Math 350 Computer Lab: Movie Data (Feb 27 2023)

Overview:

In class, we looked at how to use the SVD to find the best basis for a collection of photographs of people's faces. Today, we'll do something similar, but we'll add something interesting- Motion through time, or movie data.

First, go to our class website and download today's data file: "author.mat". I've started a script file for you, `LabBestBasis.m`, also on the class website.

The Data

The data consists of 109 frames of a movie, so each of the 109 images is itself a "photo" that is 120×160, or $19,200$ "pixels", where each pixel is an integer ranging from 0 to 255.

Note that there are several ways we could store this data. For example, we could construct a matrix that is $120 \times 160 \times 109$, or if we concatenate the columns of each matrix to a vector, we could store the data in a matrix that is 19200×109- In fact, the data set here is stored as $Y1$ that is 19200×109.

Code Snippets

- Before we start, open the editor and edit a script file rather than typing commands live- It will save a lot of time!
- First we'll need to load the data and convert it to a format that we can work with.

  This matrix was stored in a format called "unsigned integer", and we want to convert it to floating point. Call this command to do that:

```
load author.mat
Y1=double(Y1);
```

- To visualize a single vector $\mathbf{v} \in \mathbb{R}^{19200}$ as a photo, we use "reshape". In particular, below we'll visualize the 100th column of Y1 as an image:

```
v=Y1(:,100);
imagesc(reshape(v,120,160));
colormap(grey);  % For a new figure, this command only needs to be issued once.
```

- Here's a code snippet showing how to visualize the movie contained in an array Z that is 19200×109. Its fun to see the original and the mean subtracted movie!

```
for j=1:109
imagesc( reshape(Z(:,j),120,160) );
if j==1
colormap(gray);
end
M(j)=getframe;
end
```

To replay the movie, type `movie(M)`.

- Code snippet to put four graphs on the image (arranged as 2×2): We'll assume here that the matrix A is 19200×4, and we want to plot these:

```
figure;  %If you want a new figure
for j=1:4
   subplot(2,2,j)
   imagesc(reshape(A(:,j),120,160));
end
```

Computer Lab Step by Step:

In general, we want to load the data and visualize the best three dimensional representation. We'll document/visualize some things along the way.

1. Load the data. Convert it to "double" format (which is a floating point format).
2. Visualize the data as a movie. When you publish, it won't be a movie, but that's OK.
3. Compute and visualize the mean as an image.
4. Mean subtract the data.
5. Visualize the mean-subtracted data as a movie.
6. Compute the best basis vectors.
7. Visualize the first four basis vectors (using the code snippet above).
8. Project the data to the best two dimensions.
9. Plot the data in $\mathbb{R}^2$.

When you're finished, please "publish" your code and upload it to Canvas.