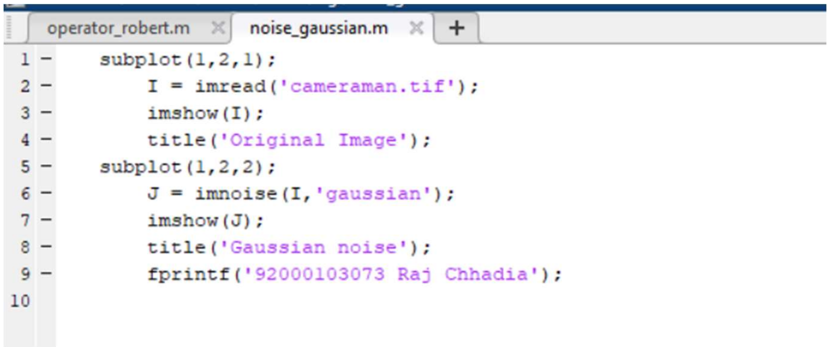
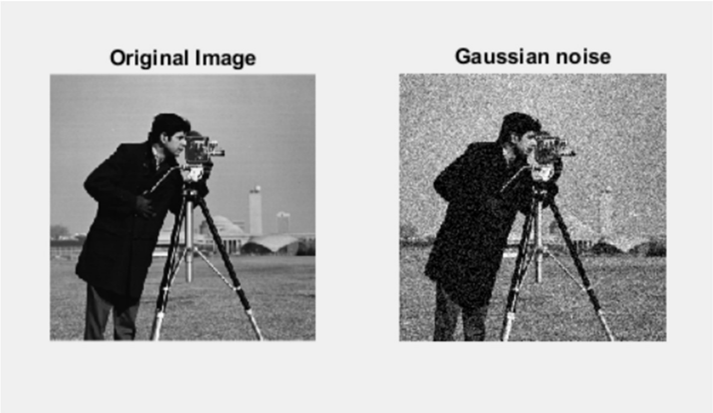
Practical 4

Aim: Write a program to apply various filtering techniques in Matlab.

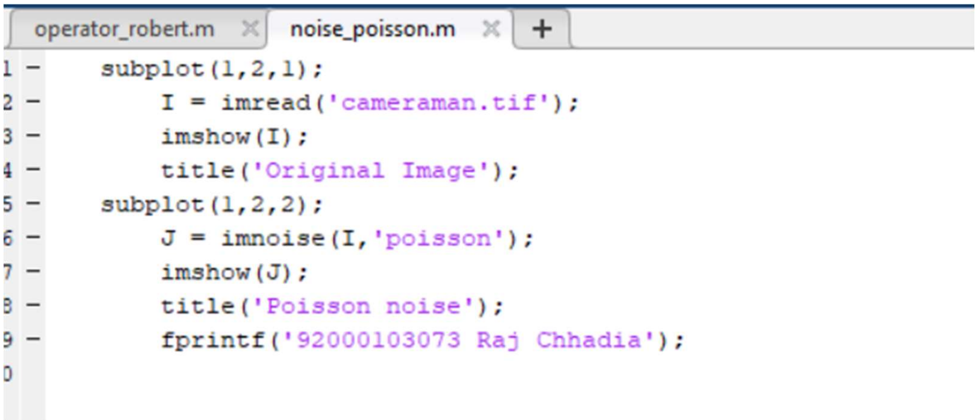
- **Types of Noise (Gaussian Noise, Poisson noise, Salt & Pepper Noise, Speckle Noise)**
  - **Gaussian noise**



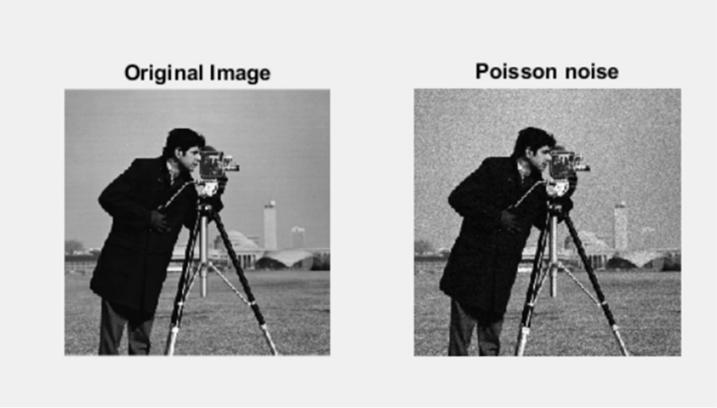
```
subplot(1,2,1);
    I = imread('cameraman.tif');
    imshow(I);
    title('Original Image');
subplot(1,2,2);
    J = imnoise(I,'gaussian');
    imshow(J);
    title('Gaussian noise');
    fprintf('92000103073 Raj Chhadia');
```



  - **Poisson noise**



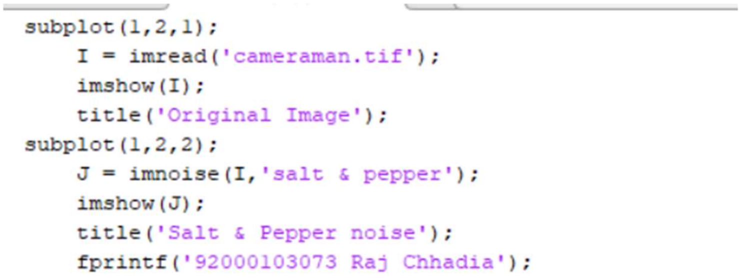
```
subplot(1,2,1);
    I = imread('cameraman.tif');
    imshow(I);
    title('Original Image');
subplot(1,2,2);
    J = imnoise(I,'poisson');
    imshow(J);
    title('Poisson noise');
    fprintf('92000103073 Raj Chhadia');
```



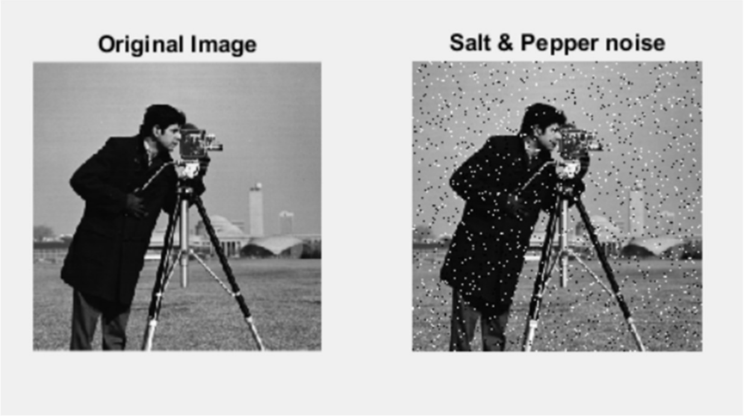
Original Image

Poisson noise

- ## Salt & pepper noise



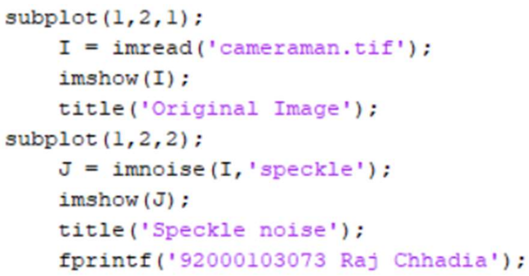
```
subplot(1,2,1);
    I = imread('cameraman.tif');
    imshow(I);
    title('Original Image');
subplot(1,2,2);
    J = imnoise(I,'salt & pepper');
    imshow(J);
    title('Salt & Pepper noise');
    fprintf('92000103073 Raj Chhadia');
```



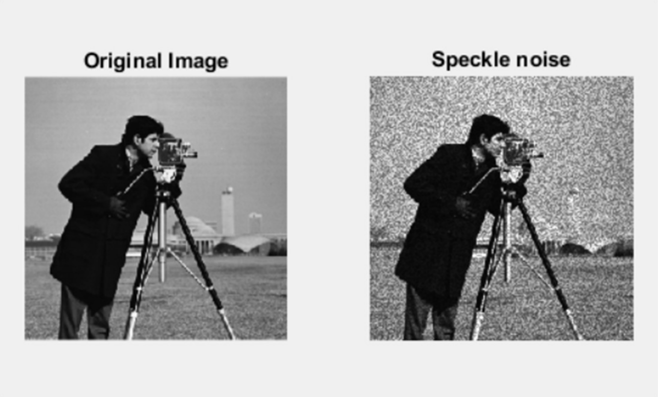
Original Image

Salt & Pepper noise

- ## Speckle noise



```
subplot(1,2,1);
    I = imread('cameraman.tif');
    imshow(I);
    title('Original Image');
subplot(1,2,2);
    J = imnoise(I,'speckle');
    imshow(J);
    title('Speckle noise');
    fprintf('92000103073 Raj Chhadia');
```

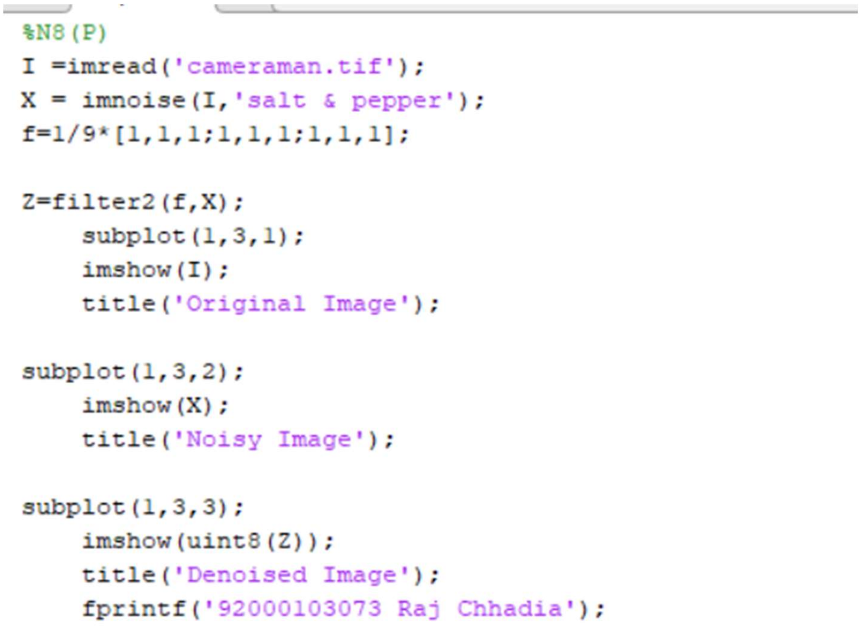


➢ Spatial Domain - Low Pass Filters / The Smoothing Spatial Filter

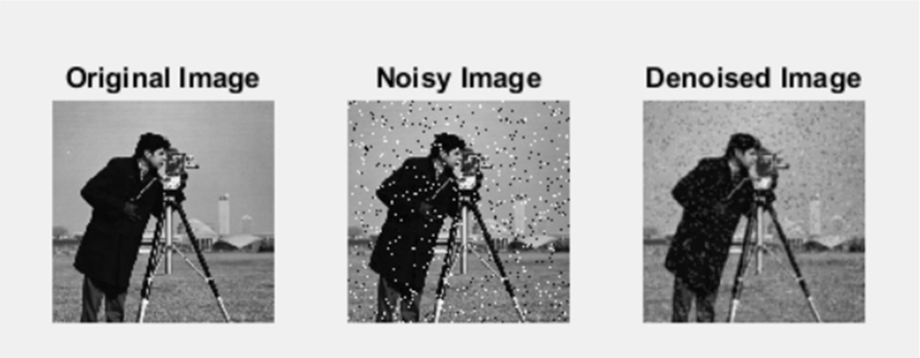
1. Linear Filters / Mean Filter

a. Averaging Filter / Standard Average Filter / Arithmetic Mean Filter

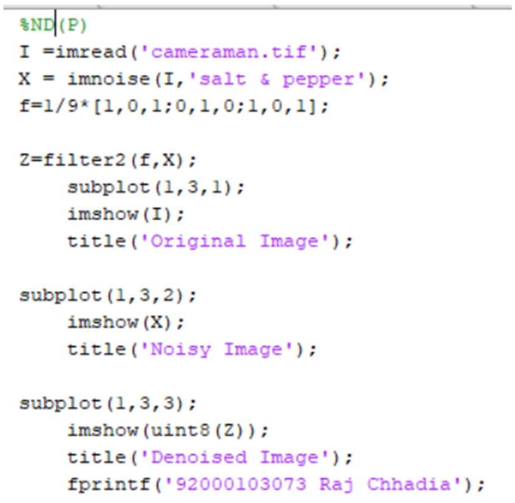
i. N_8(P) Neighbor



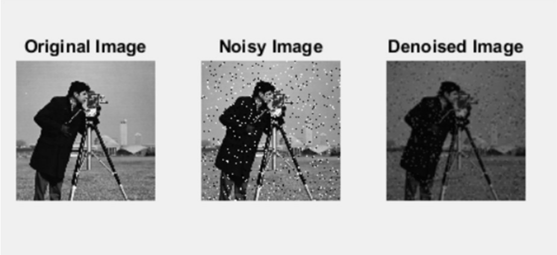
```
%N8(P)
I =imread('cameraman.tif');
X = imnoise(I,'salt & pepper');
f=1/9*[1,1,1;1,1,1;1,1,1];

Z=filter2(f,X);
    subplot(1,3,1);
    imshow(I);
    title('Original Image');

subplot(1,3,2);
    imshow(X);
    title('Noisy Image');

subplot(1,3,3);
    imshow(uint8(Z));
    title('Denoised Image');
    fprintf('92000103073 Raj Chhadia');
```



ii. $N_D(P)$ Neighbor



```
%ND(P)
I =imread('cameraman.tif');
X = imnoise(I,'salt & pepper');
f=1/9*[1,0,1;0,1,0;1,0,1];

Z=filter2(f,X);
    subplot(1,3,1);
    imshow(I);
    title('Original Image');

subplot(1,3,2);
    imshow(X);
    title('Noisy Image');

subplot(1,3,3);
    imshow(uint8(Z));
    title('Denoised Image');
    fprintf('92000103073 Raj Chhadia');
```

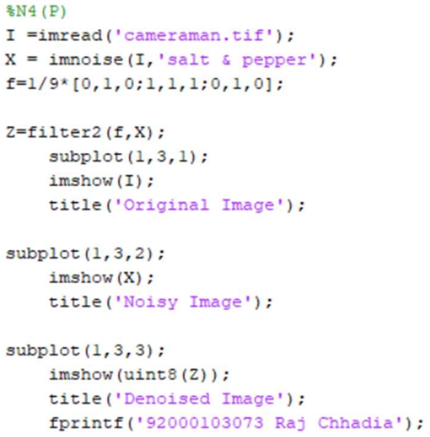


Original Image

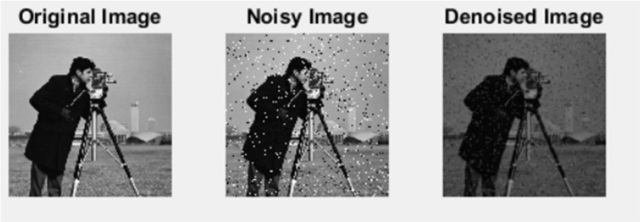
Noisy Image

Denoised Image

iii. $N_4(P)$ Neighbor



```
%N4(P)
I =imread('cameraman.tif');
X = imnoise(I,'salt & pepper');
f=1/9*[0,1,0;1,1,1;0,1,0];

Z=filter2(f,X);
    subplot(1,3,1);
    imshow(I);
    title('Original Image');

subplot(1,3,2);
    imshow(X);
    title('Noisy Image');

subplot(1,3,3);
    imshow(uint8(Z));
    title('Denoised Image');
    fprintf('92000103073 Raj Chhadia');
```

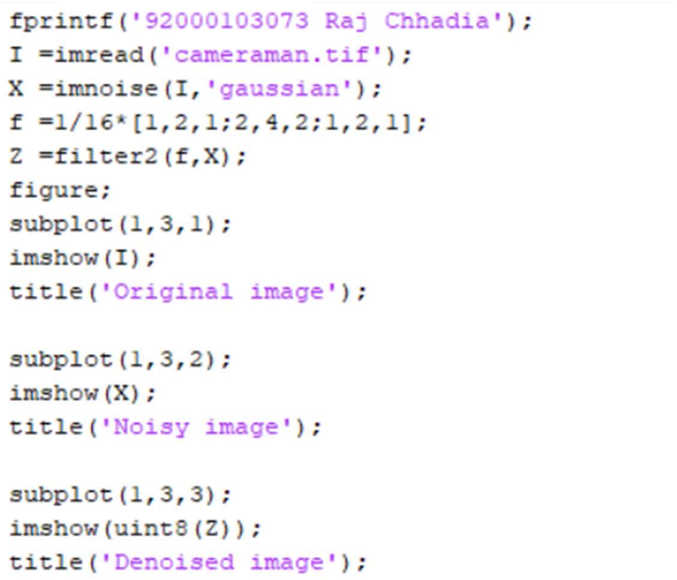


Original Image

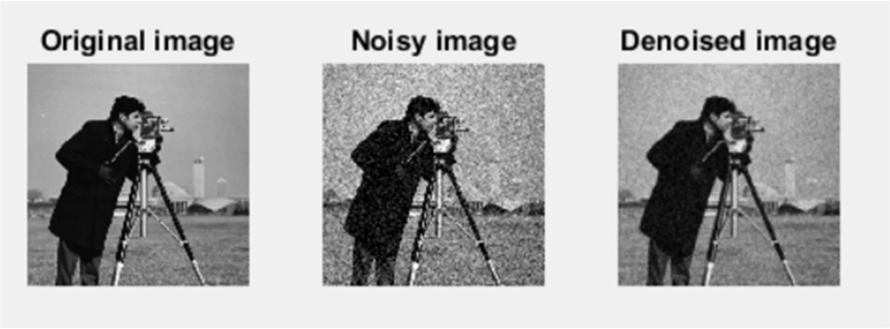
Noisy Image

Denoised Image

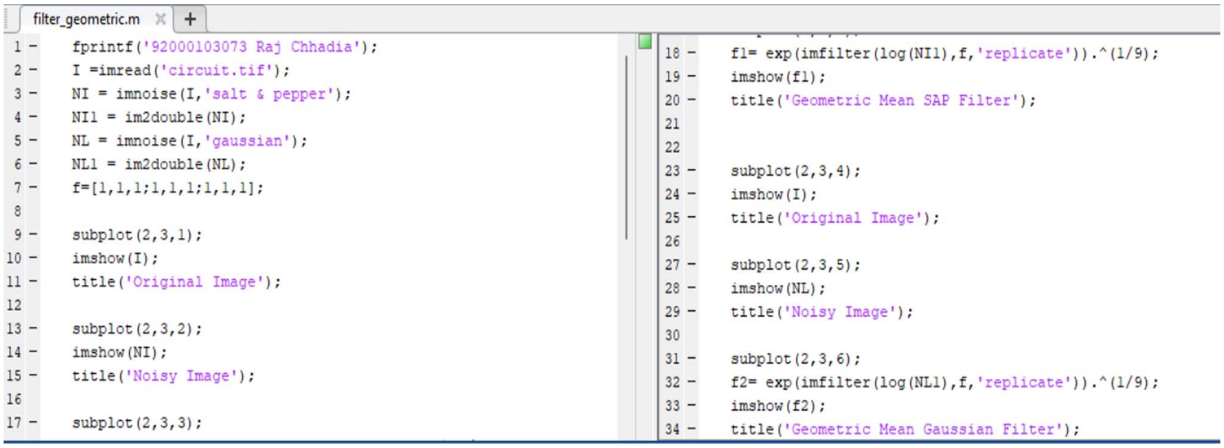
b. Weighted Averaging Filter / Gaussian Filter



```
fprintf('92000103073 Raj Chhadia');
I =imread('cameraman.tif');
X =imnoise(I,'gaussian');
f =1/16*[1,2,1;2,4,2;1,2,1];
Z =filter2(f,X);
figure;
subplot(1,3,1);
imshow(I);
title('Original image');

subplot(1,3,2);
imshow(X);
title('Noisy image');

subplot(1,3,3);
imshow(uint8(Z));
title('Denoised image');
```

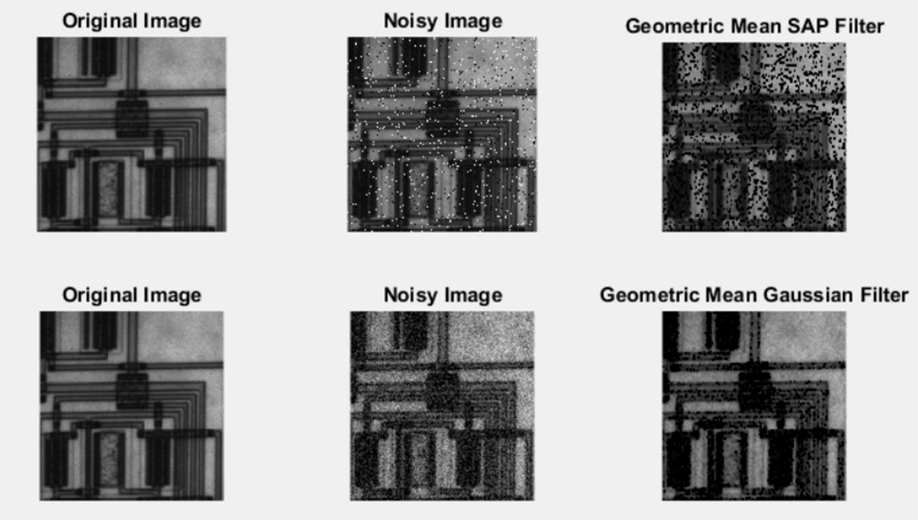


c. Geometric Mean

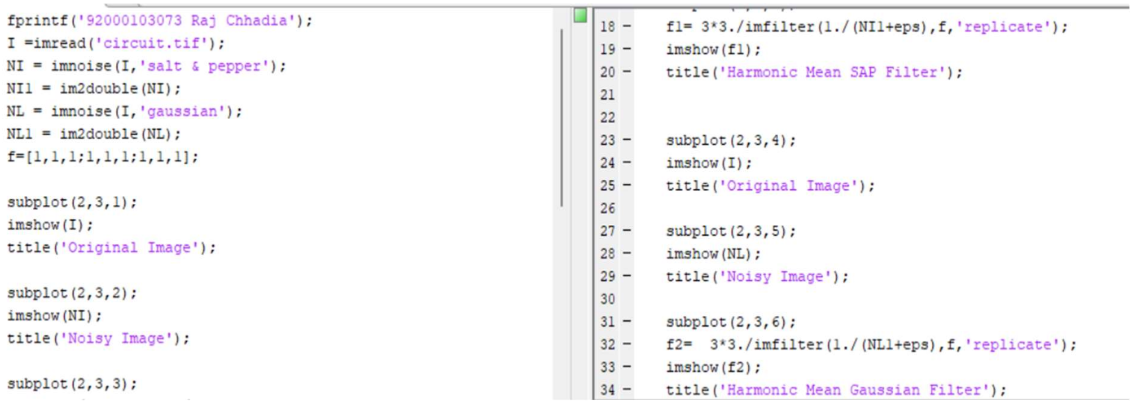


```
fprintf('92000103073 Raj Chhadia');
I =imread('circuit.tif');
NI = imnoise(I,'salt & pepper');
NI1 = im2double(NI);
NL = imnoise(I,'gaussian');
NL1 = im2double(NL);
f=[1,1,1;1,1,1;1,1,1];

subplot(2,3,1);
imshow(I);
title('Original Image');

subplot(2,3,2);
imshow(NI);
title('Noisy Image');

subplot(2,3,3);
```

```
f1= exp(imfilter(log(NI1),f,'replicate')).^(1/9);
imshow(f1);
title('Geometric Mean SAP Filter');


subplot(2,3,4);
imshow(I);
title('Original Image');

subplot(2,3,5);
imshow(NL);
title('Noisy Image');

subplot(2,3,6);
f2= exp(imfilter(log(NL1),f,'replicate')).^(1/9);
imshow(f2);
title('Geometric Mean Gaussian Filter');
```

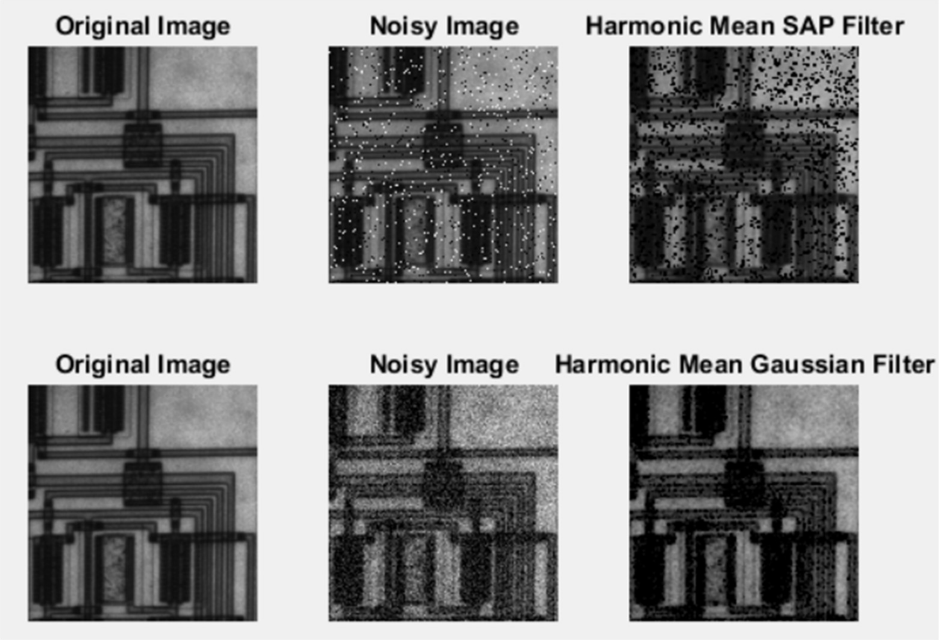


d. Harmonic Mean



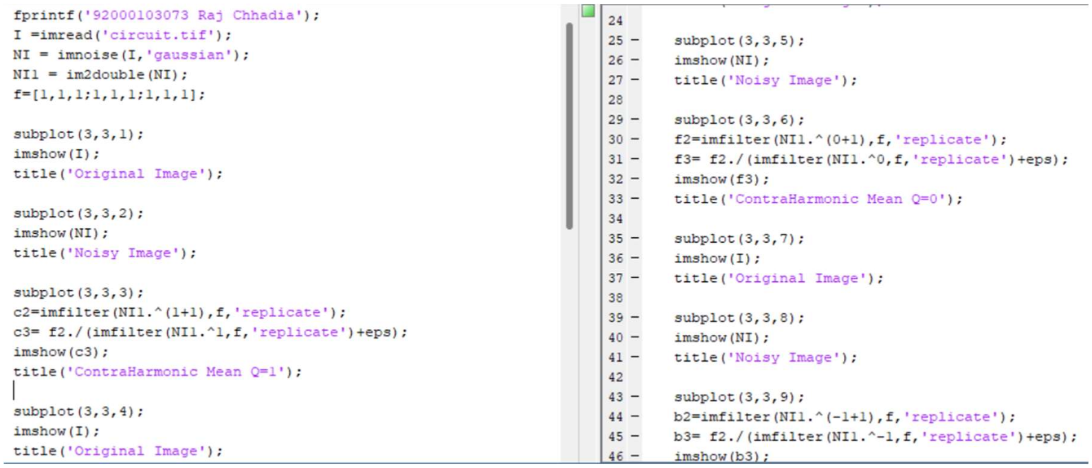
```
fprintf('92000103073 Raj Chhadia');
I =imread('circuit.tif');
NI = imnoise(I,'salt & pepper');
NI1 = im2double(NI);
NL = imnoise(I,'gaussian');
NL1 = im2double(NL);
f=[1,1,1;1,1,1;1,1,1];

subplot(2,3,1);
imshow(I);
title('Original Image');

subplot(2,3,2);
imshow(NI);
title('Noisy Image');

subplot(2,3,3);
```

```
f1= 3*3./imfilter(1./(NI1+eps),f,'replicate');
imshow(f1);
title('Harmonic Mean SAP Filter');


subplot(2,3,4);
imshow(I);
title('Original Image');

subplot(2,3,5);
imshow(NL);
title('Noisy Image');

subplot(2,3,6);
f2=  3*3./imfilter(1./(NL1+eps),f,'replicate');
imshow(f2);
title('Harmonic Mean Gaussian Filter');
```



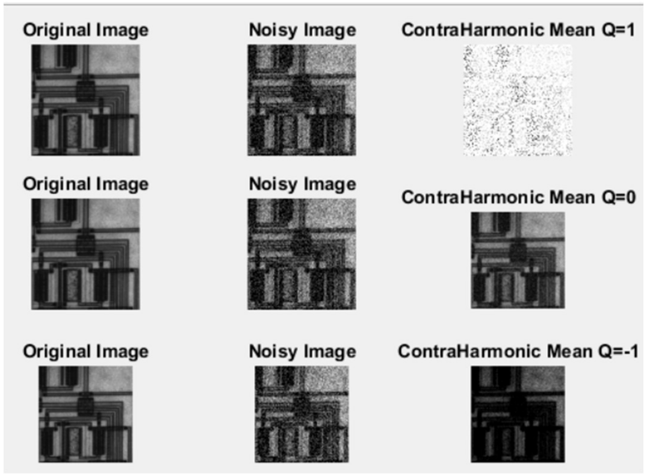
e. Contraharmonic Mean

i. Using gaussian noise

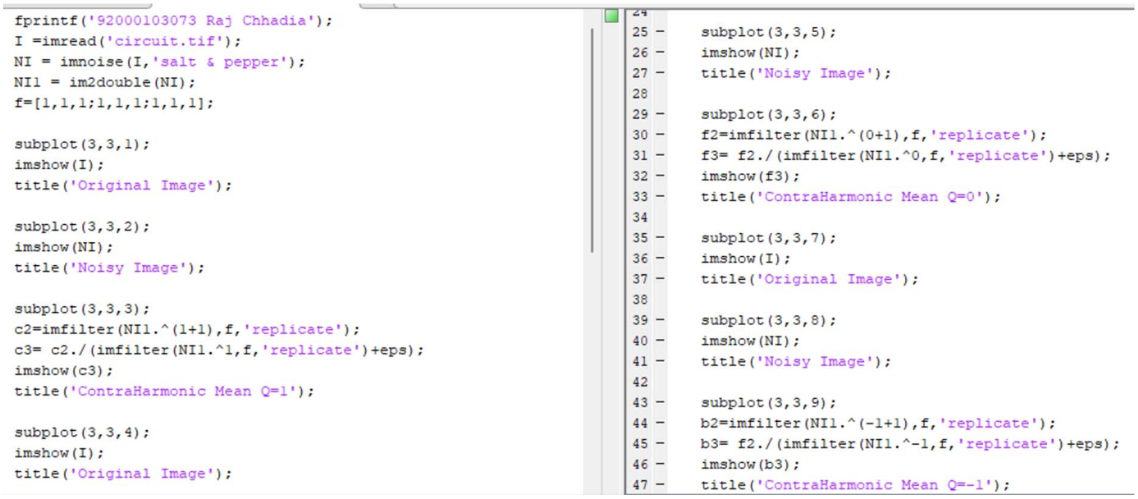


```
fprintf('92000103073 Raj Chhadia');
I =imread('circuit.tif');
NI = imnoise(I,'gaussian');
NI1 = im2double(NI);
f=[1,1,1;1,1,1;1,1,1];

subplot(3,3,1);
imshow(I);
title('Original Image');

subplot(3,3,2);
imshow(NI);
title('Noisy Image');

subplot(3,3,3);
c2=imfilter(NI1.^(1+1),f,'replicate');
c3= f2./(imfilter(NI1.^1,f,'replicate')+eps);
imshow(c3);
title('ContraHarmonic Mean Q=1');

subplot(3,3,4);
imshow(I);
title('Original Image');
```

```

subplot(3,3,5);
imshow(NI);
title('Noisy Image');

subplot(3,3,6);
f2=imfilter(NI1.^(0+1),f,'replicate');
f3= f2./(imfilter(NI1.^0,f,'replicate')+eps);
imshow(f3);
title('ContraHarmonic Mean Q=0');

subplot(3,3,7);
imshow(I);
title('Original Image');

subplot(3,3,8);
imshow(NI);
title('Noisy Image');

subplot(3,3,9);
b2=imfilter(NI1.^(-1+1),f,'replicate');
b3= f2./(imfilter(NI1.^-1,f,'replicate')+eps);
imshow(b3);
```

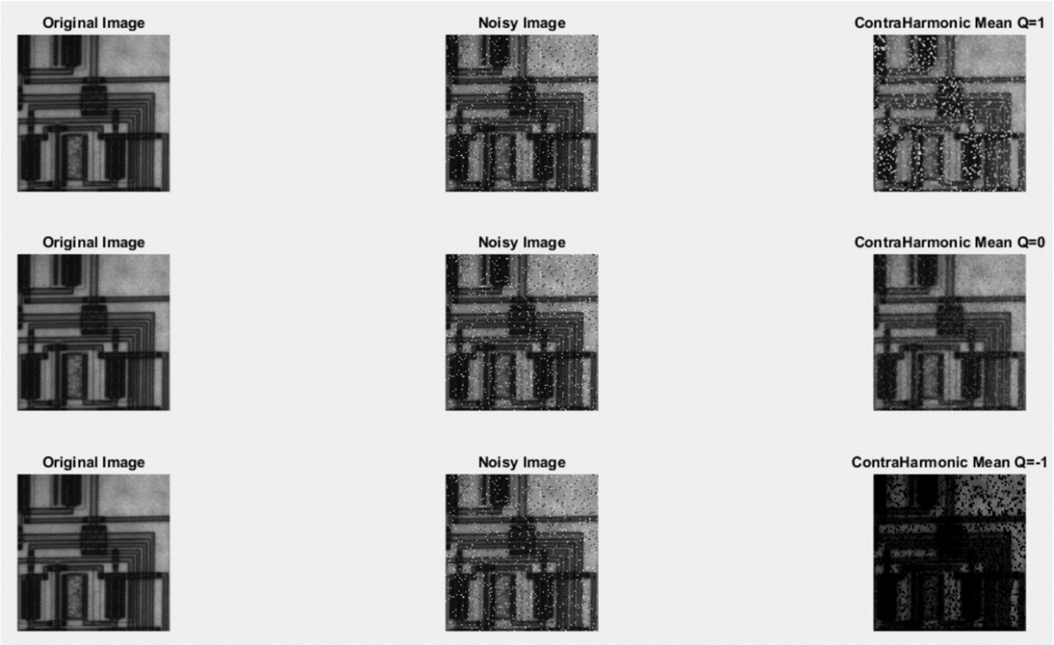


ii. Using salt & pepper noise



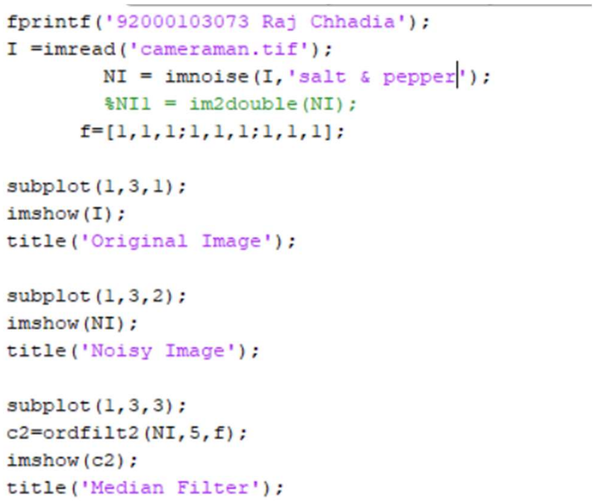
```
fprintf('92000103073 Raj Chhadia');
I =imread('circuit.tif');
NI = imnoise(I,'salt & pepper');
NI1 = im2double(NI);
f=[1,1,1;1,1,1;1,1,1];

subplot(3,3,1);
imshow(I);
title('Original Image');

subplot(3,3,2);
imshow(NI);
title('Noisy Image');

subplot(3,3,3);
c2=imfilter(NI1.^(1+1),f,'replicate');
c3= c2./(imfilter(NI1.^1,f,'replicate')+eps);
imshow(c3);
title('ContraHarmonic Mean Q=1');

subplot(3,3,4);
imshow(I);
title('Original Image');
```

```
subplot(3,3,5);
imshow(NI);
title('Noisy Image');

subplot(3,3,6);
f2=imfilter(NI1.^(0+1),f,'replicate');
f3= f2./(imfilter(NI1.^0,f,'replicate')+eps);
imshow(f3);
title('ContraHarmonic Mean Q=0');

subplot(3,3,7);
imshow(I);
title('Original Image');

subplot(3,3,8);
imshow(NI);
title('Noisy Image');

subplot(3,3,9);
b2=imfilter(NI1.^(-1+1),f,'replicate');
b3= f2./(imfilter(NI1.^-1,f,'replicate')+eps);
imshow(b3);
title('ContraHarmonic Mean Q=-1');
```

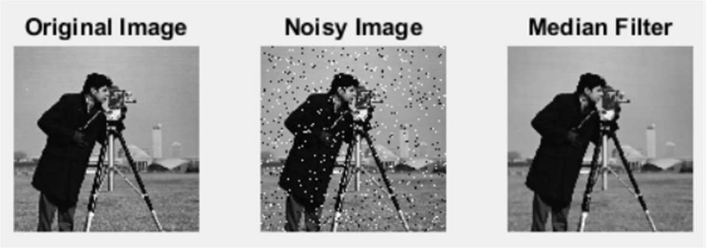


2. Non-Linear Filters / Order Statistics Filter

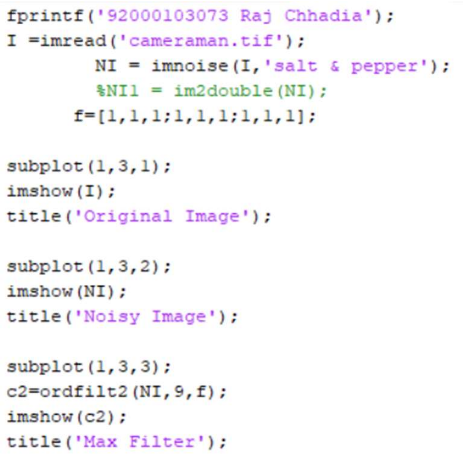
a. Median Filtering



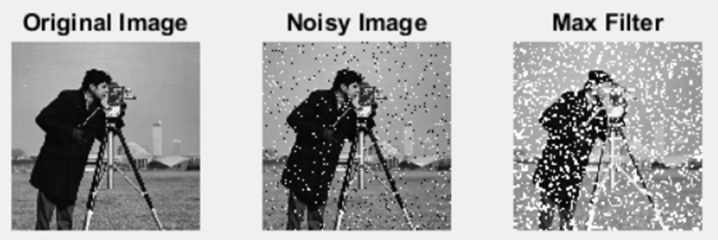
```
fprintf('92000103073 Raj Chhadia');
I =imread('cameraman.tif');
        NI = imnoise(I,'salt & pepper');
        %NI1 = im2double(NI);
      f=[1,1,1;1,1,1;1,1,1];

subplot(1,3,1);
imshow(I);
title('Original Image');

subplot(1,3,2);
imshow(NI);
title('Noisy Image');

subplot(1,3,3);
c2=ordfilt2(NI,5,f);
imshow(c2);
title('Median Filter');
```



b. Max Filtering



```
fprintf('92000103073 Raj Chhadia');
I =imread('cameraman.tif');
        NI = imnoise(I,'salt & pepper');
        %NI1 = im2double(NI);
      f=[1,1,1;1,1,1;1,1,1];

subplot(1,3,1);
imshow(I);
title('Original Image');

subplot(1,3,2);
imshow(NI);
title('Noisy Image');

subplot(1,3,3);
c2=ordfilt2(NI,9,f);
imshow(c2);
title('Max Filter');
```

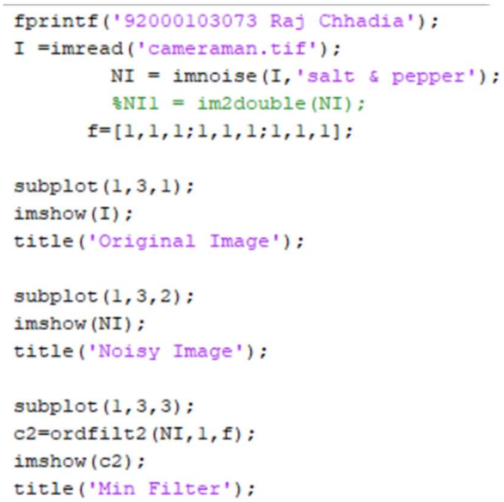


Original Image

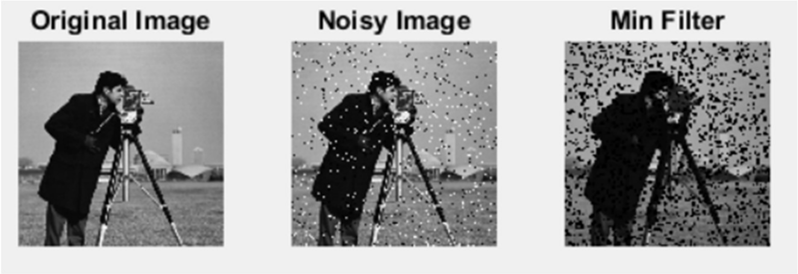
Noisy Image

Max Filter

c. Min Filtering



```
fprintf('92000103073 Raj Chhadia');
I =imread('cameraman.tif');
        NI = imnoise(I,'salt & pepper');
        %NI1 = im2double(NI);
      f=[1,1,1;1,1,1;1,1,1];

subplot(1,3,1);
imshow(I);
title('Original Image');

subplot(1,3,2);
imshow(NI);
title('Noisy Image');

subplot(1,3,3);
c2=ordfilt2(NI,1,f);
imshow(c2);
title('Min Filter');
```

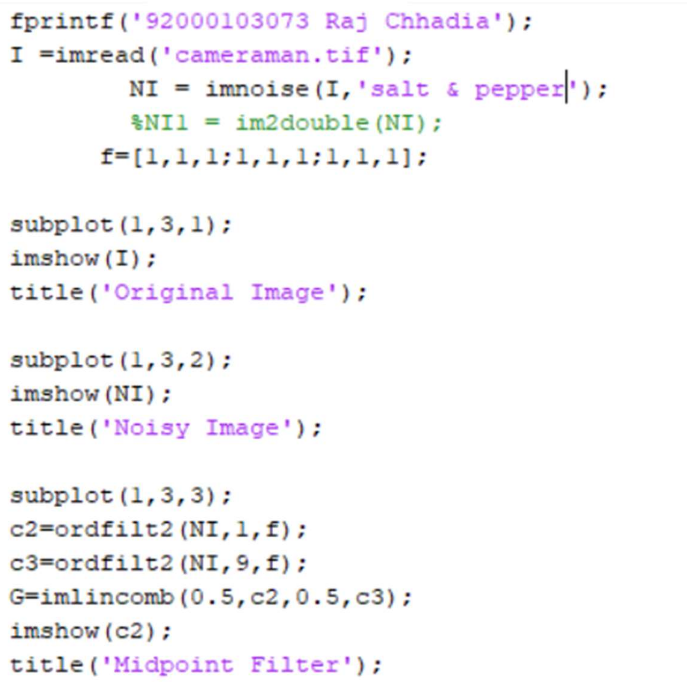


Original Image

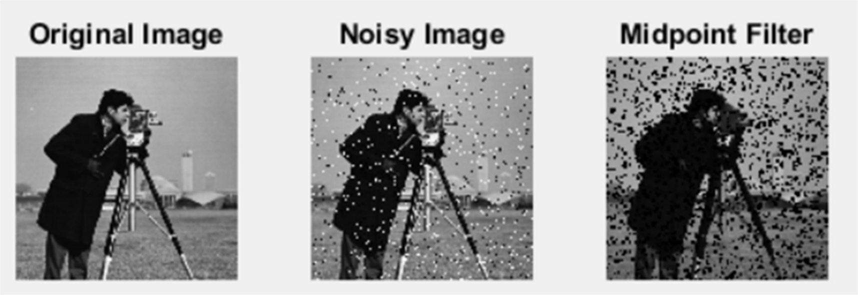
Noisy Image

Min Filter

d. Mid-point Filtering



```
fprintf('92000103073 Raj Chhadia');
I =imread('cameraman.tif');
        NI = imnoise(I,'salt & pepper');
        %NI1 = im2double(NI);
      f=[1,1,1;1,1,1;1,1,1];

subplot(1,3,1);
imshow(I);
title('Original Image');

subplot(1,3,2);
imshow(NI);
title('Noisy Image');

subplot(1,3,3);
c2=ordfilt2(NI,1,f);
c3=ordfilt2(NI,9,f);
G=imlincomb(0.5,c2,0.5,c3);
imshow(c2);
title('Midpoint Filter');
```


Original Image
Noisy Image
Midpoint Filter