Project 1

Face Image Classification

Purpose:

This project is for classification. Students are expected to be applying what they have learnt in lectures and labs from week 1 to week 5 to complete this project. This is a group-work based project.

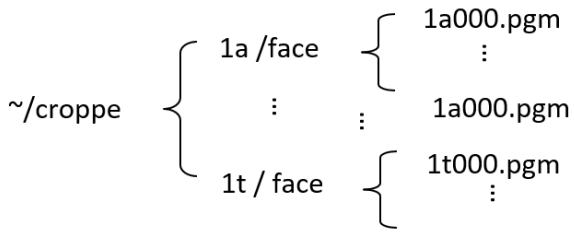
Data:

The Sheffield (previously UMIST) Face Database consists of 564 images of 20 individuals (mixed race/gender/appearance). Each individual is shown in a range of poses from profile to frontal views – each in a separate directory labelled 1a, 1b, … 1t and images are numbered consecutively as they were taken. The files are all in PGM format, approximately 220 x 220 pixels with 256-bit grey-scale. To simplify the implementation, the images had been cropped to focus the informative regions on facial information. Each cropped image has a resolution of 112 x 92 pixels.

Main Task:

- Represent each facial image by vectorising image pixels;
- Classify facial images using logistic regression and non-linear SVM, and compare their performance;
- Reduce feature dimensions using PCA and LDA, and compare Eigen-face and Fisher-face.
- Verify if the reduced features help improve classification performance.

The storage structure of the file is as follows.



This task requires programming to convert the data from images to vectors to organize datasets that can be used for training and validation.

The number of pictures of each character is not exactly the same, and it is necessary to divide the data samples for training and the data samples for testing and verification according to a certain method and proportion.

When testing, it is necessary to be able to apply various metrics flexibly to comprehensively test and evaluate each method and to be able to interpret the meaning of different evaluation results.

Submission deadline:

This project is due on: 11:59pm, April 24, 2021 (Week 9 Sunday)

This project occupies 20% of the total marks.

Submissions:

Please submit

(1) a complete **report** (more instructions could be as follows), and

(2) a **spreadsheet** of performance evaluation and a **source code file**

Evaluation

The final evaluation of this report is 40% each for report evaluation and task evaluation, and 20% for the quality of code and results representation (with spreadsheet or visualization). Finally, a comprehensive score will be given based on the completion of the task and the writing of the report.

As for the report, the team members are requested to submit an individual report written by themselves, and clearly state the contribution of each team member at the beginning of the report. It is recommended to organize the report in the following way.

Section I: Aims and Background

Section II: Contributions of Team Members

Section III: Methodology

Section IV: Results (See Task Evaluation Guidance)

Section V: Discussion

Section VI: Conclusion

Report Evaluation Criterion:

Criteria	Ratings			
Introduction: Aims and Background (20%)	20.0 pts **Exceptional** Defines and elucidates the problem. Develops compelling rationale for the lab. Persuasively explains the multifactorial contribution of learning gained from the lab.	15.0 pts **Good** Defines problem with some depth. States rationale for the lab. Provides explanation beyond basic contribution.	10.0 pts **Average** Defines problem. States only obvious rationale for the lab. Explains the basic contribution of the activities to the understanding of the lab.	3.0 pts **Poor** Shows fundamental lack of understanding. Does not state rationale for the activity. Does not explain the contribution of the activities to the understanding of the lab.
Background and Methods: Knowledge of the area and use of sources (30%)	30.0 pts **Exceptional** Demonstrates exceptional depth of knowledge of the field. Comprehensive use of most recent and seminal sources. Clearly discriminates among seminal sources.	25.0 pts **Good** Demonstrates proficient knowledge of the field. Thorough selection of sources pertinent to project. Shows some discrimination among seminal sources.	15.0 pts **Average** Demonstrates a basic knowledge of the field. Selected sources relevant to project. Limited discrimination among seminal sources.	7.0 pts **Poor** Lacks a basic knowledge of the field. Selected sources irrelevant to project. Does not discriminate among seminal sources. Misinterprets sources.
Results (20%)	20.0 pts **Exceptional** Results organised into sections and subsections in a logical order.	18.0 pts **Good** Results are well organised in a logical order.	15.0 pts **Average** Results organised into sections and subsections.	7.0 pts **Poor** Results are poorly organised.
Discussion and Conclusion (30%)	30.0 pts **Exceptional** Outstanding and innovative synthesis between results and sources.	25.0 pts **Good** Demonstrates synthesis between results and sources.	20.0 pts **Average** Relevant information about the results is discussed under each heading.	10.0 pts **Poor** Information on the results are repeatedly reported without any synthesis from sources.

			Demonstrates information synthesis to a limited extent.	
Total Points: 100.0				

Task Evaluation Guidance

In Section Results, the report needs to answer the following main questions. Each question is assigned a certain number of points according to the importance of the task. The details are listed below.

A. Data Organization 10'

1. Data Modeling

1) What is the data modeling design (1')

2) how to implement it (3')

3) why do you desgin it in this way (1')

2. how to organize the training set and test set

1) what is training set/test set(1')

2) how to design and organize the training set and test set(2')

3) why do you design it in this way(2')

B. Training, Testing and Evaluation 18'

1. SVM 9'

1) What is the SVM mechanism (2')

2) how to implement it (5': if use package 1', if programming it with coding 5')

3) why do you desgin it in this way (2')

2. Logistic Regression 9'

1) What is the mechanism (2')

2) how to implement it (5': if use package 1', if programming it with coding 5')

3) why do you desgin it in this way (2')

C. Evaluation (36')

1) Why do we need and how to Evalute the performance (2')

2) What are the TP, FP, TN, FN? (4')

3) What are the common used metrics for the evaluation and their meaning (10')

(Accuracy, precision, sensitivity, specificity, F1-Score, Confusion Matrix, AUC, ROC, each one for 1' and the rest points are for how the explanation of the answer and writing is)

4) What are the metrics do you use and how to implement them (10' same as above)

5) Why do you use that (10' same as above)

D. Improvement

4. How to improve the performance of SVM (9')

1) Why is inferior performance of the model (2')

2) how to improve it and implement it (5')

3) why do you desgin it in this way (2')

5. How to improve the performance of Logistic Regression (9')

1) Why is inferior performance of the model (2')

2) how to improve it and implement it (5')

3) why do you design it in this way (2')

E. PCA 9'

1. how to use PCA for training

1) What is the PCA mechanism (2')

2) how to implement it (5': if use package 1', if programming it with coding 5')

3) training and testing with PCA, and why do we use it in machine learning (2')

F. LDA 9'

1. how to use LDA for training

1) What is the LDA mechanism (2')

2) how to implement it (5': if use package 1', if programming it with coding 5')

3) training and testing with LDA, and why do we use it in machine learning (2')

Total Points: 100.0