

Group 12

Mid Review Report

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In the Mid Review, we wanted to explore different Fine tuning Techniques to adapt LLMs to our downstream tasks

We majorly tried out :

- LORA (Low-Rank Adaption) Fine tuning
- Prompt Tuning
- Prefix Tuning

Models Used :

- Mistral 8x-7b - Instruct hf
- LLama 3.1-8b - Instruct hf
- Gemma 7b

Note:

For LORA Fine tuning we used a hosted platform, Fireworks.ai, which supports LoRA fine tuning for the hosted models aforementioned. For prefix and prompt tuning, we were unable to find any cloud platforms, so we did it using Kaggle.

Results of LORA FineTuning:

MODELS \ DATASET	SVAMP	GSM8K
LLama 3.1-8b - Instruct hf	62.66666666666667%	40.9967845659164%
Mistral 8x-7b - Instruct hf	56.99999999999999%	48.421052631578945%
Gemma 7b	Not supported	Not supported

Metric : Accuracy

Prompt Tuning

We tried to prompt tune all 3 models on the SVAMP dataset. The following were the hyperparameters we used:

1. **Optimizer:** Adaptive Gradient Descent
2. **Learning Rate:** 5e-5
3. **Epochs:** 3
4. **Length of Soft Prompt:** 20 tokens

The model started hallucinating even more with the presence of the soft prompts which indicates that the soft prompts were unable to encode any useful information for the task.

Prefix Tuning

We tried to prefix tune all 3 models on the SVAMP dataset. We used the following parameters:

1. **Epochs:** 3
2. **Optimizer:** Adaptive Gradient Descent
3. **Learning Rate:** 1e-3
4. **Weight Decay:** 1e-4
5. **Length of Prefix:** 10

Once again we noticed more severe hallucinations with prefix tuning which indicated that the presence of the prefix was unable to encode any information that could be useful to the task.

Observation :

- We Observed Catastrophic Forgetting upon Fine tuning LLMs.
- During the prefix and prompt tuning procedure we noticed that though the training loss did reduce with each step, the response was completely unrelated to the prompt. This could be due to catastrophic forgetting or because the model was severely deviating from its initial causal LM objective.

Inference:

We mainly observe that all the models show Catastrophic Forgetting which means they all deviate from the knowledge that they were originally pre trained on. We believe that this could be due to the following reasons:

- **Limited Fine-Tuning Scope:** LoRA updates only a small portion of the model, which may not be enough for tasks requiring deep reasoning like SVAMP and GSM8K.
- **Task-Specific Mismatch:** These datasets require complex problem-solving and multi-step reasoning. LoRA, focusing on low-rank adaptations, lacks the in adjustment of weights of these tasks.
- **Insufficient Reasoning:** Baseline methods like COT and ReAct perform much better because they emphasize reasoning and logical steps, which LoRA fine-tuning does not directly ensure by tuning weights.
- **Dataset Complexity:** SVAMP and GSM8K involve complex logical and mathematical reasoning, which may require larger updates to the model than what LoRA provides.
- **Training Data Misalignment:** If the data used for LoRA fine-tuning was not aligned with the complexity of the tasks, it would result in the model underperforming on these specific datasets.
- **Few Epochs:** Due to memory and GPU limitations we were able to train only for a few epochs. Fine tuning for more epochs may lead to improvement in performance.