

Assignment: Image Feature Extraction and Classification

Machine Learning in Cyber Security (20CYS215)

Dead Line: 25/03/2025

Number of students per team: 2

Objective:

To explore various image feature extraction techniques and analyse their impact on classification performance across different machine learning models.

Instructions:

Part 1: Literature Review (20 Marks)

1. Conduct a literature review on image feature extraction techniques. Discuss the significance of feature extraction in computer vision tasks.
2. Identify and describe at least three conventional image feature extraction methods (e.g., HOG, SIFT, GLCM, ORB). Explain their underlying principles and real-world applications.

Part 2: Experimentation (40 Marks)

Choose an image dataset for experimentation. You can use standard datasets such as MNIST (digits), CIFAR-10 (objects), LFW (faces), or any dataset of your choice.

- Implement and experiment with the following feature extraction techniques:
 - Traditional feature extraction (e.g., Histogram of Oriented Gradients (HOG), Local Binary Patterns (LBP), Edge Detection)
 - Deep learning-based feature extraction (e.g., CNN-based pre-trained models like ResNet, VGG, or MobileNet)
- For each method, perform the following:
 - Preprocess the image data (**grayscale conversion, resizing, normalization**)
 - Extract features using the selected method
 - Train a simple classifier (**Logistic Regression, KNN, Decision Trees, or Random Forests**) on the extracted features
 - Evaluate the classifier's performance using appropriate metrics (**accuracy, precision, recall, F1-score**)

Part 3: Analysis (30 marks)

- **Compare and analyze** the results obtained from different feature extraction techniques. Consider the following factors:

- Classification performance (**accuracy, precision, recall, F1-score**)
 - Computational time taken for feature extraction and model training
 - Differences in robustness and generalization of the models
- Discuss the **trade-offs** between conventional and deep learning-based feature extraction methods. How does feature representation impact model performance?

Part 4: Report and Presentation (10 Marks)

- Prepare a **detailed report** summarizing your literature review, experimentation, and analysis.
- Create a **presentation** highlighting key findings and insights. Be prepared to present your results to the class.

Submission Guidelines:

- Submit your report, code, and presentation slides electronically before the deadline.
- Clearly document your code and include reproducible steps.

Grading Rubric:

- **Literature Review:** 20 marks
- **Experimentation (Implementation and Results):** 40 marks
- **Analysis (Comparative analysis and insights):** 30 marks
- **Report and Presentation:** 10 marks

Note: You are encouraged to seek guidance and clarification from the instructor throughout the assignment.