**Homework #4**

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1. **Fine Tuning** 
   * Experimental setup:
     + The IMDB dataset was downloaded with the datasets library
     + After downloading, the dataset was tokenized using the transformers Autotokenizer library, and then mapped into batches
     + The batches of training data were shuffled randomly
     + The “bert-base-uncased” model was imported using the Transformer AutoModelForSequenceClassification library
       - The uncased version was used so that all words are represented as their lowercase version, consequently shrinking the vocabulary size
   * Results:
     + Accuracy: 91%
     + F1 score: 91%
     + Test Accuracy: 90%
     + Test F1 Score: 90%
2. Linear Probing
   * Experimental setup:
     + The same data set used for the fine-tuned model was also utilized for this model so the data preprocessing methods are the same
     + The same model was imported as the fine-tuned model
     + The attribute “grad\_required” was set to false for all the weights for each layer of the pretrained model
       - This ensured that the pretrained model’s weights would not be altered while training the linear classifier
   * Results:
     + Accuracy: 60%
     + F1 Score: 63%
     + Test Accuracy: 60%
     + Test F1 Score: 63%
3. Analysis:
   * The fine-tuned version of Bert did much better than the linear-probed model
     + This is due in part to training all the layer of Bert with the linear classifier
   * A base line model was not able to be trained, due to issues with defining the Transformer class
   * Overall: Fine-tuning models makes for much more comprehensive language models. It also makes it easier to accomplish downstream tasks