Due Date: End of April 2024

Assignment: Image Classification and Text Classification using Convolutional Neural Networks (CNNs) and Transformers

Objective:

The objective of this assignment is for students to gain hands-on experience with deep learning models for image classification and text classification tasks. Students will implement and evaluate Convolutional Neural Networks (CNNs) for image classification and Transformer models using TensorFlow and the Hugging Face library for text classification.

Tasks:

Part 1: Image Classification with CNNs (50 points)

Data Preparation:

- Choose an image dataset (e.g., CIFAR-10, MNIST) for image classification.
- Preprocess the dataset by normalizing pixel values and splitting it into training, validation, and test sets.

Model Building:
- Implement a CNN architecture for image classification using TensorFlow.
- Experiment with different architectures (e.g., LeNet, VGG, ResNet) and hyperparameters to optimize model performance.

Model Training and Evaluation:
- Train the CNN model on the training data and validate it on the validation set.
- Evaluate the model's performance using appropriate evaluation metrics (e.g., accuracy, precision, recall).
- Fine-tune the model based on validation performance and re-evaluate it.

Model Visualization:
- visualize the learned features (e.g., feature maps, filters) of the CNN model using techniques like activation maximization or filter visualization.

Part 2: Text Classification with Transformers (50 points)

Data Preparation:

- Choose a text classification dataset (e.g., IMDb movie reviews, sentiment analysis dataset).
- Preprocess the text data by tokenization, padding, and splitting it into training, validation, and test sets.

Model Building:
- Implement a Transformer-based architecture (e.g., BERT, GPT) for text classification using the Hugging Face library.
- Fine-tune the pre-trained transformer model on the text classification task.

Model Training and Evaluation:
- Train the transformer model on the training data and validate it on the validation set.
- Evaluate the model's performance using appropriate evaluation metrics (e.g., accuracy, F1-score).
- Compare the performance of the transformer model with traditional machine learning models (e.g., logistic regression, SVM).

Deliverables:

- Jupyter Notebook or Python scripts containing the implementation of CNN and Transformer models.
- Model training logs, evaluation results, and performance metrics.
- Summary report discussing the methodology, results, and insights gained from the assignment.

TensorFlow documentation: https://www.tensorflow.org/
Hugging Face Transformers documentation: https://huggingface.co/transformers/