MAT 343 Lab 5 - Amanda Haffner

```
A=imread('gauss.jpg'); %load the picture
B=double(A(:,:,1));  %convert to double precision
B=B/255;             %scale the values of B
[U S V]=svd(B);      %compute the SVD decomposition of B
```

Problem 1

Compute the dimensions of U, S and V

```
size(U)
```

```
ans = 1×2
   286   286
```

```
size(S)
```

```
ans = 1×2
   286   186
```

```
size(V)
```

```
ans = 1×2
   186   186
```

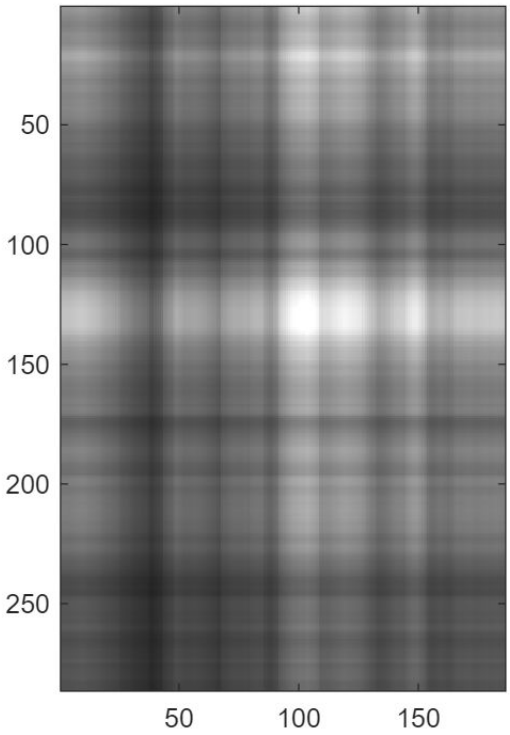
Problem 2

Compute the best rank-1 approximation and store it in `rank1`

```
rank1 =S(1,1)*U(:,1)*V(:,1)';
```

Visualize rank1 by performing steps 3 -6

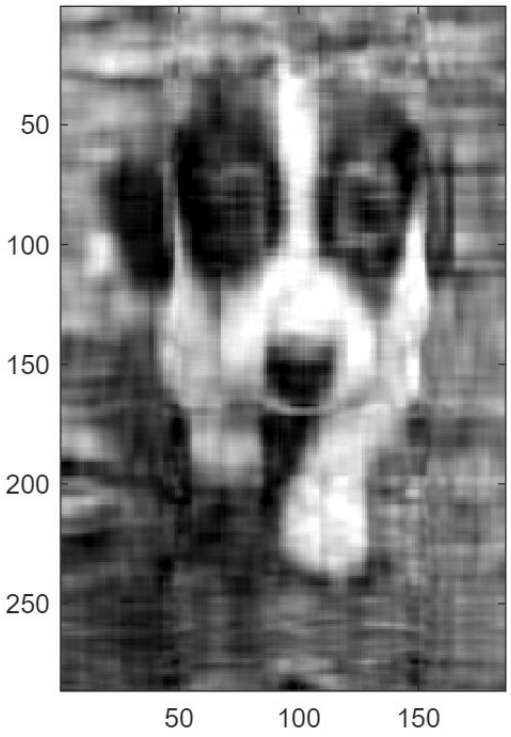
```
C = zeros(size(A));
C(:,:,1) = rank1;
C(:,:,2) = rank1;
C(:,:,3) = rank1;
C = max(0,min(1,C));
figure
image ( C ) , axis image
```



Problem 3

Create and view a rank-10 approximation to the original picture

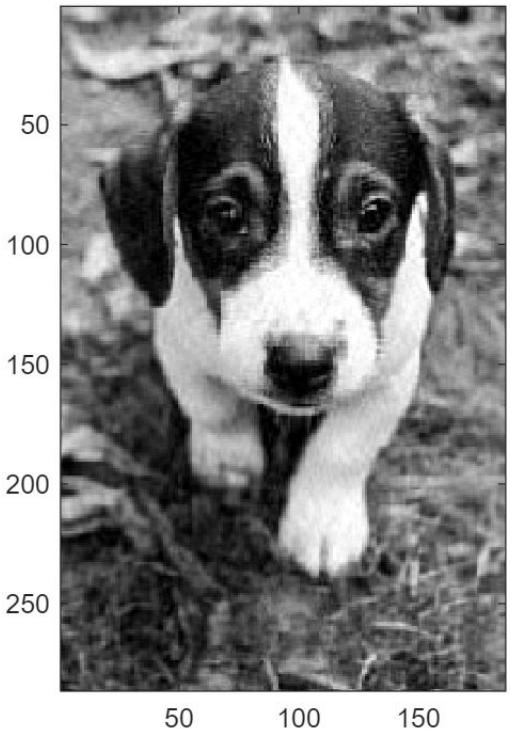
```
rank10 =S(1,1)*U(:,1)*V(:,1)';
for i = 2:10
    rank10 = rank10+S(i,i)*U(:,i)*V(:,i)';
end
C(:,:,1) = rank10;
C(:,:,2) = rank10;
C(:,:,3) = rank10;
C = max(0,min(1,C));
figure
image ( C ) , axis image
```



Problem 4

Experiment with different ranks until you found one that gives, in your opinion, an acceptable approximation.

```
rank50 =S(1,1)*U(:,1)*V(:,1)';
for i = 2:50
    rank50 = rank50+S(i,i)*U(:,i)*V(:,i)';
end
C(:,:,1) = rank50;
C(:,:,2) = rank50;
C(:,:,3) = rank50;
C = max(0,min(1,C));
figure
image ( C ) , axis image
```



Problem 5

What rank-r approximation exactly reproduces the original picture? Explain,

Answer: rank 186, this is the highest rank possible, therefore it will exactly reproduce the original picture.

Problem 6

(i)

How much data is needed to represent a rank-k approximation? Explain.

Answer: S(k,k)*U(:,k)*V(:,k)' or k+k*286+k*186 = amt of data. This uses the number of columns and rows of S, U, and V.

(ii)

Find the compression rate for the value of the rank you determined in problem 4. Explain.

Answer: rank 50 = 50 (values) +50 (columns of U)*286(entries)+50(columns of V)*186 (entries) = 23650/53196(data in original picture = 286*186 = 53196) = 0.445

What does the compression rate represent? Explain.

Answer: This rate represents the ratio of the amount of data being used by the compressed photo compared to the original, 45% of data of the original photo.

Problem 7

Find the smallest value of k such that the rank-k approximation uses the same or more amount of data as the original picture. Explain how you obtained the answer.

Answer: rank 186 will use the same amount of data as the original picture, I found this by testing a high value (200) and MATLAB telling me this was too high and the highest rank due to the size of the matrix is 186.