

In-Context Learning

Instruction Fine-Tuning & In-Context Learning

- (Instruct FT) & (ICL)

- Instruction

What is the sentiment of this?

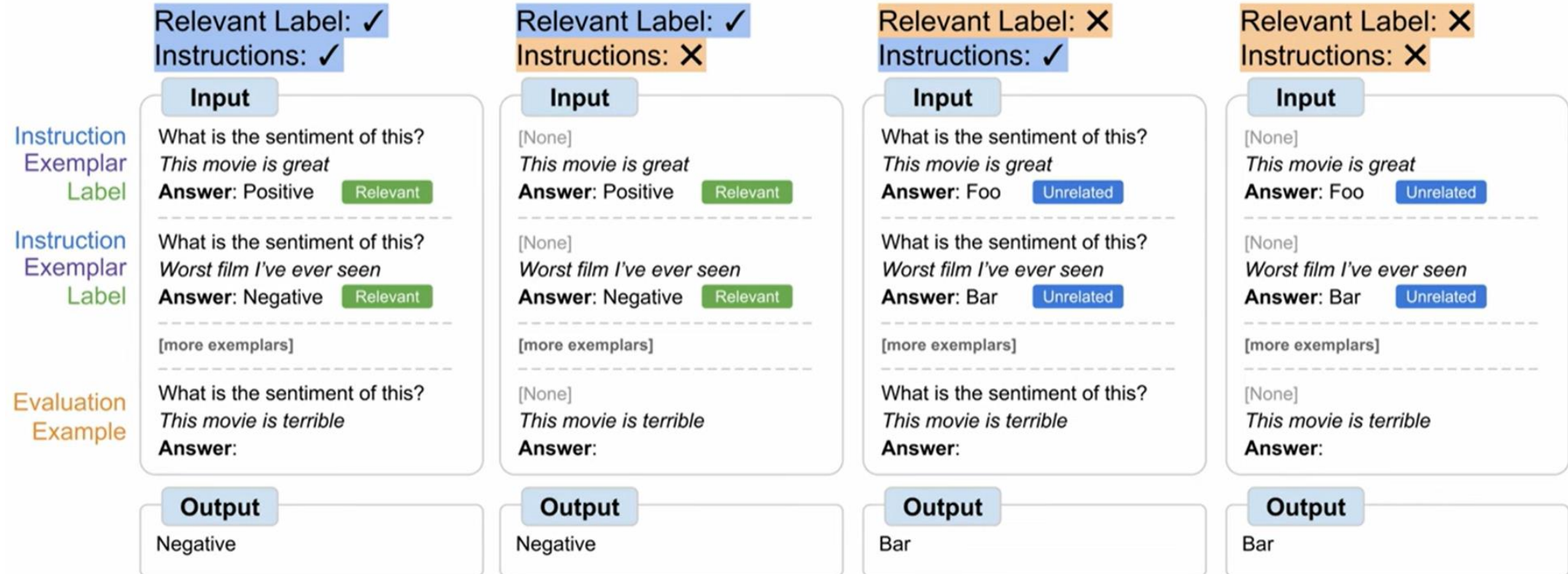
- Exemplar

The movie is great

- Label

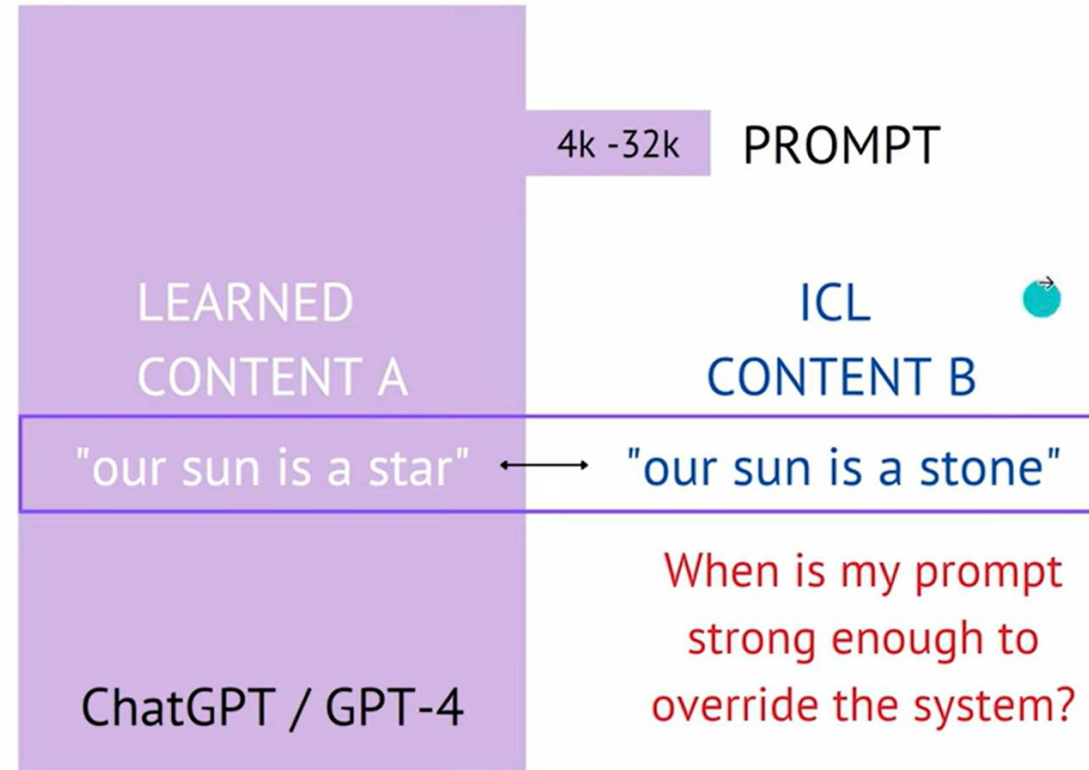
Positive | 1 | +

Instruction Fine-Tuning & In-Context Learning

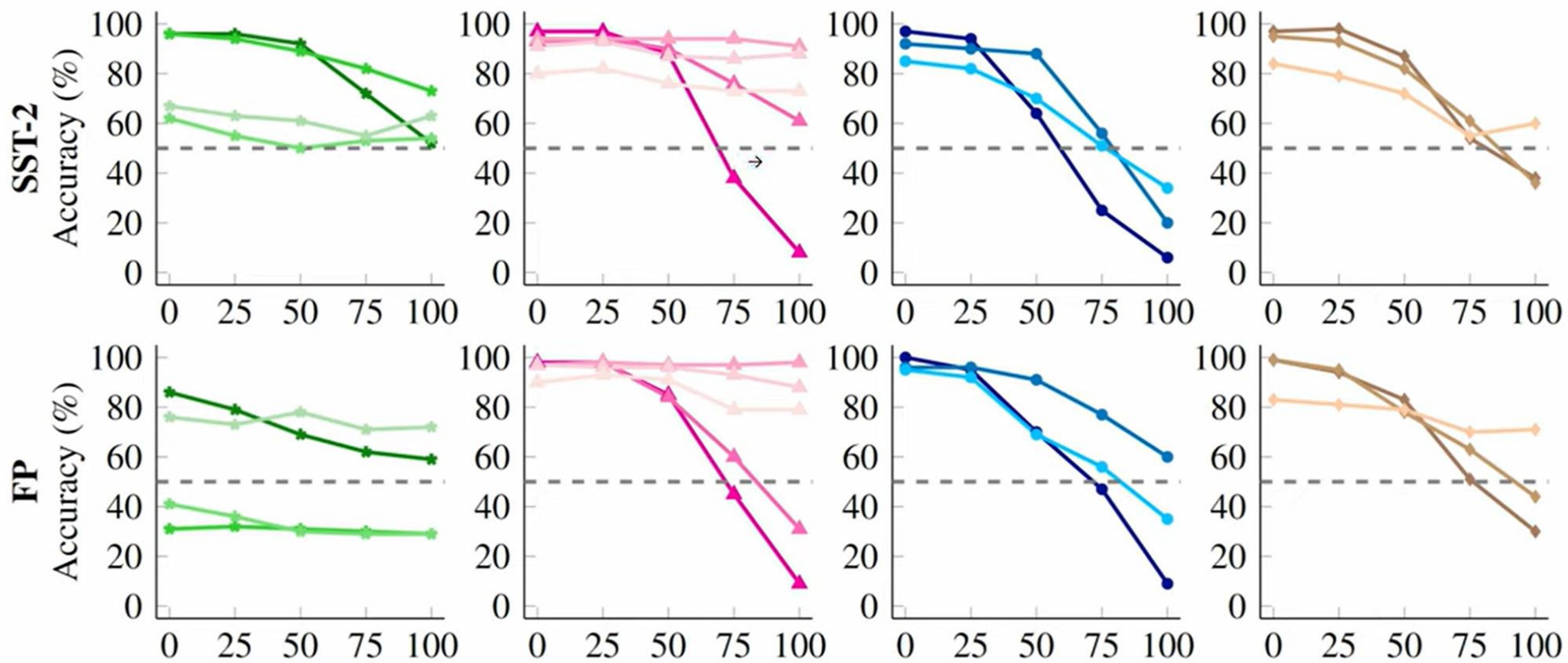


Instruction Fine-Tuning & In-Context Learning

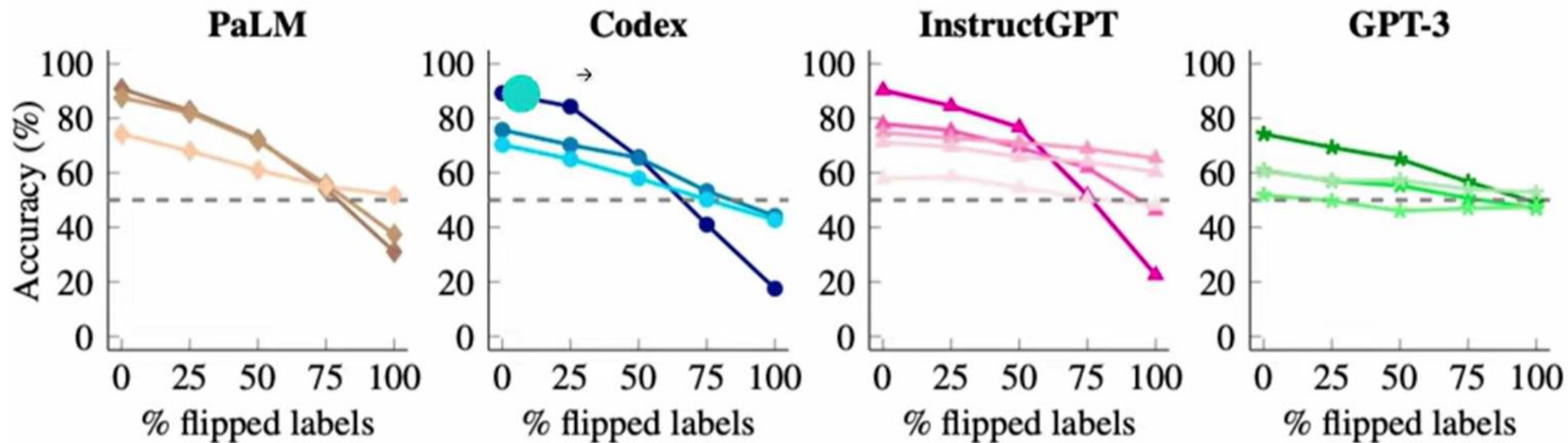
- Flipped-label ICL
- SUL-ICL
- Larger models > Smaller models



Flipped-label ICL



Flipped-label ICL



In-Context Learning

- What about ICL PROMPT content overrides?

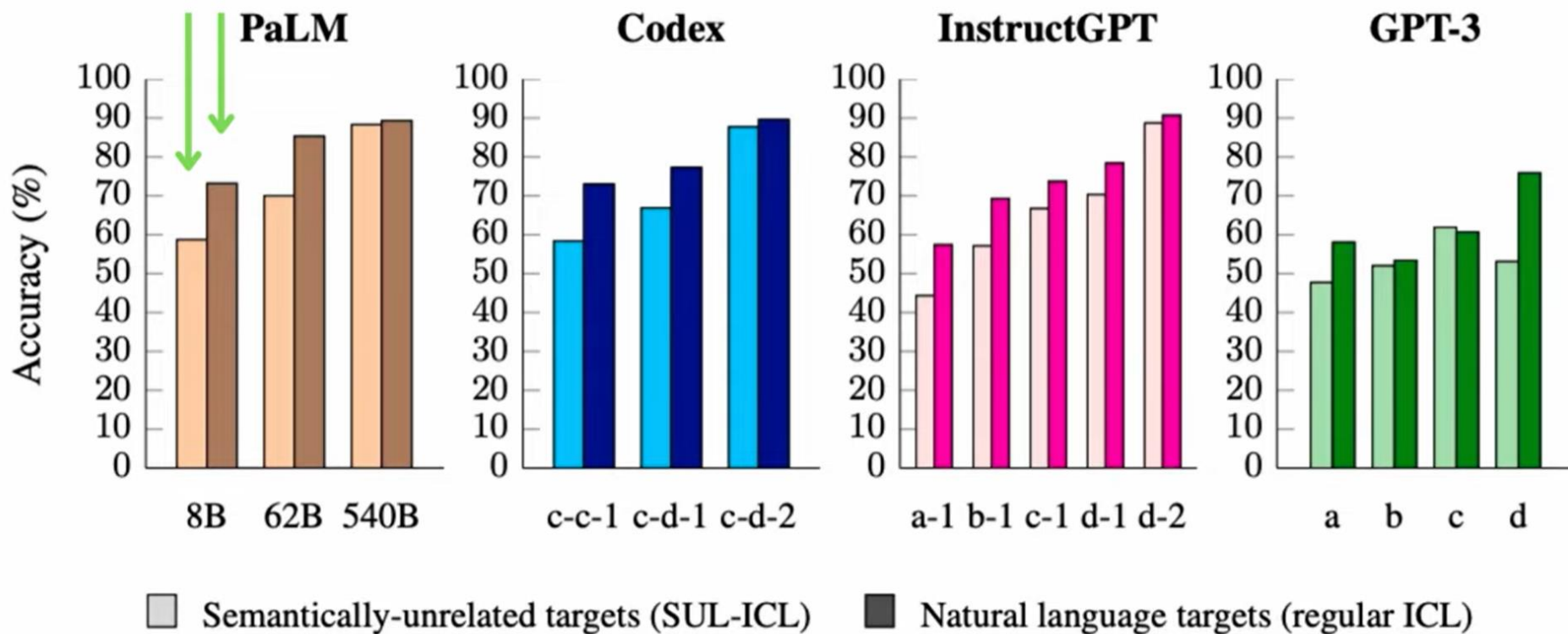
- | | | |
|---------------|----|---------------|
| • Weights | vs | Activations |
| • Fine-tuning | vs | Prompt-tuning |

- What about combination of two approaches?

In-Context Learning

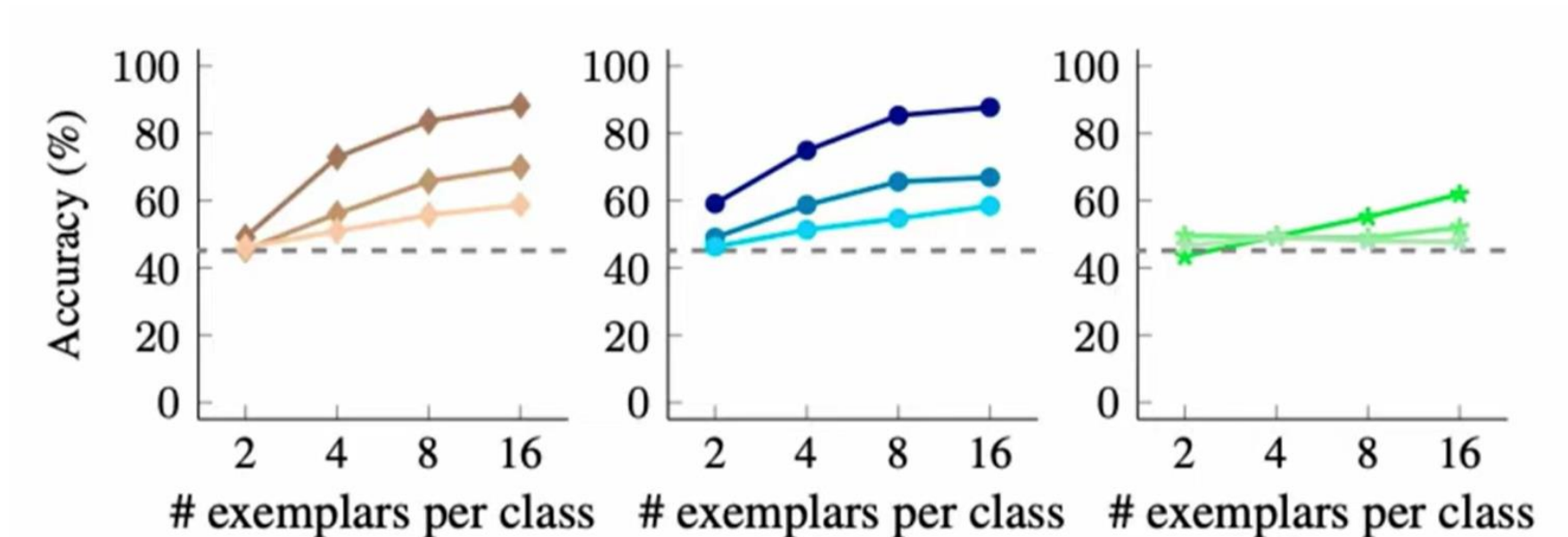
- Papers:
 - In-Context Retrieval-Augmented Language Models
 - What Learning Algorithms is In-Context Learning? Investigating With Linear Models
 - Large Language Models Do In-Context Learning Differently
 - Symbol Tuning Improves In-Context Learning in Language Models

Semantically-unrelated targets ICL



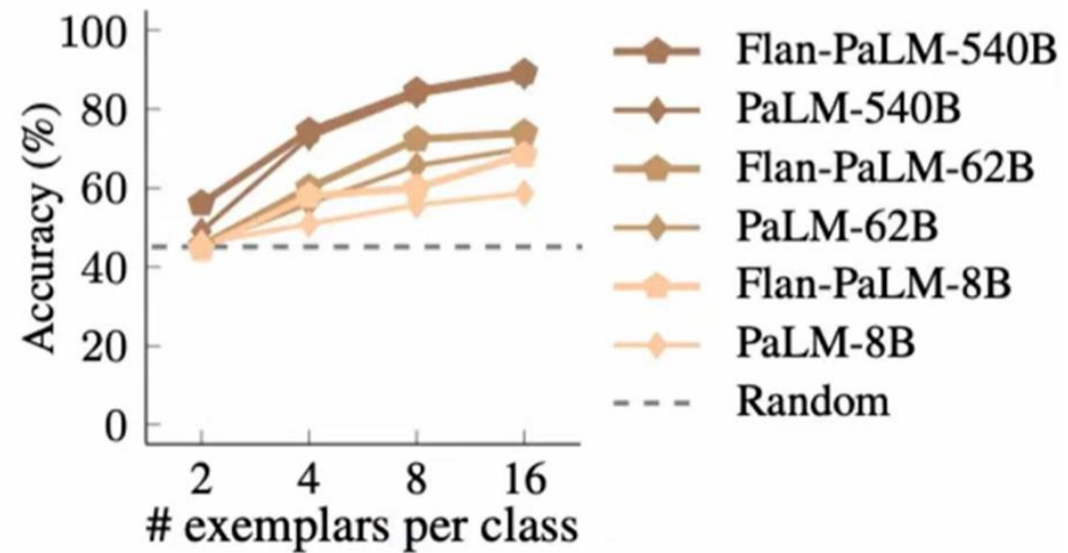
Semantically-unrelated targets ICL

- Small models rely more on semantic priors
- Large models have the ability to learn input-label mapping in-context when the semantic nature of label is removed.
- The effect of number of examples



Instruction tuning

- Learning input-label mappings vs Semantic prior knowledge
 - Which one is stronger?
- More confident on their inherent instruction fine-tuned knowledge



Symbol tuning

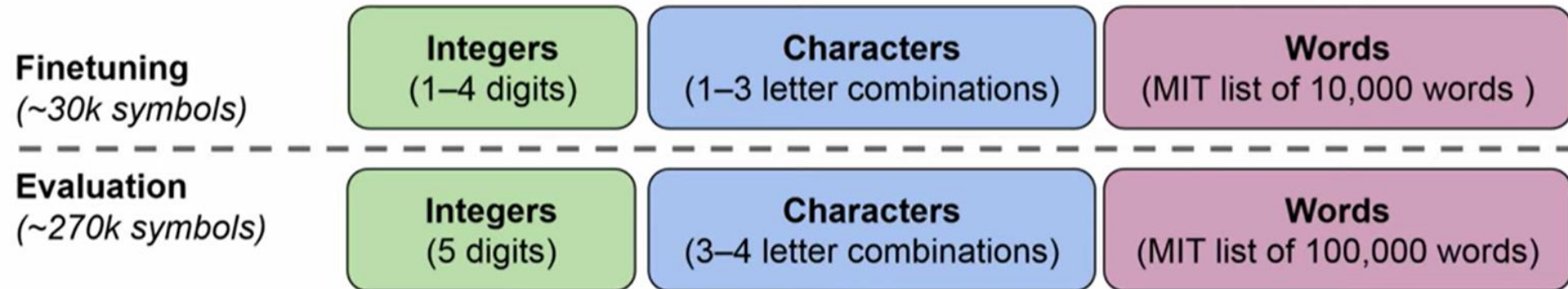
- A form of fine-tuning on input-label pairs where labels are remapped to arbitrary symbols
- Symbol tuning: Remove instructions, change labels to unrelated symbols. Task can only be learned from exemplars.

Symbol tuning

Dataset	Instruction
SUBJ	“Is the following sentence subjective or objective?”
TEH	“Label the following tweet based on whether it contains hate speech.”
TEAB	“Read the following tweet and determine its stance on abortion.”
TEAT	“Read the following tweet and determine its stance on atheism.”
TEFE	“Read the following tweet and determine its stance on feminism.”
TEHI	“Read the following tweet and determine its stance on Hillary Clinton.”
ADEC	“Label the following sentence based on whether it is related to an adverse drug event.”
OR	“Label the following sentence based on whether it is overruling or not.”
SOT	“Read the following paper title and institution name and classify the institution as a university, company, or research institute.”
TOS	“Label the following sentence from a Terms of Service based on whether it is potentially unfair.”
TC	“Label the following tweet text based on whether it contains a complaint.”

Symbol tuning

- Which symbol to use?



Symbol tuning

- Which symbol to use?

Model	Algorithmic Reasoning		In-Context Learning				
	Turing Concepts	List Functions	Flipped Labels	Relevant Target + Instruction	Relevant Target + No Instruction	No Relevant Target + Instruction	No Relevant Target + No Instruction
Random Guessing	0	0	50	42.4	42.4	42.4	42.4
Flan-PaLM-8B	17.6	19.2	26.5	63.9	61.6	42.4	44.2
+ Symbol tuning (integers)	34.1	38.1	33.3	66.9	65.5	54.0	53.5
+ Symbol tuning (characters)	32.9	32.7	34.3	63.5	61.8	56.7	54.7
+ Symbol tuning (words)	52.9	42.5	54.8	60.6	56.6	56.9	54.9
Flan-PaLM-62B	61.2	56.1	23.8	74.3	70.0	57.0	50.5
+ Symbol tuning (integers)	75.3	64.4	30.7	74.4	70.4	65.4	52.7
+ Symbol tuning (characters)	72.9	64.5	33.5	76.9	70.1	70.8	59.4
+ Symbol tuning (words)	78.8	68.9	54.2	77.3	73.4	71.4	60.7

Symbol tuning

- Prompt Formats

- “Input: [input] \n Output: [label]”
- “Input: [input] \n Target: [label]”
- “Input: [input] \n Symbol: [label]”
- “Input: [input] \n Label: [label]”
- “Question: [input] \n Answer: [label]”
- “Student: [input] \n Teacher: [label]”
- “X = [input] \n Y = [label]”
- “Q: [input] \n A: [label]”
- “[input] -> [label]”
- “Sentences: [input] \n Mapped To: [label]”

Symbol tuning prompts

- Prompt containing $k = 2$ In-context examples per class. The original labels [“entailment”, “not entailment”] have been remapped to [“4348”, “forests”]

Prompt:

Input: In the May 2005 general election Michael Howard failed to unseat the Labour Government, although the Conservatives did gain 33 seats, playing the most significant role in reducing Labour’s majority from 167 to 66.

In the May 2005 general election Conservatives got 33 seats.

Output: forests

Prompt:

X = Which restaurant did Madonna work in New York City?.

In 1978, she dropped out of college and relocated to New York City.

Y = 8529

Symbol tuning results

	Average performance on eleven tasks			
Relevant labels:	✓	✓	✗	✗
Task instructions:	✓	✗	✓	✗
Random Guessing	42.4	42.4	42.4	42.4
Flan-PaLM-8B	63.9	61.6	42.4	44.2
+ Symbol tuning (ours)	57.6 (-6.3)	54.3 (-7.3)	58.2 (+15.8)	52.8 (+8.6)
Flan-PaLM-62B	74.3	70.0	57.0	50.5
+ Symbol tuning (ours)	75.5 (+1.2)	70.8 (+0.8)	71.4 (+14.4)	60.3 (+9.8)
Flan-cont-PaLM-62B	77.3	70.3	56.3	51.0
+ Symbol tuning (ours)	78.9 (+1.6)	74.5 (+4.2)	71.8 (+15.5)	62.1 (+11.1)
Flan-PaLM-540B	82.2	77.4	70.7	58.1
+ Symbol tuning (ours)	84.4 (+2.2)	78.8 (+1.4)	80.0 (+9.3)	63.6 (+5.5)

Symbol tuning

- It works best when relevant labels are unavailable
- The symbol tuning can allow much smaller models to perform as well as large models
- Potential of improvements especially when tasks are not clear
- For small models when the task is clear the performance decreases
 - This may suggest that symbol tuning can override its prior knowledge

Symbol tuning

- Symbol tuning is based on the intuition that when models cannot use instructions or relevant labels, it must do so by instead learning from in-context exemplars.
- Much better on algorithmic tasks...