

Fine-tuning LM and Alpaca

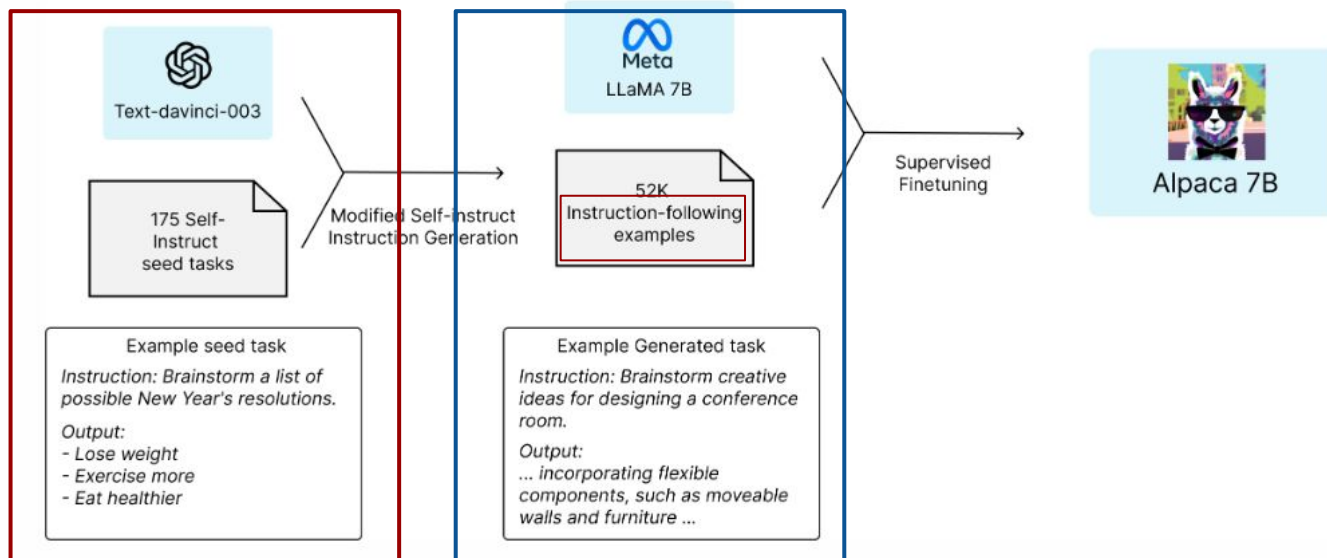
Data Networks Lab

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“Alpaca” Overview

Hugo Touvron, Thibaut Lavril, Gautier Izacard , et al. “LLaMA: Open and Efficient Foundation Language Models”. ArXiv. 2023.
Rohan Taori and Ishaan Gulrajani, et al. “Stanford Alpaca: An Instruction-following LLaMA model”. GitHub. 2023.

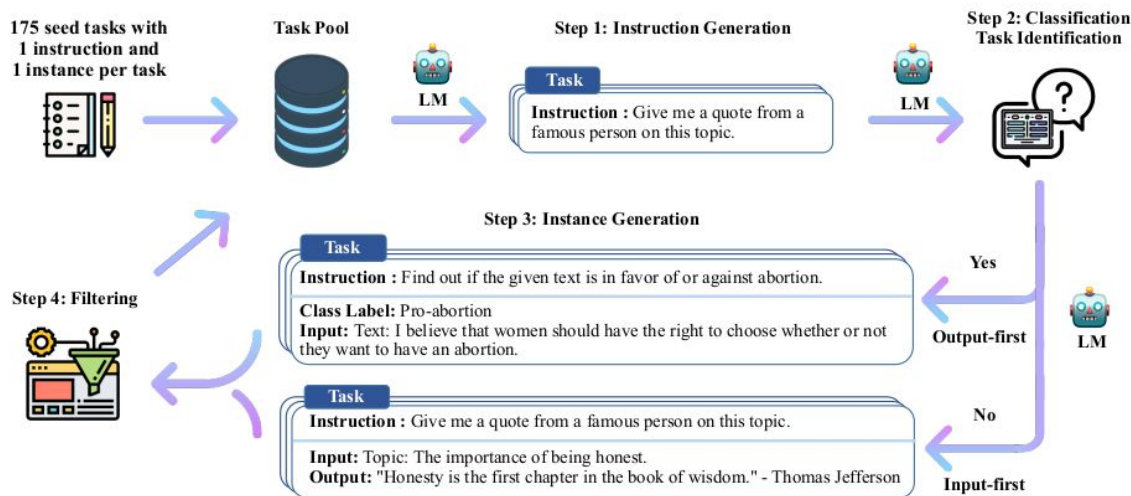
- LLaMA - an open-source large language model trained on trillions of tokens.
- Alpaca - a LLM **fine-tuned** from the **LLaMA 7B** model on **52K** instructions:
 - **52K** unique instructions were generated from **175** human-written instruction-output pairs
 - Cost-efficient: the research cost totaled **<600\$ (OpenAI API + cloud GPU)**
 - Application: allows to train affordable instruction-following language model for specific tasks



Overview of Alpaca training process

Instruction Generation: Self-Instruct

- Self-Instruct: Aligning Language Model with Self Generated Instructions
 - Pretrained language models can be prompted to generate new and novel instructions when presented with instructions in the context
 - For every step, 8 task instructions were sampled from the pool (6 human-written tasks, and 2 model-generated tasks)



A high-level overview of SELF-INSTRUCT

Instruction Generation - results

```
{"id": "seed_task_87", "name": "behavioral_interview",  
"instruction": "Suppose you are interviewing with Amazon, write  
an answer to the behavioral question.", "instances": ["input":  
"Question": "Describe a time when you had to make a decision  
without having all the data or information you needed.",  
"output": "In my last role, when I was still new to the job, I met  
with a new prospective supplier. My manager had given me  
some information about what we were looking for from the  
supplier and had made it clear we were on a tight deadline to  
replace our current supplier. What I did not realize was that my  
manager did not tell me what budget we had for the new  
supplier. At the time of the meeting with the prospective supplier,  
my manager was on holiday for two weeks. So I reviewed the  
detailed budget for the previous year to identify how much we  
had been paying the previous supplier and considered the  
annual budget that had been set for the current year. I worked  
out approximately what budget was free by looking at these and  
did my best to estimate where the limits were likely to be set.  
Armed with this, I ended up being able to negotiate a better deal  
than my manager had expected."}], "is_classification": false
```

Alpaca seed tasks example



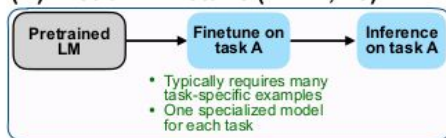
```
"instruction": "Describe a time when you had to  
make a difficult decision.",  
"input": "",  
"output": "I had to make a difficult decision  
when I was working as a project manager at a  
construction company. I was in charge of a  
project that needed to be completed by a certain  
date in order to meet the client's  
expectations. However, due to unexpected  
delays, we were not able to meet the deadline  
and so I had to make a difficult decision. I  
decided to extend the deadline, but I had to  
stretch the team's resources even further  
and increase the budget. Although it was a risky  
decision, I ultimately decided to go ahead with it  
to ensure that the project was completed on time  
and that the client's expectations were  
met. The project was eventually successfully  
completed and this was seen as a testament to  
my leadership and decision-making abilities."
```

Result of self-generated instructions

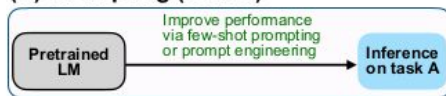
FLAN - Finetuned Language Models Are Zero-Shot Learners

“ Instruction tuning substantially improves **zero-shot performance** on unseen tasks”

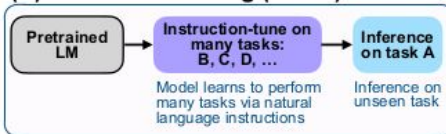
(A) Pretrain–finetune (BERT, T5)



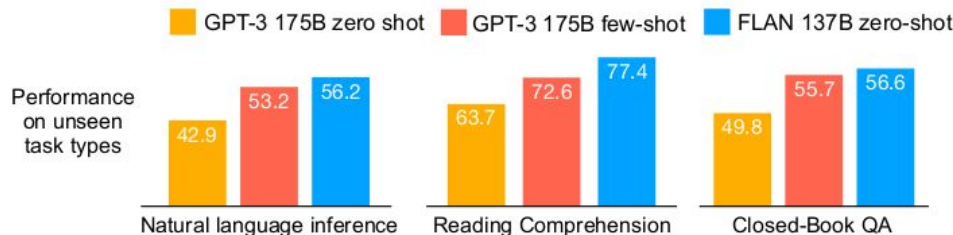
(B) Prompting (GPT-3)



(C) Instruction tuning (FLAN)



Comparing instruction tuning with pretrain–finetune and prompting



In contrast to prompt learning, instruction fine-tuning model is explicitly instructed to generate text in a specific format.

This allows to enforce **constraints on generated text** and when faced with unseen tasks, the model generates better response by following the instructions.

Key takeaways:

- Transfer knowledge learned from related tasks to the target task
- Provided with structured training data, this approach can improve the model's performance

FLAN - Finetuned Language Models Are Zero-Shot Learners

62 text datasets that are publicly available on Tensorflow Datasets:

- 12 task clusters, including both language understanding and language generation tasks (NLU and NLG)

10 unique templates for each dataset:

- 3 templates are “**inversions of the original task**” was used to diversify the templates:
- Instead of movie sentiment classification, expressing a sentiment by generating a movie review

Fine-tuning the pretrained language model(**LaMDA-PT 137B**) on a mixture of datasets using randomly selected instruction templates. The examples of each dataset are formatted using instruction templates

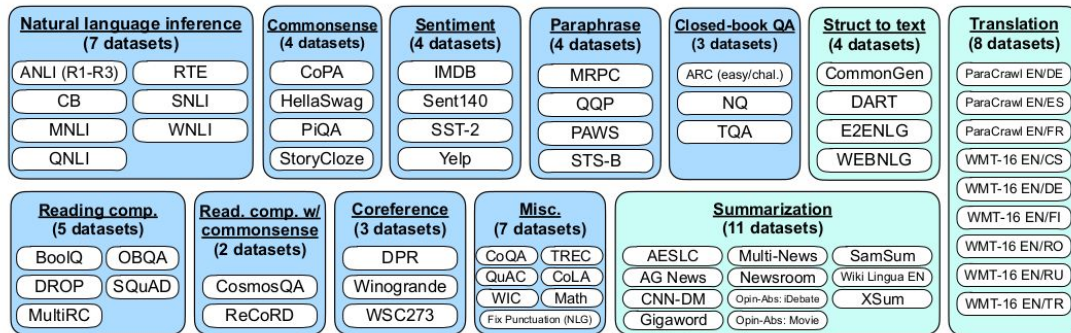


Figure 3: Datasets and task clusters used in this paper (NLU tasks in blue; NLG tasks in teal).

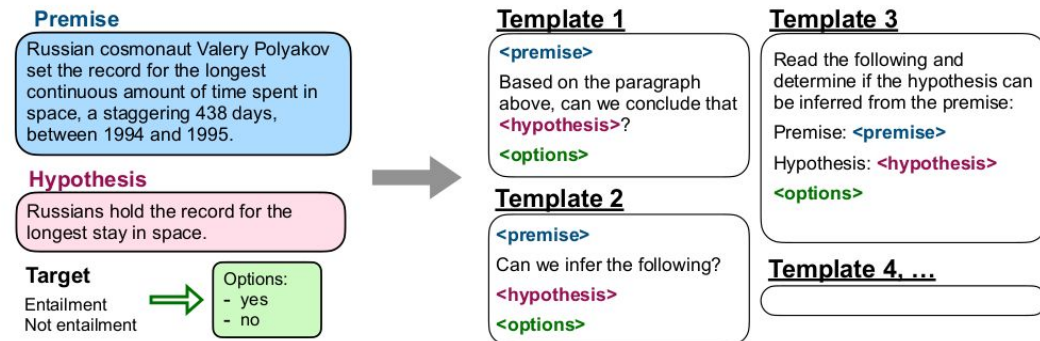


Figure 4: Multiple instruction templates describing a natural language inference task.

FLAN performance results and challenges

Zero-shot FLAN outperforms:

- **zero-shot GPT-3** on **20** of **25** datasets and even surpasses **GPT-3's few-shot** performance on **10** datasets.
- **zero-shot GLaM** on **13** of **19** available datasets
- **one-shot GLaM** on **11** of **19** datasets.

Challenge: Depends heavily on **human-written instruction data**, which is limited in quantity, versatility and creativity.

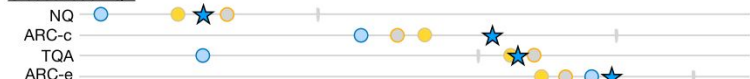
Natural language inference



Reading comprehension



Closed-book QA



Translation

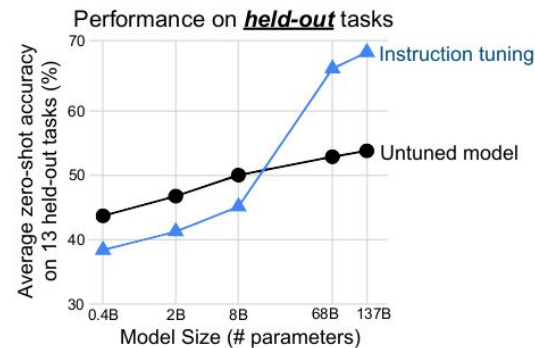
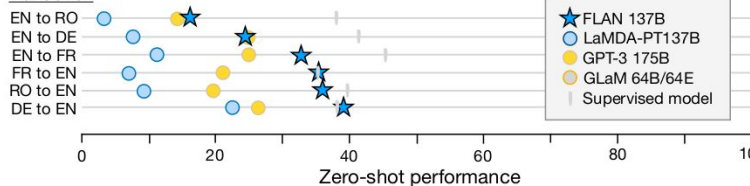


Figure 7: Whereas instruction tuning helps large models generalize to new tasks, for small models it actually hurts generalization to unseen tasks, potentially because all model capacity is used to learn the mixture of instruction tuning tasks.

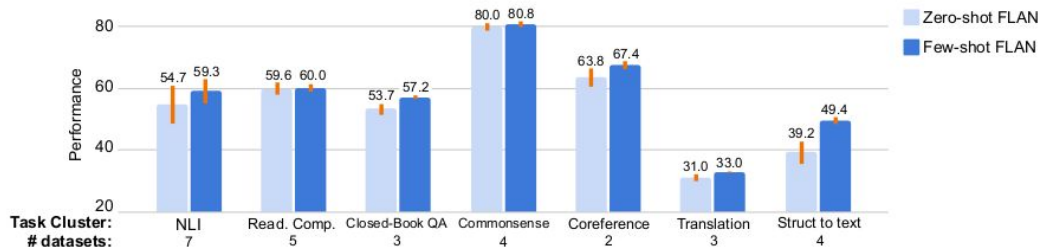
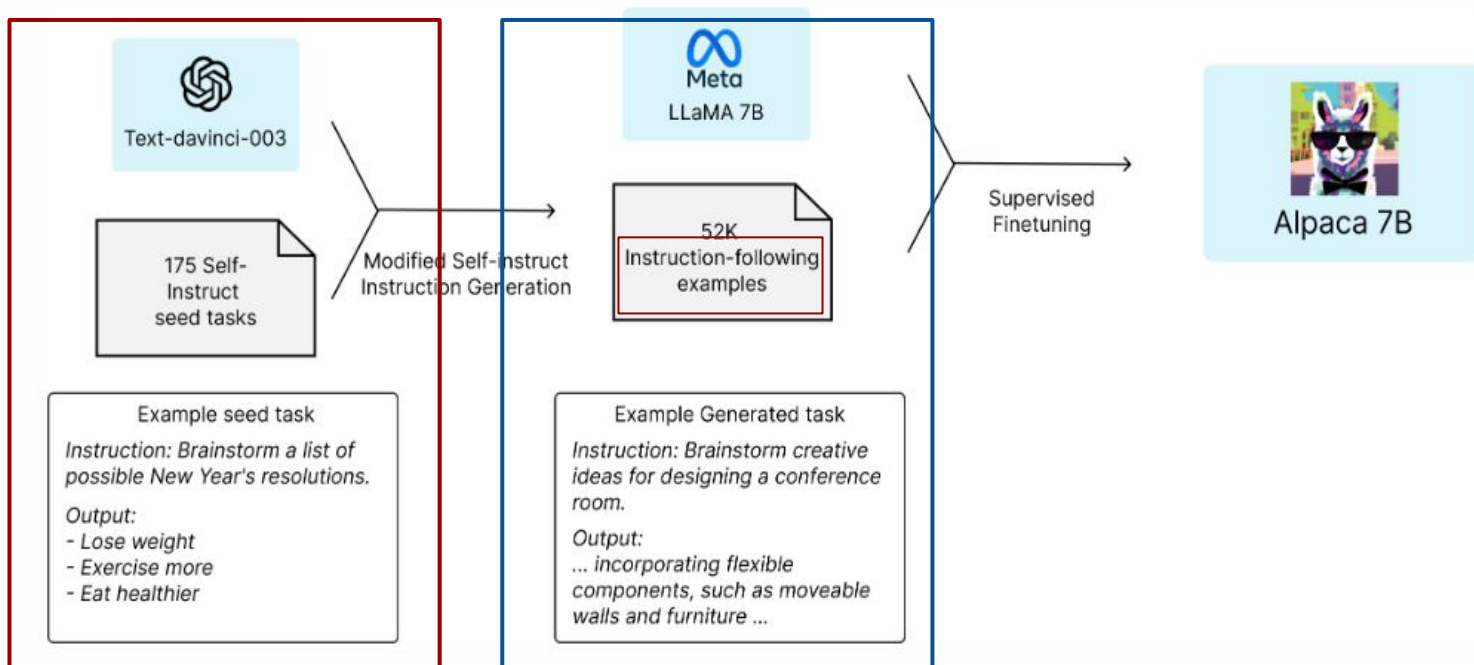


Figure 9: Adding few-shot exemplars to FLAN is a complementary method for improving the performance of instruction-tuned models. The orange bars indicate standard deviation among templates, averaged at the dataset level for each task cluster.

Advantages of Self-Instruct

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- By using self-instruct method, we can generate unique and diverse instruction tasks without the need of large datasets for training



Overview of Alpaca training process

Total cost

Fine-tuning LLaMA 7B - over 100 GB of VRAM (varies depending on GPU model and train time):

- GPU: 8, 80GB A100s
- Time: 3 hours
- Cost: 100\$
- Cost of OpenAI API < 500\$

To reduce the memory required for training - PEFT, LoRA, LLaMA-Adapter, etc. are used;