

# ECE 311 Lab 6

Jacob Hutter

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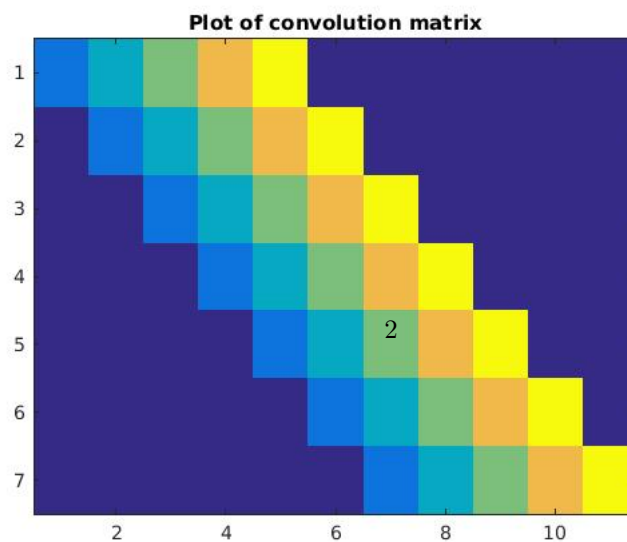
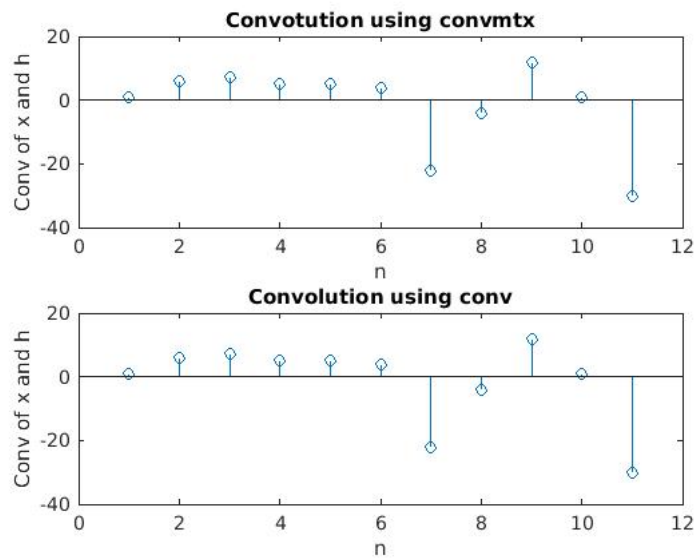
```

1 x = [ 1 4 -4 -3 2 5 -6];
  h = [1 2 3 4 5];
3 a = convmtx(h,length(x));
  figure;
5 imagesc(a);
  title('Plot of convolution matrix');
7
  cx = x*a;
9 c = conv(x,h);

11 figure;
  subplot(211);
13 stem(cx);
  title('Convolution using convmtx');
15 ylabel('Conv of x and h');
  xlabel('n');
17 subplot(212);
  stem(c);
19 title('Convolution using conv');
  ylabel('Conv of x and h');
21 xlabel('n');

```

report1.m



$$\begin{aligned}
A &= U\Sigma V^H \\
A^H A &= V\Sigma^H U^H U \Sigma V^H \\
&= V\Sigma^H \Sigma V^H \\
A^H A V &= V\Sigma^H \Sigma = V\Sigma^2
\end{aligned}$$

```

1 clear all;
2 clc;
3 A = [1,4,-2; 3,11,5; 7,7,7];
4 AH = A';
5 AHA = AH*A;
6 AAH = A*AH;
7
8 [V1,D1] = eig(AAH);
9 [V2,D2] = eig(AHA);
10
11 [U3,S3,V3] = svd(A);
12
13 A*AH*U3 - U3*S3^2 % formula given, gives zero matrix
14
15 AH*A*V3 - V3*S3^2 % zero matrix returned

```

report2.m

```

ans =

    1.0e-12 *

   -0.0142   -0.0107   -0.0009
    0.0853    0.0018   -0.0027
    0.1137    0.0178    0.0036

ans =

    1.0e-13 *

    0.9948    0.0888    0.0355
    0.8527   -0.2132    0.1171
    0.8527         0    0.0222

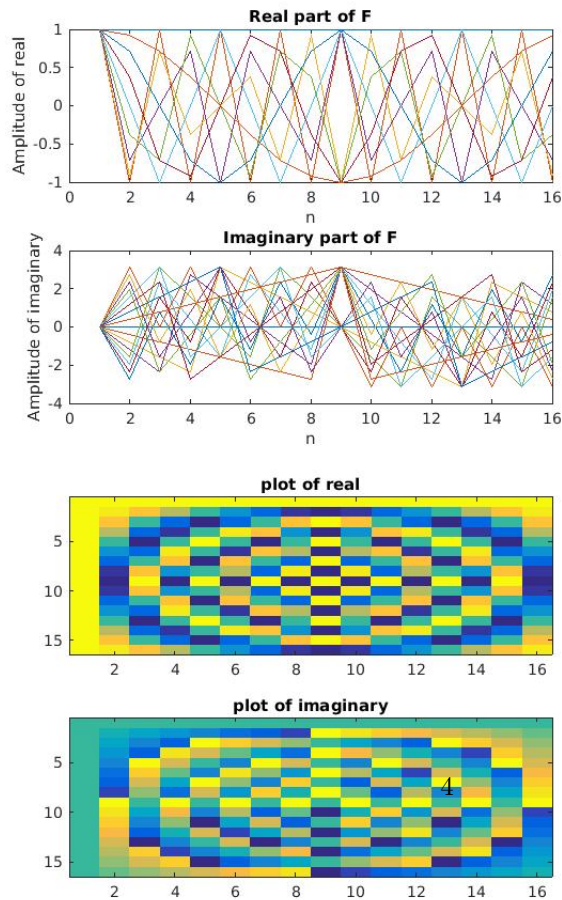
```

```

1  clc;
   clear all;
3  x = [1 1 4 -4 -3 2 5 -6 3 2 4 -2 5 9 -8 4]';
   F = dftmtx(length(x));
5  X = F*x;
   r = real(F);
7  a = angle(F);
   figure;
9  subplot(211);
   plot(r);
11 title('Real part of F');
   ylabel('Amplitude of real');
13 xlabel('n');
   subplot(212);
15 plot(a);
   title('Imaginary part of F');
17 xlabel('n');
   ylabel('Amplitude of imaginary');
19
   figure;
21 subplot(211);
   imagesc(r);
23 title('plot of real');
   subplot(212);
25 imagesc(a);
   title('plot of imaginary');

```

report4.m



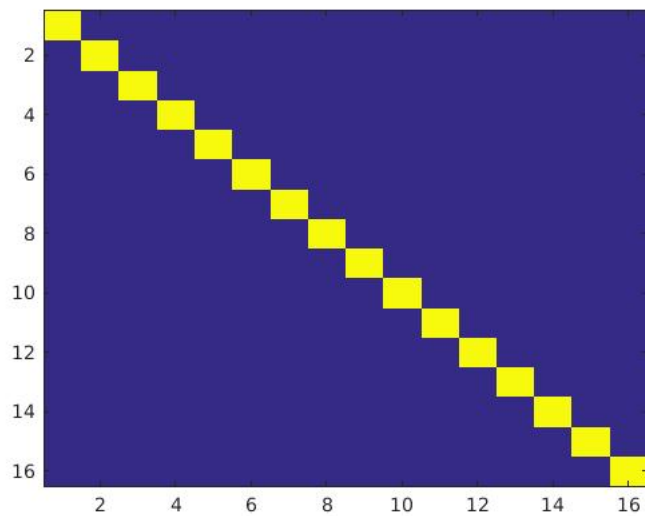
```

1  clc;
   clear all;
3  x = [1 1 4 -4 -3 2 5 -6 3 2 4 -2 5 9 -8 4]';
   F = dftmtx(length(x));
5  Fh = (1/length(x))*F';
   A = Fh*F;
7  figure;
   subplot(211);
9  plot(abs(A));
   subplot(212);
11 plot(angle(A));

13 figure;
   imagesc(abs(A));

```

report5.m



```

1 clc;
2 clear all;
X = loadImages('yalefaces');
4 Y = compMeanVec(X);
Z = reshape(Y,[60,80]);
6 imagesc(Z);
colormap gray

```

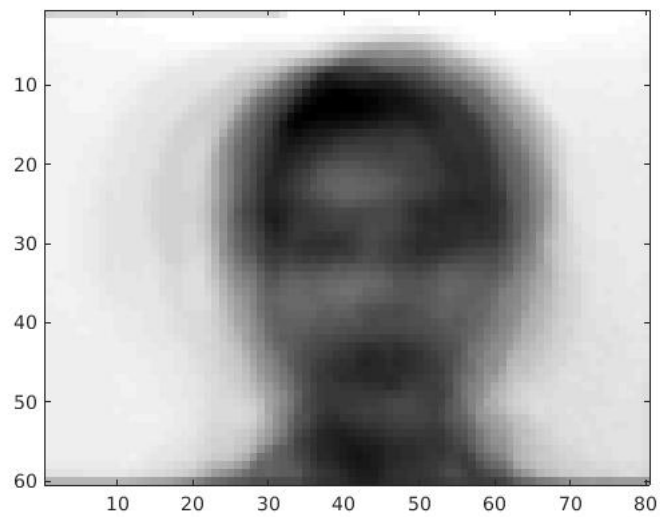
report6.m

```

1 function [ Y ] = compMeanVec( X )
[ height,width] = size(X);
3 sum = zeros(1,width);
for i=1:height
5     sum = sum + X(i,:);
end
7 sum = sum/height;
Y = sum;
9 end

```

compMeanVec.m



```

clc;
clear all;
X= loadImages('yalefaces');
Y = compMeanVec(X);
X_hat = zeros(165,4800);
for i=1:165
    X_hat(i,:) = X(i,:) - Y;
end
R = (X_hat')*(X_hat);
[U,S,V] = svd(R);
s = svd(R);
figure;
s = s(1:100,1);
plot(s);
title('Plot of first 100 eigenvalues');

figure;
imagesc(reshape(U(:,1),[60,80]));
colormap gray
title('1st eigenvector');

figure;
imagesc(reshape(U(:,2),[60,80]));
colormap gray
title('2nd eigenvector');

figure;
imagesc(reshape(U(:,3),[60,80]));
colormap gray
title('3rd eigenvector');

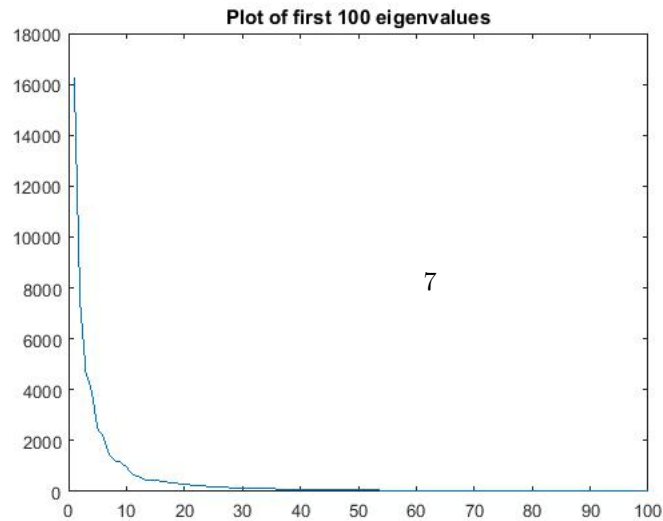
figure;
imagesc(reshape(U(:,4),[60,80]));
colormap gray
title('4th eigenvector');

figure;
imagesc(reshape(U(:,50),[60,80]));
colormap gray
title('50th eigenvector');

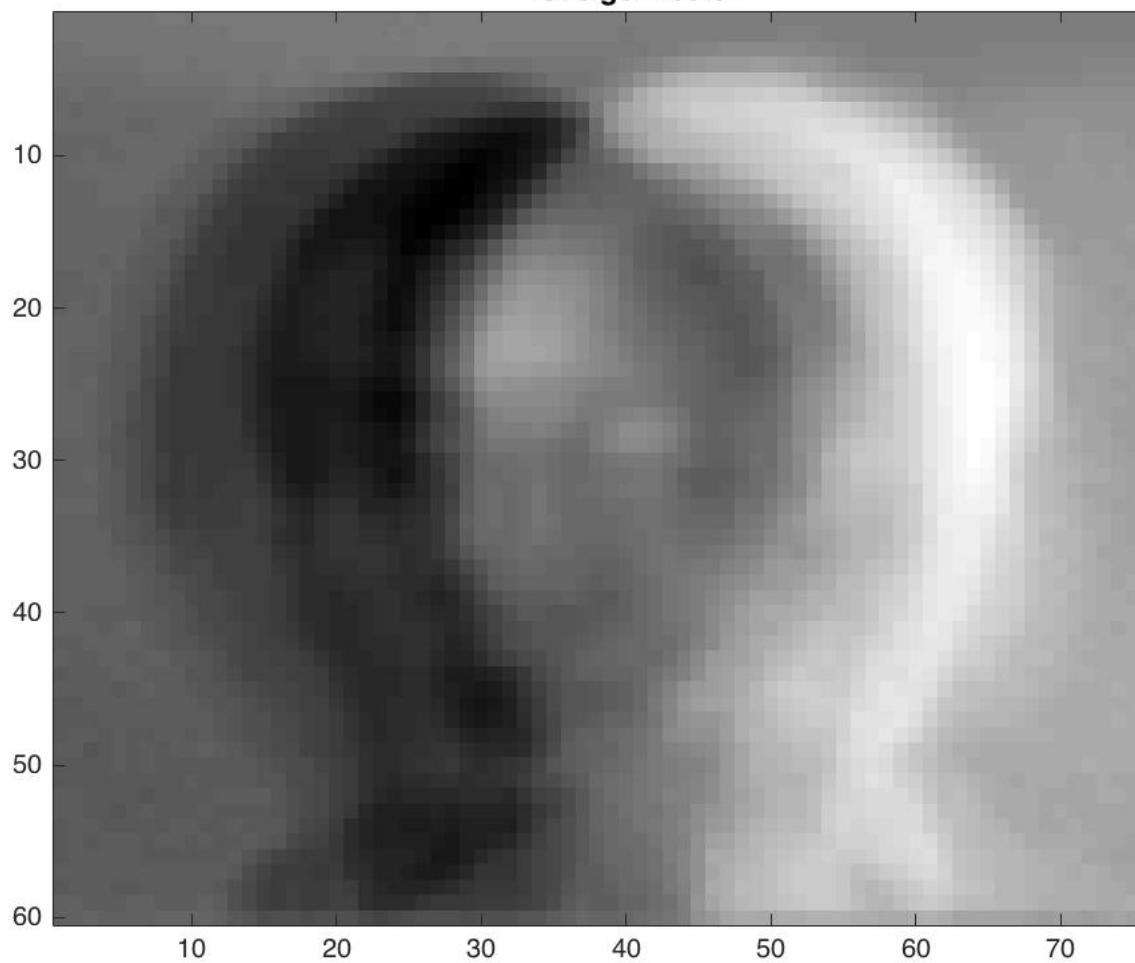
figure;
imagesc(reshape(U(:,100),[60,80]));
colormap gray
title('100th eigenvector');

```

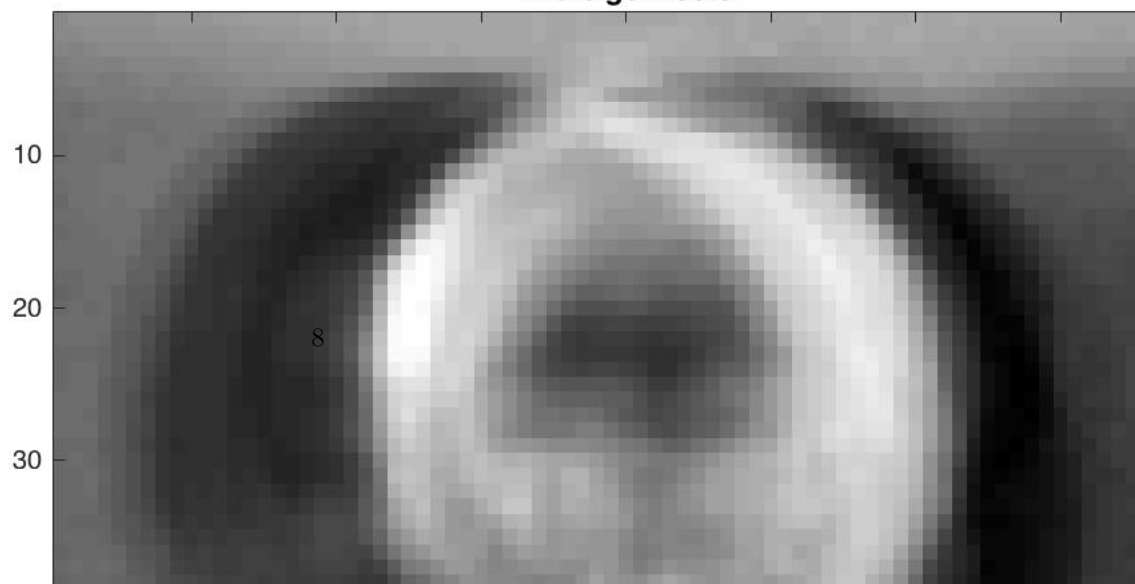
report7.m



**1st eigenvector**

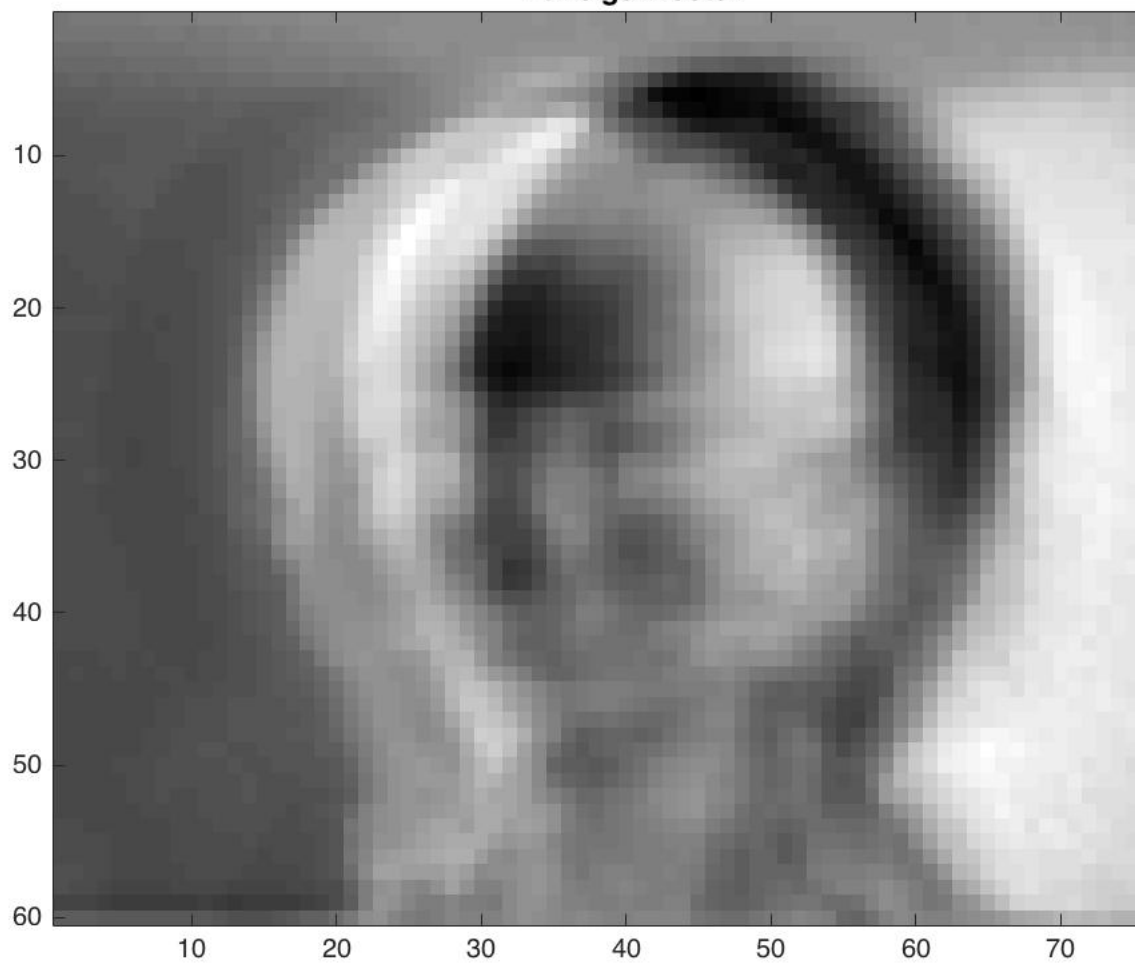


**2nd eigenvector**

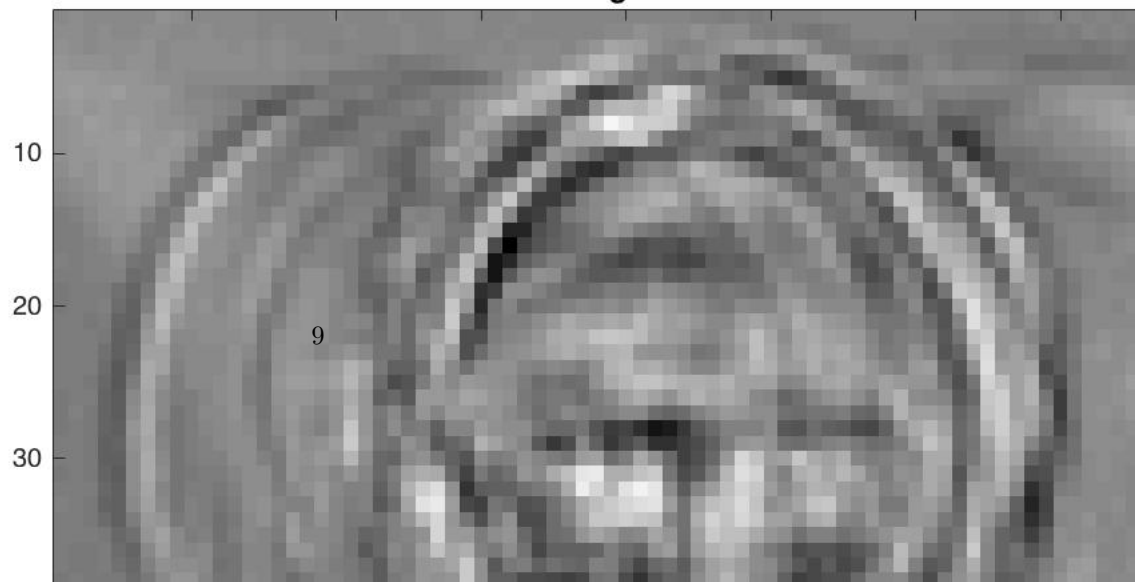




4th eigenvector



50th eigenvector



```

function [ x_pca ] = PCAtransform( Ux, V, x_orig )
2     %[height,width] = size(x_orig);
    x_hat = x_orig - Ux;
4
    %{ for i=1:height
6     %     x_hat(i,:) = x_orig(i,:) - Ux;
    %end
8     x_pca = inv(V) * x_hat';
end

```

PCAtransform.m

```

1 function [ x_orig ] = invPCAtransform( Ux, V, x_pca )
3
    x_orig = x_pca * V';
5    x_orig = x_orig + Ux;
7 end

```

invPCAtransform.m

```

1  clc;
3  clear all;
X = loadImages('yalefaces');
5  Y = compMeanVec(X);
Ux = Y;
7  X_hat = zeros(165,4800);
for i=1:165
9      X_hat(i,:) = X(i,:) - Y;
end
11 R = (X_hat')*(X_hat);
[U,S,V] = svd(R);
13
%%%%%% get U and Ux
15 A = imread('noisy_face.png');
A = im2double(A); % convert integer precision to double precision
for mean
17 A = reshape(A,[1,4800]);

19 % start of PCA transform
A_pca = PCAtransform(Ux,U,A);
21 % end of PCA transform

23 A_pca(1,100:4800) = 0; % limit noise

25 %%%%%%%%%%%obtained pca version%%%%%%%%%%
%start of inv PCA transform
27 A_orig = invPCAtransform(Ux,U,A_pca);
%end of inv PCA transform
29 figure;
imagesc(reshape(A_orig,[60,80]));
31 colormap gray

```

report8.m

