Chapter 16
Night 8

16.1   *Eigenfaces Paper*

Check out *Eigenfaces for Recognition*, an early paper on eigenfaces, by M. Turk and A. Pentland. You have most of the tools to understand this paper, but the writing style might be unfamiliar (intense!). Spend 1 hour on this paper and then feel free to move on. The first 6 pages of this paper describe the use of eigenfaces in face recognition. Check out other sources as well. Wikipedia is pretty useful for eigenfaces, and this later paper talks about eigenfaces and an extension called Fisherfaces (not fish faces).

Exercise 16.1

We are asking you read this paper for several reasons. We hope that it highlights and synthesizes all the material you've learned in this module. It will also give you practice reading a technical paper, which is a skill you'll continue to develop over your career.

1. In what ways was your approach to implementing the eigenfaces algorithm similar or different from the authors' approach?

2. In what ways did your understanding of the eigenfaces algorithm change after reading the paper?

3. Were there places in the reading that you "got stuck?" If so, how did you address that?

4. What questions do you have after reading the paper?

16.2   *Beginning the Project*

In this project you will extend the work you have already done on facial recognition and feature detection by analyzing the performance of an existing algorithm within a real context. We know that facial recognition and other forms of feature detection algorithms are incredibly powerful, but they are often prone to failure, and those failures can have very real consequences on people's lives. This is a new formulation of this project where we are challenging you to think deeply about the contexts and consequences for facial/feature recognition algorithms. To prepare for tomorrow's in-class ideation activities, we ask you to do two things:

1. Read the project description, which can be found in the next chapter (Chapter 17), and write down any questions you find yourself asking.

2. Fill out this partner survey by midnight tonight, Feb. 19th. We will announce the teams tomorrow morning.

2. Choose an important question related the context and ethics of your chosen *FeaRDeClass*. This should be rooted in a real context, and you do not have to be able to answer it. Break off a small sub-question that you think you can answer in one and a half weeks through an analytical approach that utilizes eigenfaces, another facial recognition algorithm, or linear regression. Consider the ethical consequences of your chosen topic. Under what circumstances could the technology be harmful? Whom might it harm, and how?

3. Plan, execute, and document some analysis (which could include modifying/creating an algorithm) to answer your sub-question.

4. Explain the mathematical algorithm you are using in detail, explaining the various steps and what the purpose of each step of the process is. Use equations!

5. Explain how the results of your analysis inform the question you are trying to answer. Tie the results of your sub-question back into your larger question and chosen context. What can you conclude from the analysis you did? Recommend areas for future investigation.

6. You should understand the metrics against which your programs should be measured. How do you characterize the accuracy of your approach? Against what should you compare this accuracy? How do you quantify the consequences of your approach?

7. Communicate the context, analytical approach, and findings via a formal technical report to the LinAlgCo.

17.3 Resources

1. Your existing eigenfaces algorithm or the example solution posted. Let us know if you need help getting eigenfaces working.

2. The smile detection algorithm, which uses linear regression. Your version or the walkthrough from class can be modified to do something similar.

3. Training and test images for your class and past QEA classes.

4. The 10k faces database. This includes >2,000 images that have been classified in terms of demographics and other info (like whether people are facing the camera) and a software tool to narrow the database by classifiers (e.g., to only smiling men). The downside of this database is there is only one photo of each person.

5. The internet. In addition to doing context/background research, you can go find a different algorithm or face database if you prefer, but be aware that this will take extra time!

6. Your teaching team. Remember that we are here to support your learning! Bounce ideas off of us in office hours. Don't let MATLAB get you down; ask for help early and often.