King AbdulAziz University
Faculty of Computing and
Information Technology
Computer Science Department

جامعة الملك عبدالعزيز
كلية الحاسبات وتقنية المعلومات
قسم علوم الحاسبات

CPCS – 432 : Artificial Intelligence (II) 1st Semestre, 2025

Assignment 1 - 10 Marks

Assign date : 23-10-2024 **Due date : 3-11-2024 at 11 :59 PM**

This assignment will guide students through both classical computer vision and deep learning pipelines, exploring various feature extraction techniques alongside Convolutional Neural Networks (CNNs). Students will implement and compare classical approaches using feature extraction methods and modern CNN-based techniques for image classification.

Objective

The objective of this assignment is to apply classical and deep learning methods for feature extraction and image classification. Students will implement classical methods such as HOG and LBP, along with additional feature extraction methods of their choice, followed by image classification using classifiers such as ANN, SVM, and KNN. In addition, CNN models will be implemented with and without dropout layers.

Part 1: Classical Computer Vision Pipeline

Task 1: Implementing Feature Extraction with Classifiers (ANN, SVM, KNN)

In this task, students will implement multiple feature extraction methods followed by the application of classifiers:

1. **T1.1** Feature Extraction (HOG or LBP): Apply Histogram of Oriented Gradients (HOG) or Local Binary Patterns (LBP) to generate feature vectors and visualize the feature patterns for three selected images.
2. **T1.2** Other Feature Extraction Methods: Choose at least one from SIFT, SURF, ORB, or Gabor filters.
3. **T1.3 - T1.5** Classifiers (ANN, SVM, KNN): Train and evaluate the classifiers using the extracted features.

Part 2: CNN-based Classification

Task 2: Implement CNN Models with and without Dropout

In this task, students will implement two variations of CNN models and analyze their performance on the classification task:

T2.1 CNN Model without Dropout: Implement a CNN architecture without dropout layers.
T2.2 CNN Model with Dropout: Implement the same CNN architecture but with dropout layers to reduce overfitting.
Training Curves: Plot and analyze the training and validation curves for both models to compare the learning behavior.

Part 3: Model Comparison and Analysis

T3.1 Confusion Matrices: Generate confusion matrices for all models (classical and CNN-based) to evaluate their performance on the test set.
T3.2 Dropout Impact: Discuss the effect of dropout on overfitting and how it influenced the model performance.
T3.3 Comparison: Compare the results from the classical pipelines (HOG, LBP, etc.) and CNN models in terms of accuracy, precision, and recall.

Deliverables

- Python code for:
  - Feature extraction (HOG, LBP, optional methods) and classifiers (ANN, SVM, KNN)
  - CNN models (with and without dropout).
- Report Structure:

1. **Your Personal Information:**
   - **Name**: Your full name.
   - **ID**: Your student ID.
   - **Section**: The section you are enrolled in.
2. **Group Members Information (if applicable):**
   - Although this is an individual assignment, including the **names, IDs, and sections** of other group members involved in your overall project (for clarity and reference).
3. **Project Name and Proposal Paragraph:**
   - **Project Name**: The name of the overall project you're working on.
   - **Proposal Paragraph**: A brief description (about 3-5 sentences) of your project. This should summarize the main objective of your project, the problem you're addressing, and how AI or computer vision methods are being used to solve it.
4. **Dataset Description:**
   - **Dataset Used in this Assignment**: Provide details about the dataset(s) you used for this assignment. Include the source, type of data (images, text, etc.), the number of samples, and any relevant characteristics.
   - **Other Datasets in the Project**: If your project involves additional datasets, briefly describe these too, even if they weren't used for this assignment.
5. **Comparison of Classical and CNN Methods:**
   - **Training Curves**: Include the plots of training and validation curves for both classical and CNN-based models. These should illustrate the models' learning progress, helping to show whether the models overfit or generalize well.

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- **Confusion Matrices**: Provide confusion matrices for both classical and CNN methods, which visually display the performance of the models on classification tasks, indicating true positives, false positives, false negatives, and true negatives.
- **Analysis**: Discuss and analyze the results. How did the classical methods (like HOG, LBP, etc.) compare to CNN models? Discuss accuracy, precision, recall, and other relevant metrics. Highlight any observations, such as which method performed better and why.

Important Notes

- Dataset: If your project dataset is not suited for classification, use an Eye disease dataset or another relevant dataset.
- This is an **individual assignment**, so each student must complete it independently.
- The group members on the student's project should choose **different methods** than others, and this also applies to the project datasets being used.