Part 1: Fundamentals of Fine-Tuning - Oorja D

Concept Check (Multiple Choice Questions):

1. **What is the key benefit of fine-tuning a pre-trained model?**
   A) It reduces the need for computational resources
   B) It avoids using training data
   C) It removes the need for evaluation
   D) It simplifies deployment
   Correct Answer: A

2. **Which of the following tools optimizes model deployment in Azure?**
   A) ONNX Runtime
   B) TensorBoard
   C) Google Sheets
   D) SQL Server
   Correct Answer: A

Application Task:

Potential Tasks for Fine-Tuning:

1. **Legal Document Summarization:**

   o **Pre-Trained Model:** BERT (Bidirectional Encoder Representations from Transformers)

   o **Why Fine-Tuning is Beneficial:** Fine-tuning BERT on legal documents allows the model to understand domain-specific terminology and generate concise summaries, improving efficiency for legal professionals.

2. **Sentiment Analysis:**

   o **Pre-Trained Model:** GPT (Generative Pre-trained Transformer)

   o **Why Fine-Tuning is Beneficial:** Fine-tuning GPT on customer reviews or social media data enables the model to accurately classify sentiments, helping businesses analyze customer feedback and improve services.

3. **Image Captioning:**

   o **Pre-Trained Model:** Vision Transformer (ViT)

o **Why Fine-Tuning is Beneficial:** Fine-tuning ViT on specific image datasets (e.g., medical images or product photos) allows the model to generate accurate and contextually relevant captions, enhancing applications in healthcare or e-commerce.

Part 2: Implementing Fine-Tuning on Azure

Case Study Activity:

Selected Task: Sentiment Analysis for Customer Feedback

Pre-Trained Model: GPT-4 (OpenAI)

Dataset and Preparation:

- **Dataset:** A collection of customer reviews from an e-commerce platform.

- **Preparation:** The dataset is cleaned by removing irrelevant text (e.g., HTML tags, special characters) and labeled with sentiment categories (positive, negative, neutral). It is then split into training, validation, and test sets.

Fine-Tuning Process:
The GPT-4 model is fine-tuned using Azure Machine Learning. The training data is fed into the model, and hyperparameters like learning rate and batch size are optimized for better performance.

Reflection on Evaluation:
After fine-tuning, the model's performance is evaluated using metrics like accuracy, precision, recall, and F1-Score. Cross-validation is performed to ensure the model generalizes well to unseen data. Challenges include overfitting, where the model performs well on training data but poorly on test data. To address this, techniques like regularization and early stopping are used. Additionally, the model's predictions are manually reviewed to ensure they align with human judgment.

Part 3: Evaluating and Deploying Models

Concept Check (True/False):

1. **Fine-tuning eliminates the need for evaluation metrics.**
   Answer: False

2. **Azure Machine Learning provides tools for real-time monitoring of deployed models.**
   Answer: True

Reflection Activity:

Importance of Evaluating Fine-Tuned Models:
Evaluating a fine-tuned model using metrics like F1-Score and cross-validation is crucial to ensure its reliability and effectiveness. For example, the F1-Score balances precision and recall, providing a comprehensive measure of the model's performance, especially in imbalanced datasets. Cross-validation helps assess the model's ability to generalize to new data, reducing the risk of overfitting.

Skipping or poorly executing evaluation can lead to significant pitfalls. For instance, deploying a model without proper evaluation might result in inaccurate predictions, damaging user trust and causing financial losses. In a sentiment analysis tool, poor evaluation could lead to misclassifying customer feedback, resulting in misguided business decisions. Therefore, thorough evaluation is essential to ensure the model meets performance standards and delivers value in real-world applications.