

Assignment 2: Building a Simple Image Classifier and Image Analysis

Objective

Learn how to apply machine learning methods for image classification and compare the effectiveness of classical algorithms and neural networks.

Task

1. Data Preparation

- Choose a dataset:
 - MNIST for handwritten digit classification.
 - CIFAR-10 for object classification in color images.
- Split the data into training (80%) and test (20%) sets.

2. Classification Using kNN or SVM

- Implement a k-Nearest Neighbors (kNN) classifier or a Support Vector Machine (SVM).
- Train the model on the training set.
- Predict classes on the test set.
- Calculate evaluation metrics: accuracy, recall, F1-score.
- Construct a confusion matrix.

3. Building and Training a Neural Network

- Create a Multilayer Perceptron (MLP) using Keras or PyTorch.
- Define the network architecture (number of layers, neurons, activation functions).
- Train the model on the same dataset.
- Analyze the learning dynamics (loss and accuracy graphs).

4. Comparative Analysis of Models

- Compare the results of the classical algorithm (kNN/SVM) and the neural network.
- Discuss the advantages and disadvantages of each approach.
- Suggest ways to improve the models.

Formatting Requirements

The report should be in PDF format and include:

- Description of the selected methods and model settings.
- Training and testing results (metrics, graphs, confusion matrices).
- Comparative analysis and conclusions.
- Code with comments, uploaded to GitHub or attached to the report.

Additional Guidelines

1. Using Jupyter Notebook is recommended for combining code and explanations conveniently.
2. Independent research and application of additional methods (e.g., data normalization, alternative metrics) are encouraged.
3. In case of questions, consult the professor or refer to lecture and seminar materials.

Evaluation Criteria

Points	Criteria
0-3	Completeness of the task <ul style="list-style-type: none">• 3 points: All stages completed (data preparation, kNN/SVM implementation, MLP training, comparative analysis). The report is detailed, with necessary visualizations (graphs, confusion matrices, etc.).• 2 points: 1 or/and 2 stages are missing, or descriptions lack sufficient details (e.g., missing graph explanations or metrics).• 1 point: More than 2 stages are missing, or there are major reporting issues (e.g., missing confusion matrices, no model analysis).• 0 points: The main part of the task is not completed, and the result does not meet the requirements.
0-3	Code correctness and quality <ul style="list-style-type: none">• 3 points: The code is fully functional, clean, and readable. Key points are explained with comments. The choice and implementation of algorithms are logical and optimal.• 2 points: The code contains minor errors or suboptimal solutions but still runs and produces reasonable results.• 1 point: The code has significant errors that hinder task completion (e.g., incorrect metric calculations, network architecture errors).• 0 points: The code does not run or is missing.
0-2	Depth of analysis and conclusions <ul style="list-style-type: none">• 2 points: Conclusions are substantial, well-argued, and supported by results. A comparative model analysis is provided, discussing the strengths and weaknesses of each approach.

	<ul style="list-style-type: none"> • 1 point: Conclusions are superficial, lack sufficient arguments, or the model analysis is done formally without explaining differences. • 0 points: Conclusions are missing or do not match the obtained results.
0-2	<p>Report formatting quality</p> <ul style="list-style-type: none"> • 2 points: The report is structured, includes all required elements, and visualizations are neat and understandable. • 1 point: The report has formatting issues (e.g., poor structure, missing visualizations, disorganized content). • 0 points: The report is missing or extremely poorly formatted.

Late Submission Penalties

- from 1 day to 1 week late → **-1 point**
- More than 1 week late → **-2 points**

Plagiarism Policy: Submissions containing plagiarism will receive 0 points.