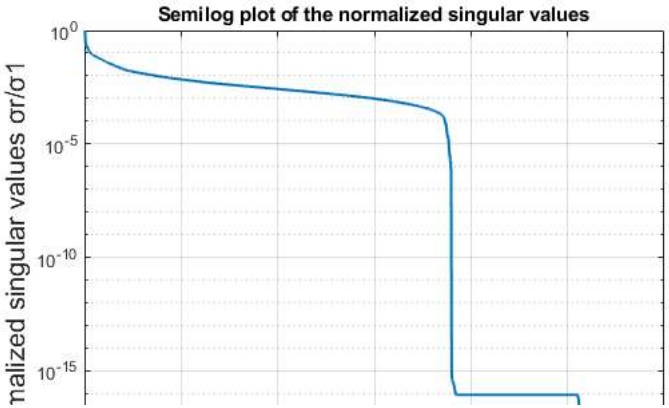
```
function[r0,c]=project_1226315950(image)

clear
clc
close all

%to ask user to upload the image file
fprintf("Choose any image of any size:\n");
I = uigetfile;

%Load image
image = importdata(I);
imshow(image)
axis off
title('Original image');

% Find the size of the image
[M, N] = size(image);

% convert the image into double
x=im2double(image);

% to perform Singular value decomposition
[U,S,V] = svd(x, "econ");

% normalize singular values:
S_norm = diag(S);
S_norm = S_norm/S_norm(1);

% Make a semilog plot of the normalized singular values
figure(2);
semilogy(S_norm,'Linewidth',1.5);
title('Semilog plot of the normalized singular values');
grid on
xlabel('Rank r0','FontSize',15);                    % Defining X axis
ylabel('Normalized singular values σr/σ1','FontSize',15);

% to find the rank r0 such that σr0/σ1 < 0.01?
r0 = find( S_norm<0.01, 1);
fprintf('\nValue of r0 for σr0/σ1 = 0.01 is : %d\n',r0);

% Compression ratio for rank-r0 approximation
c = (r0*M + r0*N + r0)*100/(M*N);
fprintf('Compression ratio for rank-r0 approximation = %f\n',c);

% Build and display rank-2, rank-10, rank-50, rank-100 and rank-r0 approximations
figure
rank = 2;
S2 = S;
S2(3,end,:) =0;
S2(:,3:end)=0;
compressed = U*S2*V';
imshow(compressed)
axis off
c =(rank*M + rank*N + rank)*100/(M*N);
title(['Rank ' int2str(rank) ' approximation of the original image',])
fprintf('\nCompression ratio for rank %d approximation = %f\n', rank, c);
fprintf('Comment: Rank 2 image is very blur as compared to other rank images and cannot be seen whats the image is all about.\n')
     % Rank 2 image is very blur as compared to other ranks images and cannot be seen whats the image is all about

figure
rank = 10;
S10 = S;
S10(11,end,:) =0;
S10(:,11:end)=0;
compressed = U*S10*V';
imshow(compressed)
```

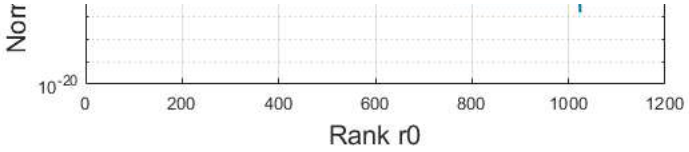
```
axis off
c =(rank*M + rank*N + rank)*100/(M*N);
title(['Rank ' int2str(rank) ' approximation of the original image'])
fprintf('\nCompression ratio for rank %d approximation = %f\n', rank, c);
fprintf('Comment: Rank 10 image is blur than higher rank images but clearer than Rank 2 and slightly visible about what is in the image.\n')
    % Rank 10 image is blur and slightly visible about whats in the image

figure
rank = 50;
S50 = S;
S50(51,end,:) =0;
S50(:,51:end)=0;
compressed = U*S50*V';
imshow(compressed)
axis off
c = (rank*M + rank*N + rank)*100/(M*N);
title(['Rank ' int2str(rank) ' approximation of the original image'])
fprintf('\nCompression ratio for rank %d approximation = %f\n', rank, c);
fprintf('Comment: Rank 50 image is visible but quality is degraded as comapred to Rank 100 and better quality than previous Ranks and image can be seen.\n')
    % Rank 50 image is visible but quality is degraded and image can be seen

figure
rank = 100;
S100 = S;
S100(101,end,:) =0;
S100(:,101:end)=0;
compressed = U*S100*V';
imshow(compressed)
axis off
c = (rank*M + rank*N + rank)*100/(M*N);
title(['Rank ' int2str(rank) ' approximation of the original image'])
fprintf('\nCompression ratio for rank %d approximation = %f\n', rank, c);
fprintf('Comment: Rank 100 image is very clear as comapred to earlier Ranks and image is clearly seen.\n')
     % Rank 100 image is very clear

figure
rank = r0;
Sr0 = S;
Sr0(r0+1,end,:) =0;
Sr0(:,r0+1:end)=0;
compressed = U*Sr0*V';
imshow(compressed)
axis off
c = (rank*M + rank*N + rank)*100/(M*N);
title(['Rank ' int2str(rank) ' approximation of the original image'])
fprintf('\nCompression ratio for rank r0 (Rank %d) approximation = %f\n', rank, c);
fprintf('Comment: Visual quality of Rank r0 image depends upon the value of r0, if r0 is greater than 100 then the image quality will be better than Rank 100 image\n and if r0 is less than 100 then the image will be deg
   % Visual quality of Rank r0 image depends upon the value of r0, if r0 is greater than 100 then the image quality will be better than Rank 100 image\n and if r0 is less than 100 then the image will be degraded quality

end
```

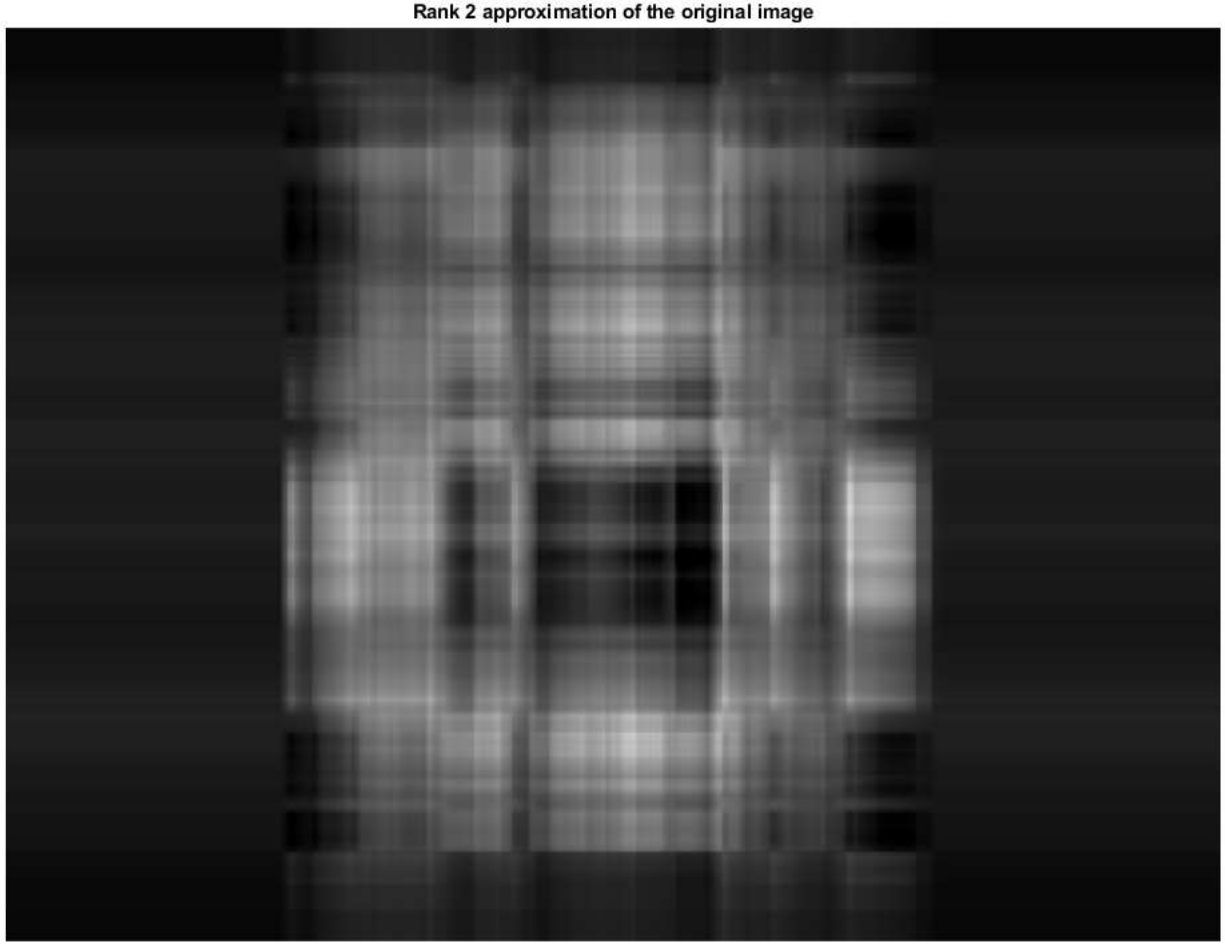
```
Choose any image of any size:

Value of r0 for σr0/σ1 = 0.01 is : 149
Compression ratio for rank-r0 approximation = 25.477192

Compression ratio for rank 2 approximation = 0.341976
Comment: Rank 2 image is very blur as compared to other rank images and cannot be seen whats the image is all about.

Compression ratio for rank 10 approximation = 1.709879
Comment: Rank 10 image is blur than higher rank images but clearer than Rank 2 and slightly visible about what is in the image.

Compression ratio for rank 50 approximation = 8.549393
Comment: Rank 50 image is visible but quality is degraded as comapred to Rank 100 and better quality than previous Ranks and image can be seen.

Compression ratio for rank 100 approximation = 17.098787
Comment: Rank 100 image is very clear as comapred to earlier Ranks and image is clearly seen.
```

```
Compression ratio for rank r0 (Rank 149) approximation = 25.477192
Comment: Visual quality of Rank r0 image depends upon the value of r0, if r0 is greater than 100 then the image quality will be better than Rank 100 image
 and if r0 is less than 100 then the image will be degraded quality than Rank 100 image.

ans =

   149
```

Original image




Norm
10^{-20}
0
200
400
600
800
1000
1200
Rank r0


Rank 2 approximation of the original image

Rank 10 approximation of the original image

Rank 50 approximation of the original image

Rank 100 approximation of the original image

Rank 149 approximation of the original image

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