Transformers for pattern recognition

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Project Submission Deadline: saturday (30 november 2024)

You are tasked with completing the following sections in the provided notebook. Follow the instructions carefully and document your findings.

SECTION 1: Implementing a Transformer Model and Analyzing Temperature Effects

- Implement a basic Transformer model from scratch using PyTorch.

- Generate outputs from your model by varying the temperature parameter. Use the following temperature values:

- $T<1$ (e.g., 0.5)
- $T=1$
- $T>1$ (e.g., 1.5 or 2)

- Analyze how changing the temperature affects the output

SECTION 2: Prompt Engineering

1- Zero-shot Learning:

- Use provided pre-trained language model to perform sentiment analysis without any additional training on the provided dataset.
- Perform sentiment analysis directly on the provided dataset using a carefully designed zero-shot prompt.

2- Few-shot Learning:

- Enhance the model's performance by providing a few labeled examples in the prompt.
- Apply the few-shot approach on the same dataset to classify sentiments.

2- Compare Results:

- Analyze and compare the accuracy of the zero-shot and few-shot approaches on the dataset.

SECTION 3: Understanding LoRA and Fine-Tuning LLaMA

- Write a summary of the Low-Rank Adaptation (LoRA) technique. Refer to the paper *LoRA: Low-Rank Adaptation of Large Language Models* for details.
- Using the **provided notebook**, perform fine-tuning of the LLaMA model with the LoRA technique. Follow the steps in the notebook and document the process.