Matlab Homework: Movie Data

You'll be given a set of 109 photos, each "photo" being an array of size 120×160, or $19,200$ "pixels"- Each pixel is an integer from 0 to 255 representing the gray level for that position in the image.

On the class website, the matrix holding the photos is called "author.mat".

Code Snippets

- The data is stored in the Matlab file `author.mat`. When you download it, type `load author.mat`, and a matrix $Y1$ will be loaded into memory. 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:

```
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
```

Homework 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 three dimensions.
9. Plot the data in $\mathbb{R}^3$.

Also, here is a good place to explore a little- Why do we perform mean-subtraction? If we don't, then the first basis vector points in the direction of the mean. See if you can verify that by taking the SVD of the original (non-mean subtracted) data, then visualize the first vector as an image. You might compare that to the mean.