Part 1a Simple Loading and Manipulation

```
inputf = { 'Pokemon.wav' };

[x, Fs] = audioread(char(inputf));

%Separating Channels
ch1raw = x(:,1);
ch2raw = x(:,2);

%Basic Editing (for windowing) Silence! Sweet Silence!

ch1raw(44101:1:88200) = 0;
ch2raw(44101:1:88200) = 0;

%Package for playback

y = [ch1raw ch2raw];
audiowrite('Pokemon_silent_1to2sec.wav', y, Fs)
```

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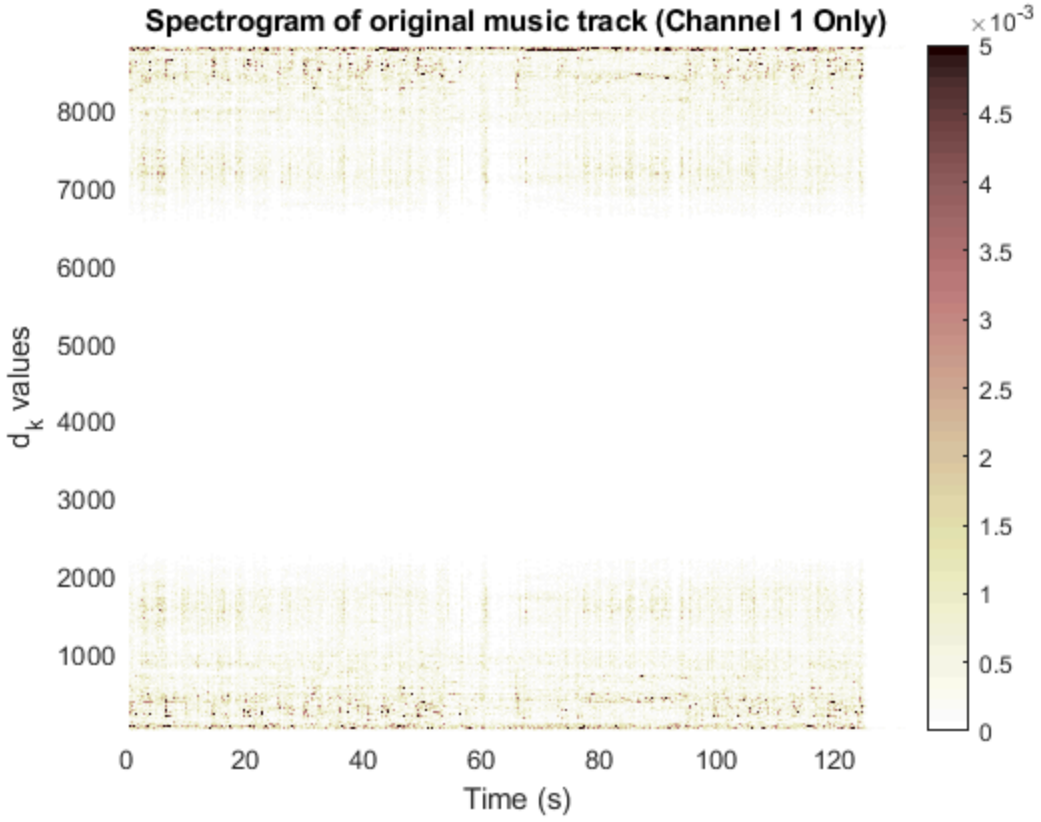
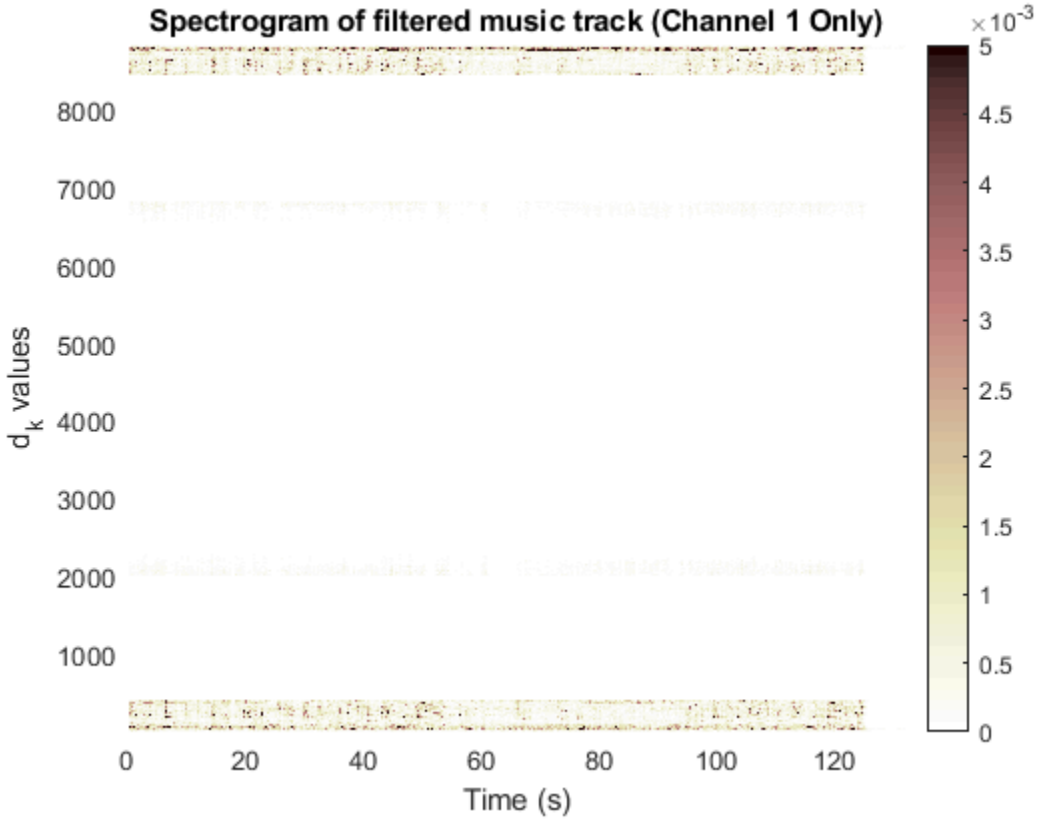
```
clear all
clc
close all

inputf = { 'Pokemon.wav' };

[x1,Fs1] = audioread(char(inputf));
ch1_raw = x1(:,1);
ch2_raw = x1(:,2);
ch1_rawT = ch1_raw';
ch2_rawT = ch2_raw';
L = 8820;

x1_ghost = [fliplr(ch1_rawT(1:4411)) ch1_rawT
 fliplr(ch1_rawT(5816789:5821200))];
x1_ghostT = x1_ghost';

x2_ghost = [fliplr(ch2_rawT(1:4411)) ch2_rawT
 fliplr(ch2_rawT(5816789:5821200))];
x2_ghostT = x2_ghost';


astor = zeros(8820,661);
astor2 = zeros(8820,661);

j = 1;
for i = 1:8820:5821200
    d_k = 1/L .* fft(x1_ghostT(i:8820+i-1));
    d_k2 = 1/L .* fft(x2_ghostT(i:8820+i-1));
    astor(:,j) = d_k;
    astor2(:,j) = d_k2;
    j = j+1;
end



f0 = figure('Name', 'Original');
T = 0:0.2:132;
K = 1:8820;
specto = pcolor(T, K, abs(astor));
set(specto, 'EdgeColor', 'none');
colorbar
caxis([0 0.005])
xlabel('Time (s)');
ylabel('d_k values');
title('Spectrogram of original music track (Channel 1 Only)');
colormap(flipud(pink))

%filter out guitar remove dk 490:520 = 0 and 8301:8331

astor_filt = astor;
astor_filt(400:2000, :) = 0;
```

```
astor_filt(6822:8422,:) = 0; %this is only range in which I can barely
% hear the highest guitar riff at around 95sec
astor_filt2 = astor2;
astor_filt2(400:2000, :) = 0;
astor_filt2(6822:8422,:) = 0;
astor_filt2(4411,:) = 0;
% astor_filt(75:115, :) = 0;


astor_filt(4411,:) = 0;
y_a = [0];


%Spectrogram of filtered
f1 = figure('Name', 'Filtered Guitar');
specto_filt = pcolor(T, K, abs(astor_filt));
set(specto_filt, 'EdgeColor', 'none');
colorbar
caxis([0 0.005])
xlabel('Time (s)');
ylabel('d_k values');
title('Spectrogram of filtered music track (Channel 1 Only)');
colormap(flipud(pink))

%stitch channel one back together
for i = 1:661
    y_d = L .* ifft(astor_filt(:,i));
    y_a = [y_a y_d'];
end

%make 2 channels
y = [y_a', y_a'];
audiowrite('Pokemon_LPF_noGuitar.wav', y, Fs1)
```


Spectrogram of original music track (Channel 1 Only)
×10^-3
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
8000
7000
6000
5000
4000
3000
2000
1000
d_k values
0
20
40
60
80
100
120
Time (s)


Spectrogram of filtered music track (Channel 1 Only)
×10^-3
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
8000
7000
6000
5000
4000
3000
2000
1000
d_k values
0
20
40
60
80
100
120
Time (s)

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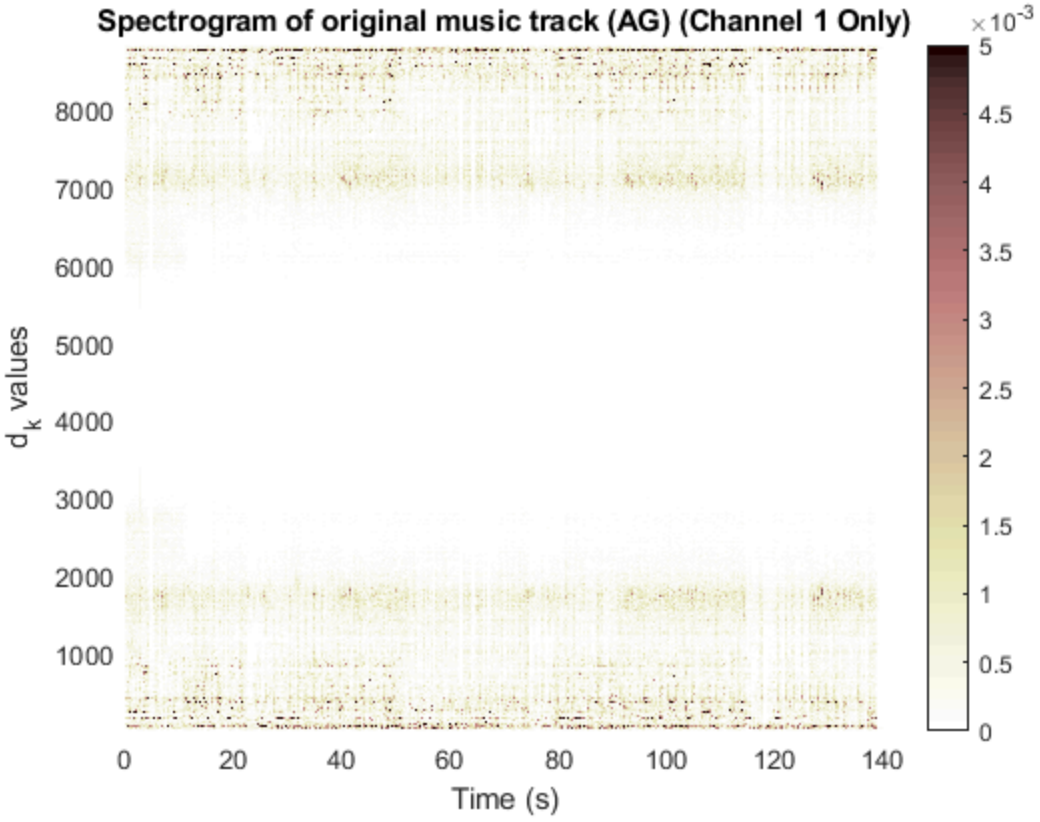
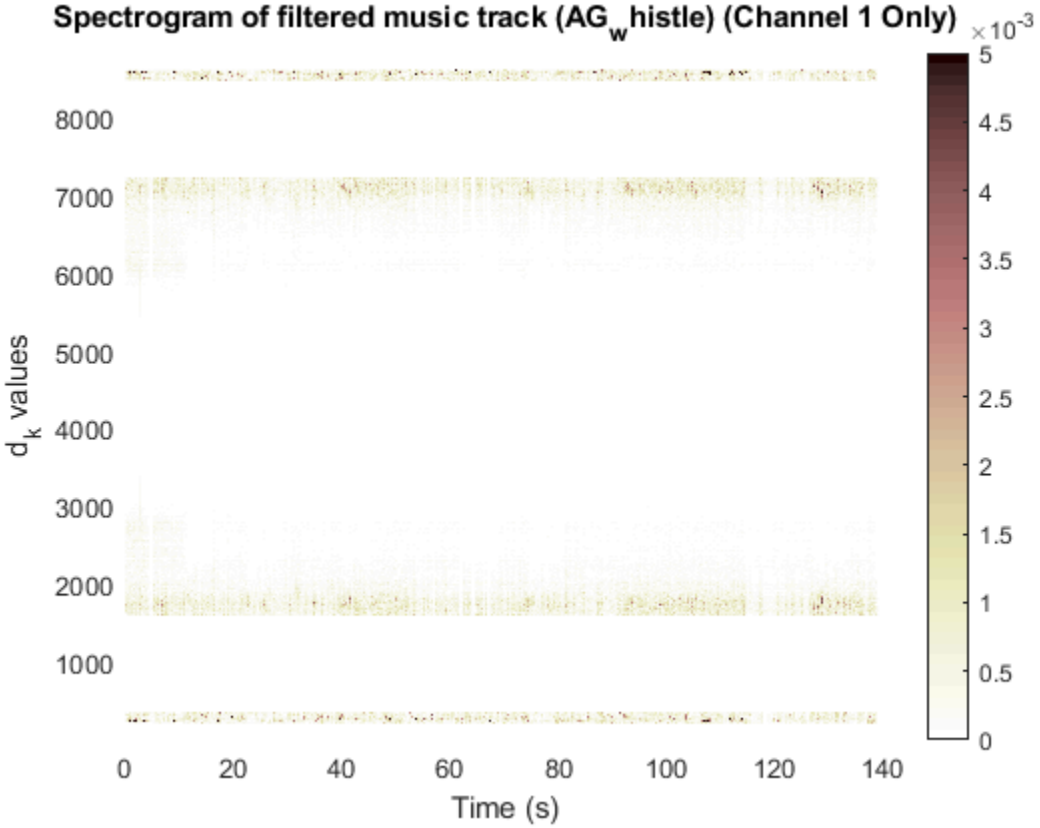
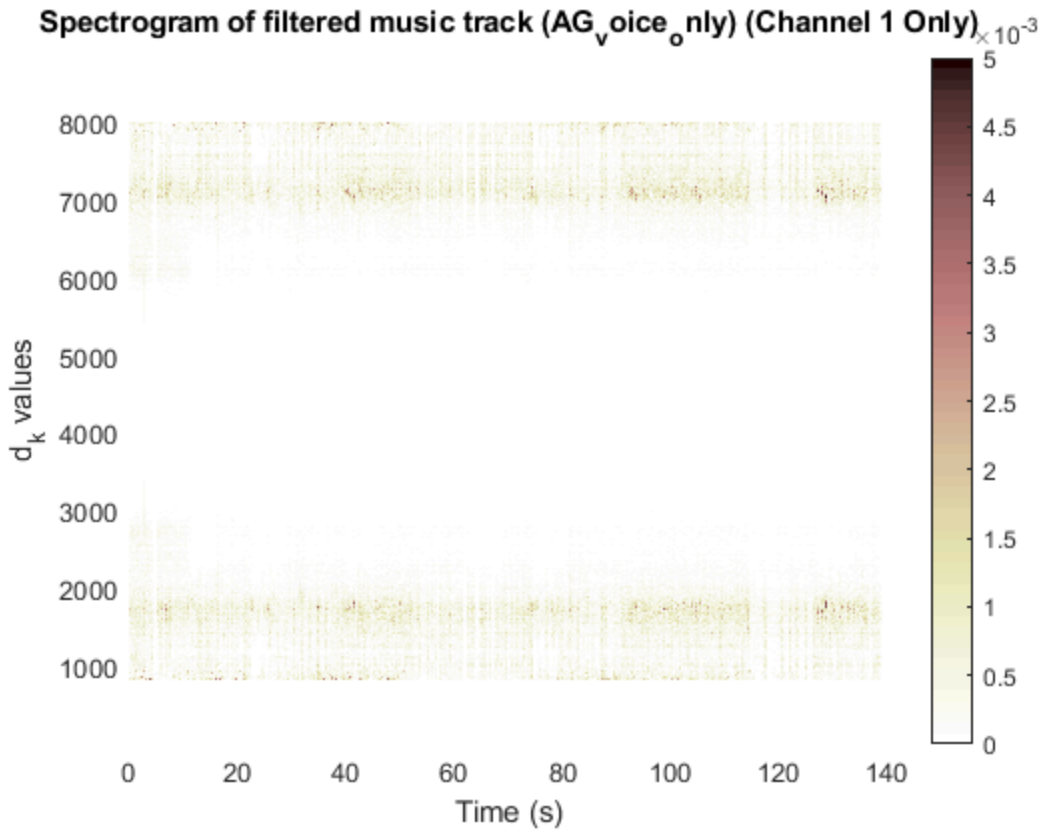
```
%Problem 1c

inputf = { 'Ariana_Grande_TheWay.wav' };

[x1,Fs1] = audioread(char(inputf));

ch1_raw = x1(:,1);
ch2_raw = x1(:,2);
ch1_rawT = ch1_raw';
ch2_rawT = ch2_raw';
L = 8820;

%add ghost zero nodes at end
x1_ghost = [ch1_rawT zeros(1,8822)];
x1_ghostT = x1_ghost';

astor = zeros(8820,700);
j = 1;

for i = 1:8820:6182822-8820
    d_k = 1/L .* fft(x1_ghostT(i:8820+i-1));
    astor(:,j) = d_k;
    j = j+1;
end

f0 = figure('Name', 'Original');
T = 0:0.2:140;
K = 1:8820;
specto = pcolor(T, K, abs(astor));
set(specto, 'EdgeColor', 'none');
colorbar
caxis([0 0.005])
xlabel('Time (s)');
ylabel('d_k values');
title('Spectrogram of original music track (AG) (Channel 1 Only)');
colormap(flipud(pink))
% xlim([90 120]);
% ylim([0 2000]); whistle location zoom in
% xlim([50 80]) mac miller
% ylim([0 600])

astor_filt = astor;
astor_filt(351:1599,:) = 0;
astor_filt(7223:8471,:) = 0;
astor_filt(4411,:) = 0;
astor_filt(2:200,:) = 0;
astor_filt(8622:8820,:) = 0; %emphasizing whistles

% astor_filt2 = 5 .* astor_filt;
f1 = figure('Name', 'Filtered');
specto_filt = pcolor(T, K, abs(astor_filt));
set(specto_filt, 'EdgeColor', 'none');
```

```
colorbar
caxis([0 0.005])
xlabel('Time (s)');
ylabel('d_k values');
title('Spectrogram of filtered music track (AG_whistle) (Channel 1
 Only)');
colormap(flipud(pink))
y_a = [0];

for i = 1:701
    y_d = L .* ifft(astor_filt(:,i));
    y_a = [y_a y_d'];
end

%make 2 channels
y = [y_a', y_a'];
audiowrite('Ariana_whistles_only.wav', y, Fs1)


astor_getoutMac = astor;
astor_getoutMac(2:820,:) = 0;
astor_getoutMac(8002:8820,:) = 0;
% astor_getoutMac(600:4000,:) = 0;
% astor_getoutMac(4822:8222,:) = 0;

f2 = figure('Name', 'Filtered 2');
specto_filt = pcolor(T, K, abs(astor_getoutMac));
set(specto_filt, 'EdgeColor', 'none');
colorbar
caxis([0 0.005])
xlabel('Time (s)');
ylabel('d_k values');
title('Spectrogram of filtered music track (AG_voice_only) (Channel 1
 Only)');
colormap(flipud(pink))
y_b = [0];

for i = 1:701
    y_d2 = L .* ifft(astor_getoutMac(:,i));
    y_b = [y_b y_d2'];
end

%make 2 channels
y1 = [y_b', y_b'];
audiowrite('Ariana_voice_only.wav', y1, Fs1)
```


Spectrogram of original music track (AG) (Channel 1 Only)
×10^-3
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
8000
7000
6000
5000
4000
3000
2000
1000
d_k values
0
20
40
60
80
100
120
140
Time (s)


Spectrogram of filtered music track (AG_whistle) (Channel 1 Only)
×10^-3
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
8000
7000
6000
5000
4000
3000
2000
1000
d_k values
0
20
40
60
80
100
120
140
Time (s)



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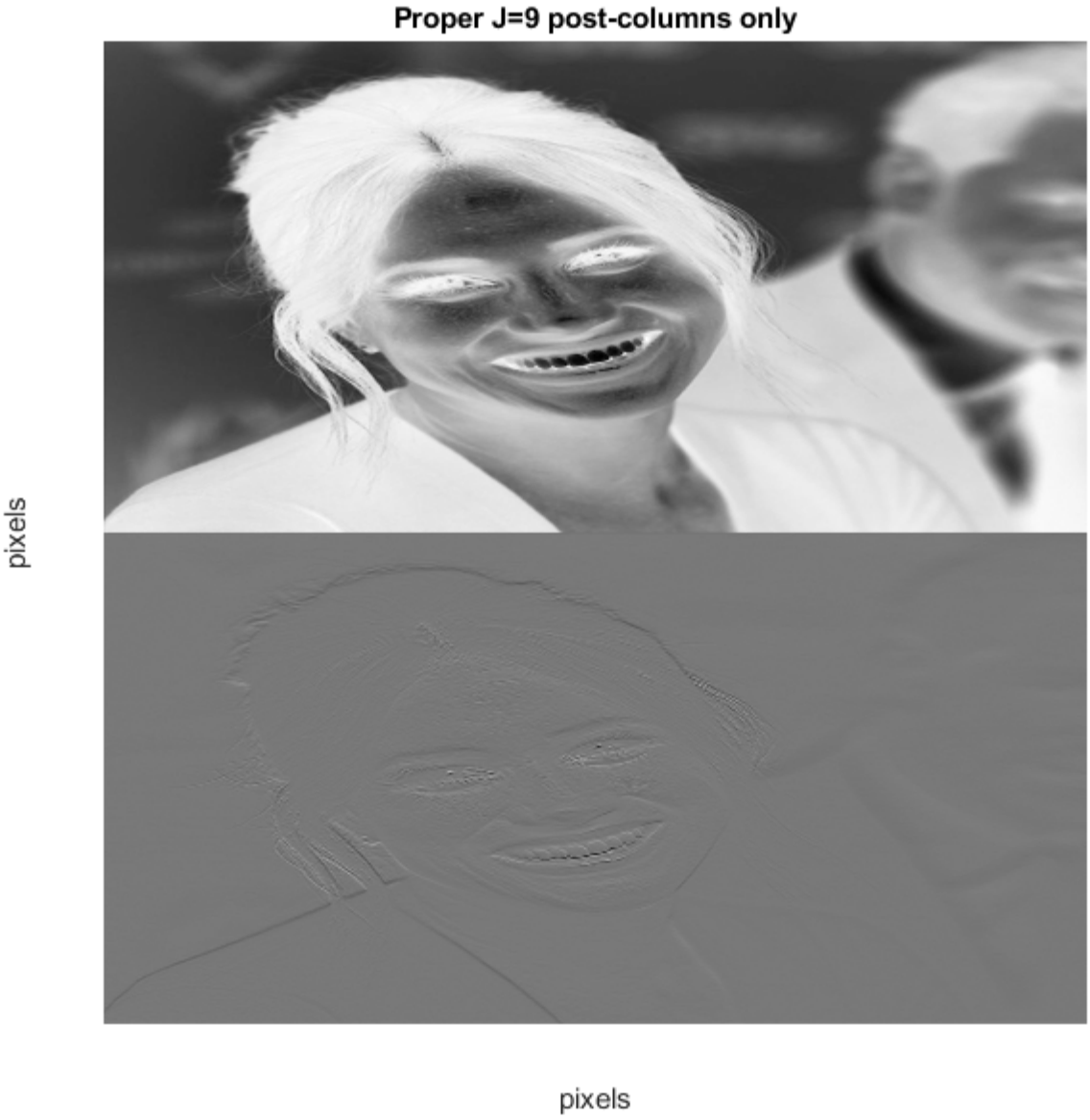
Contents


```
%%Problem 2 Harr
close all
clear all
A = imread('Meghan_Markle_BW.tif');

nbits = 8;
A = single(A);
%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
A = -(A - (2^nbits-1)/2);


%column rastering is just top average, bottom 1/2 differences from each
%column vector


%practice with just one column then generalize
% B1 = A(:,1);

% B2 = 0.5 * (B1(1) + B1(2));
%next term is
% 0.5 * (B1(3) +B1(4));
% B3 = 0.5 * (B1(1) - B1(2));
%put the average in a new matrix


% b3 = [b2;b3];

%ok time to generalize
B2_int = [0;0];
B3_int = [0;0];

for ii = 1:512
    j = 1;
    B1 = A(:,ii);
    for i = 1:2:511

    B2_int(j,ii) = 0.5 * (B1(i) + B1(i+1));

    B3_int(j,ii) = 0.5 * (B1(i) - B1(i+1));

    j = j+1;
    end
    clear B1
end

B4 = [B2_int; B3_int];
B = B4;

B_mg = mat2gray(B);
f0 = figure('Name', 'J=9');
```

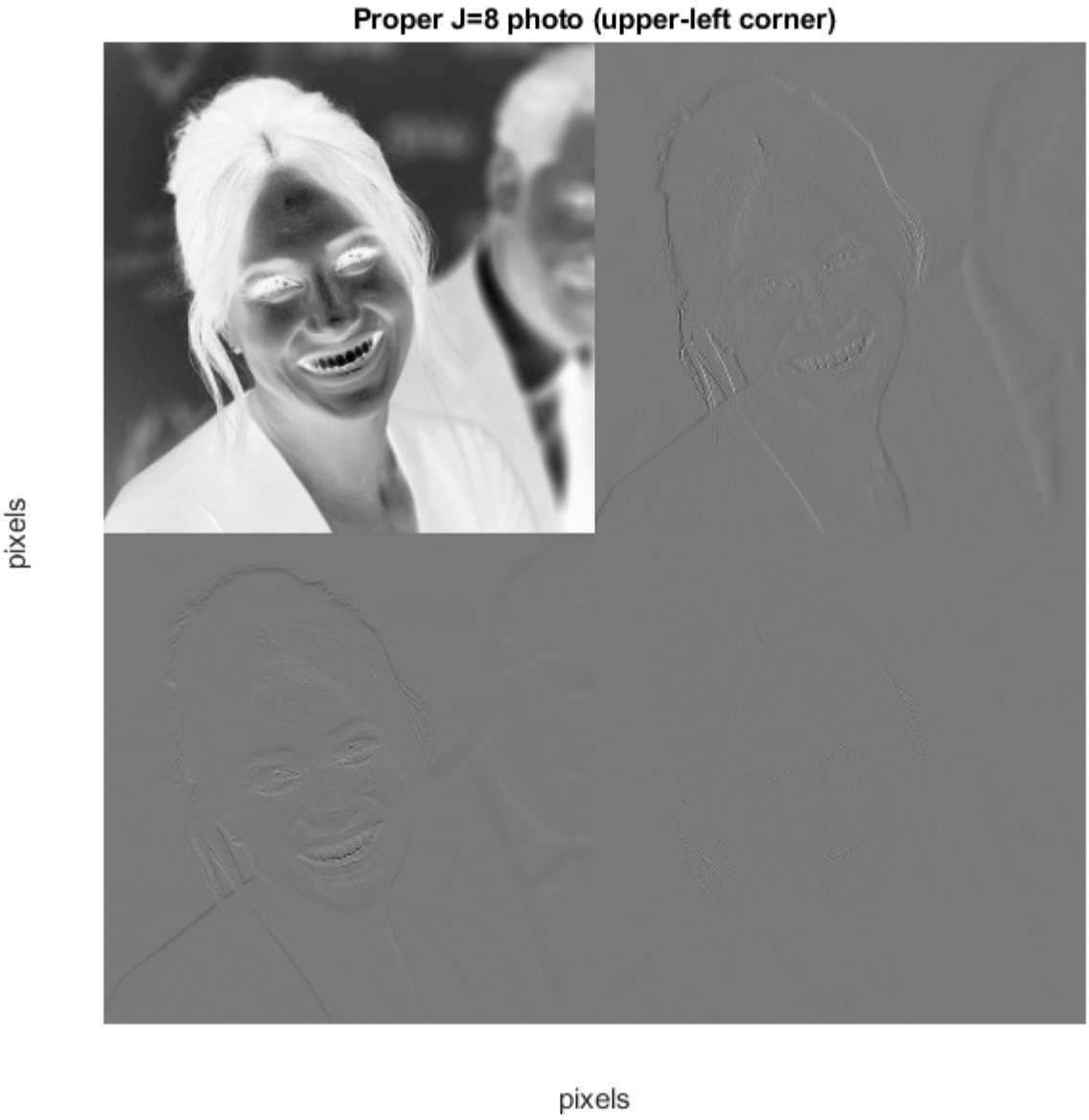
```
imshow(B_mg)
%title later J=9, post-columns only
title("Proper J=9 post-columns only")
xlabel('pixels')
ylabel('pixels')
%okay for row we just need to transpose and do it again!
```



Task 2

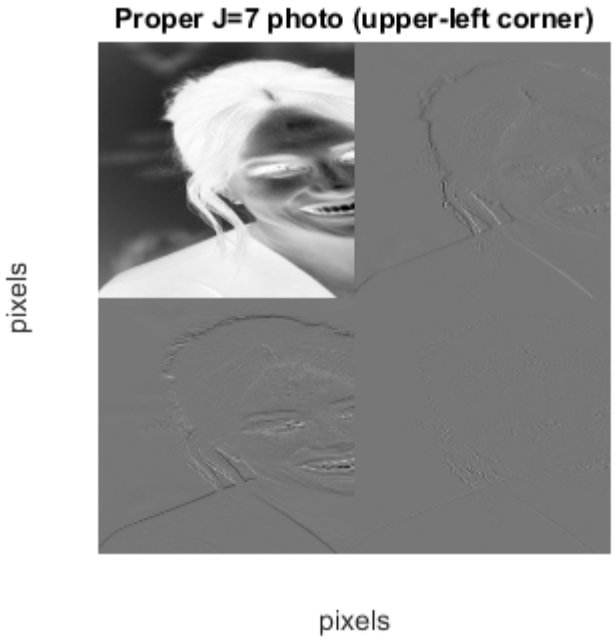
```
B_t = B';
%repeat above process
B6_int = [0;0];
B7_int = [0;0];

for ii = 1:512
    j = 1;
    B5 = B_t(:,ii);
    for i = 1:2:511
```

```
    B6_int(j,ii) = 0.5 * (B5(i) + B5(i+1));

    B7_int(j,ii) = 0.5 * (B5(i) - B5(i+1));

    j = j+1;
    end
    clear B5
end

B8 = [B6_int; B7_int];
C1 = B8';

C1_mg = mat2gray(C1);
f1 = figure('Name', 'J=8');
imshow(C1_mg)
title("Proper J=8 photo (upper-left corner)")
xlabel('pixels')
ylabel('pixels')
```



Task 3

```
C = B(1:256,1:256);

%repeat the above process just with 256 x 256
B10_int = [0;0];
B11_int = [0;0];
%column
for ii = 1:256
    j = 1;
    B9 = C(:,ii);
    for i = 1:2:255

    B10_int(j,ii) = 0.5 * (B9(i) + B9(i+1));

    B11_int(j,ii) = 0.5 * (B9(i) - B9(i+1));

    j = j+1;
    end
    clear B9
end

B12 = [B10_int; B11_int];

B13_int = [0;0];
B14_int = [0;0];

C2 = B12';


for ii = 1:256
    j = 1;
    B12 = C2(:,ii);
    for i = 1:2:255

    B13_int(j,ii) = 0.5 * (B12(i) + B12(i+1));

    B14_int(j,ii) = 0.5 * (B12(i) - B12(i+1));

    j = j+1;
    end
    clear B12
end

B15 = [B13_int; B14_int];
C3 = B15';

C3_mg = mat2gray(C3);
f2 = figure('Name', 'J=7');
imshow(C3_mg);
title("Proper J=7 photo (upper-left corner)")
xlabel('pixels')
ylabel('pixels')
```



Task 4

```
%J= 6
C4 = C3(1:128,1:128);

%i probably should make this a function

B17_int = [0;0];
B18_int = [0;0];
%column
for ii = 1:128
    j = 1;
    B16 = C4(:,ii);
    for i = 1:2:127

    B17_int(j,ii) = 0.5 * (B16(i) + B16(i+1));

    B18_int(j,ii) = 0.5 * (B16(i) - B16(i+1));

    j = j+1;
    end
    clear B16
end

B19 = [B17_int; B18_int];

B21_int = [0;0];
B22_int = [0;0];

C5 = B19';


for ii = 1:128
    j = 1;
    B20 = C5(:,ii);
    for i = 1:2:127
```

```
    B21_int(j,ii) = 0.5 * (B20(i) + B20(i+1));

    B22_int(j,ii) = 0.5 * (B20(i) - B20(i+1));

    j = j+1;
    end
    clear B20
end

B23 = [B21_int; B22_int];
C6 = B23';

C6_mg = mat2gray(C6);
f3 = figure('Name', 'J=6');
imshow(C6_mg);
title("Proper J=6 photo (upper-left corner)")
xlabel('pixels')
ylabel('pixels')
C7 = C3(1:64,1:64);

B24_int = [0;0];
B25_int = [0;0];
%column
for ii = 1:64
    j = 1;
    B23 = C7(:,ii);
    for i = 1:2:63

    B24_int(j,ii) = 0.5 * (B23(i) + B23(i+1));

    B25_int(j,ii) = 0.5 * (B23(i) - B23(i+1));

    j = j+1;
    end
    clear B23
end

B26 = [B24_int; B25_int];

B28_int = [0;0];
B29_int = [0;0];

C8 = B26';


for ii = 1:64
    j = 1;
    B27 = C8(:,ii);
    for i = 1:2:63

    B28_int(j,ii) = 0.5 * (B27(i) + B27(i+1));

    B29_int(j,ii) = 0.5 * (B27(i) - B27(i+1));

    j = j+1;
    end
    clear B27
end

B30 = [B28_int; B29_int];
C9 = B30';
```

```
C9_mg = mat2gray(C9);
f4 = figure('Name', 'J=5');
imshow(C9_mg);
title("Proper J=5 photo (upper-left corner)")
xlabel('pixels')
ylabel('pixels')

f5 = figure('Name', 'pcolor J=5');
C10 = C9(1:32, 1:32);

pcol = pcolor(C10);
colorbar
caxis([-127.5 127.5])
colormap gray
title('pcolor plot of 32x32 J = 5 submatrix')
diary vjHW4_p2.txt
echo on
C10
echo off
```

```
C10

C10 =

  Columns 1 through 7

  -38.6250  -39.0313  -39.8438  -39.6563  -37.3125  -32.4688  -25.6250
  -42.8438  -42.1250  -43.1250  -44.0000  -44.3125  -43.4375  -40.0625
  -45.1563  -44.6875  -45.1250  -46.0938  -46.9375  -48.5000  -48.2188
  -46.1875  -45.8438  -46.9688  -47.2813  -48.4375  -49.6250  -49.6563
  -46.5000  -46.8125  -48.1563  -48.5938  -49.2500  -50.3750  -51.0625
  -47.4063  -47.2188  -48.6250  -49.1563  -50.3125  -50.9688  -52.1563
  -49.0000  -48.6875  -49.3438  -50.3750  -51.3125  -52.7500  -53.6563
  -50.3750  -49.8125  -50.3125  -52.1875  -52.5313  -53.6250  -53.8750
  -50.3125  -50.1563  -51.1250  -52.5313  -53.3125  -54.0938  -54.6563
  -51.6563  -51.4063  -52.2188  -53.0313  -54.0625  -55.0625  -55.7813
  -52.5938  -52.0938  -52.7500  -53.6250  -54.7500  -56.2500  -56.7188
  -53.5000  -52.9063  -53.2188  -54.7500  -55.5625  -56.5313  -57.1250
  -53.5625  -53.7813  -54.8750  -55.6563  -55.9375  -57.1563  -57.3125
  -53.8125  -53.8750  -54.9688  -56.1250  -56.8125  -57.1250  -57.7188
  -54.7188  -54.5938  -55.7500  -57.1250  -56.9375  -57.7188  -58.2813
  -55.5938  -55.0625  -55.8125  -57.1875  -57.0625  -58.0313  -58.7188
  -55.9688  -54.8125  -56.2188  -57.1875  -57.1875  -58.3438  -58.9688
  -55.9063  -55.6875  -57.0625  -56.9688  -57.0625  -58.4063  -59.5313
  -55.8438  -55.7813  -57.0313  -57.0938  -57.3125  -58.4063  -59.6250
  -55.6875  -55.3750  -55.8438  -57.0938  -57.1563  -57.5625  -59.3125
  -55.8438  -55.0625  -55.7500  -56.7188  -57.3125  -58.1563  -58.9063
  -55.6563  -55.1875  -56.0000  -57.3125  -57.1563  -57.9688  -59.1875
  -55.9688  -55.2188  -56.6250  -57.2500  -57.5625  -58.4063  -58.4063
  -56.1875  -55.6250  -56.2813  -57.2188  -57.2188  -57.5938  -57.2188
  -55.3125  -55.1875  -56.6250  -57.1563  -57.2188  -56.7500  -56.5000
  -55.5313  -54.7500  -55.5625  -56.1563  -57.2500  -57.6250  -56.5938
  -53.7500  -53.7188  -54.0313  -55.7500  -55.8438  -55.7500  -55.6563
  -49.7500  -47.7813  -48.4375  -47.9688  -47.7813  -47.1250  -46.8125
  -42.9688  -40.4688  -41.8125  -39.1250  -37.3750  -37.5313  -35.9375
  -40.4063  -36.2500  -40.1875  -38.8125  -36.4688  -38.7813  -38.7813
  -44.9688  -44.2188  -44.8438  -46.5313  -46.5938  -47.5000  -48.6250
  -50.8750  -50.1875  -51.6563  -52.6250  -53.8125  -55.3750  -56.0313
```

Columns 8 through 14

-20.0625	-17.5625	-18.3125	-24.0625	-31.6875	-40.5313	-47.2500
-35.5313	-31.5000	-31.5938	-33.4688	-38.3438	-43.6875	-50.1563
-46.0313	-42.0625	-39.1875	-36.9688	-36.7500	-39.3125	-44.6250
-46.9063	-43.2813	-38.6875	-33.9375	-31.0625	-29.4375	-32.6563
-50.4063	-47.1563	-42.1875	-35.8750	-29.6875	-26.3750	-26.2500
-52.8125	-52.8438	-49.9375	-46.4063	-40.3750	-33.7188	-29.7500
-54.2500	-54.5625	-56.0938	-54.2500	-51.4688	-47.1563	-40.7188
-55.5313	-55.9688	-56.9688	-57.2188	-57.7500	-56.7188	-52.7500
-56.1250	-56.6250	-57.3125	-57.9063	-59.0000	-60.0625	-58.6563
-56.6875	-57.1250	-58.1875	-59.0313	-60.7500	-61.4688	-62.0313
-57.0000	-57.6875	-58.2813	-59.9688	-61.3750	-62.4063	-63.8125
-57.4688	-58.1563	-59.5313	-60.9063	-62.0938	-62.8750	-63.9375
-58.0000	-58.8125	-60.5625	-61.2813	-62.5313	-64.2188	-64.5938
-59.0625	-59.9063	-60.4688	-61.8750	-62.9375	-64.0625	-64.9063
-59.4063	-60.5313	-61.4688	-62.6563	-63.5000	-64.5938	-65.6563
-59.4063	-60.7813	-62.2500	-63.0938	-64.2188	-64.9375	-66.2188
-60.5000	-60.8750	-62.3750	-63.4063	-65.2188	-65.5938	-67.0938
-60.6250	-61.3125	-63.3125	-63.5000	-65.2500	-66.0000	-67.6250
-60.3750	-61.4688	-63.5000	-63.6875	-65.2500	-65.5938	-67.0313
-60.6563	-60.9688	-62.5625	-63.7188	-64.7813	-65.2813	-66.6563
-60.2813	-61.1563	-63.2188	-63.7500	-64.6563	-65.5625	-66.7813
-59.8125	-60.8125	-61.5313	-61.5938	-63.0000	-63.5625	-64.1875
-57.6875	-56.8438	-56.2813	-55.6250	-55.7813	-56.3125	-56.5938
-55.2813	-52.8750	-49.2813	-47.5313	-47.4063	-47.0938	-48.3125
-53.1250	-50.0625	-47.0000	-43.8125	-44.5313	-45.9375	-49.1563
-55.4063	-53.7813	-52.3750	-51.8750	-52.7500	-53.3125	-55.9375
-54.7500	-53.8438	-54.4063	-54.9375	-55.7500	-57.0313	-57.8750
-46.6250	-46.0938	-46.4375	-47.0938	-48.0625	-50.7188	-50.9375
-36.0625	-34.5625	-37.4375	-40.5000	-40.2500	-44.1563	-45.5000
-38.5000	-38.4375	-41.6250	-45.3125	-47.0313	-49.4375	-53.0625
-49.5625	-51.0000	-52.3750	-52.7500	-54.2188	-55.4375	-56.3750
-56.6875	-57.0625	-55.8125	-55.1563	-53.1875	-50.3438	-49.1875

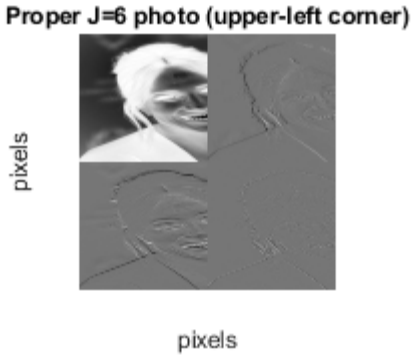
Columns 15 through 21

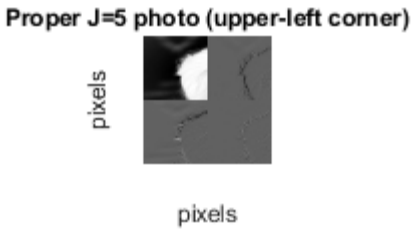
-50.5000	-51.5000	-52.4063	-52.8750	-52.9688	-52.7813	-48.4063
-53.6563	-55.0313	-55.9375	-56.2813	-56.6250	-55.2188	-51.6250
-49.8125	-54.6875	-56.8125	-58.0938	-56.9063	-52.9063	-46.9375
-38.7813	-45.5313	-51.3750	-52.3750	-46.8125	-39.5938	-33.8438
-28.1250	-32.6875	-33.0938	-32.5313	-31.1875	-26.4375	-26.5938
-27.2500	-21.2188	-18.3750	-17.9063	-21.5313	-28.9375	-35.7500
-33.1563	-26.0625	-22.3438	-24.1875	-29.3750	-40.1563	-51.8125
-44.6250	-41.1875	-40.5625	-40.1563	-44.0625	-51.1563	-58.2188
-56.1875	-55.0313	-55.3750	-53.3438	-56.5625	-58.1875	-58.4375
-61.8750	-62.4063	-62.8125	-59.6875	-58.7500	-56.2813	-39.7500
-64.3125	-64.6563	-64.6563	-60.4688	-52.2500	-36.6875	-13.1250
-64.8750	-64.4063	-59.0000	-48.2188	-21.4688	16.6250	32.0938
-65.6250	-62.5000	-43.8750	-50.3438	-19.0625	19.7500	69.0938
-65.5938	-62.9688	-45.4688	-53.7813	-31.1250	46.9063	99.2500
-66.9375	-67.8125	-54.4063	-3.7500	10.0313	89.1250	101.6250
-67.8438	-67.5938	-37.2500	7.0938	39.1563	97.4375	105.0625
-67.8750	-64.5625	-42.3438	18.9688	85.3125	103.7500	107.1875
-68.5625	-63.9688	-45.9063	47.6563	97.6875	106.6250	106.1250
-65.6250	-57.5000	0.1875	86.6875	103.9375	102.9688	103.7813
-63.5000	-49.5313	-18.9375	28.0000	78.1250	99.7500	106.5938
-66.6250	-64.3438	-66.5938	-68.0938	-19.1250	99.3125	107.5313
-61.6563	-64.5938	-65.0938	-62.9375	0.2500	104.7188	105.5625
-55.1250	-56.4063	-56.8125	-48.7813	-5.3438	103.4063	104.4375

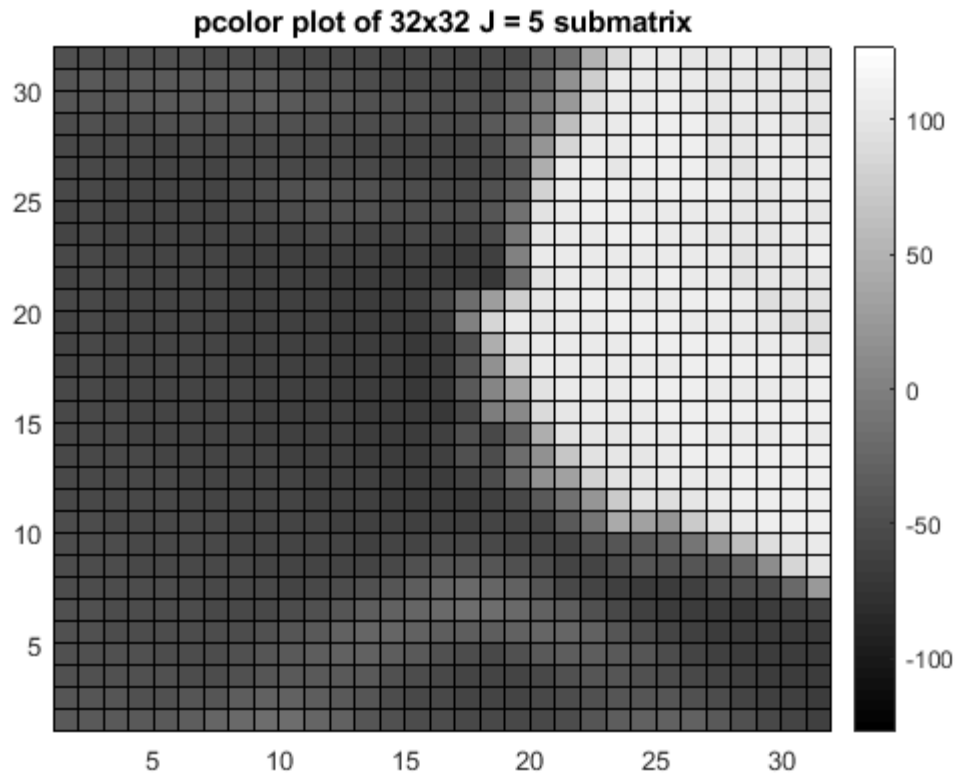
```
  -48.6563  -50.0000  -50.3125  -42.7188  -12.5000   97.5625  104.3750
  -50.2500  -52.5000  -53.5000  -46.0000  -34.5938   81.8750  105.9375
  -57.4688  -58.5938  -58.0000  -53.9688  -40.7188   45.8750  104.8750
  -58.4375  -58.5625  -57.9375  -51.1563  -31.0938   20.2188   86.3438
  -51.7188  -51.6250  -48.1563  -37.6563  -25.9063   -0.6563   62.4375
  -47.7500  -50.3438  -46.1875  -46.0313  -31.0313   -5.9063   24.6875
  -54.4063  -53.7500  -54.8750  -53.1875  -42.3750  -25.8438   15.9375
  -52.6563  -53.7813  -56.4375  -53.6563  -52.5938  -32.5000  -18.3125
  -48.4063  -42.7813  -45.5000  -46.6250  -43.7188  -39.0625  -35.0625

  Columns 22 through 28

  -42.3750  -34.5313  -29.9688  -28.4063  -29.4688  -35.9063  -45.1875
  -46.7188  -42.4688  -40.0313  -40.6875  -44.4688  -51.6875  -57.3750
  -42.0313  -41.4375  -44.5313  -48.9063  -54.3750  -59.0938  -62.9375
  -32.8750  -36.5938  -43.0313  -49.9688  -55.9375  -61.2500  -64.0313
  -31.7500  -40.9688  -51.2500  -57.6875  -61.8750  -64.4063  -66.0625
  -46.0000  -54.5313  -60.2813  -65.5313  -66.6250  -64.7188  -68.5625
  -58.9375  -63.0625  -64.2188  -65.0000  -62.2500  -55.2188  -48.8125
  -59.7188  -51.1875  -41.2813  -45.5000  -42.6250  -40.6875  -27.3125
  -45.4375  -42.9063  -39.7500  -29.0313   -8.9063   24.1250   60.4688
  -10.3125   42.2188   34.4375   21.1250   73.9375   96.5000  106.8438
   22.5313   74.5313   96.5938   93.0625  102.2813  106.7188  107.6563
   82.9063   98.3438  101.4375  104.6875  107.0938  107.4063  107.9688
   97.0625  100.2188  102.3125  105.3125  107.7813  109.4063  110.1563
  103.0000  102.4063  104.6563  107.1563  108.2500  107.2813  106.8750
  105.6250  106.0625  107.4688  107.6875  107.8438  108.9688  109.2188
  106.0313  106.8125  108.9063  108.5000  108.0625  107.1875  105.9375
  107.5000  105.8750  106.2188  107.0938  107.6250  108.3125  109.1563
  105.0938  106.6250  108.7188  108.9688  109.0625  107.6875  107.1250
  106.6875  109.2188  109.0000  108.7500  106.9688  106.9688  107.0938
  108.5313  108.3125  107.1563  105.2188  107.8438  107.9063  104.2813
  107.1563  106.9063  106.2813  108.7500  106.2188  104.4063   99.1875
  105.8438  105.6563  107.3750  106.7813  107.2813  104.4063   98.9375
  106.2813  108.5625  108.6250  106.8438  107.3438  102.3125  101.5938
  109.0625  110.9063  106.8125  106.0938  107.4063  107.2188  102.6563
  109.5000  107.7188  103.9375  109.1563  109.0313  108.8438  101.5000
  108.2188  103.5000  108.2188  110.2813  111.5313  103.5000   98.8125
  104.7813  104.3125  111.0938  109.6250  108.0313  101.6250  100.9688
  103.5000  107.0625  109.8125  107.7500  107.7500  101.7813  103.0625
   93.6250  105.5313  106.2188  108.9063  105.0938  102.9375  105.2500
   78.5625  104.9375  105.6563  105.8438  104.9063  102.7188  102.3750
   48.8125   91.0000  104.1250  103.7813  101.7813  102.5000  104.6250
   14.6250   58.0938   95.0000  103.0938  103.7500  105.7500  104.0000

  Columns 29 through 32

  -53.1250  -57.9375  -60.0313  -60.8750
  -61.7188  -62.8125  -63.7813  -64.6563
  -64.9688  -65.3750  -65.8750  -66.6875
  -65.9375  -65.6563  -66.8125  -67.8438
  -66.6250  -66.6563  -65.0625  -65.5938
  -67.3125  -62.9688  -59.4688  -39.0625
  -50.6250  -22.6250   26.8125   51.5938
   13.7188   84.2813  100.2188  104.8438
   94.2813  101.5313  103.8125  104.2188
  109.7813  110.4688  111.1250  110.7813
  108.8750  107.9063  108.2500  109.6875
  108.2500  108.4375  108.4688  109.0313
  110.5000  109.4063  108.9375  108.1563
  106.3125  107.7500  107.4688  107.7188
```

```
  108.1563  108.9063  108.2500  106.2500
  107.0625  107.0000  108.2813  108.0938
  108.1563  107.1250  108.0313  100.5938
  106.0938  105.0000   92.1875   87.4063
  102.1563   93.5000   93.2813   94.6563
   94.8750   96.2813   97.6563   98.7813
  101.6875  100.3125  102.0313  103.9375
  103.2813  101.1250  107.5938  104.0313
  103.1875  103.9375  105.7813  104.3750
  100.9375  105.3125  103.2188  102.7188
  101.1875  107.0000  104.4375  100.6563
  103.5938  106.9063  105.5313   97.7188
  106.4063  105.6563  102.3125   95.2500
  106.3125  102.3438   95.9063   99.5625
  102.5625   99.9375  100.1875   97.3438
  101.4375  101.1250   98.0625   95.8438
  102.6563   99.4375   97.0625   93.8125
  100.3750   97.4688   93.4688   94.3438
```

```
echo off
```







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Problem 3 Eigenvalues/ eigenvectors/linear transformations

Table of Contents

Part A

```
A = 1/3 * [2 -1 -1; -1 2 -1; -1 -1 2];

[V, D1, W] = eig(A);
e = eig(A);
```

Part B

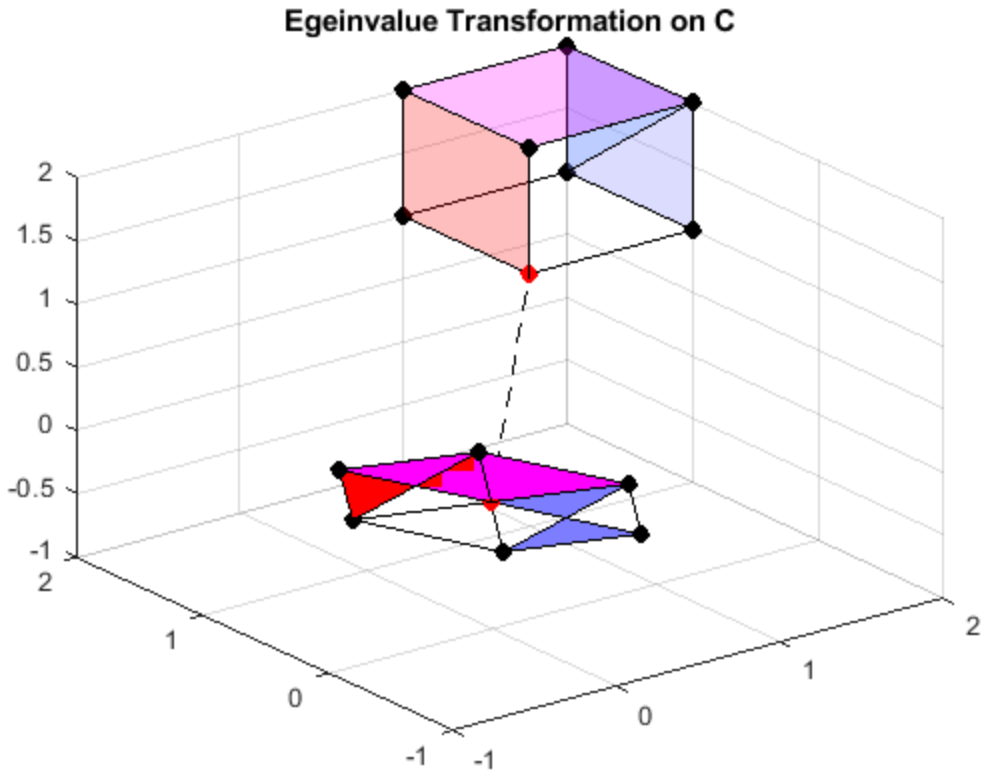
```
C = [0 1 1 0 0 1 1 0; 0 0 0 0 1 1 1 1; 0 0 1 1 0 0 1 1] + [1; 1; 1];
C1 = C';
a = scatter3(C1(:,1), C1(:,2), C1(:,3));
a.MarkerFaceColor = [0 0 0];
a.MarkerEdgeColor = [0 0 0];
% xlim([0 3])
% ylim([0 3])
% zlim([0 3])
hold on

bb = line([1 1 1], [1 1 1], [1 2 2]);
bb.Color = [0 0 0];
hold on

cc = line([1 1 1], [2 2 2], [2 1 2]);
cc.Color = [0 0 0];
hold on

dd = line([1 1 1], [2 1 1], [2 2 1]);
dd.Color = [0 0 0];
hold on

ee = line([1 1 1], [1 1 2], [2 1 1]);
ee.Color = [0 0 0];
hold on

ff = line([2 2 2], [2 1 1], [1 1 1]);
```

```
ff.Color = [0 0 0];
hold on

gg = line([2 2 2], [1 1 2], [2 2 2]);
gg.Color = [0 0 0];
hold on

ii = line([1 1 2], [2 2 2], [ 2 2 2]);
ii.Color = [0 0 0];
hold on

jj = line([1 1 2], [2 2 2], [ 1 1 1]);
jj.Color = [0 0 0];
hold on

ll = line([1 1 2], [2 1 1], [ 1 1 1]);
ll.Color = [0 0 0];
hold on

oo = line([1 1 2], [2 1 1], [ 2 2 2]);
oo.Color = [0 0 0];
hold on

mm = line([2 2 2], [2 2 2], [1 2 2]);
mm.Color = [0 0 0];
hold on

nn = line([2 2 1], [1 1 1], [2 1 1]);
nn.Color = [0 0 0];

hold on
pp = scatter3(1,1,1);
pp.MarkerFaceColor = [1 0 0];
pp.MarkerEdgeColor = [1 0 0];

hold on

a1 = patch([1 1 1 1], [2 1 1 2], [2 2 1 1], 4);
a1.FaceAlpha = 0.25;
a1.FaceColor = 'red';

hold on

b1 = patch([1 2 2 1], [2 2 1 1], [2 2 2 2], 4);
b1.FaceAlpha = 0.25;
b1.FaceColor = 'magenta';

hold on

c1 = patch([2 2 2 2], [1 1 2 2], [2 2 1 2], 4);
c1.FaceAlpha = 0.25;
c1.FaceColor = 'magenta';

hold on
```

```
d1 = patch([2 2 2 2], [2 2 1 1], [2 1 2 2], 3);
d1.FaceAlpha = 0.25;
d1.EdgeColor = 'none';
d1.LineStyle = 'none';
d1.FaceColor = 'cyan';

hold on
z1 = patch([2 2 2 2], [1 2 1 1], [1 1 2 2], 3); %for some reason the
 previous
%patch does not cover the entire square so need an extra patch
z1.FaceAlpha = 0.25;
z1.EdgeColor = 'none';
z1.LineStyle = 'none';
z1.FaceColor = [0.5 0.5 1];

hold on
% my_square_plothandle = line([ C(1,:)  ],  [C(2,:) ],  [C(3,:) ]);
% hold on
% my_square_plothandle2 = line([ C(:,1)  ],  [C(:,2) ],  [C(:,:3 ]);
% set(my_square_plothandle, 'Color', 'blue', 'Linewidth', 2)

D = A*C;
E = D';
E2 = E(2:8,1:3);
%1 1 1 became 0 0 0

CT = scatter3(E2(:,1), E2(:,2), E2(:,3));
CT.MarkerFaceColor = [0 0 0];
CT.MarkerEdgeColor = [0 0 0];
% xlim([0 3])
% ylim([0 3])
% zlim([0 3])
hold on

pp2 = scatter3(0,0,0);
pp2.MarkerFaceColor = [1 0 0];
pp2.MarkerEdgeColor = [1 0 0];

hold on
z2 = line([2/3 1/3 -1/3], [-1/3 -2/3 -1/3], [-1/3 1/3 2/3]);
z2.Color = [0 0 0];

hold on
z3 = line([-1/3 -2/3 -1/3], [-1/3 1/3 2/3], [2/3, 1/3, -1/3]);
z3.Color = [0 0 0];

hold on
z4 = line([2/3 1/3 -1/3], [-1/3 1/3 2/3], [-1/3 -2/3 -1/3]);
z4.Color = [0 0 0];
hold on

z5 = line([0 2/3 1/3], [0 -1/3 -2/3], [0 -1/3 1/3]);
z5.Color = [0 0 0];
hold on
```

```
z6 = line([ 0 0 -1/3], [0 0 2/3], [0 0 -1/3]);
z6.Color = [0 0 0];
hold on

z7 = line([ 0 0 1/3], [0 0 1/3], [0 0 -2/3]);
z7.Color = [0 0 0];
hold on

z8 = line([ 0 0 1/3], [0 0 -2/3], [0 0 1/3]);
z8.Color = [0 0 0];
hold on

z9 = line([ 0 0 -1/3], [0 0 -1/3], [0 0 2/3]);
z9.Color = [0 0 0];
hold on

z10 = line([ 0 0 -2/3], [0 0 1/3], [0 0 1/3]);
z10.Color = [0 0 0];
hold on

pp3 = patch([0 -1/3 -1/3 -2/3], [0 -1/3 2/3 1/3], [0 2/3 -1/3 1/3],
 4);
pp3.FaceColor = 'red';
hold on

pp4 = patch([0 -2/3 -1/3 1/3], [0 1/3 -1/3 -2/3], [0 1/3 2/3 1/3], 4);
pp4.FaceColor = 'magenta';
hold on

pp5 = patch([0 1/3 1/3 2/3], [0 -2/3 1/3 -1/3], [0 1/3 -2/3 -1/3], 4);
pp5.FaceColor = [0.5 0.5 1];
hold on

z11 = line([0 1], [0 1], [0 1]);
z11.Color = [0 0 0];
z11.LineStyle = '--';

title('Egeinvalue Transformation on C')


disp('The initial cube  was collapsed such that the midpoint was the
 origin with a abs slope of 1/3. The point 1,1,1 and 2,2,2 became the
 same 0,0,0 when transformed.')
```

```
The initial cube  was collapsed such that the midpoint was the origin
 with a abs slope of 1/3. The point 1,1,1 and 2,2,2 became the same
 0,0,0 when transformed.
```



echoing output

```
diary vjHW4_p3.txt
echo on
disp('right eigenvectors')
V

disp('left eigenvectors')
W
echo off
```

```
disp('right eigenvectors')
right eigenvectors
V

V =

   -0.5774    0.8165    0.0000
   -0.5774   -0.4082   -0.7071
   -0.5774   -0.4082    0.7071


disp('left eigenvectors')
left eigenvectors
W
```

```
W =

   -0.5774    0.8165    0.0000
   -0.5774   -0.4082   -0.7071
   -0.5774   -0.4082    0.7071

echo off
```

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