Intro to GPT & X-shot learning

GPT & Benchmarks

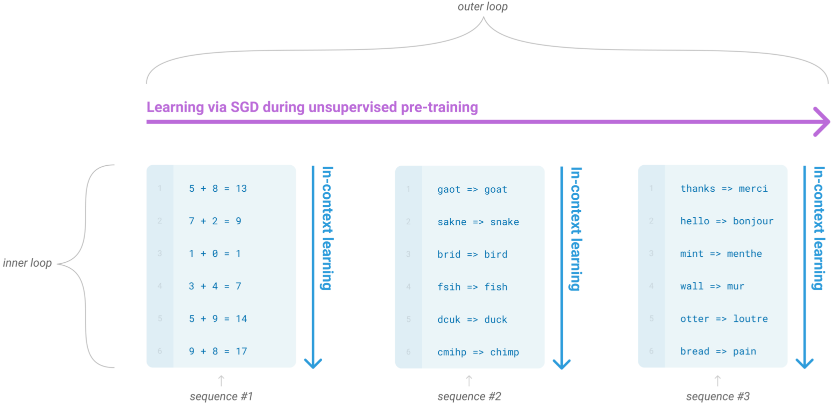
Learning goals

- Recap GPT and the ideas behind standard language modelling
- Understand the difference between fine-tuning and X-shot learning

GPT

- Like BERT, GPT is a language model.
- But not MLM, but a conventional language model: it predicts the next word (or subword).
- Like BERT, GPT is trained on a huge corpus, actually an even huger corpus.
- Like BERT, GPT is a transformer architecture.
- Difference 1: GPT is a single model that aims to solve all tasks.
    - It can also switch back and forth between tasks and solve tasks within tasks, another human capability that is important in practice. “fluidity”
- Difference 2: GPT leverages task descriptions.
- Difference 3: GPT is effective at few-shot learning.

GPT: TWO TYPES OF LEARNING

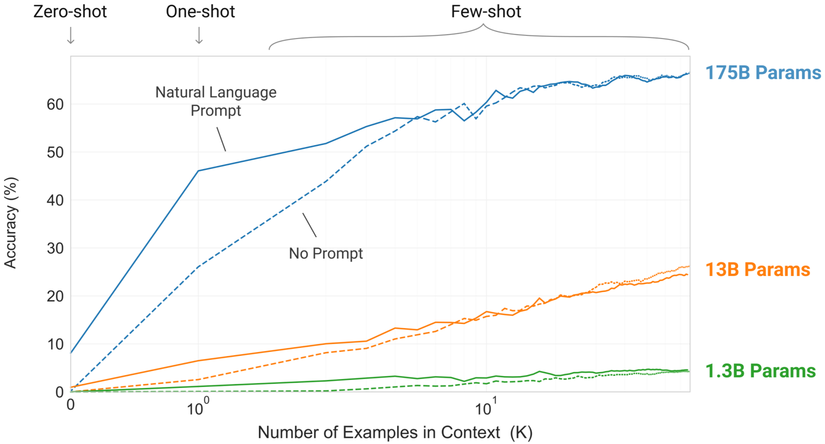


```
5 + 8 = 13
7 + 2 = 9
1 + 0 = 1
3 + 4 = 7
5 + 9 = 14
9 + 8 = 17
```

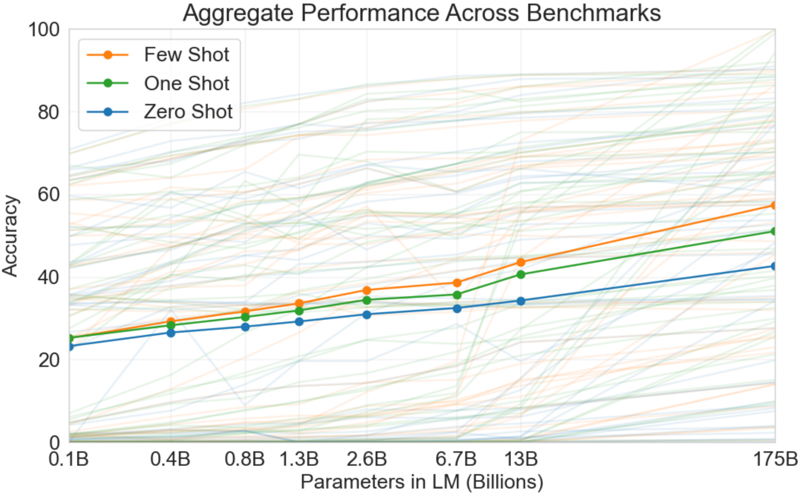
```
gaot => goat
sakne => snake
brid => bird
fsih => fish
dcuk => duck
cmihp => chimp
```

```
thanks => merci
hello => bonjour
mint => menthe
wall => mur
otter => loutre
bread => pain
```

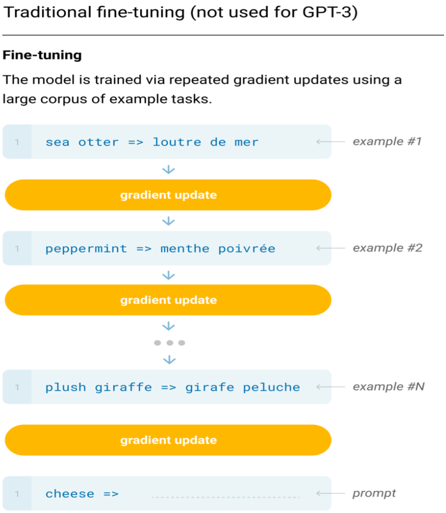
GPT: EFFECTIVE IN-CONTEXT LEARNING



X-SHOT COMPARISON AND EFFECT OF LARGER CORPORA



FINE-TUNING (NOT USED BY GPT)



Traditional fine-tuning (not used for GPT-3)

Fine-tuning

The model is trained via repeated gradient updates using a large corpus of example tasks.

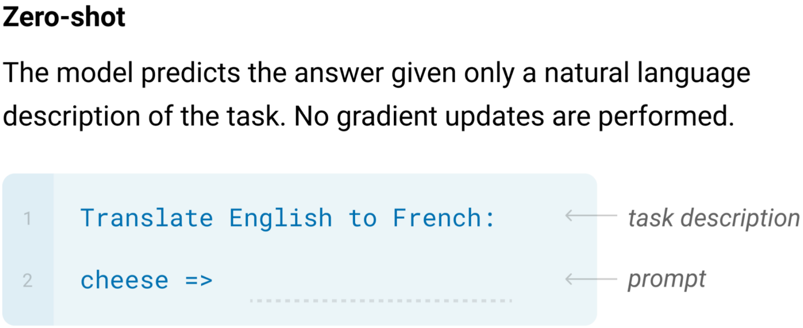
```
sea otter => loutre de mer
```

```
peppermint => menthe poivrée
```

```
plush giraffe => girafe peluche
```

```
cheese =>
```

ZERO-SHOT (NO GRADIENT UPDATE)

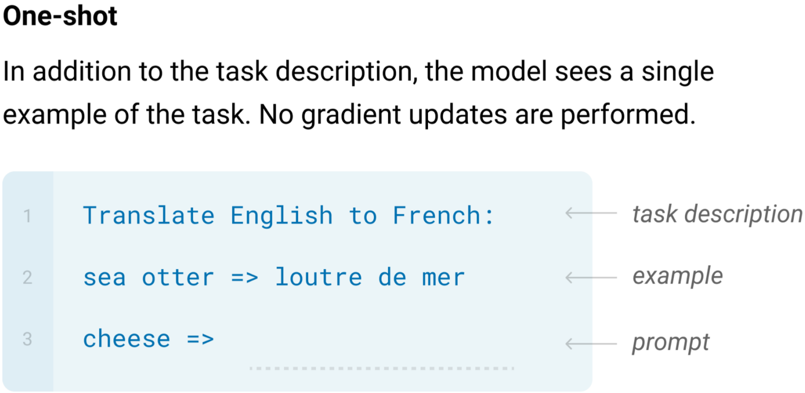


Zero-shot

The model predicts the answer given only a natural language description of the task. No gradient updates are performed.

```
Translate English to French:
cheese =>
```

ONE-SHOT (NO GRADIENT UPDATE)

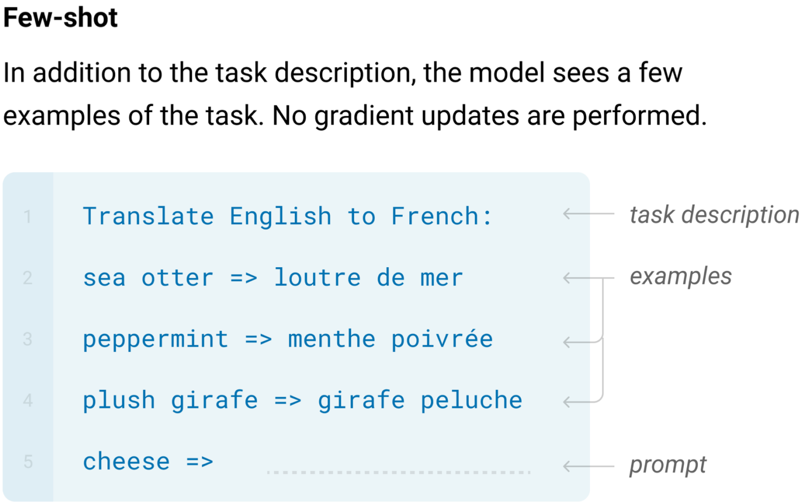


One-shot

In addition to the task description, the model sees a single example of the task. No gradient updates are performed.

```
Translate English to French:
sea otter => loutre de mer
cheese =>
```

FEW-SHOT (NO GRADIENT UPDATE)



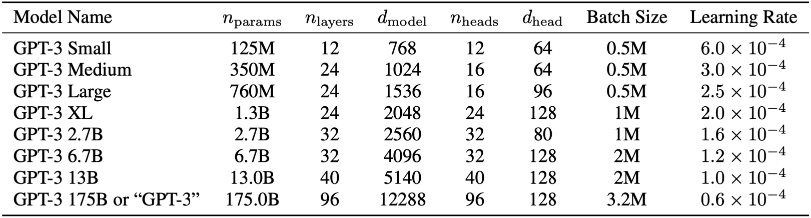
Few-shot

In addition to the task description, the model sees a few examples of the task. No gradient updates are performed.

```
Translate English to French:
sea otter => loutre de mer
peppermint => menthe poivrée
plush girafe => girafe peluche
cheese =>
```

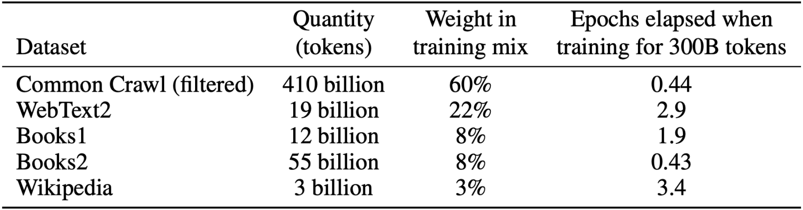
task description
examples
prompt

ARCHITECTURE



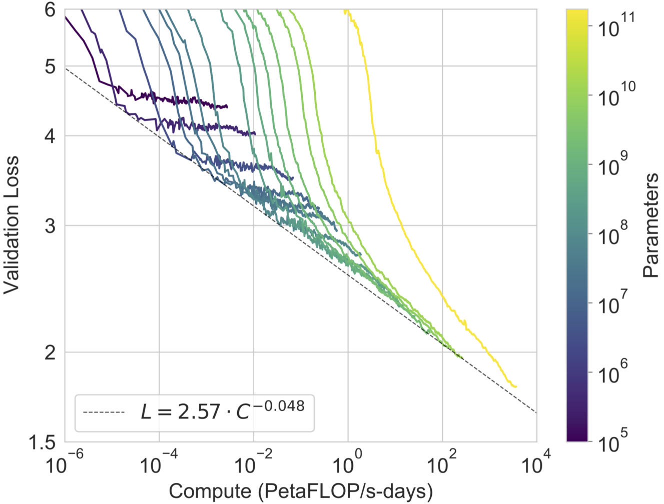
Model Name	n_{params}	n_{layers}	d_{model}	n_{heads}	d_{head}	Batch Size	Learning Rate
GPT-3 Small	125M	12	768	12	64	0.5M	6.0×10^{-4}
GPT-3 Medium	350M	24	1024	16	64	0.5M	3.0×10^{-4}
GPT-3 Large	760M	24	1536	16	96	0.5M	2.5×10^{-4}
GPT-3 XL	1.3B	24	2048	24	128	1M	2.0×10^{-4}
GPT-3 2.7B	2.7B	32	2560	32	80	1M	1.6×10^{-4}
GPT-3 6.7B	6.7B	32	4096	32	128	2M	1.2×10^{-4}
GPT-3 13B	13.0B	40	5140	40	128	2M	1.0×10^{-4}
GPT-3 175B or “GPT-3”	175.0B	96	12288	96	128	3.2M	0.6×10^{-4}

TRAINING CORPUS



Dataset	Quantity (tokens)	Weight in training mix	Epochs elapsed when training for 300B tokens
Common Crawl (filtered)	410 billion	60%	0.44
WebText2	19 billion	22%	2.9
Books1	12 billion	8%	1.9
Books2	55 billion	8%	0.43
Wikipedia	3 billion	3%	3.4

LOSS AS A FUNCTION OF COMPUTE


Validation Loss
10^{-6}
10^{-4}
10^{-2}
10^{0}
10^{2}
10^{4}
Compute (PetaFLOP/s-days)
$L = 2.57 \cdot C^{-0.048}$
10^{11}
10^{10}
10^{9}
10^{8}
10^{7}
10^{6}
10^{5}
Parameters