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Q1.1

```
%The location for each pixel
nX = 200; %number of columns
nY = 200; %number of rows
xj = 1:nX; %x location of each column
yi = 1:nY; %y location of each row

[xij,yij] = meshgrid(xj,yi); %x,y location of each pixel

%define an image of an annulus
cx = 75; % x component of center
cy = 75; % y component of center
r1 = 30; % inner radius in pixels
r2 = 45; %outer radius in pixels
% define the image using binary equations
I = ((xij - cx).^2 + (yij-cy).^2 <= r2^2 )- ((xij-cx).^2 + (yij-cy).^2
 < r1^2);

%display it
figure;
grid on;
imagesc(I);
axis image;
title('I(x)');
set(gca,'ydir','normal'); % put origin at bottom left
```

Q1.2

```
%set the coordinates of landmarks in I
X = [110 75;95 105; 55 105;37.5 75;55 42.5;95 42.5];
%set the coordinates of landmarks in J
Y = [180 120; 150 170; 90 170;60 120;90 70;150 70];
```

Q1.3

```
syms s
```

```
eqn=0;
%find scale factor
for i = 1:max(size(X))
    for j = 1:min(size(X))

        eqn=eqn+diff((abs((s*X(i,j)-Y(i,j))))^2,s);
    end

end

scaleFactor = double(solve(eqn==0,s));
```

Q1.4

```
%transformed landmarks by scale factor
sX = scaleFactor.*X;

hold on;
scatter(X(:,1),X(:,2),'c');
scatter(sX(:,1),sX(:,2),'b');
scatter(Y(:,1),Y(:,2),'r');
```

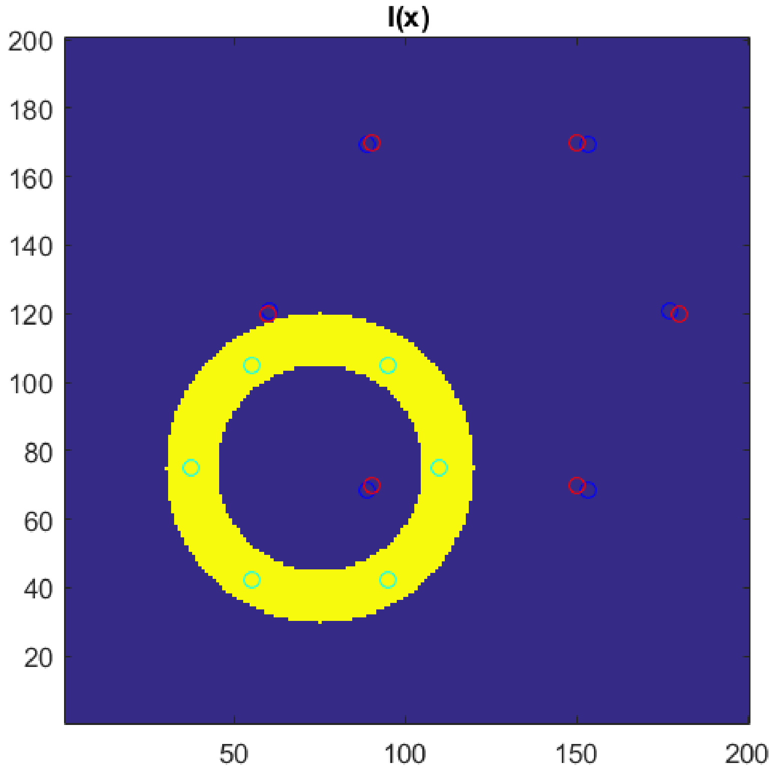
Q1.5

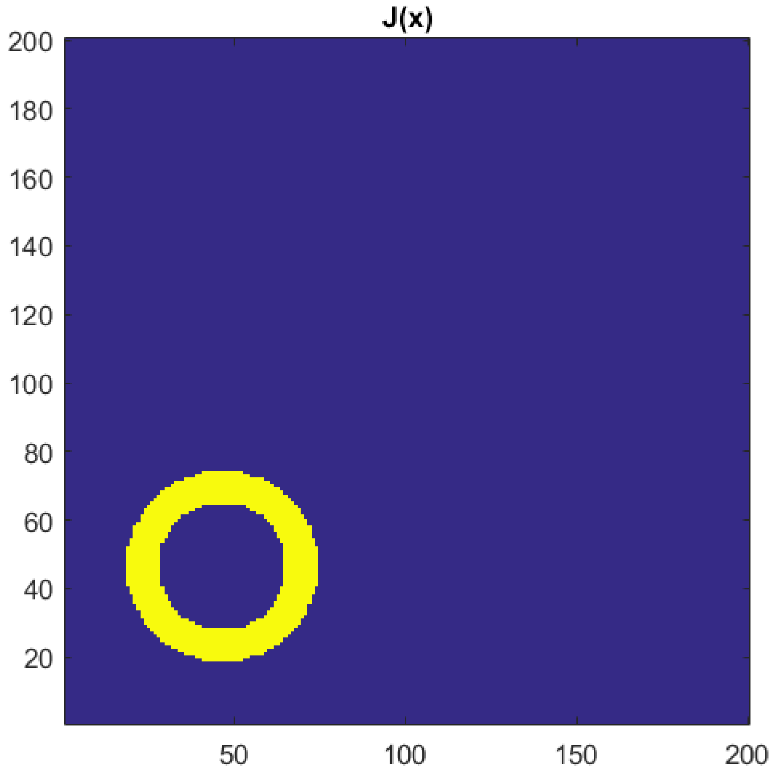
```
%initialize an image of all zeroes
ITransformed = zeros(size(I));

for i = 1:nY %loop through each row
    for j= 1:nX %loop through each column

        %we are looking for the value to assign to Isx(j,i)

        %find the posiiton to look at in the image J
        iLook = i*scaleFactor;
        jLook = j*scaleFactor;

        %round them to the nearest integer
        iLookRound = round(iLook);
        jLookRound = round(jLook);

        %check if we're out of bounds,
        if iLookRound < 1 || iLookRound > nY || jLookRound < 1 ||
 jLookRound > nX
            %if so, fill the image with the value zero
            ITransformed(j,i) = 0;
        else
            %otherwise, assign the value in our image at this point
            ITransformed(j,i) = I(jLookRound,iLookRound);
        end
        %don't forget to index your images by (row,column) and not
 (x,y)!
    end
```

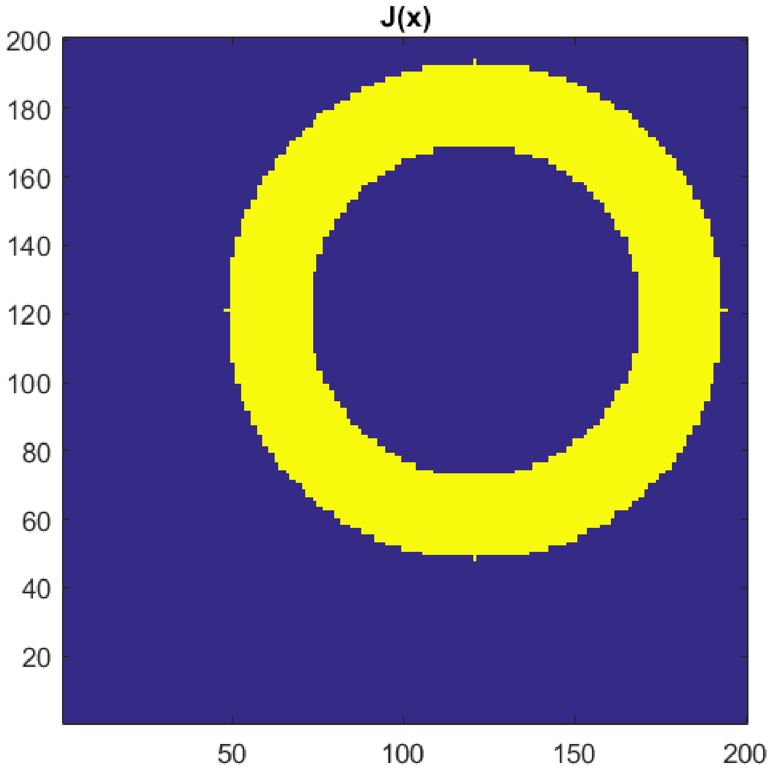
```
end
figure
grid on
imagesc(ITransformed);
axis image;
title('J(x)');
set(gca,'ydir','normal');
```

Q1.6

```
%initialize an image of all zeroes
ITransformed = zeros(size(I));

for i = 1:nY %loop through each row
    for j= 1:nX %loop through each column

        %we are looking for the value to assign to Isx(j,i)

        %find the posiiton to look at in the image J
        iLook = i*(scaleFactor^-1);
        jLook = j*(scaleFactor^-1);

        %round them to the nearest integer
        iLookRound = round(iLook);
        jLookRound = round(jLook);

        %check if we're out of bounds,
        if iLookRound < 1 || iLookRound > nY || jLookRound < 1 ||
 jLookRound > nX
            %if so, fill the image with the value zero
            ITransformed(j,i) = 0;
        else
            %otherwise, assign the value in our image at this point
            ITransformed(j,i) = I(jLookRound,iLookRound);
        end
        %don't forget to index your images by (row,column) and not
 (x,y)!
    end
end
figure
grid on
imagesc(ITransformed);
axis image;
title('J(x)');
set(gca,'ydir','normal');
```


I(x)
200
180
160
140
120
100
80
60
40
20
50
100
150
200


J(x)
200
180
160
140
120
100
80
60
40
20
50
100
150
200



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