**Module 2: AWS MLU Lab 5 - Fine-Tuning BERT**

**Learning Insights**

This lab introduced me to the process of fine-tuning BERT for text classification, which helped me understand how powerful pre-trained language models are for natural language processing tasks. One of the most important concepts I learned was how tokenization works with BERT, turning raw text into numerical inputs the model can process. I also gained a better understanding of freezing model layers to train only the classifier portion, which can save time and reduce overfitting.

A moment that stood out was when I took the time to learn how Stochastic Gradient Descent (SGD) works. I learned how SGD updates model weights in small, random batches to gradually improve accuracy. This gave me a clearer picture of what’s happening under the hood during training.

This lab connected to broader machine learning principles by showing how transfer learning works. Instead of training a model from scratch, we adapted an already trained model (DistilBERT) to our specific dataset, which is a common and highly effective strategy in deep learning.

**Challenges and Struggles**

One of the challenges I encountered in this lab was understanding how tokenization and attention masks are handled in BERT. I wasn’t fully clear on how the text got transformed into numbers that the model could use, so I spent extra time exploring methods like convert\_ids\_to\_tokens() to better visualize how sentences were tokenized.

I also struggled at first with understanding why we freeze model layers during fine-tuning. I worked through these challenges by researching the topics, experimenting in the notebook, and using ChatGPT to clarify concepts when I felt stuck.

For problem-solving, I started focusing on breaking down complex steps into smaller pieces. For example, I would test individual sentences through the tokenizer to check what was happening before passing full datasets into the model. This made debugging easier and helped me better understand each part of the process.

**Personal Growth**

This lab definitely improved my understanding of how text classification models work. Before this, I didn't really know how pre-trained language models like BERT were used in real-world applications. Now, I feel more comfortable working with these types of models, and I understand the full pipeline from raw text to predictions.

What surprised me most was how interesting it was to see how the raw reviews were broken into tokens and how those tokens connected back to the model’s understanding. It was a lot more technical than I expected, but it made sense once I saw the steps play out.

Skills from this lab could be useful for any project involving NLP tasks like sentiment analysis, spam detection, or customer feedback classification. Knowing how to fine-tune models like BERT will be valuable in any AI-focused job that uses text data.

**Critical Reflection**

If I repeated this lab, I wouldn’t change much, but I would spend a bit more time upfront exploring the tokenizer and vocabulary to understand the data flow better before diving into training. That really helped once I took the time to do it.

One key experiment in this lab was increasing the training epochs from 10 to 20 to see if it improved model performance. Initially, the validation loss was 0.425, but after training longer, it dropped to 0.304, confirming that additional training helped the model generalize better instead of overfitting. This showed me the importance of testing different training lengths to optimize performance.

This lab made me interested in learning more about natural language processing and deep learning. I want to explore other areas like text generation, summarization, and question answering, which also use models like BERT.

Overall, this lab showed me how fine-tuning pre-trained models on custom datasets is a powerful machine learning strategy. Seeing how BERT can quickly adapt to new tasks reinforced how transfer learning has become such an essential part of modern deep learning workflows.