ASSIGNMENT-3

Objective: Build on the image classification model from Assignment 2 by implementing **active learning strategies** to enhance model performance and efficiency in training.

Key Requirements:

1. **CNN Model Implementation (Baseline)**:
    - Retain the CNN architecture designed in Assignment 2 with at least two convolutional layers, ReLU activation, and max pooling.
    - Continue experimenting with architectural components (e.g., number of layers, filter sizes) and hyperparameters (e.g., learning rate, batch size) to optimize performance.
    - Use a suitable dataset for training (e.g., CIFAR-10, MNIST, Fashion-MNIST).
2. **Optional Pretrained Model Extension**:
    - Utilize a pretrained model (e.g., ResNet, VGG, etc.) from the PyTorch model zoo.
    - Fine-tune the pretrained model for your chosen dataset and compare its performance with the custom CNN.
3. **Active Learning Integration**:
   Implement active learning strategies to enhance data efficiency by selecting the most informative samples for training. The strategies should include:
    - **Uncertainty Metrics**:
        - ***Least Confidence***: Select samples where the model has the least confidence in its predictions.
        - ***Prediction Entropy***: Use entropy to measure uncertainty in predictions.
        - ***Margin Sampling***: Choose samples where the difference between the top two predicted probabilities is smallest.
    - **Diversity Metrics**:
        - ***Cosine Similarity***: Ensure diverse selection of samples by minimizing cosine similarity.
        - ***L2 Norm***: Evaluate diversity based on the Euclidean distance in feature space.

        - ***KL Divergence***: Compare the distribution of predicted probabilities to enhance diversity.

4. **Training and Evaluation**:
    - Divide the dataset into labeled and unlabeled subsets for active learning.
    - Use the active learning strategies to iteratively select batches of samples for labeling and training.
    - Compare the model's performance (e.g., accuracy) using active learning against the baseline model.
5. **Report and Analyze Results**:
    - Report the classification accuracy achieved for:
        - Custom CNN.
        - Pretrained model (if implemented).
        - Active learning-enhanced model.
    - Provide insights on how active learning impacts training efficiency and accuracy.
    - Highlight the most effective active learning strategy for your dataset and model.