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```
close all
clear all
```

Problem 4 Part 1

```
%load images and change black and white tone
%want white -127.5 black 127.5 from 255 0
%when A = 0, -(0-127.5) = 127.5
%when A = 255, -(255-127.5) = -127.5
nbits = 8;
A1 = imread('StevenTyler_BW_cropped(1)(1).tif');
A1 = single(A1);
A1 = -(A1 - (2^nbits-1)/2);
A2 = imread('MelissaRivers_BW_cropped(1)(1).tif');
A2 = single(A2);
A2 = -(A2 - (2^nbits-1)/2);
A3 = imread('LivTyler_BW_cropped(1)(1).tif');
A3 = single(A3);
A3 = -(A3 - (2^nbits-1)/2);
A4 = imread('KieferSutherland_BW_cropped(1)(1).tif');
A4 = single(A4);
A4 = -(A4 - (2^nbits-1)/2);
A5 = imread('RachelSutherland_BW_cropped(1)(1).tif');
A5 = single(A5);
A5 = -(A5 - (2^nbits-1)/2);
A6 = imread('EmilyDeschanel_BW_cropped(1)(1).tif');
A6 = single(A6);
A6 = -(A6 - (2^nbits-1)/2);
A7 = imread('ZooeyDeschanel_BW_cropped(1)(1).tif');
A7 = single(A7);
A7 = -(A7 - (2^nbits-1)/2);
A8 = imread('ZooeyDeschanel2_BW_cropped(1)(1).tif');
A8 = single(A8);
A8 = -(A8 - (2^nbits-1)/2);
A9 = imread('KatyPerry_BW_cropped(1)(1).tif');
A9 = single(A9);
A9 = -(A9 - (2^nbits-1)/2);

% sanity check
% imshow(mat2gray(A2))
```

Part 2

```
A1 = A1';
x1 = A1(:);
A2 = A2';
x2 = A2(:);
A3 = A3';
x3 = A3(:);
A4 = A4';
x4 = A4(:);
A5 = A5';
x5 = A5(:);
A6 = A6';
x6 = A6(:);
A7 = A7';
x7 = A7(:);
A8 = A8';
x8 = A8(:);
A9 = A9';
x9 = A9(:);

X = [x1 x2 x3 x4 x5 x6 x7 x8 x9];
```

Part 3 and 4

```
%deveiation matrix for original X
xmean = [];
for i=1:9
    xmean(i) = mean(X(:,i));
end

xm_m = repmat(xmean, length(x1), 1);

D = X - xm_m;

S = 1/(length(x1)-1) * D' * D;

[eigVec,eigVal] = eig(S); %echo these

mineigVec = min(eigVec);

%normalized by x1/min(x1)
V_norm = eigVec./mineigVec;

%Pearson Correlation

for i=1:9
    Dnorm(:,i) = D(:,i)./norm(D(:,i));
end

R = Dnorm'*Dnorm;
```

```
% Rllone = R(find(R < 1,5,'last'));
diary vjprob4.txt
echo on
disp('2nd max is 0.8335, index at 7,8 and 8, this is because both
 those images are of the same person Zooey Deschanel')
```

disp('2nd max is 0.8335, index at 7,8 and 8, this is because both
 those images are of the same person Zooey Deschanel')
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 images are of the same person Zooey Deschanel

Part 5

```
disp('The first three PCs can explain')

TotVar = (eigVal(1,1) + eigVal(2,2) + eigVal(3,3))/(sum(sum(eigVal)))
 *100

disp('percent of the total variance')


disp('In the second PC eigenvector and for group 1 photos, the entries
 are most influenced by mouth shape.')
disp('For Group 2 photos, the last 3 entries all have the same sign
 and relatively large magnitudes as the most prominent features
 recongized are possibly basic facial shape.')
disp('For Group 3 photos those are images of the same person at
 different angles, so the features are largely the same.')
disp('The oddball entry seems to be photo 4, as the abs(value) is the
 smallest.')
disp('In the third PC eigenvector those psoitions (1,2.6) all
 correspond to people who are smiling wide showing their teeth. These
 reveal a nearly max intensity white.')
disp('The nearly max instensity present will essentially act as a
 persisten max value through all our manipulations.')


%echoing all other values needed

disp('Part 4 Values')
eigVal
eigVec
V_norm

disp('Part 3 Values')
S
R
echo off


%% Part 5
disp('The first three PCs can explain')
The first three PCs can explain
```

```
TotVar = (eigVal(1,1) + eigVal(2,2) + eigVal(3,3))/(sum(sum(eigVal)))
  *100

TotVar =

  single

   77.2885


disp('percent of the total variance')
percent of the total variance


disp('In the second PC eigenvector and for group 1 photos, the entries
 are most influenced by mouth shape.')
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 max value through all our manipulations.


%echoing all other values needed

disp('Part 4 Values')
Part 4 Values
eigVal

eigVal =

  9×9 single matrix
```

```
    1.0e+04 *

  Columns 1 through 7

    1.8706         0         0         0         0         0         0
         0    0.4649         0         0         0         0         0
         0         0    0.4069         0         0         0         0
         0         0         0    0.2418         0         0         0
         0         0         0         0    0.0674         0         0
         0         0         0         0         0    0.0736         0
         0         0         0         0         0         0    0.1685
         0         0         0         0         0         0         0
         0         0         0         0         0         0         0

  Columns 8 through 9

         0         0
         0         0
         0         0
         0         0
         0         0
         0         0
         0         0
    0.1234         0
         0    0.1311

eigVec

eigVec =

  9×9 single matrix

  Columns 1 through 7

    0.1684    0.6266   -0.4424    0.2087    0.0736    0.1279    0.1221
    0.2011    0.3782    0.6078   -0.5394   -0.0135    0.1064    0.2342
    0.3213    0.4964   -0.1796   -0.1047    0.0079   -0.0053   -0.3295
    0.1031    0.0275    0.1659    0.6053   -0.1171    0.4160    0.4302
    0.1590    0.1282    0.2538    0.3810    0.2827   -0.7928    0.0151
    0.3944   -0.0560    0.4540    0.3302   -0.1951    0.2051   -0.4879
    0.4900   -0.3555   -0.1909   -0.1093    0.5293    0.2243   -0.2283
    0.3828   -0.1655   -0.2502   -0.1018   -0.7534   -0.2627    0.0043
    0.4999   -0.2092   -0.0744   -0.1075    0.1219   -0.0966    0.5884

  Columns 8 through 9

    0.5489    0.0407
    0.1459   -0.2618
   -0.7022    0.0740
   -0.3100   -0.3560
    0.0228   -0.1988
    0.2414    0.3869
    0.1032   -0.4381
    0.0943   -0.3278
```

```
     -0.0995    0.5558

V_norm

V_norm =

  9×9 single matrix

  Columns 1 through 7

    1.6335   -1.7627    1.0000   -0.3869   -0.0977   -0.1614   -0.2502
    1.9506   -1.0639   -1.3737    1.0000    0.0179   -0.1342   -0.4801
    3.1168   -1.3962    0.4060    0.1941   -0.0105    0.0067    0.6753
    1.0000   -0.0773   -0.3750   -1.1223    0.1554   -0.5247   -0.8818
    1.5422   -0.3607   -0.5737   -0.7064   -0.3752    1.0000   -0.0310
    3.8267    0.1575   -1.0260   -0.6121    0.2589   -0.2588    1.0000
    4.7540    1.0000    0.4314    0.2026   -0.7025   -0.2829    0.4679
    3.7143    0.4656    0.5655    0.1888    1.0000    0.3314   -0.0088
    4.8495    0.5884    0.1681    0.1992   -0.1618    0.1219   -1.2060

  Columns 8 through 9

   -0.7817   -0.0929
   -0.2077    0.5976
    1.0000   -0.1689
    0.4414    0.8127
   -0.0325    0.4538
   -0.3438   -0.8833
   -0.1470    1.0000
   -0.1342    0.7482
    0.1417   -1.2688


disp('Part 3 Values')
Part 3 Values
S

S =

  9×9 single matrix

   1.0e+03 *

  Columns 1 through 7

    3.6726    0.5110    2.1887    0.3043    0.5569    0.5221    0.8432
    0.5110    3.8449    1.4910    0.3265    0.9678    1.8129    0.9799
    2.1887    1.4910    4.0326    0.4014    0.9264    1.9229    2.2882
    0.3043    0.3265    0.4014    1.9335    0.8820    0.9947    0.6370
    0.5569    0.9678    0.9264    0.8820    1.7316    1.6492    1.0286
    0.5221    1.8129    1.9229    0.9947    1.6492    4.7529    3.2284
    0.8432    0.9799    2.2882    0.6370    1.0286    3.2284    5.8348
    1.1077    0.7803    2.0085    0.4982    0.7853    2.2420    3.8905
    1.1248    1.4830    2.4174    0.8953    1.1327    3.2575    4.4829
```

```
Columns 8 through 9

   1.1077    1.1248
   0.7803    1.4830
   2.0085    2.4174
   0.4982    0.8953
   0.7853    1.1327
   2.2420    3.2575
   3.8905    4.4829
   3.7344    3.5533
   3.5533    5.9452

R

R =

  9×9 single matrix

  Columns 1 through 7

   1.0000    0.1360    0.5687    0.1142    0.2208    0.1250    0.1822
   0.1360    1.0000    0.3787    0.1197    0.3751    0.4241    0.2069
   0.5687    0.3787    1.0000    0.1438    0.3506    0.4392    0.4717
   0.1142    0.1197    0.1438    1.0000    0.4820    0.3281    0.1897
   0.2208    0.3751    0.3506    0.4820    1.0000    0.5749    0.3236
   0.1250    0.4241    0.4392    0.3281    0.5749    1.0000    0.6131
   0.1822    0.2069    0.4717    0.1897    0.3236    0.6131    1.0000
   0.2991    0.2059    0.5176    0.1854    0.3088    0.5322    0.8335
   0.2407    0.3102    0.4937    0.2641    0.3530    0.6128    0.7611

  Columns 8 through 9

   0.2991    0.2407
   0.2059    0.3102
   0.5176    0.4937
   0.1854    0.2641
   0.3088    0.3530
   0.5322    0.6128
   0.8335    0.7611
   1.0000    0.7541
   0.7541    1.0000

echo off
```

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