Chat-GPT 背後的關鍵技術: 預訓練 (Pre-train)
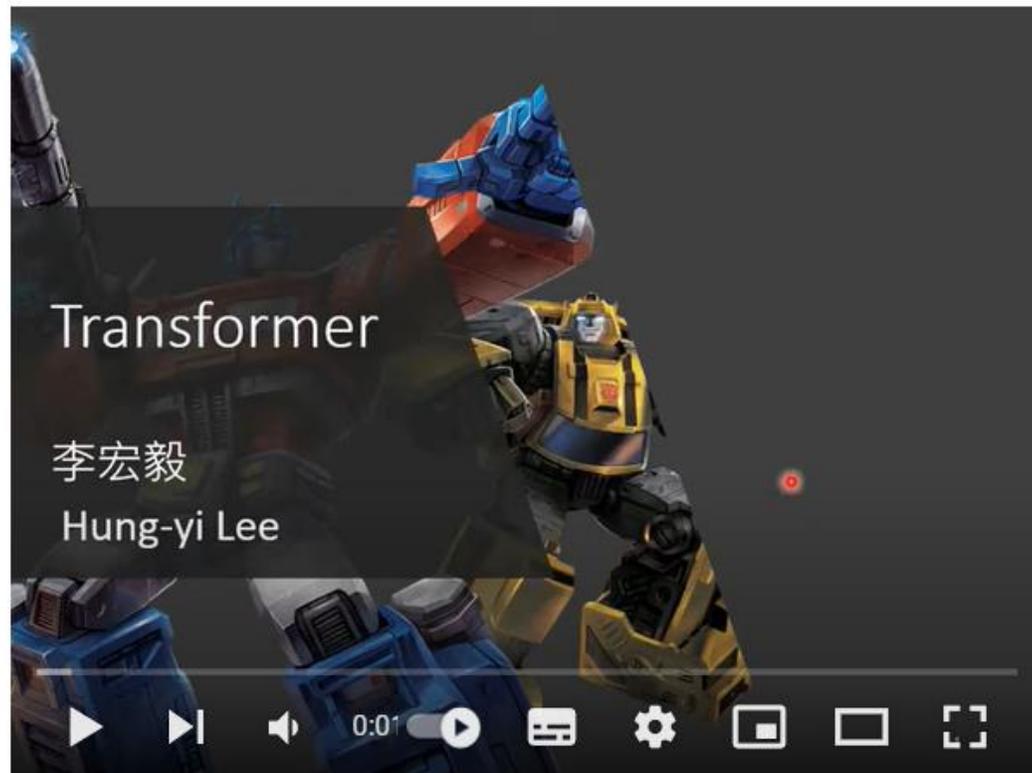
又叫自督導式學習 (Self-supervised Learning)

基石模型 (Foundation Model)

ChatGPT

Generative

Pre-trained
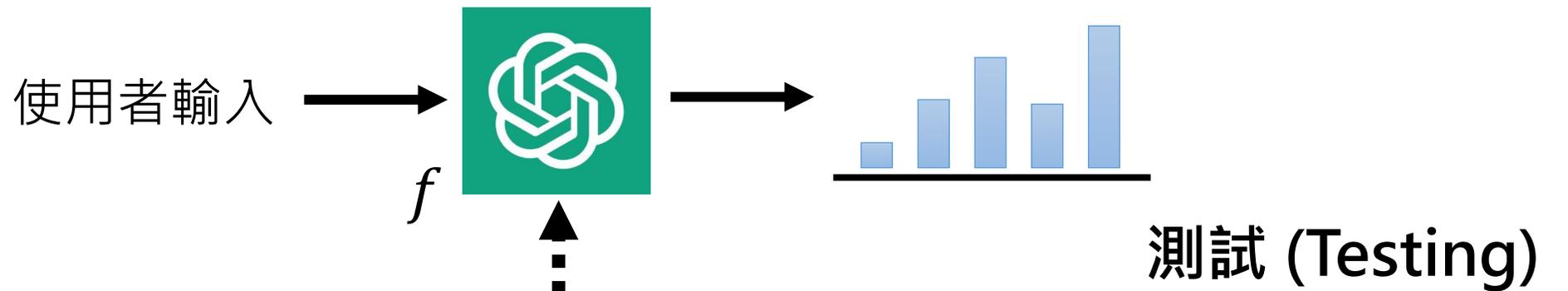
Transformer
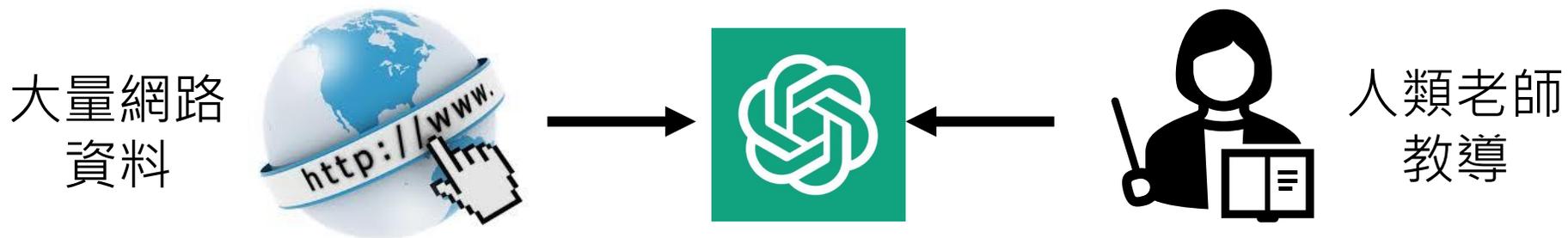

Transformer
李宏毅
Hung-yi Lee

【機器學習2021】(中文版)
【機器學習2021】Transformer (上)

https://youtu.be/n9TlOhRjYoc

ChatGPT 真正做的事 – 文字接龍

使用者輸入 →

f

測試 (Testing)

訓練 (Training)

這個神奇的函式 f 是怎麼被找出來的呢？

大量網路資料

人類老師教導

督導式學習套用到 ChatGPT 上

輸入：台灣第一高峰是那一座？　　輸出：玉山

輸入：幫我修改這段文字 ......　　輸出：好的 ......

輸入：教我做壞事 ......　　輸出：這是不對的

機器自己尋找函式 f 使得 ......

台灣第一高峰是那一座？ → f → 玉
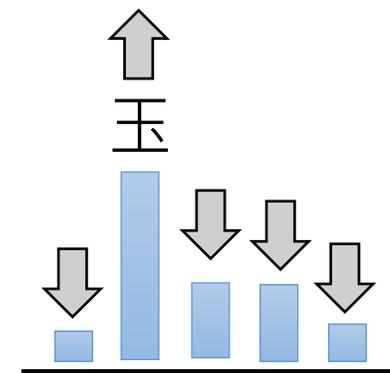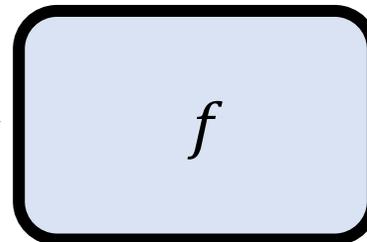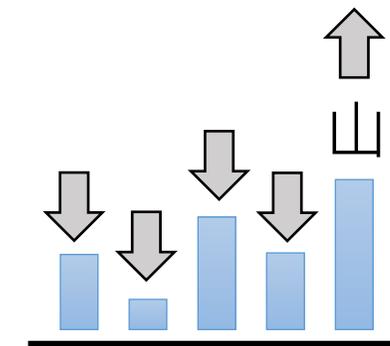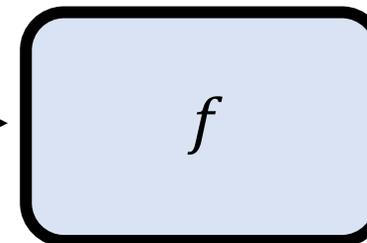
台灣第一高峰是那一座？玉 → f → 山

督導式學習套用到 ChatGPT 上

輸入：台灣第一高峰是那一座？ 　輸出：玉山

輸入：幫我修改這段文字 ...... 　輸出：好的 ......

輸入：教我做壞事 ...... 　輸出：這是不對的

機器自己尋找函式 f 使得 ......

假設機器真的根據老師的教導找出函式 f，他的能力可能還是非常有限

人類老師可以提供的成對資料是有限的

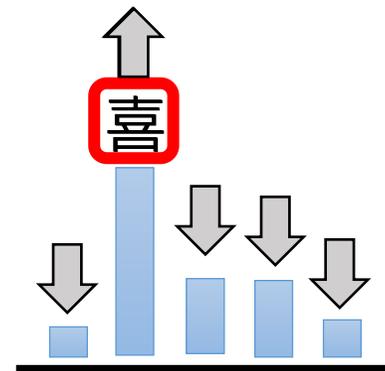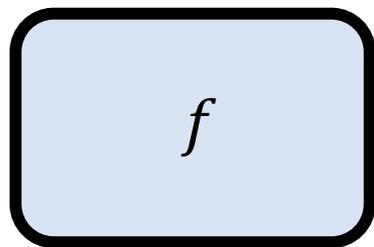世界第一高山是那一座？ ➡️ f 　？？？？？

➡️ **無痛製造成對資料**
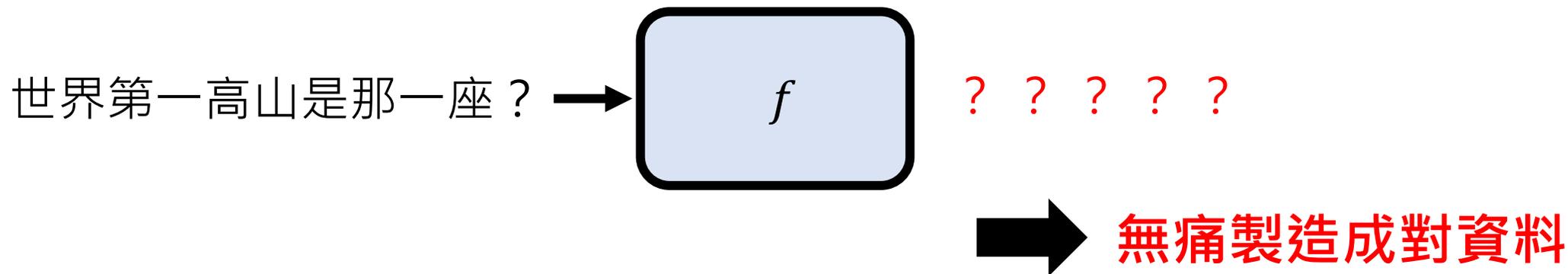
網路上每一段文字都可以教機器做文字接龍 ......
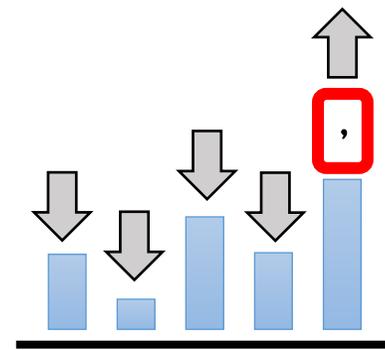

世界第一高峰是 喜馬拉雅山

今天天氣真好 ，我要出去玩

機器自己尋找函式 f 使得 ......

世界第一高峰是 → f → 喜
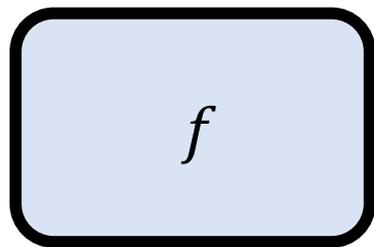
今天天氣真好 → f (GPT) → ，

在 ChatGPT 之前的 GPT 系列 ......

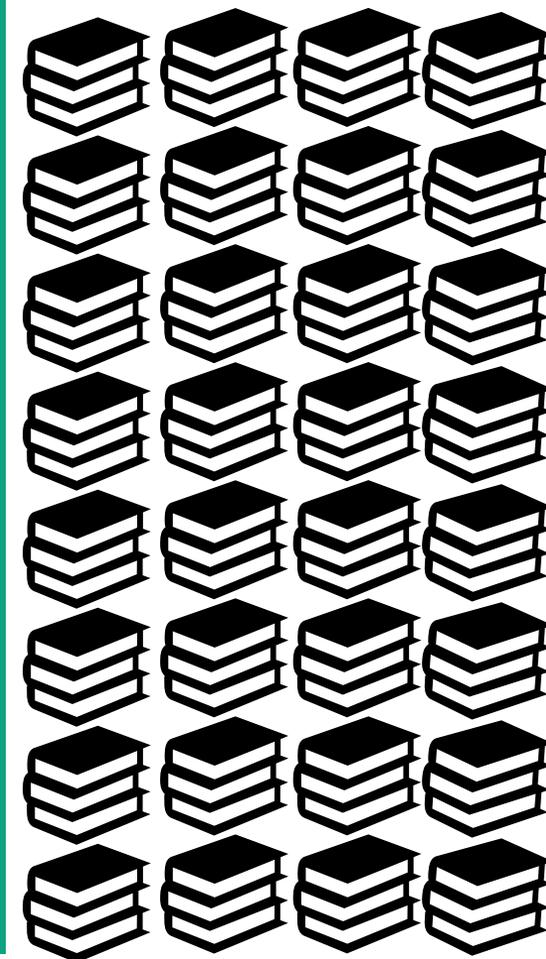Data:
40GB

Model:
1542M

Model:
117M

Data:
1GB

GPT
(2018)

GPT-2
(2019)

GPT-2

SYSTEM PROMPT
(HUMAN-WRITTEN)

In a shocking finding, scientist discovered a herd of unicorns living in a remote, previously unexplored valley, in the Andes Mountains. Even more surprising to the researchers was the fact that the unicorns spoke perfect English.

MODEL COMPLETION (MACHINE-10 TRIES)

The scientist named the population, after their distinctive horn, Ovid's Unicorn. These four-horned, silver-white unicorns were previously unknown to science.

Now, after almost two centuries, the mystery of what sparked this odd phenomenon is finally solved.

Dr. Jorge Pérez, an evolutionary biologist from the University of La Paz, and several companions, were exploring the Andes Mountains when they found a small valley, with no other animals or humans. Pérez noticed that the valley had what appeared to be a natural fountain, surrounded by two peaks of rock and silver snow.

GPT-2 也是可以回答問題的!

問答

世界第一高峰是哪一座？ ⟶ GPT ⟶ 喜馬拉雅山

摘要

很長的文章 ..... TL;DR ⟶ GPT ⟶ 文章摘要

GPT-2

https://openai.com/blog/better-language-models/
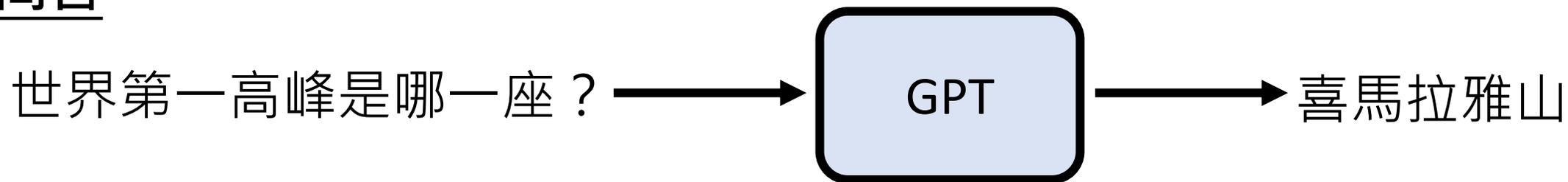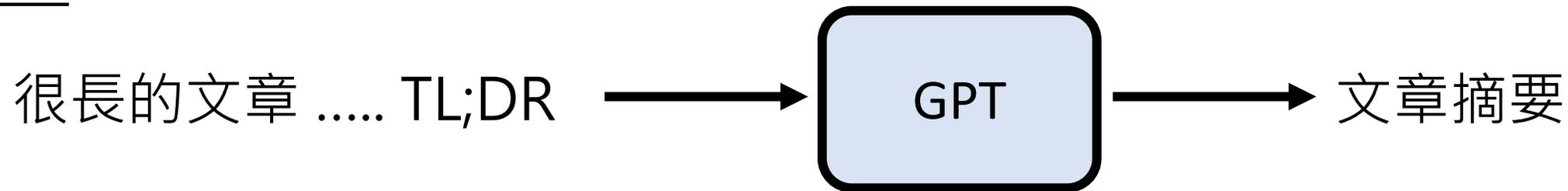
問答上表現
如何？

CoQA

在 ChatGPT 之前的 GPT 系列 ……

GPT-3.5?

https://platform.
openai.com/docs
/model-index-
for-researchers
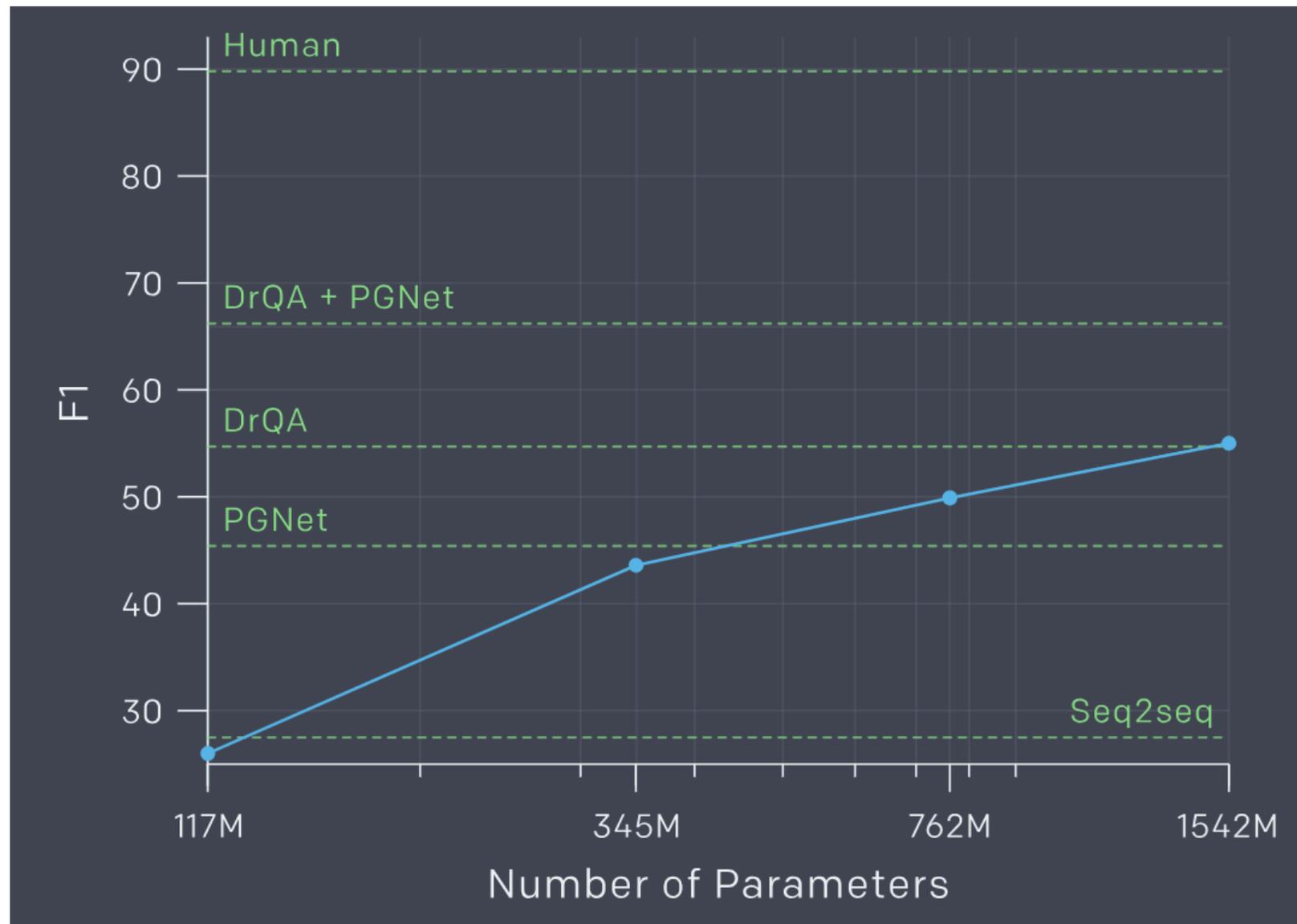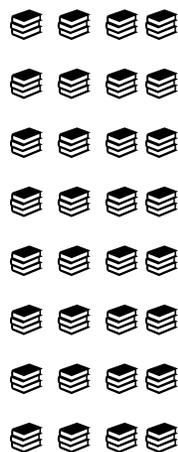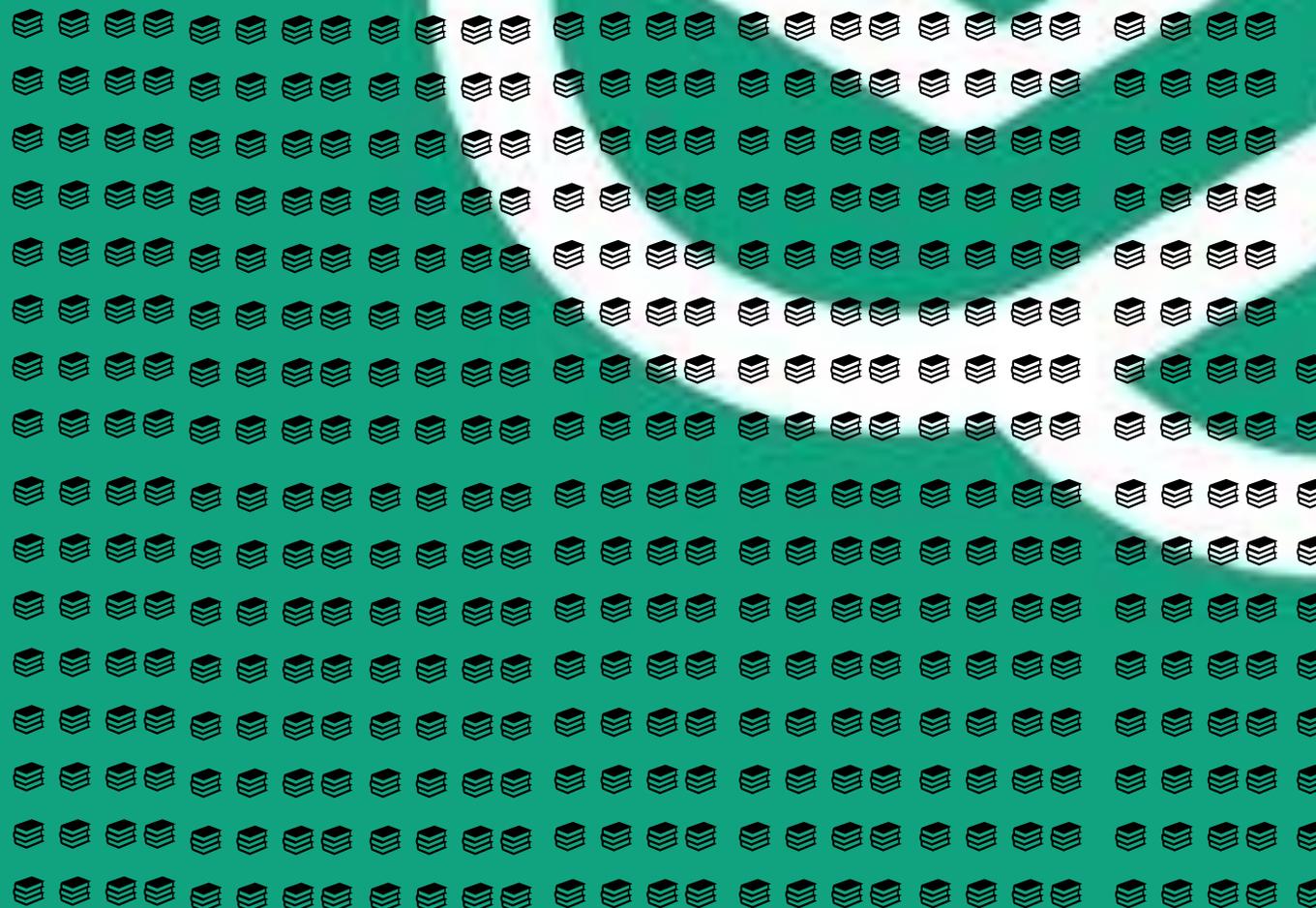
Model:
175B

Model:
1542M

GPT-2
(2019)

GPT-3
(2020)

Data: 570GB 閱讀哈利波特全集 30 萬遍
(45T before filtering)

GPT-3

Deep Learning for Human Language Processing (2020,Spring)
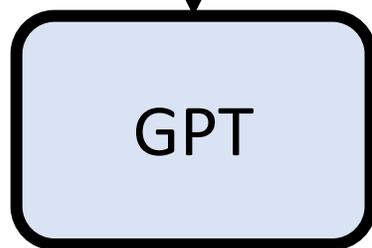
[DLHLP 2020] 來自獵人暗黑大陸的模型 GPT-3

https://youtu.be/DOG1L9lvsDY

GPT-3

Aggregate Performance Across Benchmarks
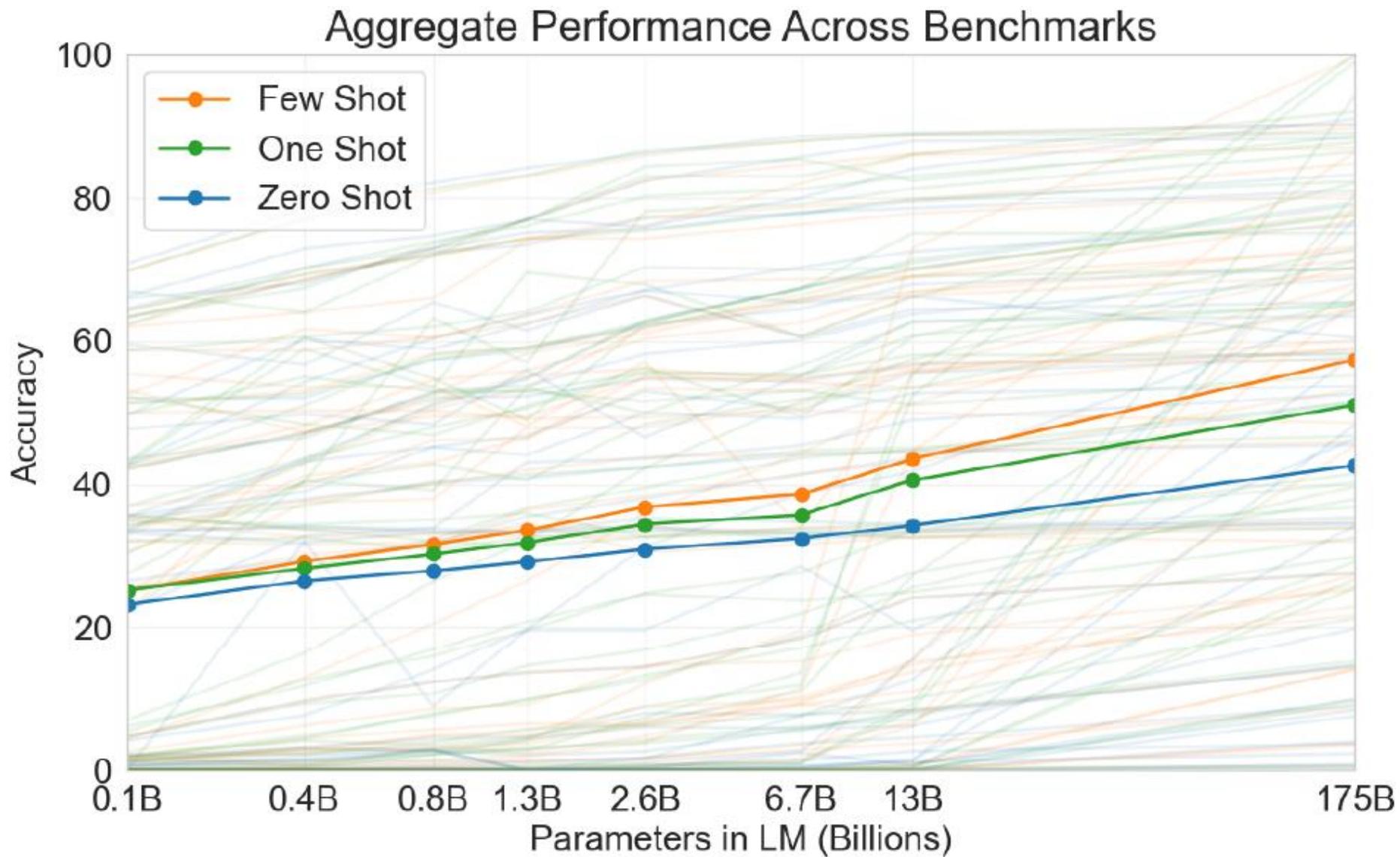
Average of **42** tasks

GPT-3

GPT

有機會根據指令
寫程式!

```python
# perform adversarial attack and generate adversarial examples
def gen_adv_examples(model, loader, attack, loss_fn):
    model.eval()
    adv_names = []
    train_acc, train_loss = 0.0, 0.0
    for i, (x, y) in enumerate(loader):
        x, y = x.to(device), y.to(device)
        x_adv = attack(model, x, y, loss_fn) # obtain adversarial
        yp = model(x_adv)
        loss = loss_fn(yp, y)
        train_acc += (yp.argmax(dim=1) == y).sum().item()
        train_loss += loss.item() * x.shape[0]
        # store adversarial examples
        adv_ex = ((x_adv) * std + mean).clamp(0, 1) # to 0-1 sc
        adv_ex = (adv_ex * 255).clamp(0, 255) # 0-255 scale
        adv_ex = adv_ex.detach().cpu().data.numpy().round() # round
        adv_ex = adv_ex.transpose((0, 2, 3, 1)) # transpose (bs,
        adv_examples = adv_ex if i == 0 else np.r_[adv_examples,
    return adv_examples, train_acc / len(loader.dataset), train_loss /
```

GPT 只從網路資料學習的缺點

What is the purpose of the list C in the code below?
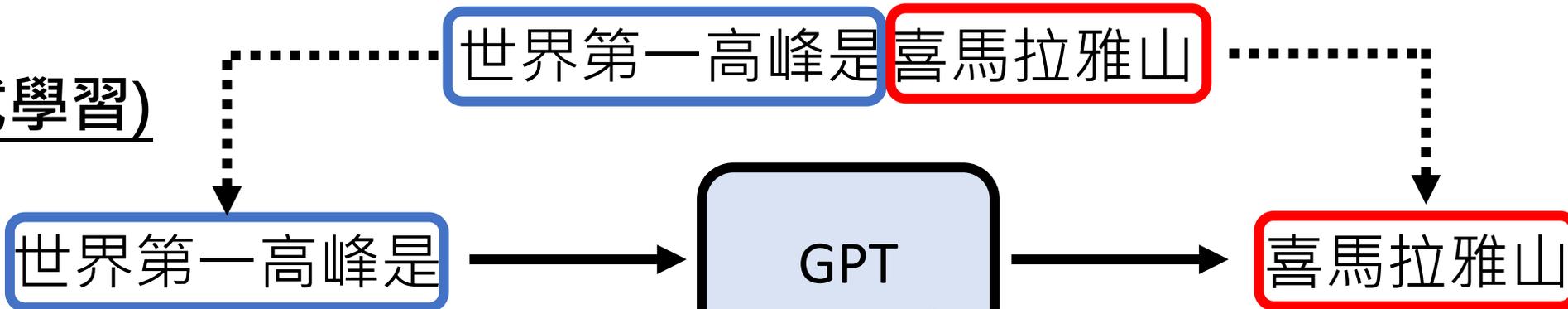
```python
def binomial_coefficient(n, r):
    C = [0 for i in range(r + 1)];
    C[0] = 1;
    for i in range(1, n + 1):
        j = min(i, r);
        while j > 0:
            C[j] += C[j - 1];
            j -= 1;
    return C[r]
```

GPT

A. to store the value of C[0]
B. to store the value of C[1]
C. to store the value of C[i]
D. to store the value of C[i - 1]

Source of image: https://arxiv.org/abs/2203.02155

世界第一高峰是 喜馬拉雅山

世界第一高峰是 → GPT → 喜馬拉雅山

繼續學習

基石模型

微調 (finetune)

督導式學習

台灣最高的山是那座？ → ChatGPT → 玉山

預訓練多有幫助呢？

也許人類老師並不需要教所有語言

預訓練多有幫助呢？

在多種語言上做預訓練後，只要教某一個語言的某一個任務，自動學會其他語言的同樣任務

Pre-training on 104 languages

Doc3
Query3
Ans3

Doc4
Query4
Ans4

Doc5
Query5
Ans5

學習英文
閱讀能力測驗

Multi-BERT

Doc1
Query1
?

Doc3
Query3
?

Doc2
Query2
?

自動會了中文
閱讀能力測驗
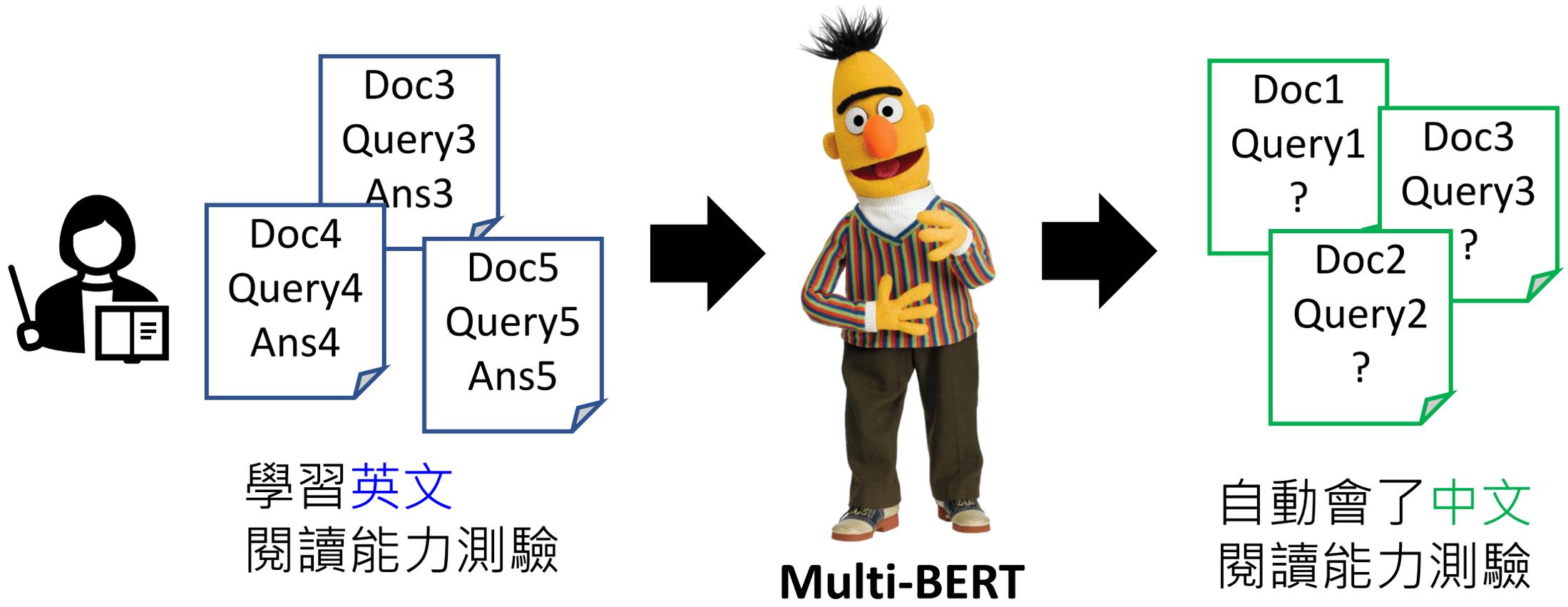
預訓練多有幫助呢？

- English: SQuAD, Chinese: DRCD

Model	Pre-train	Fine-tune	Testing	EM	F1
QANet	none	Chinese QA	Chinese QA	66.1	78.1
BERT	Chinese	Chinese QA		82.0	89.1
	104 languages	Chinese QA		81.2	88.7
		English QA		63.3	78.8
		Chinese + English		82.6	90.1

F1 score of Human performance is 93.30%
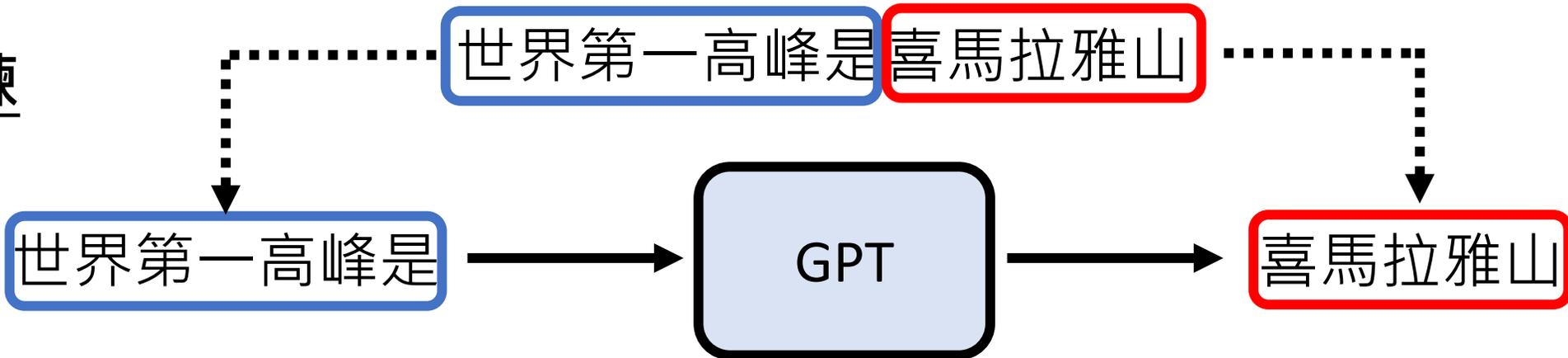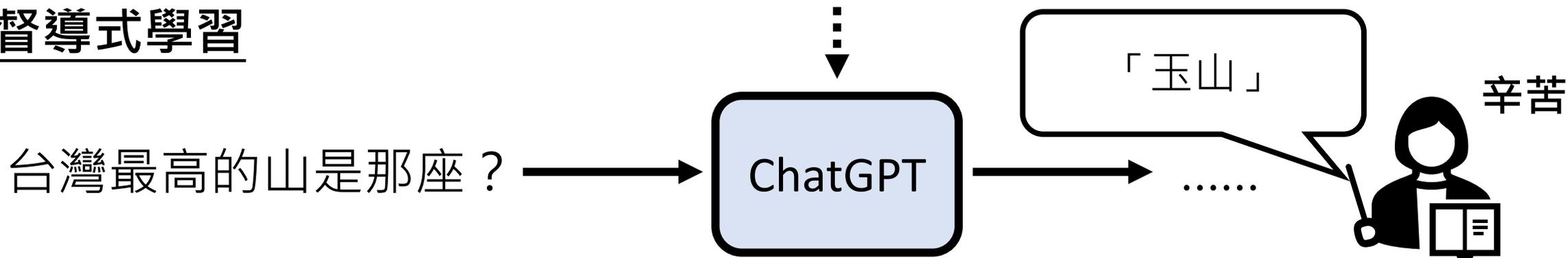
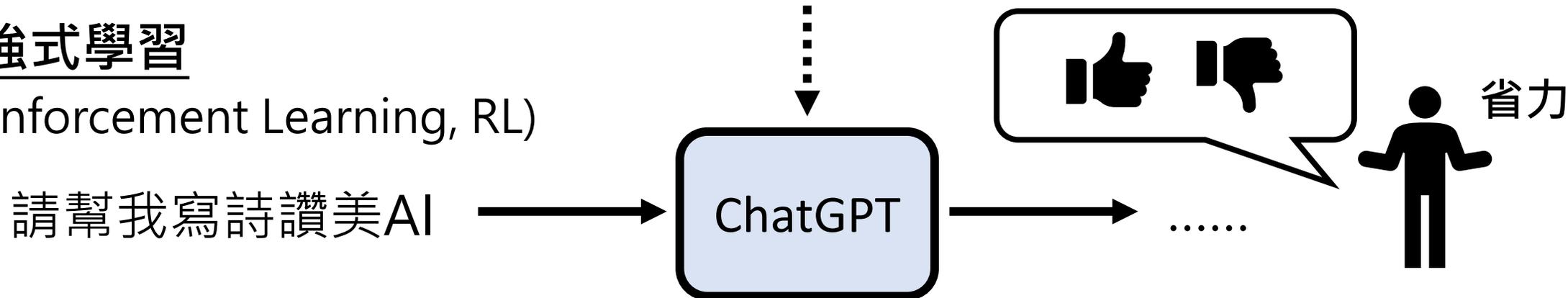# 偶爾你可以觀察到前世 (預訓練) 的記憶

今天天氣真不錯

Chat-GPT 背後的關鍵技術：預訓練 (Pre-train)

又叫自督導式學習 (Self-supervised Learning)

基石模型 (Foundation Model)