

Dataset Overview

One of the most critical components of **fine-tuning Large Language Models (LLMs)** is the **quality of the dataset** used. The dataset directly determines how well the model learns and generalizes.

- **High-quality, well-structured data**
 - ❖ Leads to better generalization
 - ❖ Reduces hallucinations
 - ❖ Produces more reliable and accurate outputs
- **Poor-quality or noisy data**
 - ❖ Causes the model to learn incorrect patterns
 - ❖ Introduces bias and factual errors
 - ❖ Increases hallucinations and inconsistency

Task :- This is a group task. Work with your existing groups to find some diverse legal datasets (preferably one that is already in question–answer format), which can be used for our case.

```
{
  "question": "How is India, that is Bharat, defined in terms of its political structure?",
  "answer": "India, that is Bharat, is defined as a Union of States according to the Union and its Territory."
},
{
  "question": "What does the territory of India comprise of?",
  "answer": "The territory of India shall comprise the territories of the States, the Union territories specified in the First Schedule, and such other territories as may be specified by the Parliament."
},
{
  "question": "What does the territory of a country, such as India, comprise of, according to their constitutional provisions?",
  "answer": "The territory of a country like India comprises the territories of the States, the Union territories specified in the First Schedule, and such other territories as may be specified by the Parliament."
},
{
  "question": "Who has the authority to admit or establish new States into the Union?",
  "answer": "Parliament may by law admit into the Union, or establish, new States."
},
{
  "question": "Who can, by law, admit or establish new States into the Union?",
  "answer": "Parliament"
},
}
```

Fine-Tuning Techniques

Fine-tuning methods vary in cost, efficiency, and performance. A detailed overview of different fine-tuning techniques can be found [here](#):

<https://harvard-iacs.github.io/2024-AC215/assets/lectures/lecture9/L09-FineTuning.pdf> (This PDF provides a detailed and highly informative explanation of fine-tuning topics.)

LLM Fine-Tuning Techniques

<https://medium.com/@jpraveenkanna/llm-fine-tuning-techniques-991b3d7b3b81>

LoRA (Low-Rank Adaptation)

LoRA is a **parameter-efficient fine-tuning technique** that updates only a small number of trainable parameters instead of the entire model.

- Reduces GPU memory usage

- Faster training
- Preserves the base model weights

Learn More About LoRA

IBM Explanation of LoRA

<https://www.ibm.com/think/topics/lora>

QLoRA (Quantized LoRA)

QLoRA is an extension of LoRA that combines **4-bit quantization** with parameter-efficient fine-tuning.

Key Advantages

- Enables fine-tuning very large LLMs on limited hardware
- Maintains performance close to full fine-tuning
- Highly memory-efficient

In-Depth Explanation

QLoRA Deep Dive

<https://medium.com/@dilliprasad60/qlora-explained-a-deep-dive-into-parametric-efficient-fine-tuning-in-large-language-models-llms-c1a4794b1766>

Implementing QLoRA

GeeksforGeeks Tutorial

<https://www.geeksforgeeks.org/nlp/fine-tuning-large-language-models-llms-using-qlora/>

(Optional) Research Papers

- LoRA Paper: <https://arxiv.org/abs/2106.09685>
- QLoRA Paper: <https://arxiv.org/abs/2305.14314>

Summary of Fine-Tuning Approaches

- **Full Fine-Tuning**
 - ❖ Updates all model parameters
 - ❖ Best performance
 - ❖ Very expensive and memory-intensive
- **Parameter-Efficient Fine-Tuning (PEFT)**
(Adapters, LoRA, QLoRA, Prompt Tuning)
 - ❖ Updates only a small subset of parameters
 - ❖ Much cheaper and faster
 - ❖ Practical for very large LLMs

Modern LLM fine-tuning mostly relies on **PEFT methods** due to their efficiency.

Unsloth Library

Unsloth is a popular Python library designed to make fine-tuning **2–4× faster** than traditional methods.

Unsloth Overview

<https://medium.com/data-science-in-your-pocket/unsloth-the-fastest-way-to-fine-tune-llms-041bb6a785ac>