University of Colorado - Boulder

APPM 3310
Matrix Methods — Fall 2024

Project Proposal - SVD Image Compression

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Section: 002 (11:15-12:05)

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Questions

1. **What are the names and sections of the people in this group?**
   The names of the people in this group are Sam Walker and Pete Walker. Both are in section 002 with Professor Grooms.

2. **What is the topic that you are proposing to investigate?**
   We are proposing to investigate the application of Singular Value Decomposition (SVD) for image compression. Specifically, we aim to demonstrate how matrix decompositions can be used to reduce the size of an image while retaining visual quality.

3. **How is the topic related to linear algebra/matrix methods?**
   SVD is a matrix factorization method that decomposes a matrix into three components: two orthogonal matrices and a diagonal matrix of singular values. It is a fundamental linear algebra technique that allows us to approximate matrices of large size (such as image data) with lower rank matrices, which is essential for compression. This project will highlight how matrix methods are applied to solve practical problems in data compression.

4. **Why are you interested in this application area?**
   We are interested in this area because image compression is a real-world problem with vast applications in storage and transmission of digital data. As programmers and mathematicians, understanding how mathematical techniques like SVD can optimize the way images are stored and transmitted is exciting. Additionally, working with images provides visual feedback that makes the mathematical results more intuitive.

5. **What do readers need to be familiar with in order to successfully read your paper?**
   Readers should be familiar with basic matrix operations, including matrix multiplication and eigenvalues. A general understanding of linear transformations and orthogonal matrices will also be helpful for understanding SVD and how it relates to image compression.

6. **Is there any prior research on your topic that might be helpful for the audience to be familiar with?**
   A key resource that is a good starting point for understanding SVD is hosted by Dennis Miczek here. Another valuable resource is any material on low-rank matrix approximations as that is a primary basis of understanding SVD.

7. **Will you run any numerical experiments/computations in your paper?**
   Yes, we will implement the SVD algorithm on various images and perform numerical experiments by varying the number of singular values used to reconstruct the images. We will compare the compressed images with the original ones in terms of visual quality and compression ratio.

8. **Will you analyze any data in your project? If so, from where did the data come? Is this an experiment or observational study? Who collected the data? Why was the data collected (if you weren't the one doing the collecting)?**
   Yes, we will analyze image data. The images we will use for this project are publicly available test images, such as The Kodak Image Set. These images are typically used for benchmarking compression algorithms and are widely available online. This site also mentions the data sizes across multiple file formats. We will be starting from raw uncompressed files (BMP). We will compare our compression to other popular file formats such as JPG and PNG. Our compression algorithm will use lossy compression similar to JPG, unlike PNG's lossless manipulation. We expect our algorithm to be able to reduce images to significantly lower sizes albeit ruining the quality of the image most likely at a faster rate than standard compressions such as JPG.