HW 1 - ME 6406 Machine Vision

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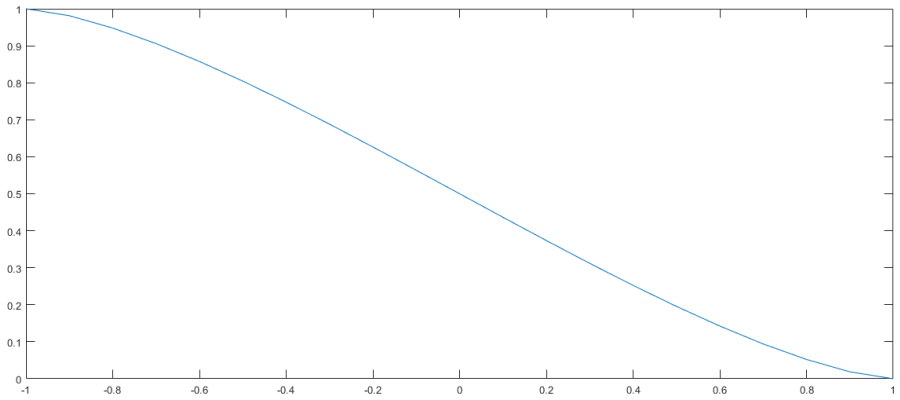
Problem 1

```
clear
% S = s/R
S = [-1:.1:1];


p = (1/pi).*(acos(S) - S.*sqrt(1-S.^2));
figure(1)
plot(S,p)
```



Problem 2a

```
clear

image_e = [122 121 115 113 118 122 125 127;
120 114 115 119 123 127 128 124;
```

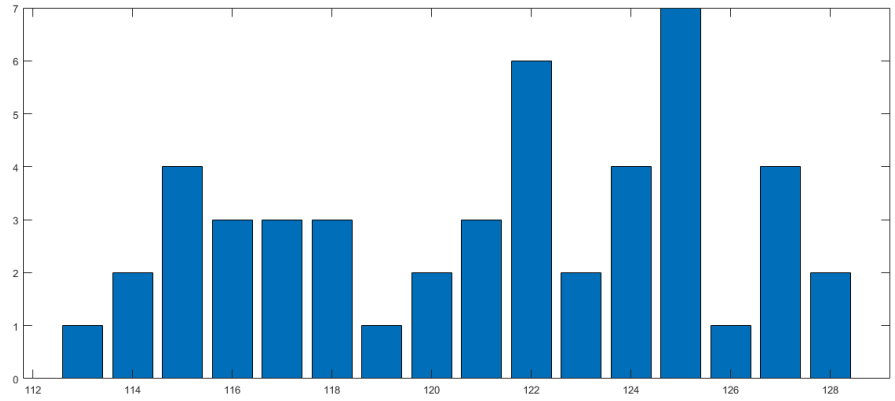
```
115 116 122 124 127 128 124 121;
114 120 125 126 127 125 122 118;
118 124 125 125 123 121 117 117;
122 125 125 122 117 116 116 115];

values = unique(image_e); %creates a vector of the unique values

count_values = histcounts(image_e)'; % count of # unique

figure(1)
bar(values,count_values)

cdf = cumsum(count_values); % the cumulative sum of the count of
 unique values

qk = ((2^(8)-1)/(6*8))*cdf;

round_qk = round(qk);

table = [values,count_values,cdf,qk,round_qk]

figure(2)
bar(round_qk,count_values)

image_e_eq = 0 * image_e;

for i = 1:length(values)
    image_e_eq(image_e==values(i)) = round_qk(i);
end
image_e_eq
```

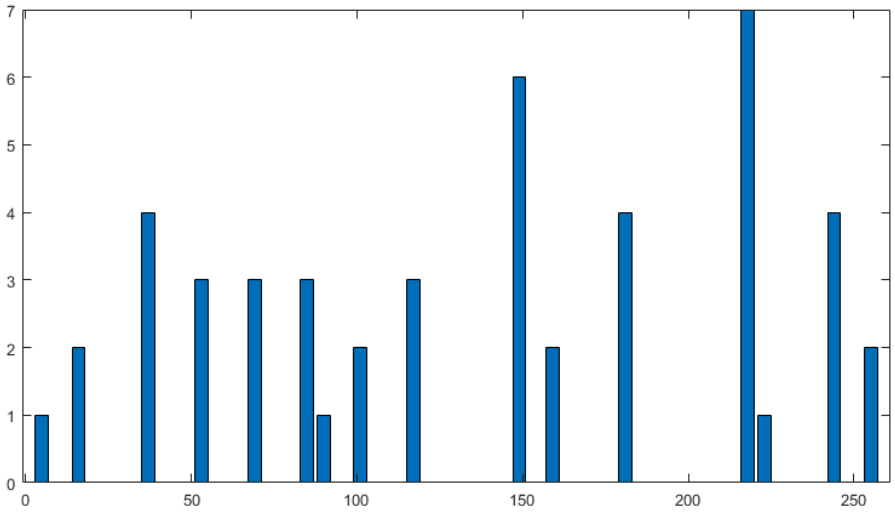
table =

113.0000	1.0000	1.0000	5.3125	5.0000
114.0000	2.0000	3.0000	15.9375	16.0000
115.0000	4.0000	7.0000	37.1875	37.0000
116.0000	3.0000	10.0000	53.1250	53.0000
117.0000	3.0000	13.0000	69.0625	69.0000
118.0000	3.0000	16.0000	85.0000	85.0000
119.0000	1.0000	17.0000	90.3125	90.0000
120.0000	2.0000	19.0000	100.9375	101.0000
121.0000	3.0000	22.0000	116.8750	117.0000
122.0000	6.0000	28.0000	148.7500	149.0000
123.0000	2.0000	30.0000	159.3750	159.0000
124.0000	4.0000	34.0000	180.6250	181.0000
125.0000	7.0000	41.0000	217.8125	218.0000
126.0000	1.0000	42.0000	223.1250	223.0000
127.0000	4.0000	46.0000	244.3750	244.0000
128.0000	2.0000	48.0000	255.0000	255.0000

image_e_eq =

```
149   117    37     5    85   149   218   244
101    16    37    90   159   244   255   181
 37    53   149   181   244   255   181   117
 16   101   218   223   244   218   149    85
 85   181   218   218   159   117    69    69
149   218   218   149    69    53    53    37
```

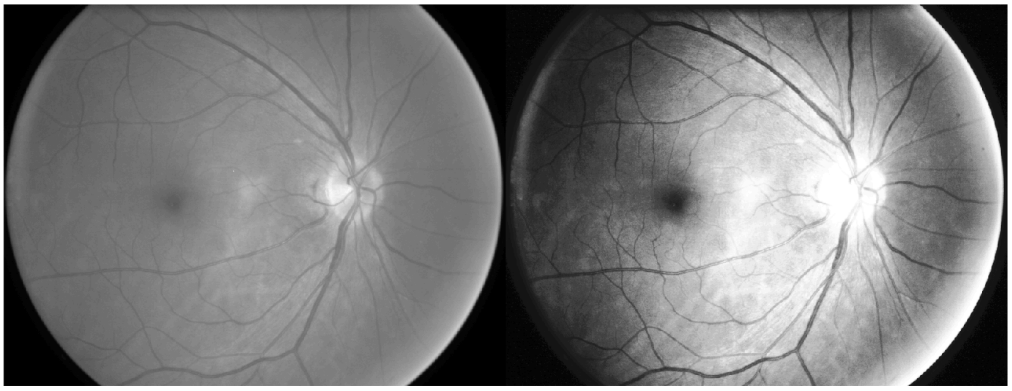


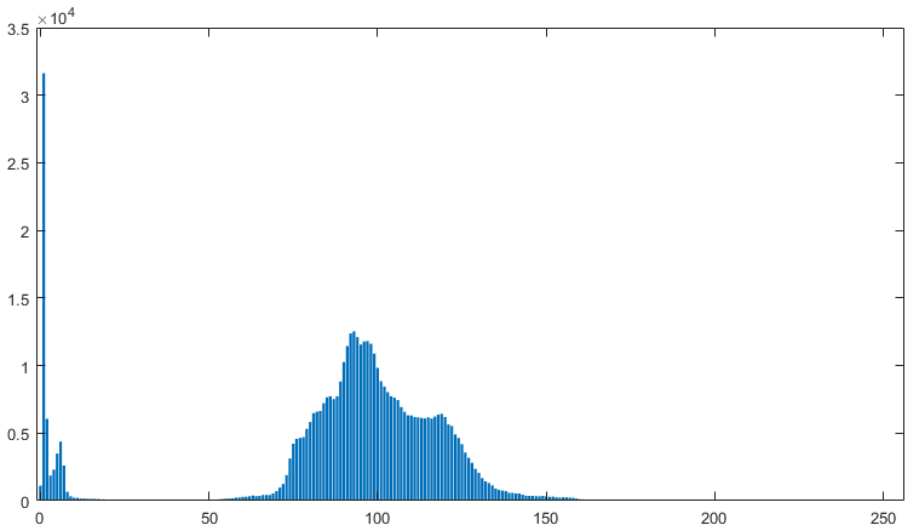


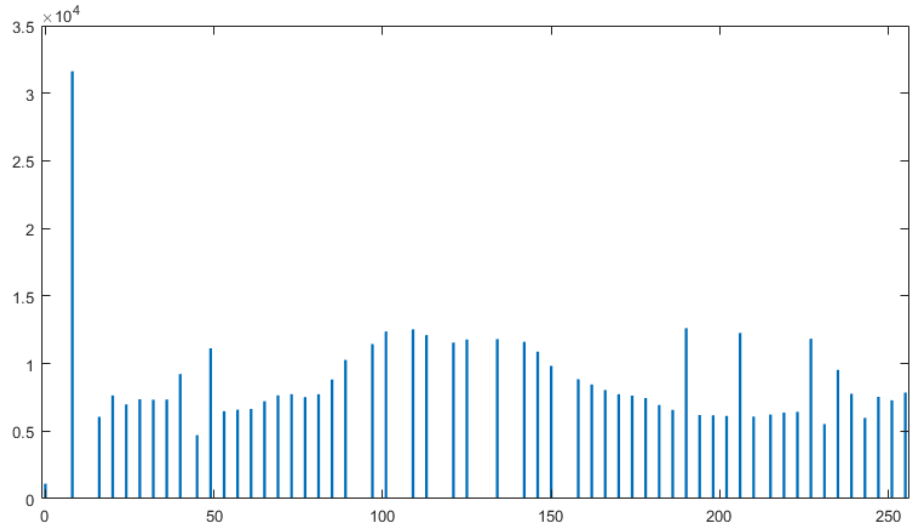
Problem 2b

```
clear

old = imread("eyeball.png");

new = histeq(old);

figure(1)
imshowpair(old,new,'montage')
```

```
[y,x] = imhist(old);

[y1,x1] = imhist(new);

figure(2)
bar(x,y)

figure(3)
bar(x1,y1)
```







Problem 3a

```
clear
%5x5 matrix, omega = 2

%G(y,x)
%G(n,m)=(1/(2*pi*omega^2))^(-(m^2+n^2)/(2*omega^2))

%          n
%          ^
%          |
% w1  w2  w3  w4  w5
% w6  w7  w8  w9  w10
% w11 w12 w13 w14 w15 -> m
% w16 w17 w18 w19 w20
% w21 w22 w23 w24 w25


omega = 2;

for n = -2:1:2
    for m = -2:1:2

    G(n+3,m+3)=(1/(2*pi*omega^2))*exp(-(m^2+n^2)/(2*omega^2));

    end
end

G


G =

    0.0146    0.0213    0.0241    0.0213    0.0146
```

```
    0.0213    0.0310    0.0351    0.0310    0.0213
    0.0241    0.0351    0.0398    0.0351    0.0241
    0.0213    0.0310    0.0351    0.0310    0.0213
    0.0146    0.0213    0.0241    0.0213    0.0146
```

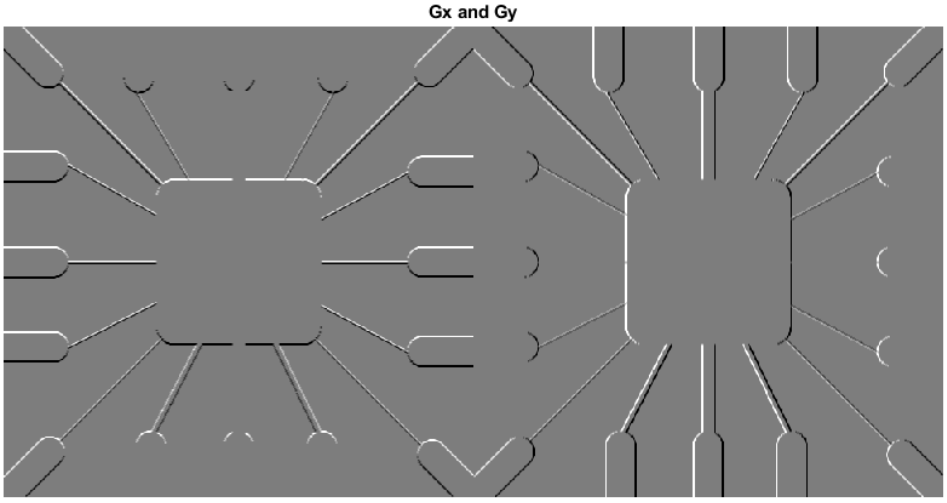
Problem 3b

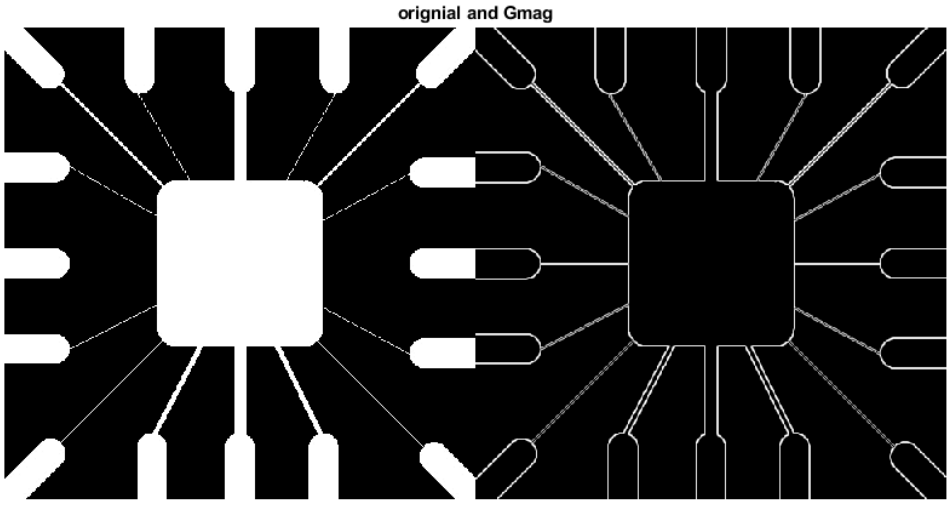
```
        at pixel(X, Y)=(4, 5)
        (1,1) is a the top left corner X axis points down and Y axis to the right

z = [124 127 128 126 1/27 125 125 123 121]';

hx = [-1 -2 -1 0 0 0 1 2 1];
hy = [-1 0 1 -2 0 2 -1 0 1 ];

Gx = hx*z
Gy = hy*z

Gmag = sqrt(Gx^2+Gy^2)

Gdir_radians = atan2(Gy,Gx) %radians


Gx =

   -14


Gy =

    -2


Gmag =

   14.1421


Gdir_radians =

   -2.9997
```

Problem 3c

```
clear

image = imread("IC_pin.png");

[Gy,Gx] = imgradientxy(image);
[Gmag,Gdir] = imgradient(image);
```

```
figure(2)
imshowpair(Gx,Gy,'montage');
title('Gx and Gy');

figure(3)
imshowpair(image,Gmag,'montage');
title('orignial and Gmag');
```

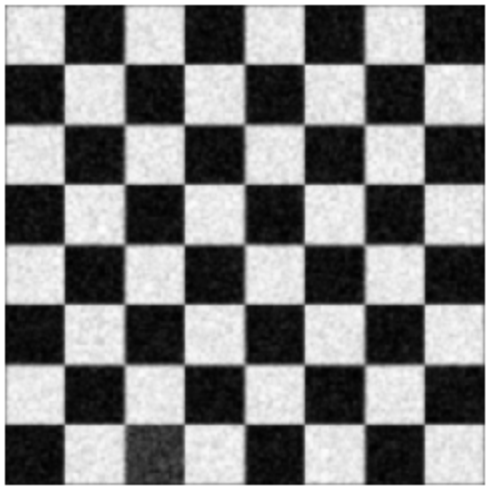


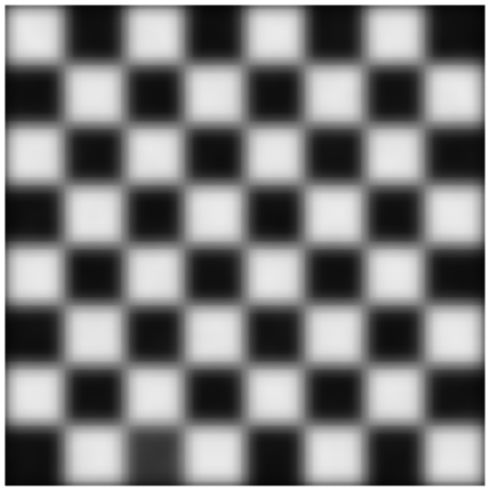


Problem 3d

```
clear


image = imread("salt_and_pepper_checker.png");
```

```
for sigma = [1 2 5]
    mask_size = 2*3*sigma + 1;
    G = zeros (mask_size);

    for i = -floor(mask_size/2):1:floor(mask_size/2)
        for j = -floor(mask_size/2):1:floor(mask_size/2)
            G(i+ceil(mask_size/2), j+ceil(mask_size/2)) = (1/
(2*pi*sigma^2))*exp(-(i^2 + j^2)/(2*sigma^2));
        end
    end
    image_blur = imfilter(image,G);
    figure()
    imshow(image_blur)
end
```





Problem 3e

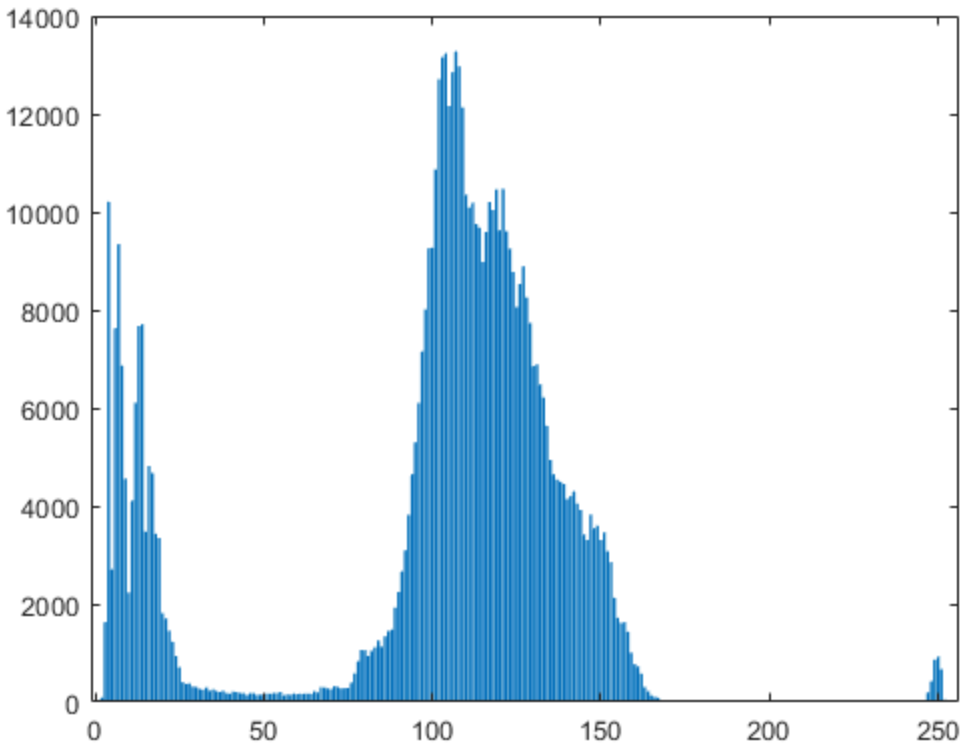
```
clear

image = imread("checker.png");

sigma = 1;
for n = -3:1:3
    for m = -3:1:3
        B(n+4,m+4) = (1/(2*pi*sigma^2))*exp(-(m^2+n^2)/(2*sigma^2));
```

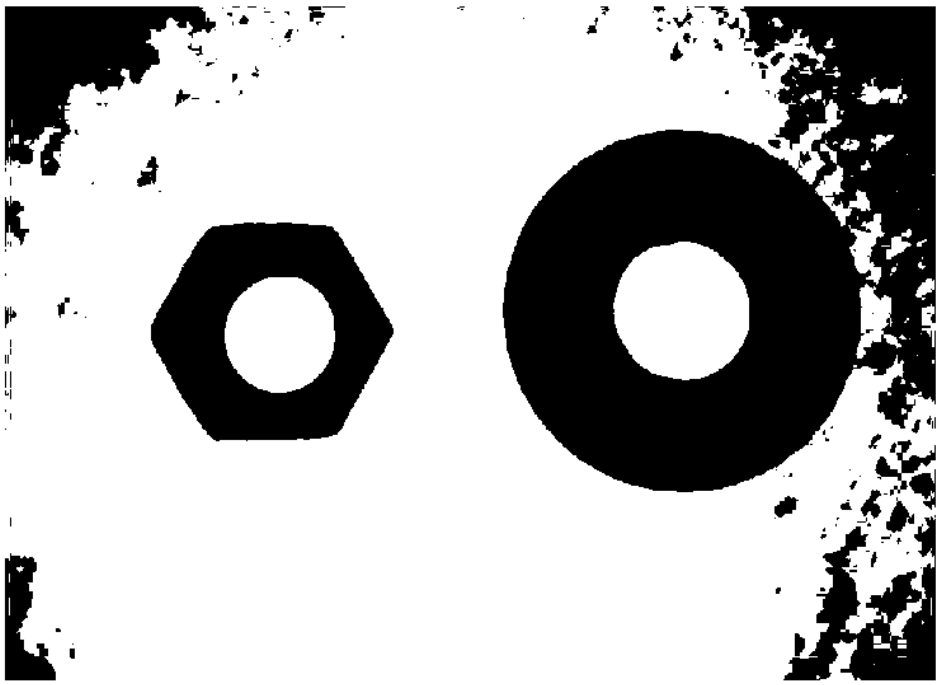
```
    end
end

% 13x13 matrix
sigma = 2;

for n = -6:1:6
    for m = -6:1:6
        A(n+7,m+7) = (1/(2*pi*sigma^2))*exp(-(m^2+n^2)/(2*sigma^2));
    end
end

Z = zeros(13);%create an 11x11 zero matrix load the 7x7 matrix

for n = -3:1:3
    for m = -3:1:3
        Z(n+7,m+7) = B(n+4,m+4); % load 7x7 values into 13x13 zero
 matrix
    end
end


difference_of_gaussian = (Z-A); %difference of Gaussian

image_blur = imfilter(image,difference_of_gaussian);
imshow(image_blur);
```

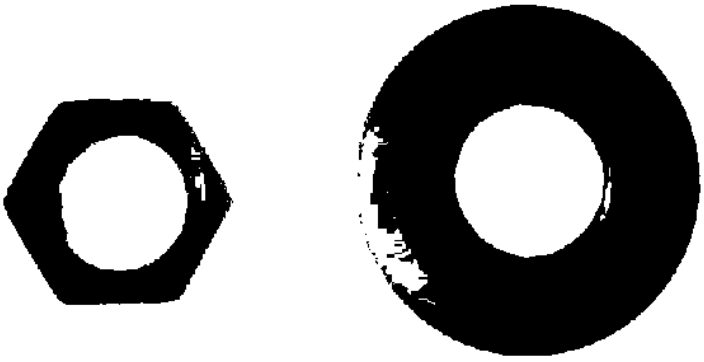
Problem 4a

```
image = imread('nut_and_shell.png');
bw_image = rgb2gray(image);
```

```
[y,x] = imhist(bw_image);
figure()
bar(x,y)
over = 100;
under = 20;
best = 50;

for threshold =[over under best]/255
    figure()
    binary_image = im2bw(bw_image, threshold);
    imshow(binary_image)
end
```



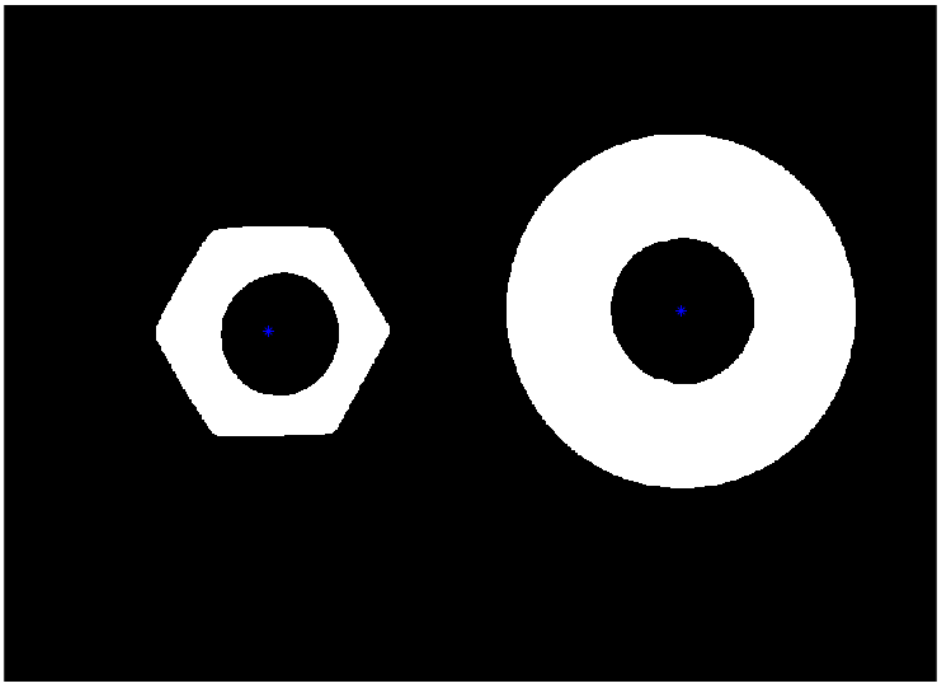




Problem 4b

```
clear

image = imread("nut_and_shell.png");
image_bw = rgb2gray(image);
threshold = 45/255;
image_binary = im2bw(image_bw, threshold);

figure()
image_rev = imcomplement(image_binary);

s = regionprops(image_rev, 'centroid');
a = regionprops(image_rev,'area');

centroids = cat(1,s.Centroid)
areas = cat(1,a.Area)

imshow(image_rev)
hold on
plot(centroids(:,1),centroids(:,2),'b*')
hold off


centroids =

  260.3966  320.5202
```

```
  666.6295  301.3561

areas =

       25212
       78266
```



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