

Project Documentation

1. Project Goals

This project aims to develop a complete instruction-tuning pipeline for a lightweight language model, focusing on both performance and efficiency. The main objectives are:

- Fine-tune the `meta-llama/Llama-3.2-1B` model using **LoRA adapters** for parameter-efficient learning.
 - Improve model output quality using **Direct Preference Optimization (DPO)** with preference datasets.
 - Load and run the model in **4-bit precision** using `bitsandbytes` for efficient computation.
 - Generate responses to user instructions, comparing results from different training strategies.
 - Build a web-based frontend with **Streamlit** and **BeautifulSoup4** to support interactive querying and display.
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2. Technologies Used

Languages & Frameworks

- Python 3.x
- PyTorch
- Hugging Face Transformers
- LoRA (`peft`)
- DPO (`trl`)
- Streamlit
- BeautifulSoup4
- Bitsandbytes (for 4-bit quantization)

Environment

- **Runtime:** Google Colab
- **GPU:** L4 GPU (or equivalent)
- **Model Base:** `meta-llama/Llama-3.2-1B`
- **Model Hosting:** Hugging Face Model Hub

Key Libraries

bash

CopyEdit
transformers
peft
trl
bitsandbytes
streamlit
beautifulsoup4
pandas
torch

3. Project Outputs

The model generates answers to user-provided instructions and stores them in `.json` format. To evaluate the impact of different tuning strategies, the following outputs are compared:

- **Base Model Output:** Raw generation from `meta-llama/Llama-3.2-1B` without any fine-tuning.
- **LoRA + PairRM Output:** Responses from the model fine-tuned using LoRA with the PairRM (Reward Modeling) dataset.
- **LoRA + Judge LLM Output:** Responses from the model fine-tuned using LoRA with a dataset scored or selected by a judge LLM.

Each set of outputs is organized by input prompt and includes:

- The original user query
- Responses from each of the three models
- (Optional) Metadata like preference score, response length, generation time

These outputs support downstream evaluation and benchmarking.

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