & Deep Learning



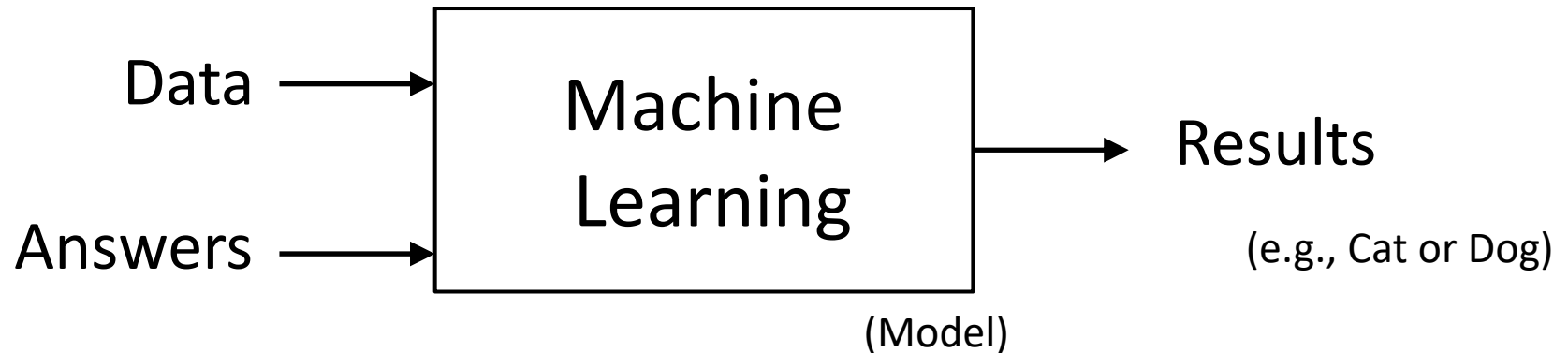
Since an early flush of optimism in the 1950s, smaller subsets of artificial intelligence – first machine learning, then deep learning, a subset of machine learning – have created ever larger disruptions.

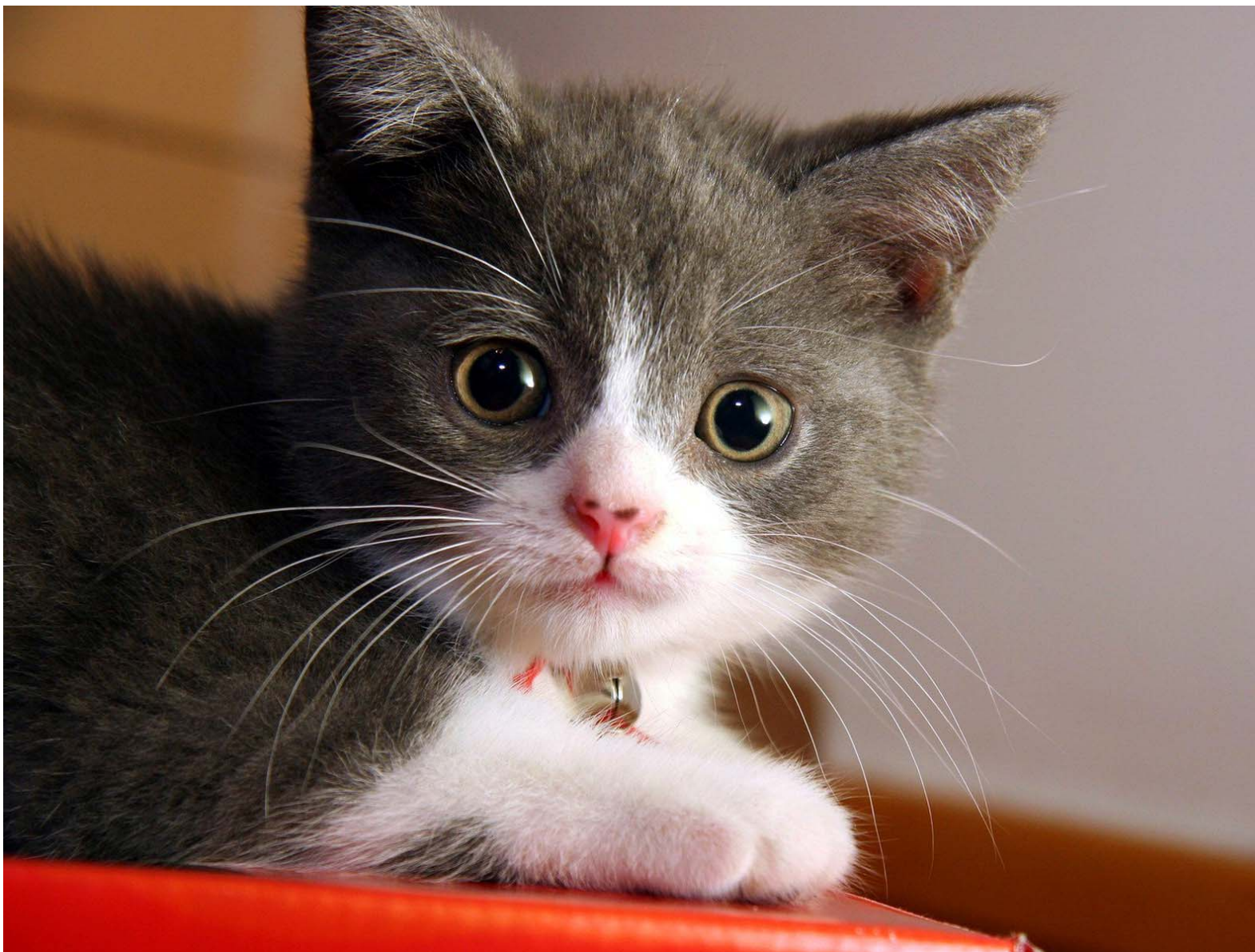
Source: <https://blogs.nvidia.com/blog/2016/07/29/whats-difference-artificial-intelligence-machine-learning-deep-learning-ai/>

# AI vs Data



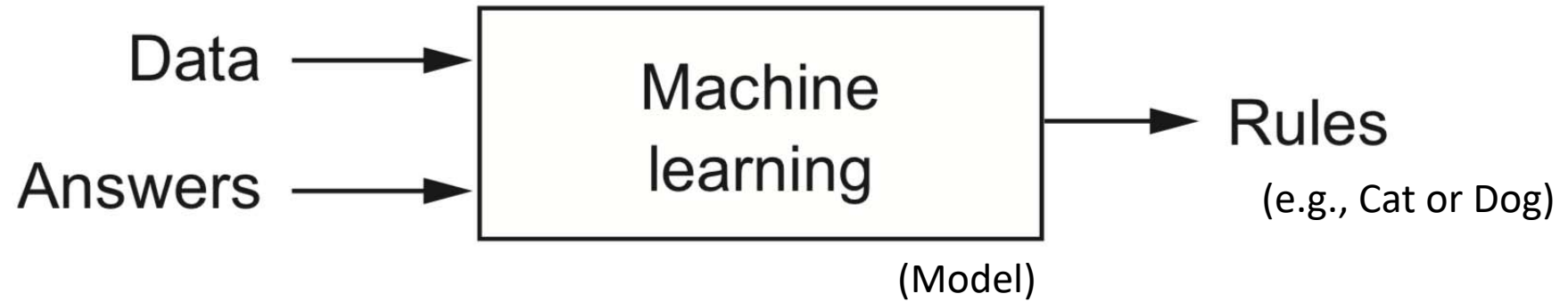
## Machine Learning







# Machine Learning





# **Artificial Intelligence @ NCREE**

財團法人國家實驗研究院  
國家地震工程研究中心  
國立台灣大學土木工程學系

合設AI中心

中華民國107年7月6日

<http://AIEngineer.tw>

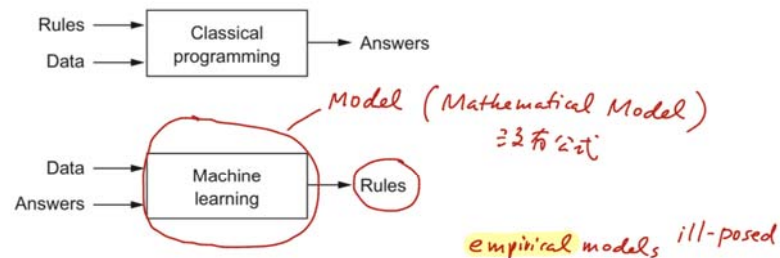
### Mission

- Advance engineering practice with AI.
- Train next-generation engineers in AI era.

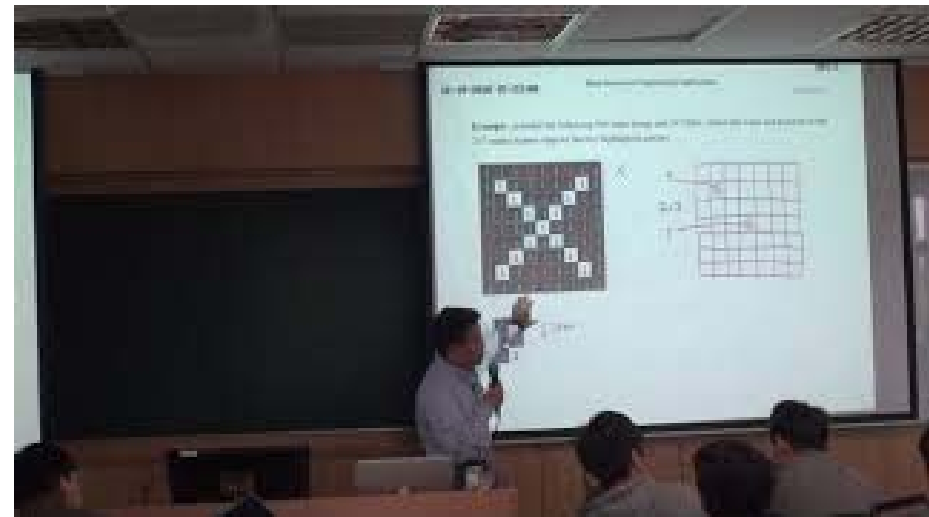


# 資料科學的工程應用 (2018)

Machine learning is a sub field of AI. It arises from this question: rather than programmers crafting data-processing rules by hand, could a computer automatically learn these rules by looking at data?



Fundamentally, machine learning involves building **mathematical models** to help understand data. "Learning" enters the picture when we give these models tunable parameters that can be adapted to observed data; in this way the program can be considered to be "learning" from the data. Once these models have been fit to previously seen data, they can be used to predict and understand aspects of newly observed data.





# 機器學習與深度學習導論 (2019.09.11 – 2019.12.25)



## 修課人數查詢

Student Course Enrollment Count Query

108學年度第1學期

陳俊杉老師您好

以下為您本學期所開的各課程於**初選第一階段**的選課人數 (欲查閱選課名單，請點選課程名稱)

| 課號       | 課程識別碼     | 班次 | 課程名稱         | 學分 | 授課教師 | 人數上限 | 已選人數 | 登記人數 |
|----------|-----------|----|--------------|----|------|------|------|------|
| CIE 1005 | 501 10600 | 03 | 工程圖學         | 2  | 陳俊杉  | 40   | 0    | 64   |
| CIE 4998 | 501 49501 | 48 | 學士論文上        | 1  | 陳俊杉  | 5    | 0    | 0    |
| CIE 5133 | 521 U9230 |    | 機器學習與深度學習導論  | 3  | 陳俊杉  | 70   | 0    | 201  |
| CIE 7074 | 521 M6230 |    | 電腦輔助工程專題討論   | 1  | 陳俊杉  | 40   | 0    | 25   |
| CIE 7206 | 521 M0330 |    | 人工智慧工程應用專題討論 | 1  | 陳俊杉  | 10   | 0    | 10   |

初選點名記分表僅提供初選階段選課學生名單，如課程為加退選期間加開課程則請於開學後第四週再下載點名記分表。

[下載修課人數](#) [下載修課名單](#)

# 博士班

甄試  
報名

4 / 15

截止

- 目標進入人工智慧產業
- 挑戰三年內畢業
- 前兩年每月三萬元獎助金

※ 表現優秀第三年也補助每月三萬元

※ 以土木系陳俊杉、韓仁毓、陳柏華、張家銘、張書瑋等指導教授之研究領域為主。

國震中心 與  
台大土木 合設

# AI 研究中心

✉ aiengineer@caece.net

🌐 AI.caece.net

- 臺大土木系博士班於2019招生新增「人工智慧工程應用」領域

# 建築耐震能力之機器學習

# The Chi-chi Earthquake

## Sep. 21, 1999



**Wu Feng Primary School**



**Wu Feng Primary School**

# 現況與問題

- 校舍專案辦公室，自 **2009** 年起建置校舍耐震資訊網及資料庫，匯集全國專業技師所上傳校舍評估與補強數據
- 校舍耐震能力評估流程：

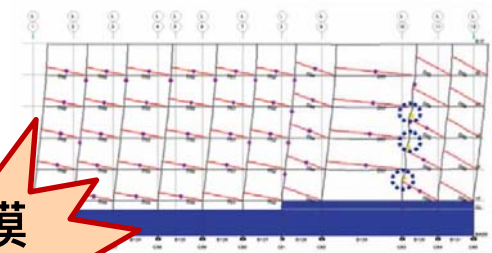


技師至現場勘驗填表  
再依據公式試算Is值  
**IsValue  $\geq 100$  → 安全**  
**IsValue  $< 100$  → 有疑慮**

現地  
勘驗

技師依據設計圖/現況  
建立**ETABS**模型進行分析  
**CDR值  $\geq 1$  → 安全**  
**CDR值  $< 1$  → 需補強**

建模  
費時



# Data

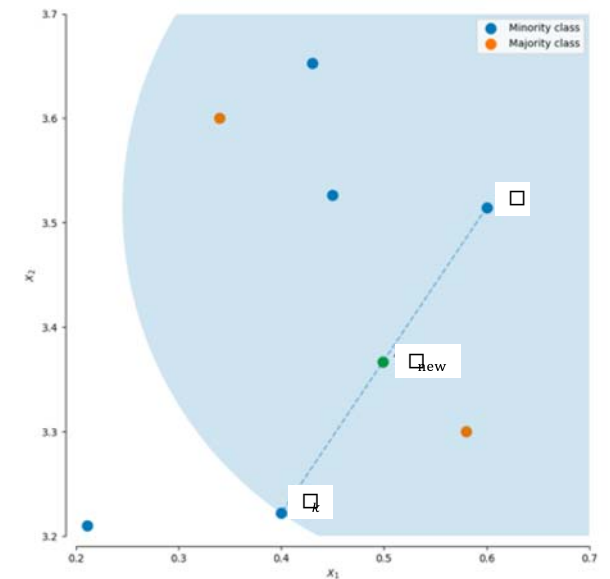
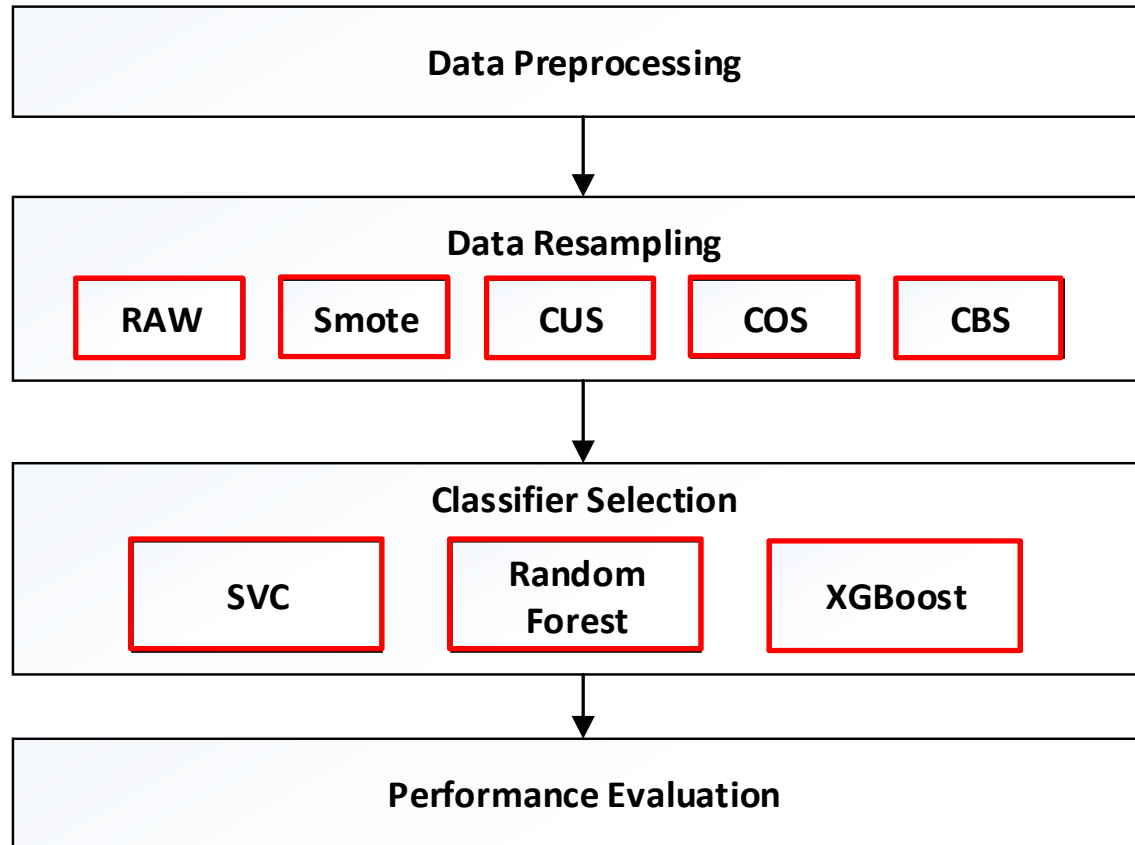
- 校舍資料庫蒐集評估資料累計如下(~2018/6/30)

| 初步評估                  |                  | 詳細評估                 |                  |
|-----------------------|------------------|----------------------|------------------|
| 14,027 棟次<br>(含未完成上傳) |                  | 8,966 棟次<br>(含未完成上傳) |                  |
| IsValue $\geq 100$    | IsValue $< 100$  | CDR $\geq 1$         | CDR $< 1$        |
| 5,311 棟<br>(37%)      | 8,706 棟<br>(62%) | 1,287 棟<br>(14%)     | 7,612 棟<br>(85%) |

Imbalanced dataset



# ML-based Seismic Capability Evaluation

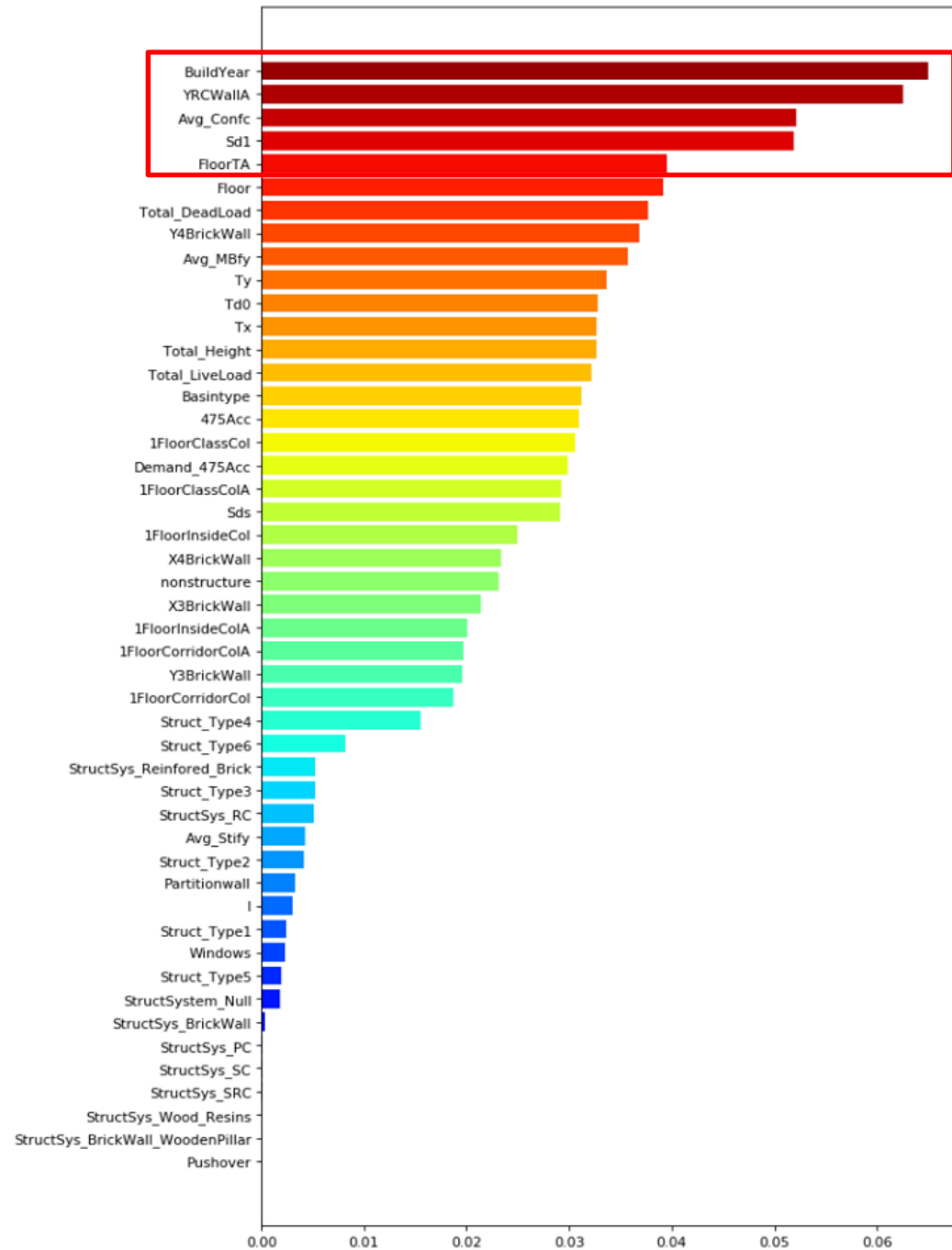


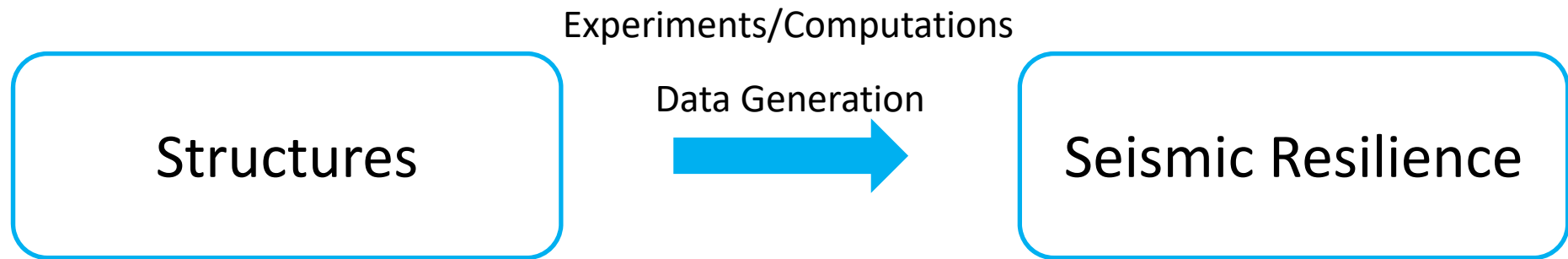
COS: Cluster-based over-sampling  
CUS: Cluster-based under-sampling  
CBS: Cluster-based smote

# The Performance on Classifications

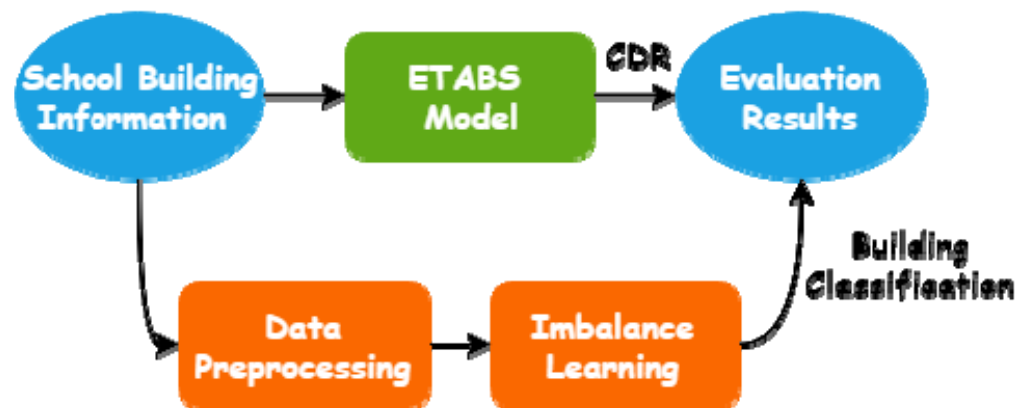
|                           | Support Vector Classifier (SVC)     |              |              |              |              |
|---------------------------|-------------------------------------|--------------|--------------|--------------|--------------|
|                           | raw                                 | SMOTE        | CUS          | COS          | CBS          |
| avg No. of minor instance | 785                                 | 4648         | 772          | 4357         | 4693         |
| avg No. of major instance | 4649                                | 4648         | 948          | 4665         | 4661         |
| instance ratio            | 0.169                               | 1.000        | 0.814        | 0.934        | 1.007        |
| f1-score                  | <b>0.806</b>                        | <b>0.789</b> | <b>0.779</b> | <b>0.847</b> | <b>0.847</b> |
|                           | Random Forest (RF)                  |              |              |              |              |
|                           | raw                                 | SMOTE        | CUS          | COS          | CBS          |
| avg No. of minor instance | 781                                 | 4661         | 775          | 4034         | 4657         |
| avg No. of major instance | 4653                                | 4661         | 948          | 4646         | 4648         |
| instance ratio            | 0.168                               | 1.000        | 0.817        | 0.868        | 1.002        |
| f1-score                  | <b>0.846</b>                        | <b>0.859</b> | <b>0.792</b> | <b>0.862</b> | <b>0.860</b> |
|                           | Extreme Gradient Boosting (XGBoost) |              |              |              |              |
|                           | raw                                 | SMOTE        | CUS          | COS          | CBS          |
| avg No. of minor instance | 770                                 | 4651         | 781          | 4427         | 4670         |
| avg No. of major instance | 4664                                | 4651         | 947          | 4649         | 4651         |
| instance ratio            | 0.165                               | 1.000        | 0.825        | 0.952        | 1.004        |
| f1-score                  | <b>0.844</b>                        | <b>0.850</b> | <b>0.795</b> | <b>0.852</b> | <b>0.859</b> |

# Feature Rank





## Instant Prediction via Supervised Learning



詳細評估預測  
XGBoost Method

|       | 預測 安全 | 需補強  |
|-------|-------|------|
| 真實 安全 | 90    | 308  |
| 需補強   | 47    | 2240 |

Error 1.75%

Accuracy 86.78%

## 從結構耐震評估到城市震災模擬



# 輔助**工地**鋼筋檢核之深度學習



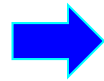


# Image Semantic Segmentation: Google DeepLab V3+

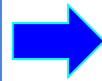


<https://github.com/tensorflow/models/tree/master/research/deeplab>

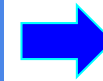
Depth  
Image



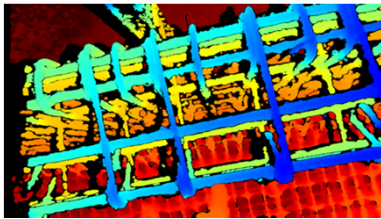
AI Model



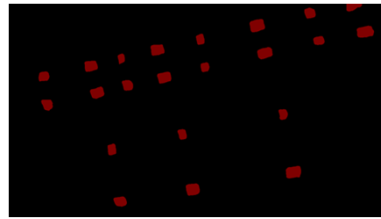
Cluster



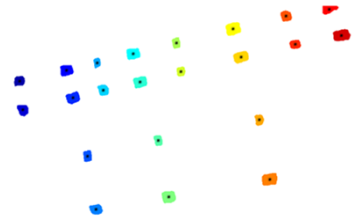
Spacing  
Calculation



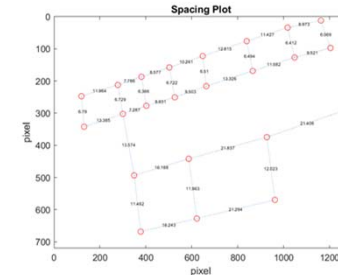
C++ to python



python



matlab to python

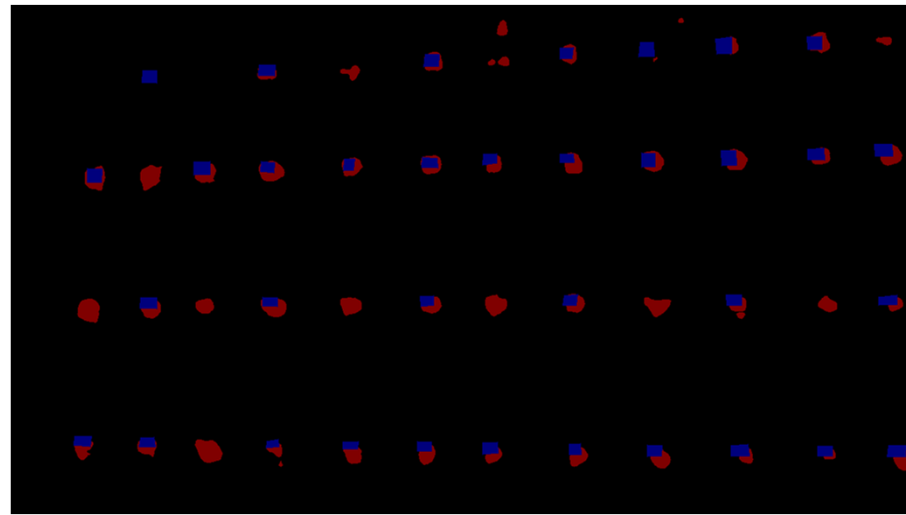
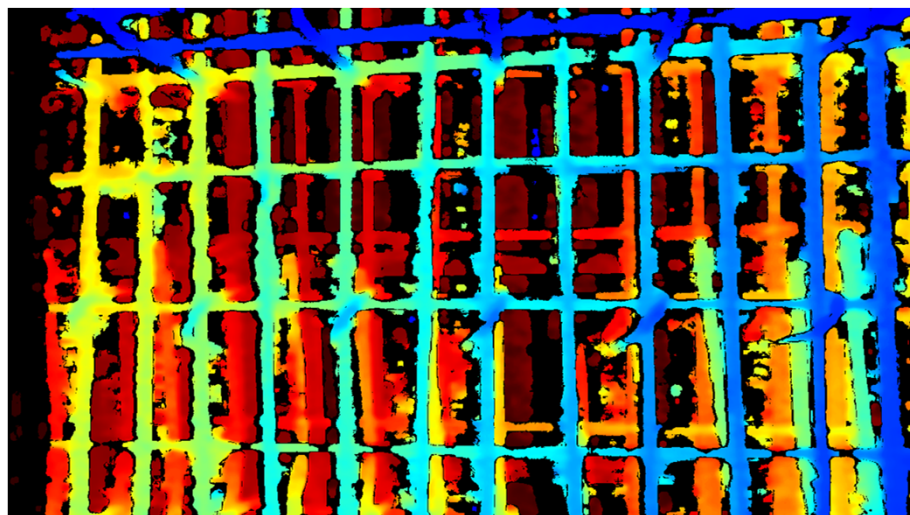
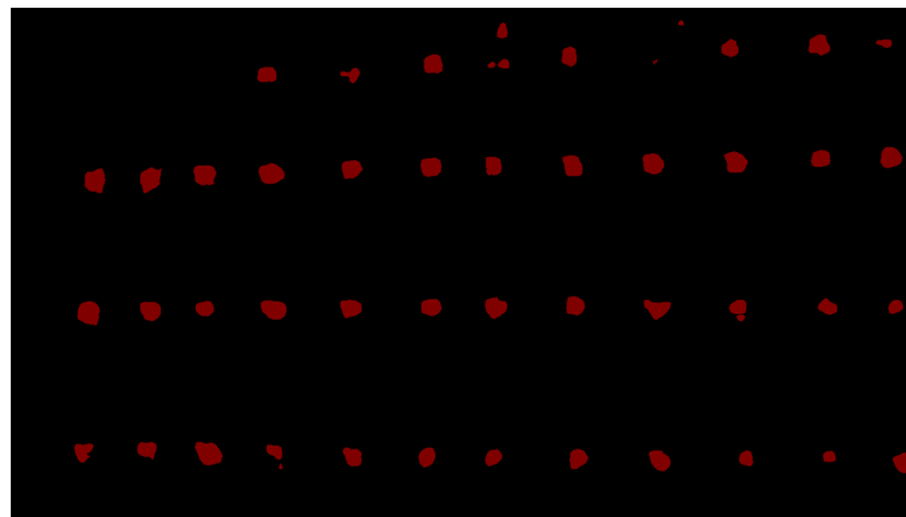


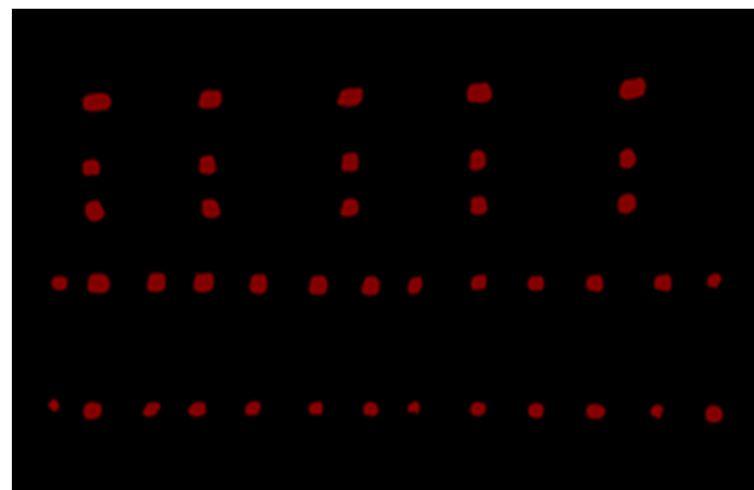
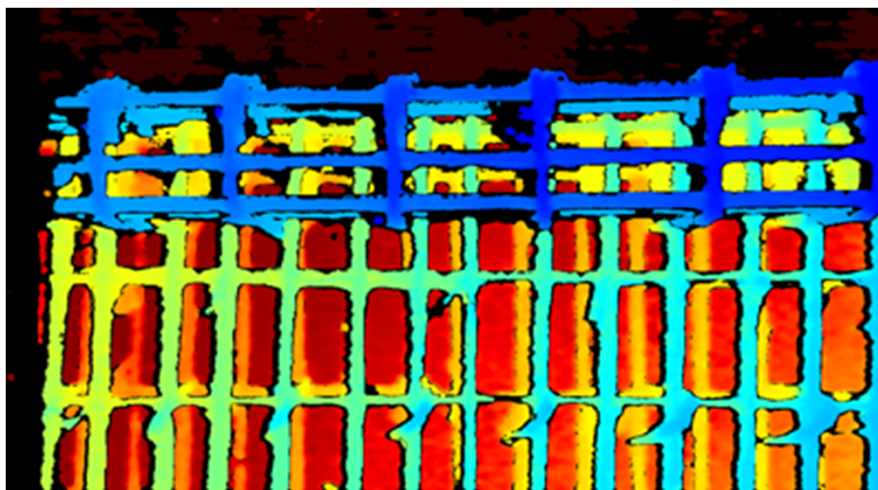
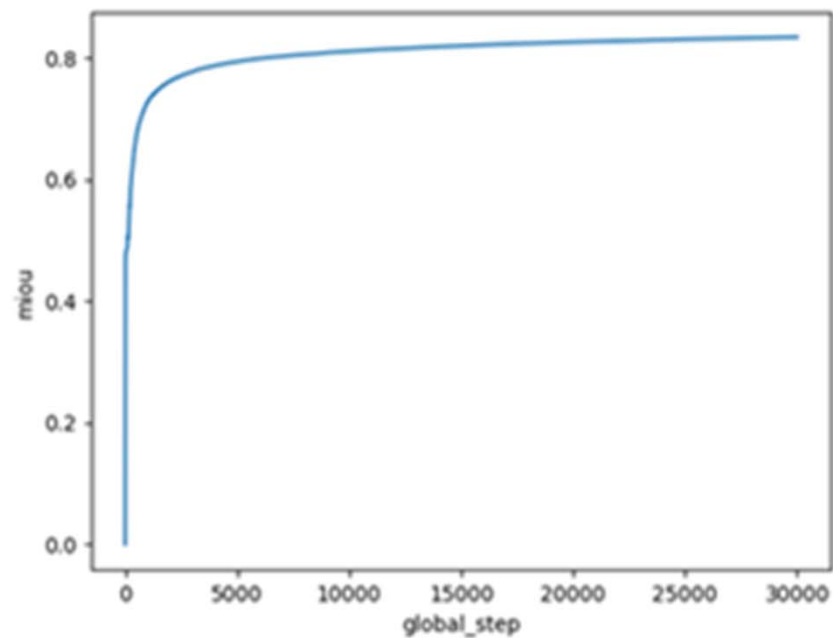
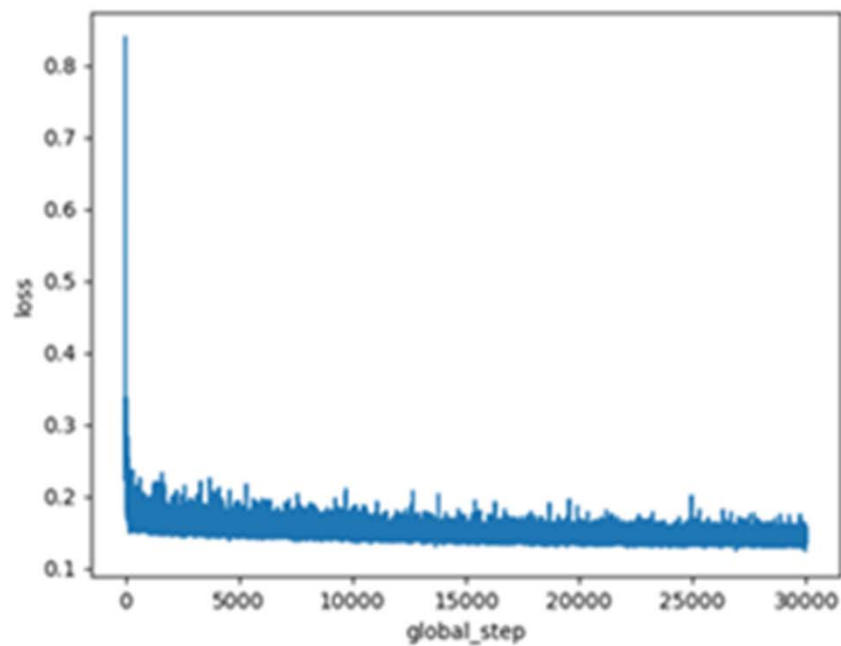
matlab to python

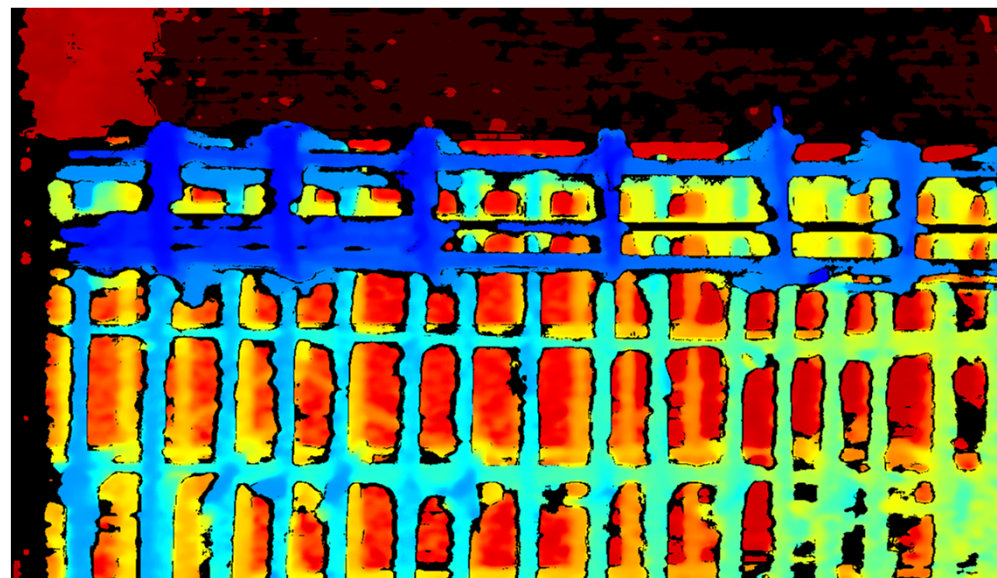


Nano

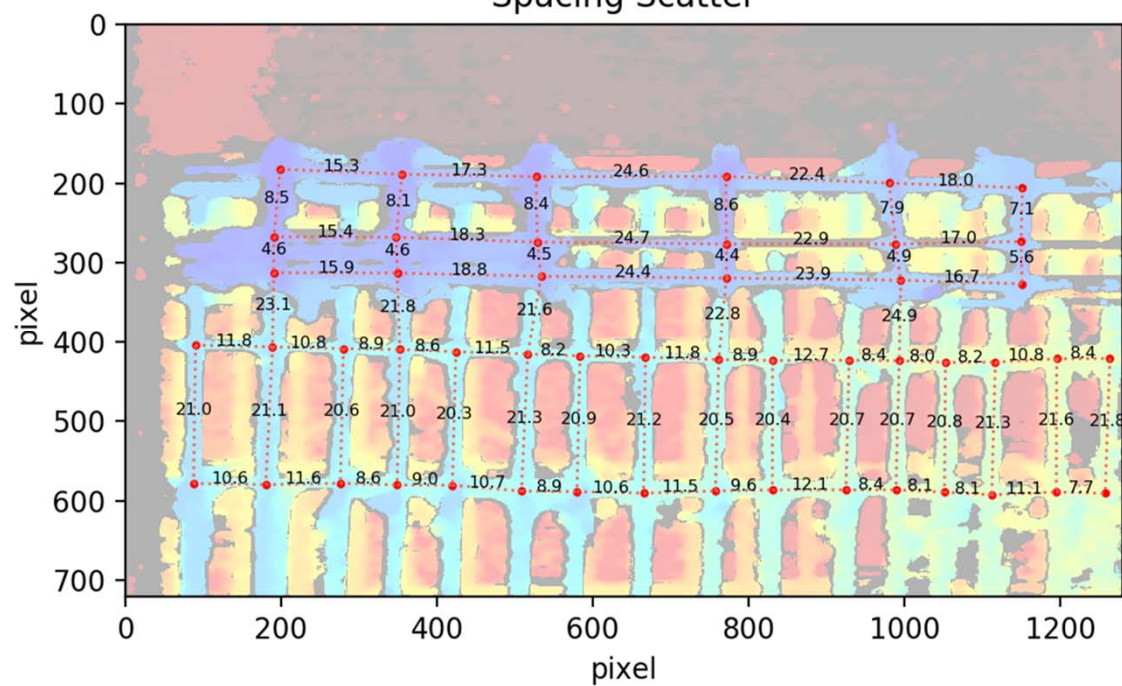








Spacing Scatter



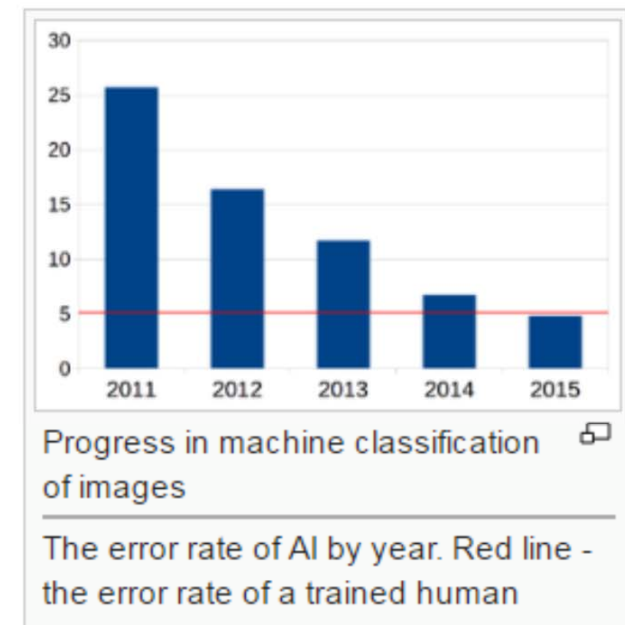


# Artificial Intelligence: Trend

# Progress in AI (wiki)

[https://en.wikipedia.org/wiki/Progress\\_in\\_artificial\\_intelligence](https://en.wikipedia.org/wiki/Progress_in_artificial_intelligence)

- Super-Human
  - Chess, Go
  - Driving a car
- Par-Human
  - OCR, Classification of images
- Sub-Human
  - Handwriting recognition
  - Translation
  - Speech recognition
    - "nearly equal to human performance"
  - Natural Language Understanding
    - "difficult to solve without contextual knowledge"
  - Many challenging problems for AI !!!



# 李開復：AI已過發明期，進入**應用期**，五年後全面普及 (2019.07.24 【AI新世界】趨勢論壇)



圖片由天下文化提供

# 簡立峰 (2019.08.26 全國大學程式設計教師教學經驗交流觀摩會)

- 少子化長期人才數量不足
  - 跨領域合作減少人才缺口
  - AI重要應用仰賴跨領域頂尖人才  
EX: 醫學+資訊
- 彈性是跨領域人才培育的關鍵
  - 師資員額，學生員額，必修課程 ...
  - UC Berkeley CS 學生五年增加七倍
  - 頂尖大學採取低年級不分系及彈性學程
- 非資訊科技學生程式能力
  - 矽谷優秀軟體工程師很多不是資訊科系畢業生
  - 台灣軟體新創缺乏多元背景，商業能力弱
- 自主學生學習
  - 多利用線上資源
  - 多參與與運用開放源碼



# Andrew Ng 吳恩達 (2019.08.27 What's Next in AI)

The image is a composite. The main part is a presentation slide with a dark background. At the top right, it features the 'TechOrange' logo with '科技報橘' above it, followed by a large 'X' and the 'MOST' logo with '科技部' and 'Ministry of Science and Technology' below it. The slide has a light gray rectangular area in the center containing the text 'Introduction' and 'AI next step is its rise outside the software industry.' where 'outside' is in blue. Below this is a blue footer bar with 'CONFIDENTIAL COPYRIGHT © 2019 LANDING AI' on the left, the 'LANDING AI' logo in the center, and 'Andrew Ng' on the right. At the bottom, there are two horizontal bars: a dark blue one with the white text '吳恩達首次來台公開演講' and a bright green one with the black text '人工智慧的下一步是什麼？'. To the right of the slide is a smaller inset photo of Andrew Ng speaking into a microphone on a stage. Behind him is a screen displaying 'What's Next AI' and the 'MOST' logo.

TechOrange 科技報橘 X MOST 科技部  
Ministry of Science and Technology

Introduction

AI next step is its rise  
**outside** the software industry.

CONFIDENTIAL COPYRIGHT © 2019 LANDING AI LANDING AI Andrew Ng

吳恩達首次來台公開演講

人工智慧的下一步是什麼？

What's Next AI MOST 科技部

*“Louis, I think this is the beginning of a beautiful friendship,”  
- Humphry Bogart to Claude Rains in Casablanca, 1941*



I hope this is the beginning of a beautiful  
friendship between you and AI.

Thank you very much for your attention.