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**Lab # 1**

**Date of completion: February 23, 2025**

1. **Lab Focuses and Outcomes:**
   1. **Main Topics covered in this Lab**

The lab focuses on fine tuning large language models using the transformer library and analyzing the impact of different parameters on model output. There are three parts to this lab. Part 1 investigates how settings like temperature, top-p, top-k, num beams, and repetition penalty affect generated responses. Part 2 of the lab is used to format prompts in a way to obtain meaningful responses from the model. Part 3 of the lab investigates how to train a model using a dataset to get relevant responses to questions.

* 1. **Software Design**

The software design for this lab is done on section 3 of the lab. It is based off the gemma\_xpu\_finetuning.ipynb file.This notebook logs into hugging face hub for model access. It loads the dataset “lavita/ChatDoctor-HealthCareMagic-100k” for fine tuning. Unnecessary fields are removed, and training parameters are set. When the fine-tuning is done, the model is merged with the LoRA parameters. The next part will be to pass queries through the model to get responses.

* 1. **Results**
     + Part 1
       - Model: Writer/camel-5b-hf
       - Using the mean values for all settings. Evaluating quality based on changing one setting higher vs lower.
         * Question: What is League of Legends?
         * Default Settings: “It is a team-based strategy game where players take on the role of a Summoner, selecting from a variety of champions to lead their team to victory. League of Legends, also known as LoL, is a free-to-play online mobile game developed and published by Riot Games.”
         * Temperature: Changing did not affect output.
         * Top P: Changing did not affect output
         * Top K: Changing did not affect output
         * Num Beams = 1: “It is played by millions of players worldwide and is known for its engaging storyline, diverse characters, and complex gameplay mechanics. League of Legends is a popular online video game that combines strategy, role-playing, and team-based gameplay.”
         * Num Beams = 10: Changing did not affect output
         * Rep Penalty = 0.1: “It is an online video game that is played by two teams of five players each. League of Legends is an online online battle arena video game. League of Legends is played on a two-dimensional arena that is divided into two teams of five players each.”
         * Rep Penalty = 2: “League of Legends, also known as LoL, is a free-to-play online mobile game developed and published by Riot Games. It is a team-based strategy game where players take on the role of a Summoner, selecting from a variety of champions to guide their team through various stages of the game.”
       - Based on the responses for the prompt, “What is league of legends?”, the answer with all settings in the middle showed the best response. It described League of Legends clearly as a free multiplayer game developed by Riot where players select champions to lead their team to victory. There were no grammar mistakes or unnecessary information given. Many of the settings did not change the output response. Temperature, Top P, and Top K did not change the response at all. Changing Rep Penalty affected the response and both extremes caused either grammar issues or a sub-par answer. Increasing the number of beams to ten did not change the output. However, decreasing the number of beams to the minimum value gave a different but coherent answer.
     + Part 2:
       - Check the attached JSON file.
       - For the reason why 2025 is not included in the json file, the answer was: “2025 cannot be included in the list.\*\* The World Series for 2025 has not yet been played.”
* Part 3:
  + When using “lavita/ChatDoctor-HealthCareMagic-100k”, the result of the question for the difference between a vegan and a vegetarian was answered incorrectly before and after the training. It responded to a completely different topic. The rest of the responses to the test inputs were coherent answers that adequately answer the questions. I took the liberty to use another dataset “GammaCorpus-Fact-QA-450k” to try to get a relevant response to vegan vs vegetarian question. The response was on the same topic but stated that vegetarian diets typically include meat, fish, and poultry.

1. **Problems Encountered and Solved:**

* Cannot get the versions of torch to work. Had to use PyTorch 2.6 instead of PyTorch GPU.
* Unable to load models other than Camel-5B. They either did not load at all or were unable to respond to the messages.
* For part 2, prompting was very important. In the beginning, the prompt asked to generate the list of world series winners from 2010 to 2025 in a json file. The original result only had results for 2010 to 2023. To get the 2024 result, the winner had to be included in the prompt. As for the winner of the 2025 world series, the answer did not say why no winner for 2025 was listed. To resolve this issue, the prompt had to include a section that asks to explain why the 2025 winner was not included.
* For part 3, the original model(databricks/databricks-dolly-15k) that was used did not answer the prompt. The most obvious error in the answer is the one where the prompt asks what are the main differences between a vegetarian and a vegan diet? The answer was about light bulbs. To solve this issue, a new model was used. GammaCorpus-Fact-QA-450k was found on the hugging face website. This model had 450k questions and answers but in the notebook, the number used to train be only 4% of that. That is due to the model size being too big and the training taking too long. After asking the same prompt after training, the answer was still incorrect. However, the answer talked about meat instead of light bulbs.

1. **Answers to Lab Questions:**
   1. **Part 1**
      * I could change temperature, top p, top k, num beams, and rep penalty.
      * Rep penalty: Changing the rep penalty clearly gave different answers and the quality of the response varied greatly. When the rep penalty was low, the response had errors in its text. When the rep penalty was high, the answer changed but it still responded to the prompt correctly.
   2. Part 2
      * + The model already knows the answers up to a certain date in 2024. That is because of the data it has from its datasets and no new update.
        + When a model is loaded using transformers library, usually the Model Weights, Model Configuration, Tokenizer Files, Preprocessing and Generation Settings are downloaded. In the example “ model = AutoModelForCausalLM.from\_pretrained(model\_id).to(device)”,

A screenshot of a computer screen

AI-generated content may be incorrect.

Figure : Downloaded files from AutoModelForCausalLM.from\_pretrained(model\_id)

* 1. Part 3
     + To prepare training and validate data samples and preprocess them according to a prompt template, one must define a prompt template, preprocess dataset using tokenization, load and map dataset, and then fine tune the model.
     + The model finetune took only 17 minutes. That is because of the limited dataset. Due to the kernel crashing, the size has to be reduced so that the training can be completed and saved.

1. **Lessons Learnt:**

You need to summarize what you have learned from this lab. Please be specific on the new knowledge and skills.