The report of mini-project N5 program

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The results of savings are written in the file: (if the log files don’t exist, the program creates it. Otherwise, it appends): **logFile.txt**

The program processes all images that must be in the **/imagesToProcess/** folder located in the same folder with the **/python** folder. In other words, **/imagesToProcess/** folder must be one level up than the code file.

The .py file could be found in **/python** folder. The image processing results are saved in the **/resultsOfProcessing** folder. There are 5 folders in the **/resultsOfProcessing** folder:

1) **/resultsOfProcessing/grayscaleImages** – contains the grayscale images;

2) **/resultsOfProcessing/meanImage** – contains the mean image;

3) **/resultsOfProcessing/eigenFaces\_unsorted** – contains the eigenfaces images;

4) **/resultsOfProcessing/eigenFaces\_sorted** – contains the eigenfaces images, sorted by the eigenvalues;

5) **/resultsOfProcessing/finalImages** – contains the final images;

Besides the main function, the functions in the program are.

1) file\_list\_to\_process(folder\_path\_to\_process) - Accepts the folder path and returns the image files with .gif, .jpg, .jpeg, .bmp, .png extensions from the folder.

2) face\_extract\_and\_creator(image\_files\_list, folder\_path\_to\_process) - Gets the images list and the folder path, processes them to extract the faces from the images. The detecting is done by detectMultiScale(gray\_image, scaleFactor=1.2, minNeighbors=3, minSize=(50, 50)) method of cv2.CascadeClassifier(cv2.data.haarcascades + "haarcascade\_frontalface\_default.xml"). After detection, the faces coordinates from y:y+height and x:x+window Returns the images with faces list. The images has 125x150px size.

3) mean\_image\_writer\_and\_returner(processed\_faces\_list, folder\_path\_to\_write\_results) - Gets the images list and the folder path to write. Calculates, writes images to the folder path, and returns the mean image.

4) image\_writer\_and\_returner(image\_list, folder\_path\_to\_write\_results, subname) - Gets the images list, folder path to write, and the string from subname to add to files. Writes images to the folder path.

5) processed\_images\_returner(processed\_faces\_list) - Gets the list of vectors and returns the list of normalized vectors.

6) covariance\_matrix\_returner(processed\_faces\_list\_vectors) - Gets the list of vectors and returns the covariance\_matrix.

7) eigen\_values\_and\_eigen\_vectors\_returner(covariance\_matrix) - Gets the covariance\_matrix and returns the eigenvalues and eigenvectors.

8) write\_restored\_image\_from\_images(processed\_faces\_list\_vectors, eigen\_vectors\_of\_covariance\_matrix\_sorted, mean\_image, number\_of\_first\_eigenvectors) - Gets the list of vectors, sorted eigenvectors of covariance matrix, mean image, and the number of first eigenvectors. Returns the list of restored faces.

The results of the program are provided in the next pages. The images in the 3x9 tables are provided in the manner:

|  |  |  |
| --- | --- | --- |
| 1 | 10 | 19 |
| 2 | 11 | 20 |
| 3 | 12 | 21 |
| 4 | 13 | 22 |
| 5 | 14 | 23 |
| 6 | 15 | 24 |
| 7 | 16 | 25 |
| 8 | 17 | 26 |
| 9 | 18 | 27 |

**Grayscale face images:**

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**The mean image:**



**The list of eigenfaces sorted by the eigenvalues:**

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Final Image Mr. Alfredo Ramos

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| --- | --- | --- | --- | --- | --- |
| 10 eigenvectors | 75% variance | 80% variance | 85% variance | 90% variance | All vectors |
|  |  |  |  |  |  |

Final Image Dr. Andres Figueroa

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| --- | --- | --- | --- | --- | --- |
| 10 eigenvectors | 75% variance | 80% variance | 85% variance | 90% variance | All vectors |
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Final Image Dr. Mr. Bari M. Siddique

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| --- | --- | --- | --- | --- | --- |
| 10 eigenvectors | 75% variance | 80% variance | 85% variance | 90% variance | All vectors |
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Final Image Dr. Beiyu Lin

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| --- | --- | --- | --- | --- | --- |
| 10 eigenvectors | 75% variance | 80% variance | 85% variance | 90% variance | All vectors |
|  |  |  |  |  |  |

Final Image Dr. Bin Fu

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| --- | --- | --- | --- | --- | --- |
| 10 eigenvectors | 75% variance | 80% variance | 85% variance | 90% variance | All vectors |
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Final Image Mr. Carlos Pena-Caballero

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| --- | --- | --- | --- | --- | --- |
| 10 eigenvectors | 75% variance | 80% variance | 85% variance | 90% variance | All vectors |
|  |  |  |  |  |  |

Final Image Mr. Domingo Molina III

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| --- | --- | --- | --- | --- | --- |
| 10 eigenvectors | 75% variance | 80% variance | 85% variance | 90% variance | All vectors |
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Final Image Dr. Dong-Chul Kim

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| --- | --- | --- | --- | --- | --- |
| 10 eigenvectors | 75% variance | 80% variance | 85% variance | 90% variance | All vectors |
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Final Image Dr. Emmett Tomai

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| --- | --- | --- | --- | --- | --- |
| 10 eigenvectors | 75% variance | 80% variance | 85% variance | 90% variance | All vectors |
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Final Image Mr. Eric Martinez

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| --- | --- | --- | --- | --- | --- |
| 10 eigenvectors | 75% variance | 80% variance | 85% variance | 90% variance | All vectors |
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Final Image Dr. Fitratullah Khan

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| --- | --- | --- | --- | --- | --- |
| 10 eigenvectors | 75% variance | 80% variance | 85% variance | 90% variance | All vectors |
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Final Image Mr. Gustavo Dietrich

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| --- | --- | --- | --- | --- | --- |
| 10 eigenvectors | 75% variance | 80% variance | 85% variance | 90% variance | All vectors |
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Final Image Dr. Hansheng Lei

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| --- | --- | --- | --- | --- | --- |
| 10 eigenvectors | 75% variance | 80% variance | 85% variance | 90% variance | All vectors |
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Final Image Dr. John Abraham

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| --- | --- | --- | --- | --- | --- |
| 10 eigenvectors | 75% variance | 80% variance | 85% variance | 90% variance | All vectors |
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Final Image Dr. Jose Poveda

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| --- | --- | --- | --- | --- | --- |
| 10 eigenvectors | 75% variance | 80% variance | 85% variance | 90% variance | All vectors |
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Final Image Dr. Lei Xu

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| --- | --- | --- | --- | --- | --- |
| 10 eigenvectors | 75% variance | 80% variance | 85% variance | 90% variance | All vectors |
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Final Image Dr. Liyu Zhang

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| --- | --- | --- | --- | --- | --- |
| 10 eigenvectors | 75% variance | 80% variance | 85% variance | 90% variance | All vectors |
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Final Image Dr. Mahmoud K. Quweider

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| --- | --- | --- | --- | --- | --- |
| 10 eigenvectors | 75% variance | 80% variance | 85% variance | 90% variance | All vectors |
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Final Image Dr. Marzieh Ayati

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| --- | --- | --- | --- | --- | --- |
| 10 eigenvectors | 75% variance | 80% variance | 85% variance | 90% variance | All vectors |
|  |  |  |  |  |  |

Final Image Dr. Lei Xu

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| --- | --- | --- | --- | --- | --- |
| 10 eigenvectors | 75% variance | 80% variance | 85% variance | 90% variance | All vectors |
|  |  |  |  |  |  |

Final Image Dr. Megan Strait

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| --- | --- | --- | --- | --- | --- |
| 10 eigenvectors | 75% variance | 80% variance | 85% variance | 90% variance | All vectors |
|  |  |  |  |  |  |

Final Image Mr. Robert Jackson

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| --- | --- | --- | --- | --- | --- |
| 10 eigenvectors | 75% variance | 80% variance | 85% variance | 90% variance | All vectors |
|  |  |  |  |  |  |

Final Image Dr. Robert Schweller

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| --- | --- | --- | --- | --- | --- |
| 10 eigenvectors | 75% variance | 80% variance | 85% variance | 90% variance | All vectors |
|  |  |  |  |  |  |

Final Image Mr. Roberto Jimenez

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| --- | --- | --- | --- | --- | --- |
| 10 eigenvectors | 75% variance | 80% variance | 85% variance | 90% variance | All vectors |
|  |  |  |  |  |  |

Final Image Dr. Sheikh Ariful Islam

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| --- | --- | --- | --- | --- | --- |
| 10 eigenvectors | 75% variance | 80% variance | 85% variance | 90% variance | All vectors |
|  |  |  |  |  |  |

Final Image Dr. Timothy Wylie

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| --- | --- | --- | --- | --- | --- |
| 10 eigenvectors | 75% variance | 80% variance | 85% variance | 90% variance | All vectors |
|  |  |  |  |  |  |

Final Image Dr. Zhixiang Chen

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| --- | --- | --- | --- | --- | --- |
| 10 eigenvectors | 75% variance | 80% variance | 85% variance | 90% variance | All vectors |
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In the final, the program outputs possible saving after PCA. These results are also written in the logFile.txt. In this project,

The saving in bytes for 10 vectors is 35340.0 bytes

The saving in bytes for 20 vectors is 9742.5 bytes

The saving in bytes for 22 vectors is 4623.0 bytes

The saving in bytes for 23 vectors is 2063.25 bytes

The lose in bytes for 24 vectors is -496.5 bytes