Chat-GPT 背後的關鍵技術：預訓練 (Pre-train)

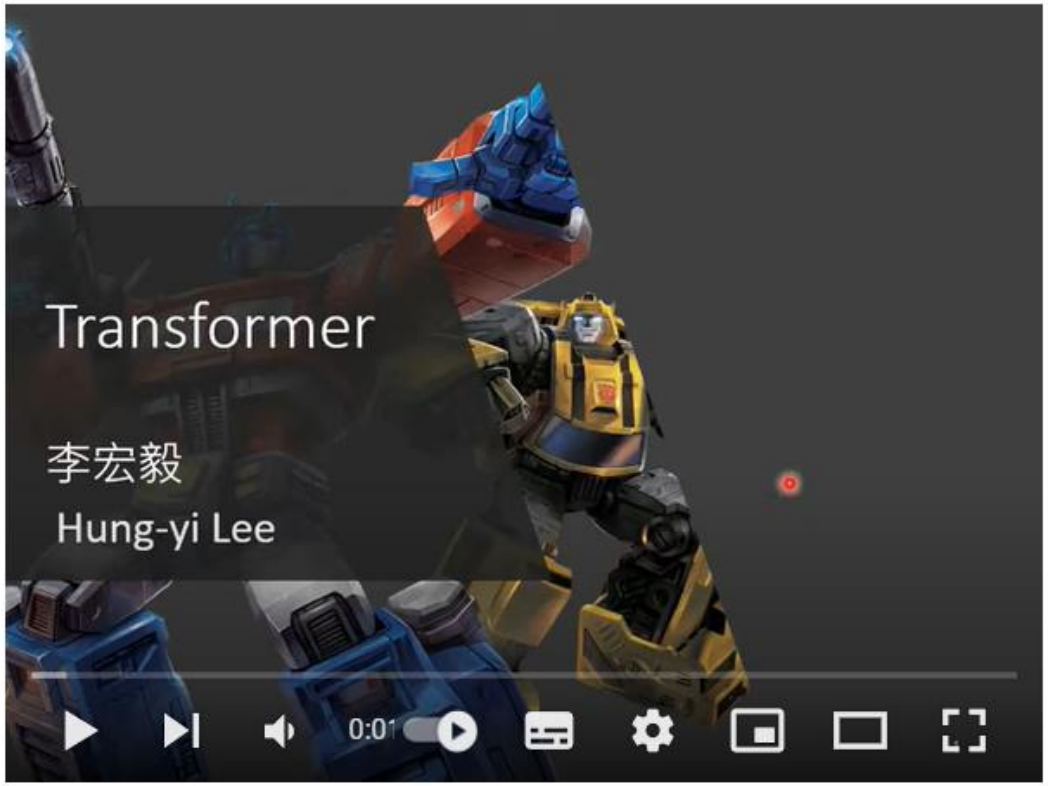
又叫自督導式學習 (Self-supervised Learning)
基石模型 (Foundation Model)

ChatGPT

Generative

Pre-trained

Transformer

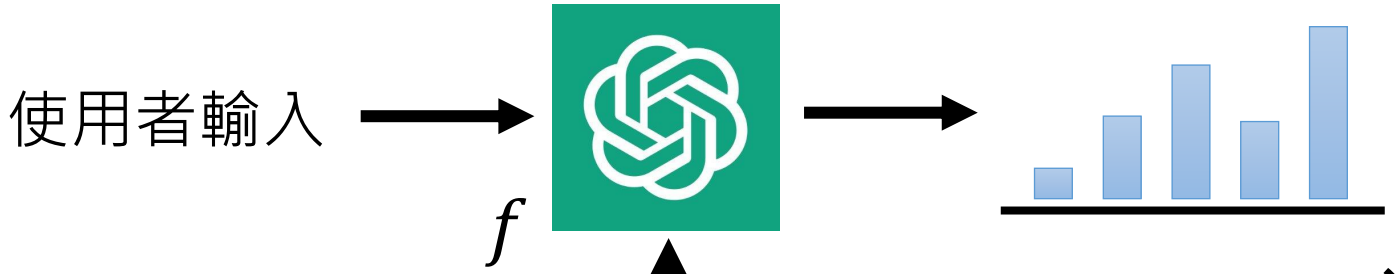


【機器學習2021】(中文版)

【機器學習2021】Transformer (上)

https://youtu.be/n9TlOhRjYoc

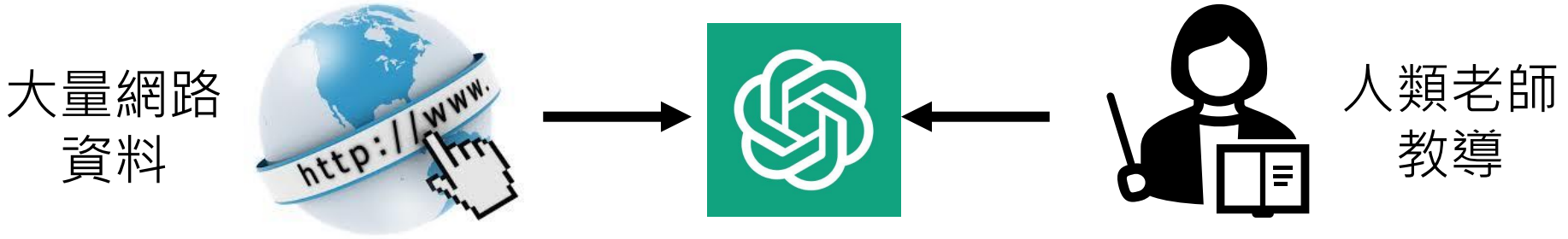
ChatGPT 真正做的事 – 文字接龍



測試 (Testing)

訓練 (Training)

這個神奇的函式 f 是怎麼被找出來的呢？



一般機器是怎麼學習的？

以英文翻中文為例

I eat an apple ⟷ 我吃蘋果

You eat an orange ⟷ 你吃橘子

⋮

蒐集大量中英成對例句

督導式學習

機器自己尋找函式 f

I = 我, you = 你,
apple = 蘋果, orange = 橘子

f

You eat an apple → ? → 你吃蘋果

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 → ？ ？ ？ ？ ？

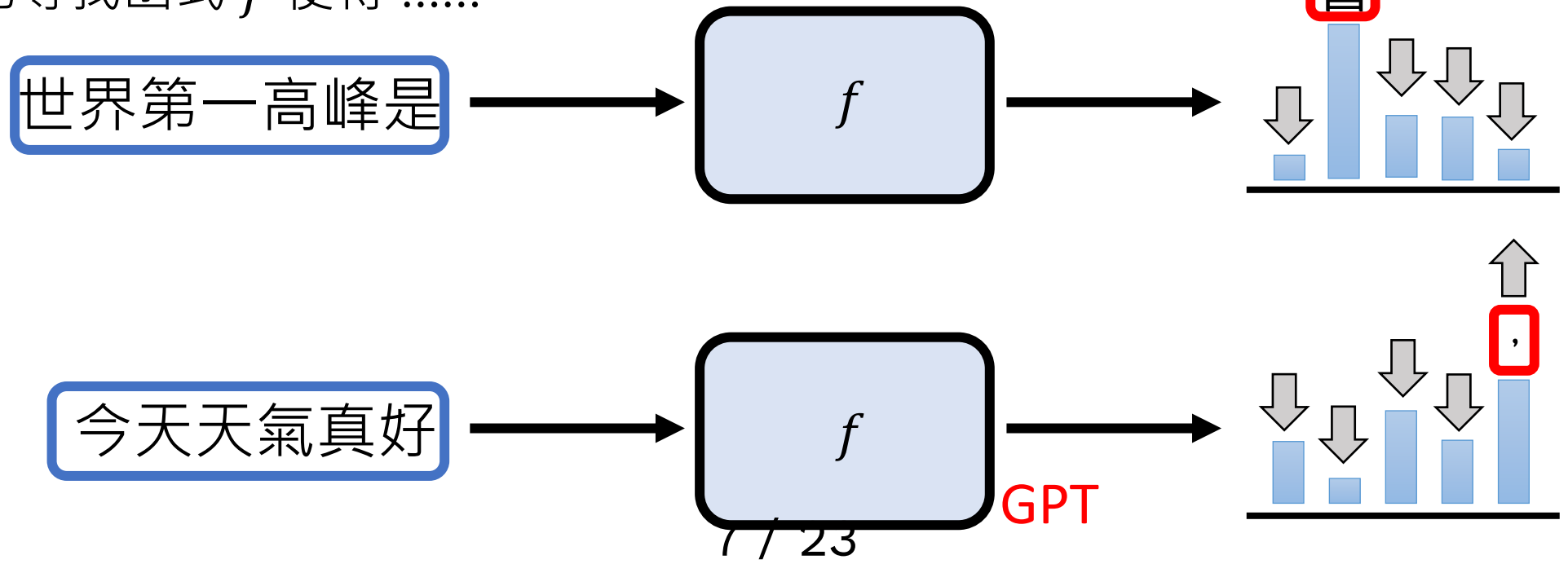
→ **無痛製造成對資料**

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

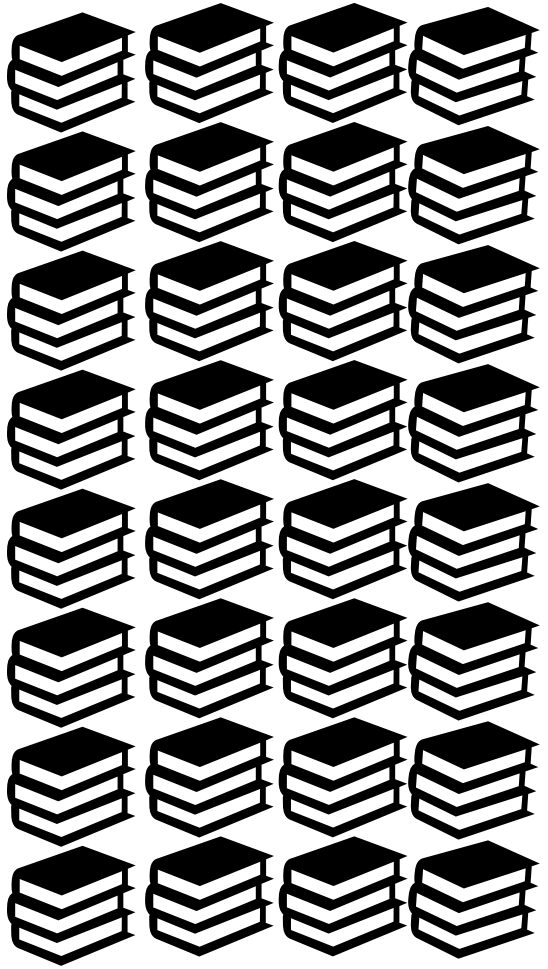
機器自己尋找函式 f 使得 .....



在 ChatGPT 之前的 GPT 系列 .....

Model:
1542M

Data:
40GB



Model:
117M

Data:
1GB

GPT
(2018)

GPT-2
(2019)

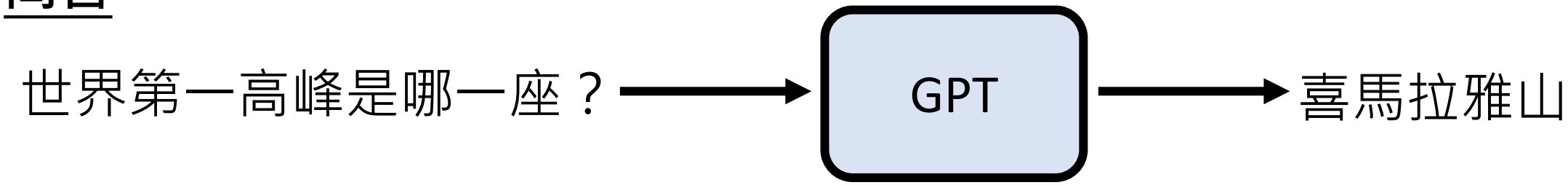
GPT-2

https://openai.com/blog/better-language-models/

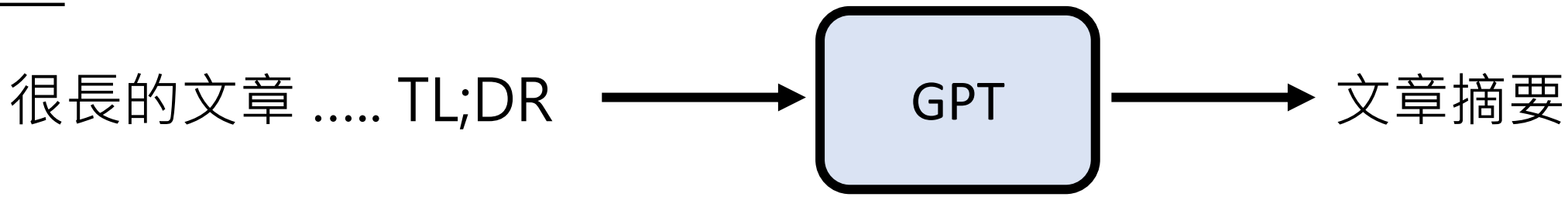
EM PROMPT -WRITTEN)	*In a shocking finding, scientist discovered a herd of unicorns living in a remote, previously unexplored valley, in the Andes Mountains. Even more surprising to the researchers was the fact that the unicorns spoke perfect English.*
MODEL MPLETION (MACHINE- 10 TRIES)	The scientist 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



摘要

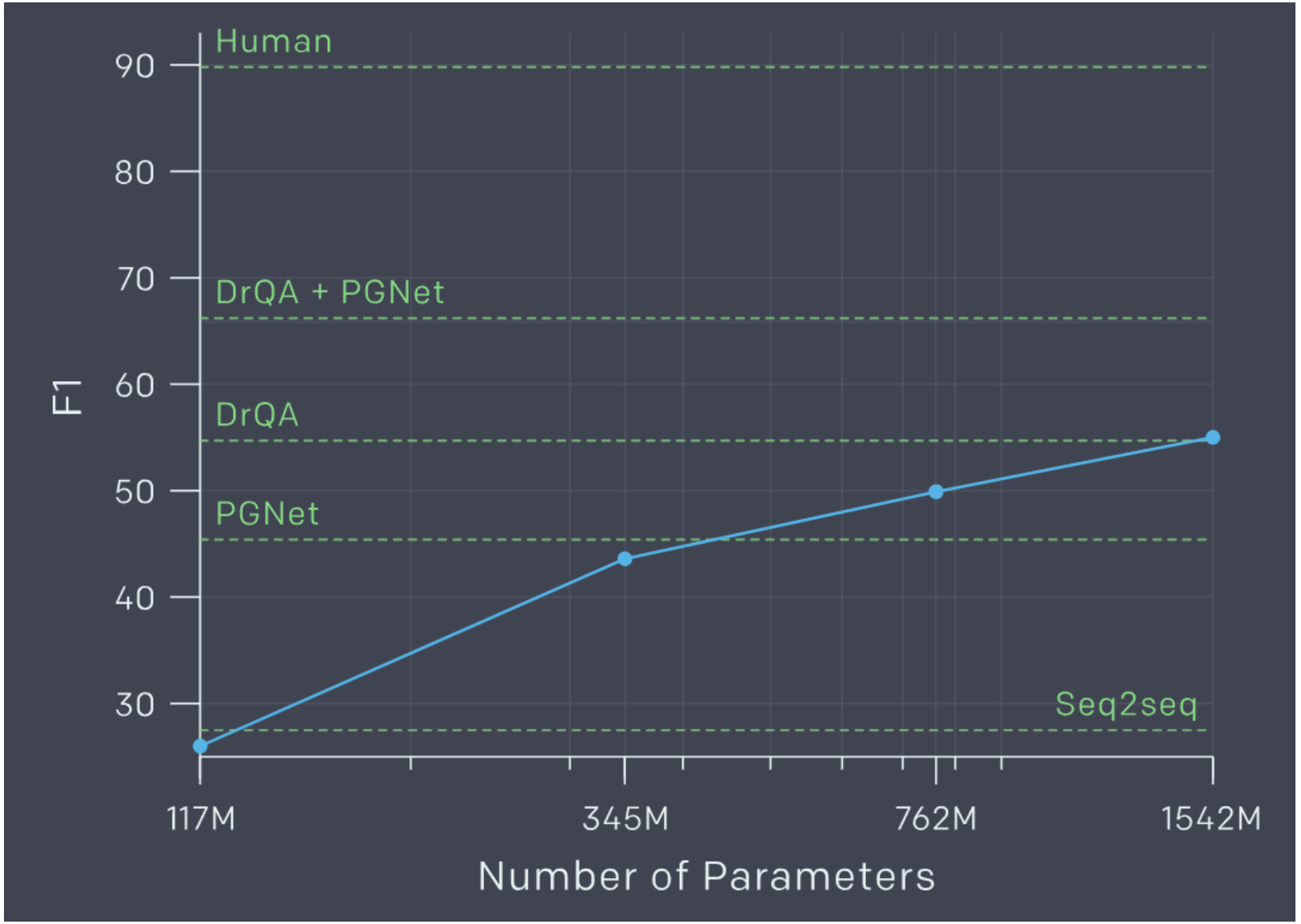


GPT-2

https://openai.com/blog/better-language-models/

問答上表現
如何？

CoQA

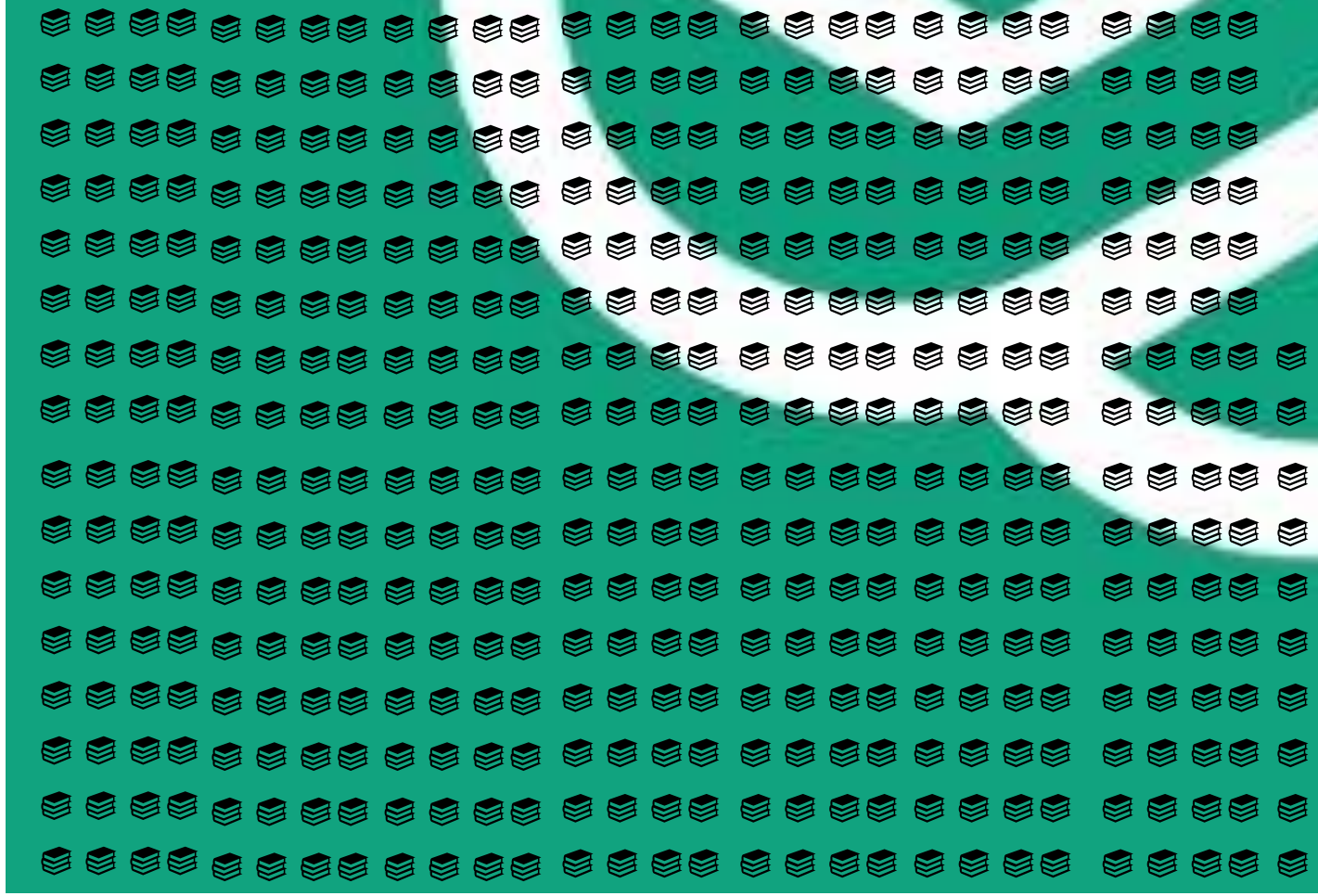


在 ChatGPT 之前的 GPT 系列 .....

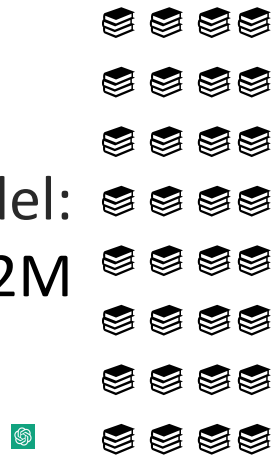
GPT-3.5?

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)

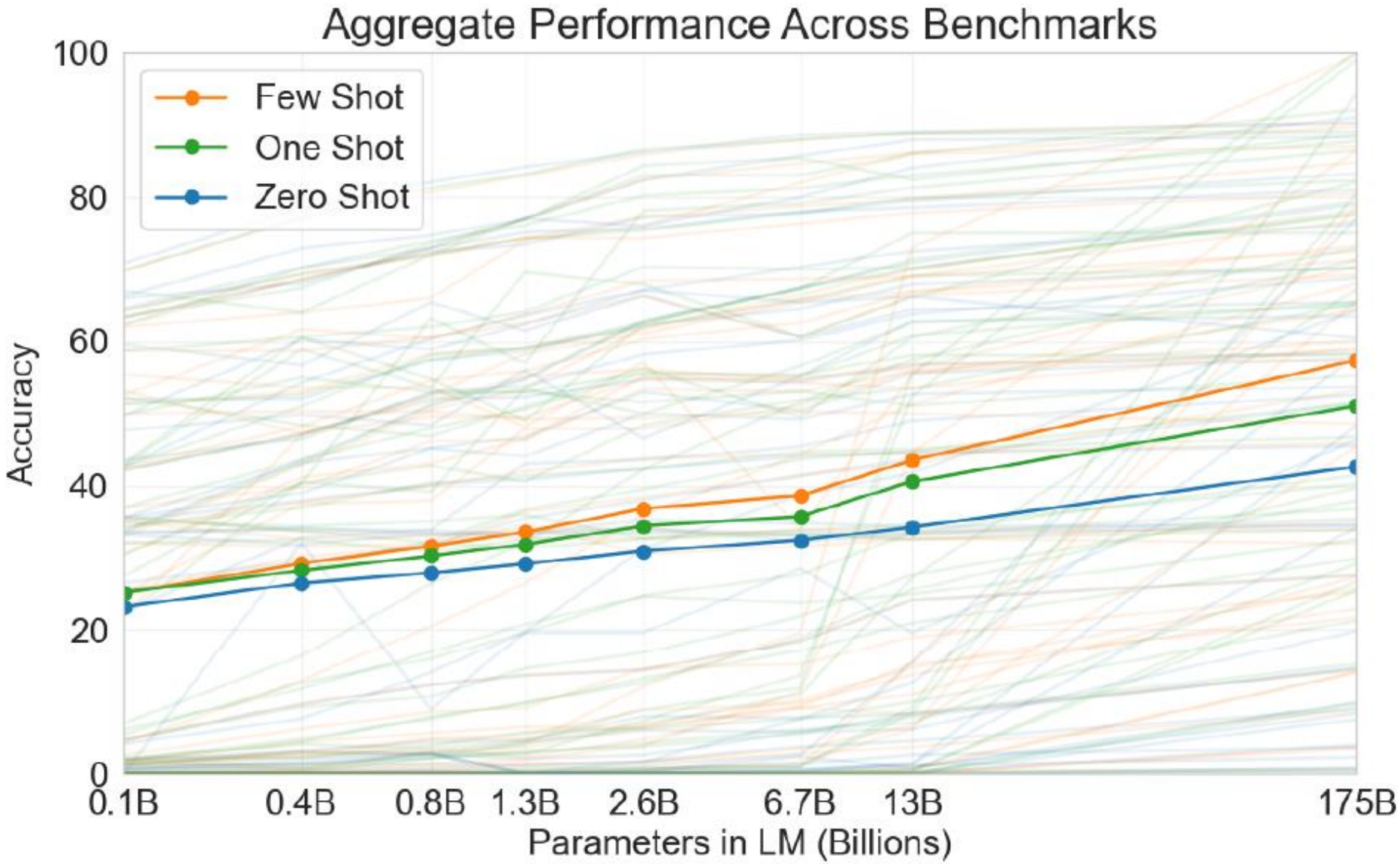
GPT-3

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

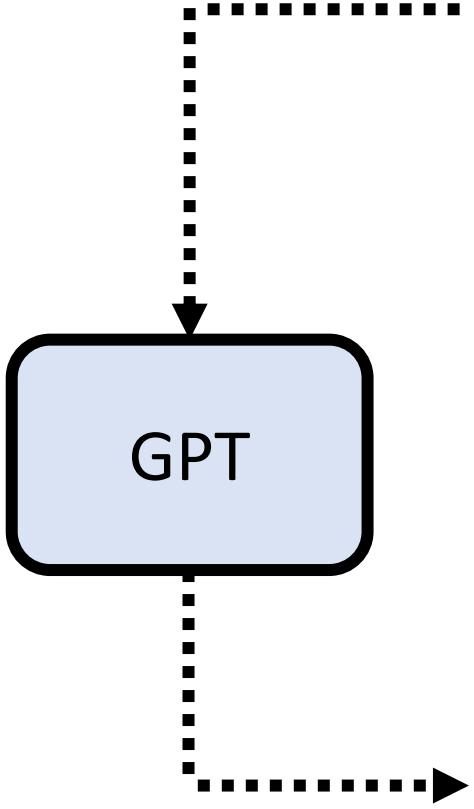
GPT-3



https://arxiv.org/abs/2005.14165

Average of **42** tasks

GPT-3



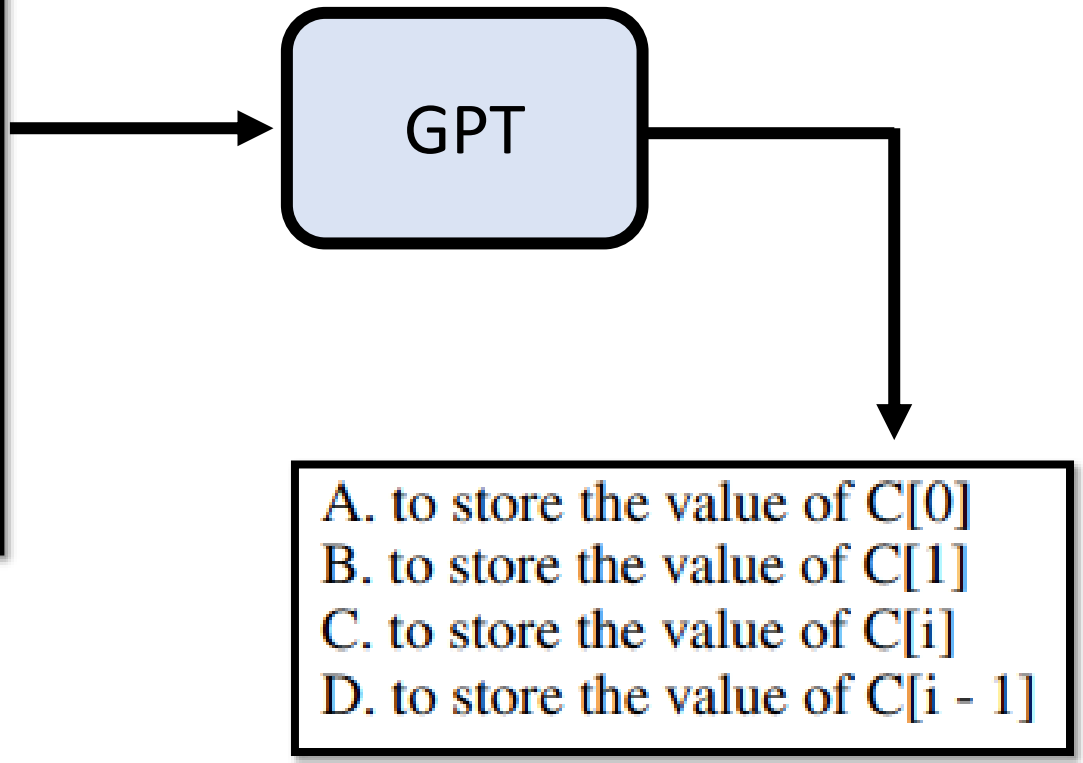
有機會根據指令寫程式!

```
# 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 /
```

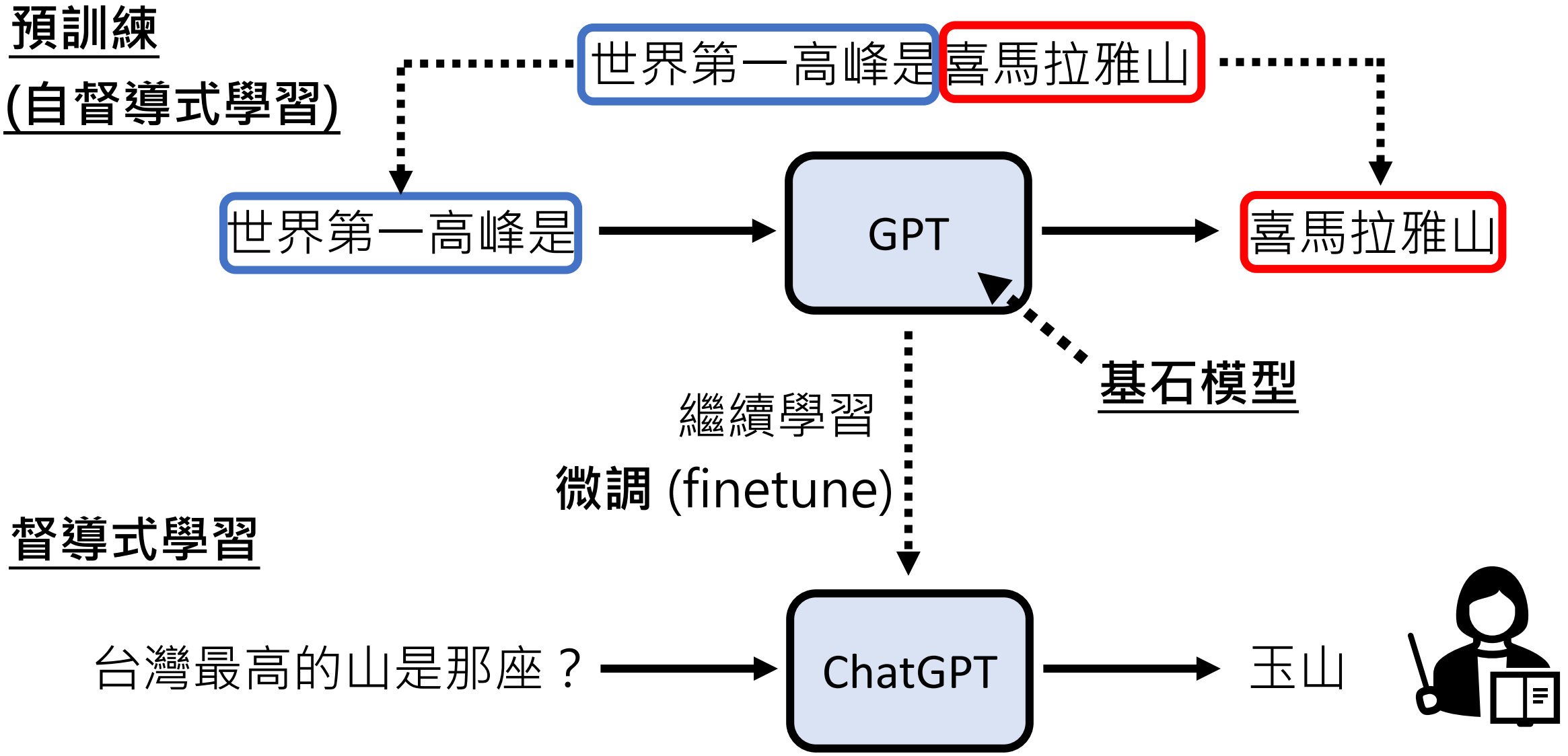
GPT 只從網路資料學習的缺點

What is the purpose of the list C in the code below?

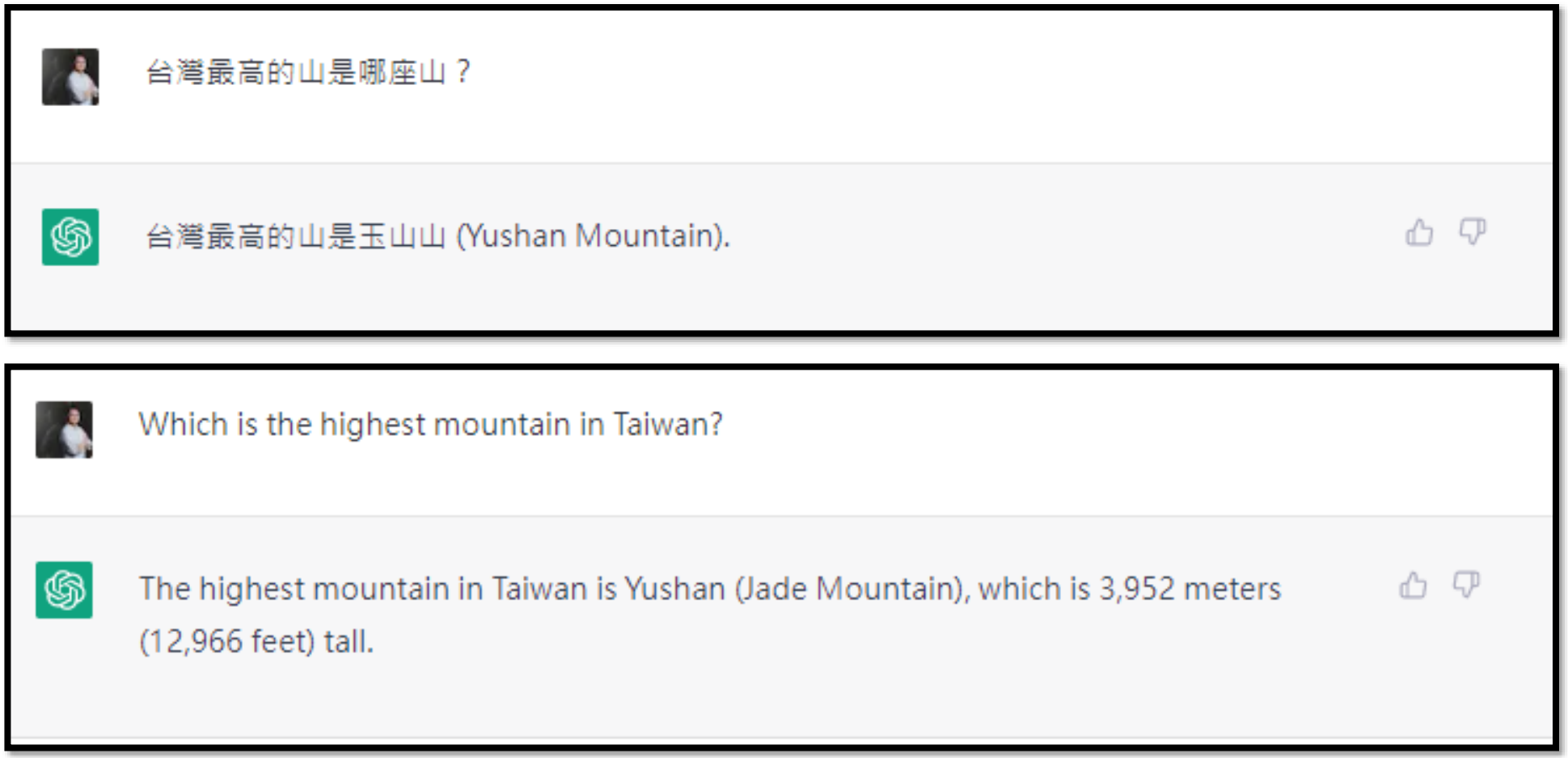
```
def binomial_coefficient(n, r):
    C = [0 for i in range(r + 1)];
    C[0] = 1;
    for i in range(1, n + 1):
        j = min(i, r);
        while j > 0:
            C[j] += C[j - 1];
            j -= 1;
    return C[r]
```



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


預訓練
(自督導式學習)
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
基石模型
繼續學習
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？

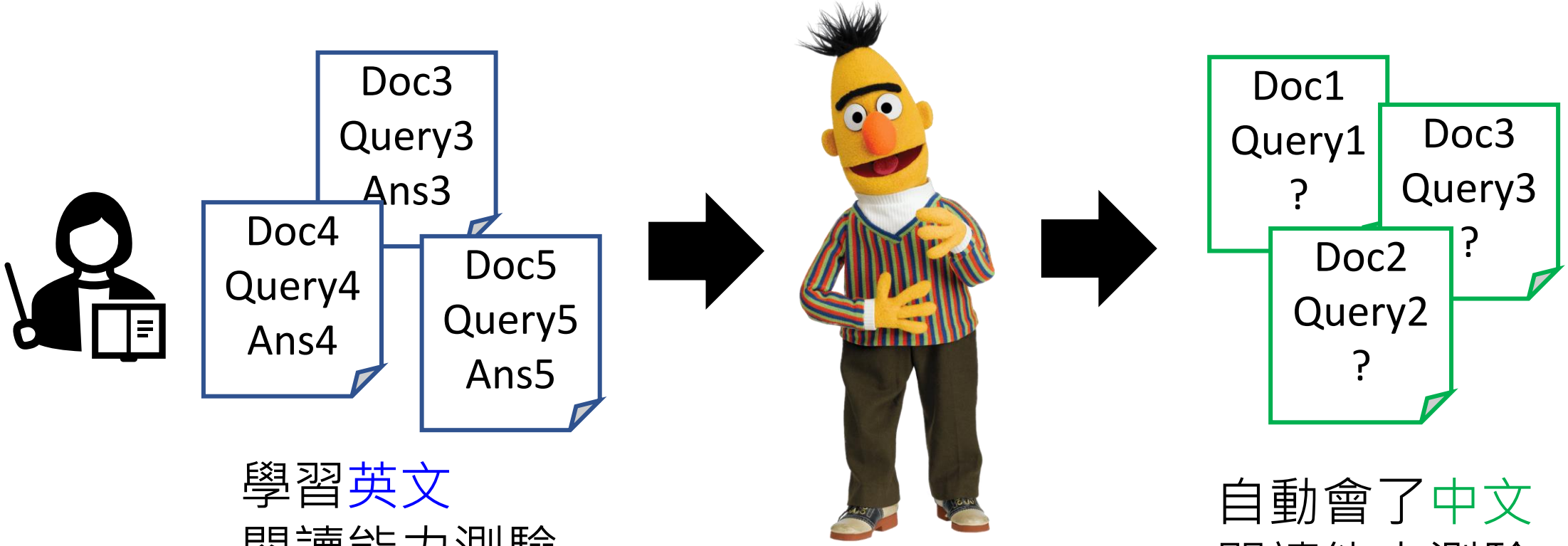


也許人類老師並不需要教所有語言

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



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%

This work is done by 劉記良、許宗嫄
https://arxiv.org/abs/1909.09587

預訓練

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

督導式學習

台灣最高的山是那座？ → ChatGPT → ……

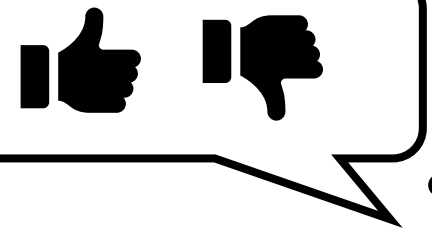
「玉山」

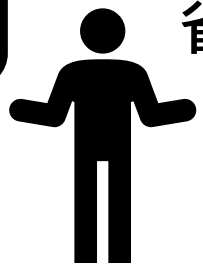
辛苦

增強式學習

(Reinforcement Learning, RL)

請幫我寫詩讚美AI → ChatGPT → ……





省力

偶爾你可以觀察到前世 (預訓練) 的記憶

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