

ECE 172 HW3  
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### Problem 1



Original Image  
(iii)



Image after sampling  
(iv)



**Image after sampling and 3-level quantization**

(v)



**Image after sampling and 5-level Quantization**

Sampling an image reduces the spatial resolution of the image. In this case, the sampling rate is 8. It makes the original 480\*640 image into 60\*80 image, which is 8 times smaller. Quantizing an image reduces the number of bits to represent an image. Sampling and quantization are often used to compress an image. The image takes up less space but loses detail information to some extent.

## Problem 2

original image



simple HE



win size=30



win size=50



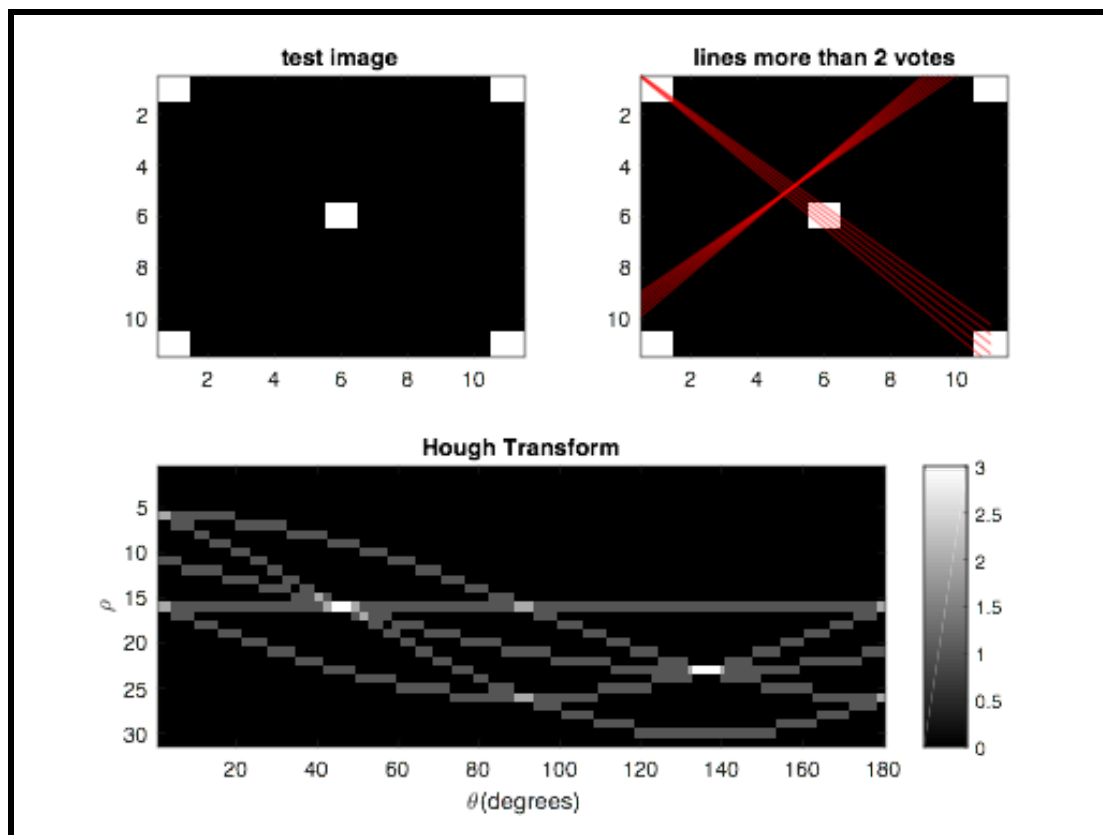
win size=150



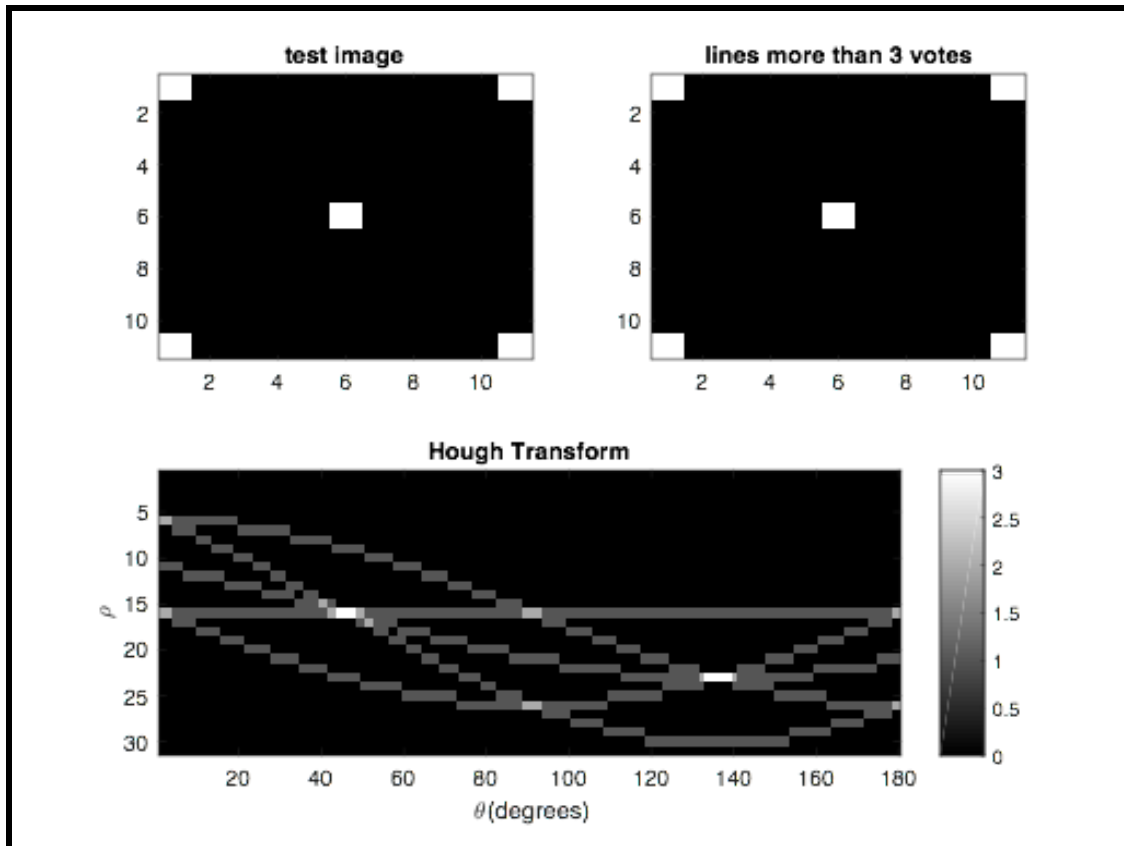
HE and AHE both improve the contrast of the image by spreading out the most frequent intensity. Different from HE, AHE improves the contrast of different local sections of an image and re-distributes the whole image. HE works best for this image because the whole image does not change a lot and the library is more clearly shown. The larger the window size, the total effect is getting closer and closer to the HE image.

### Problem 3

(ii)

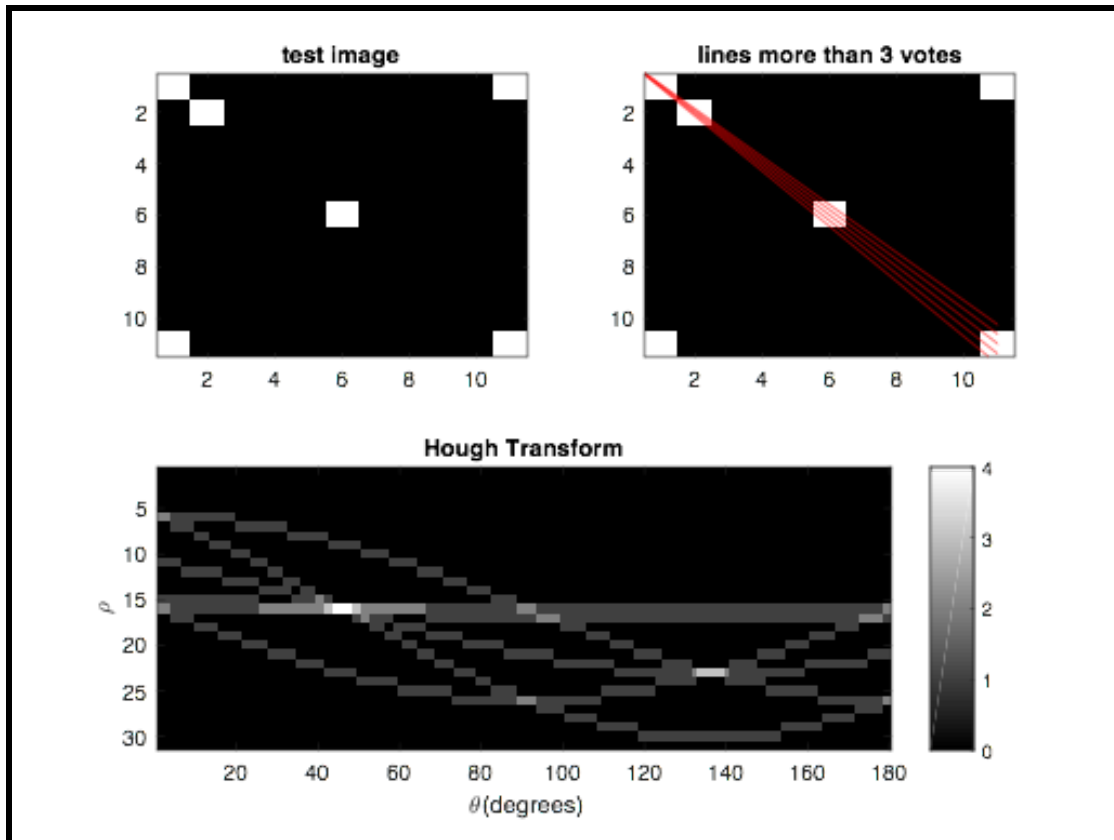


(iii)



In the Hough transform matrix where the maximum is 3, there is no entry that has more than 3 votes; we can not find any corresponding rho and theta for more than 3 votes. Thus we can not draw any lines.

(iv)

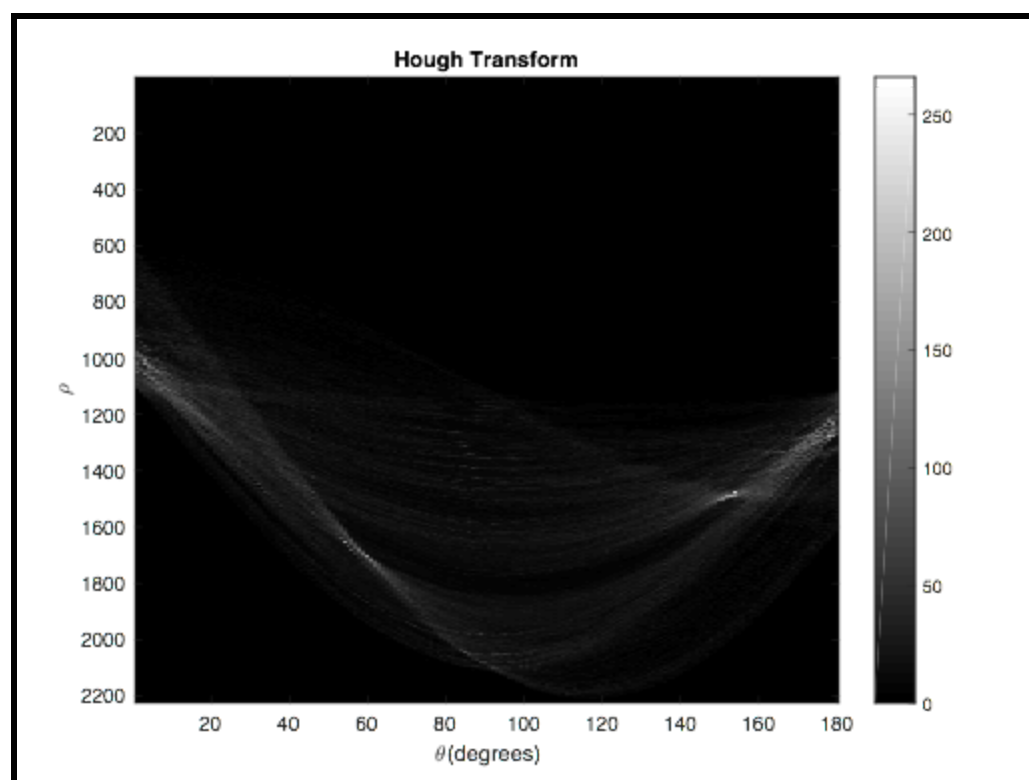
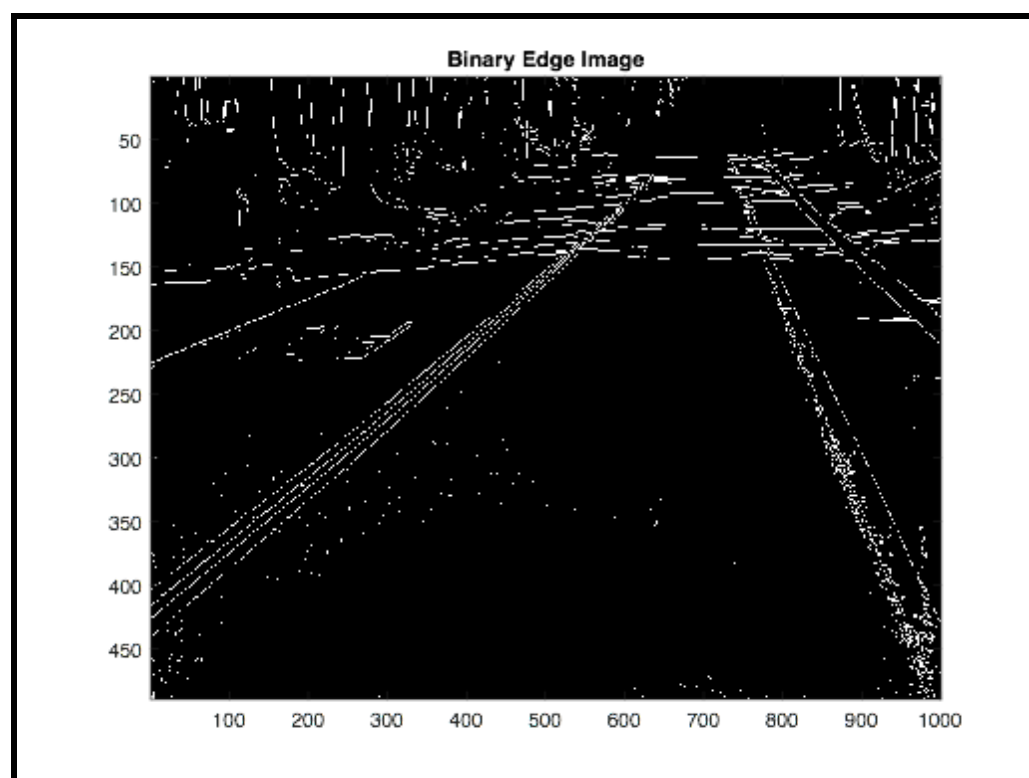


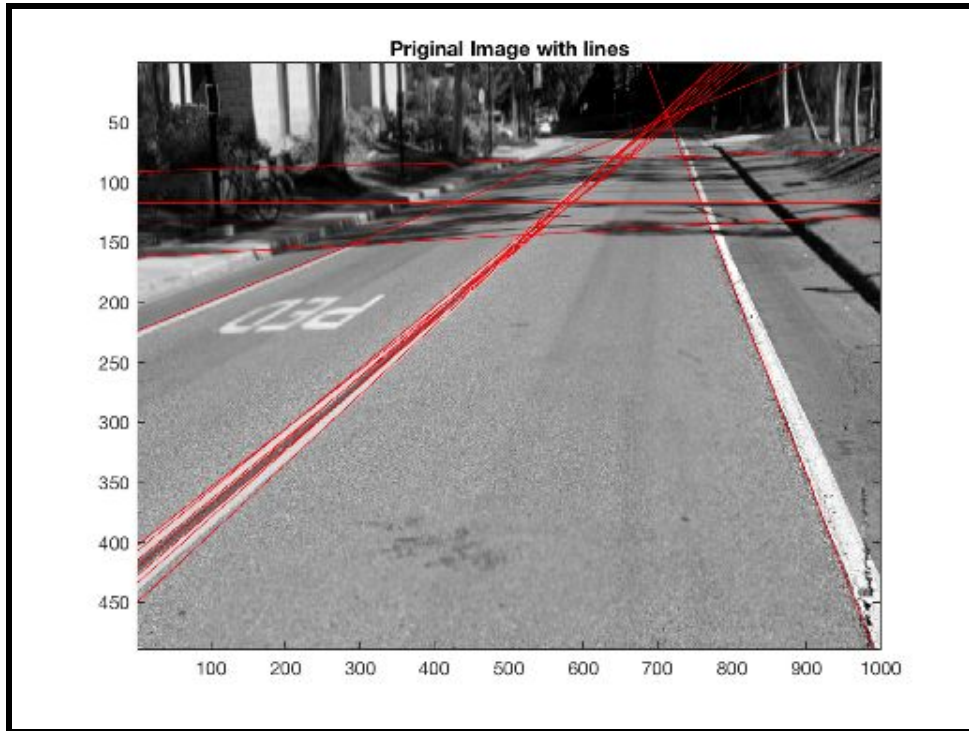
In the Hough transform matrix, there are 5 entries that have more than 3 votes; we can find these corresponding rho and theta for more than 3 votes. Thus we can draw 5 lines.



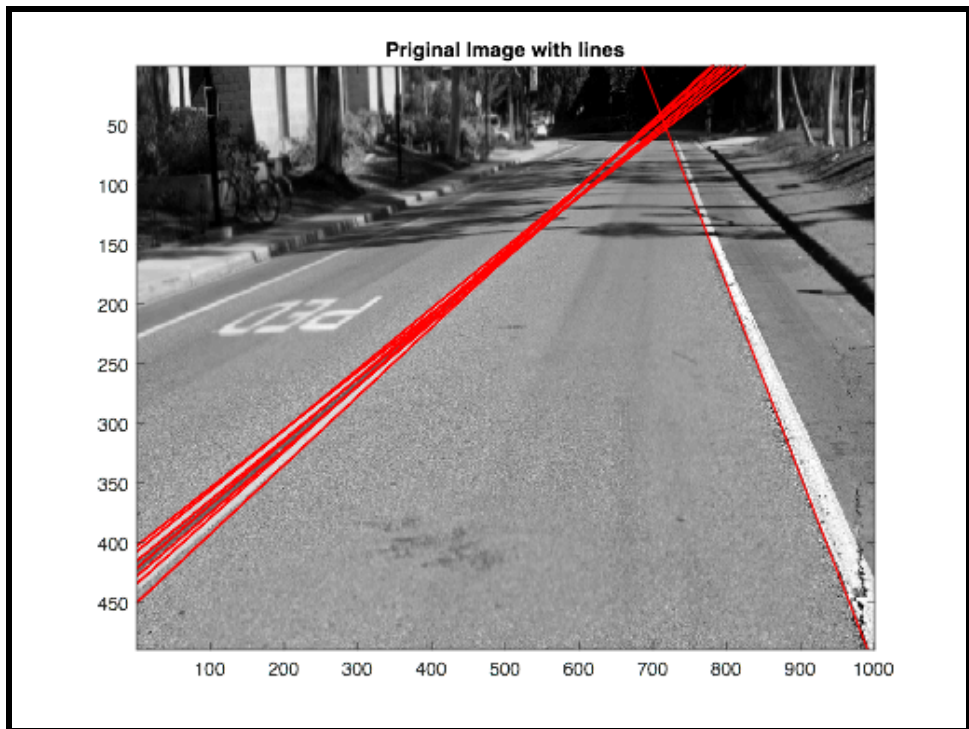
(v)







(vi)



**Theta from 3(vi)**

```
theta_line =  
-32    60    61    62    62    63    63    64
```

**So I set the theta in the range [-40,65]**

## Problem 1

```
function image_sq = sample_quantization(filename)
a=imread('filename');
assert(size(a,3)==1);
a_sample=a(1:8:end,1:8:end,:);
step1=round(256/5);
step2=round(256/3);
range1=round(0:step1:255);
range2=round(0:step2:255);
a_sample_5quantization=uint8(zeros(size(a_sample)));
a_sample_3quantization=uint8(zeros(size(a_sample)));
for i = 1:length(range1)-1
a_sample_5quantization(a_sample>range1(i) &a_sample<= range1(i+1)) =...
    round((range1(i)+range1(i +1))/2) ;
end
for i = 1:length(range2)-1
a_sample_3quantization(a_sample>range2(i) &a_sample<= range2(i+1)) =...
    round((range2(i)+range2(i +1))/2) ;
end
figure
imshow('a')
title('original image')
figure
imshow(a_sample);
title('sampling')
figure
imshow(a_sample_5quantization);
title('sampling and 5 level quantization')
figure
imshow(a_sample_3quantization);
title('sampling and 3 level quantization')
end
```

## Problem 2

```
function output=AHE(im, win_size)
assert(size(im,3)==1);
output=uint8(zeros(size(im)));
im=padarray(im,[(win_size)/2,(win_size)/2], 'symmetric', 'both');
for x=(win_size)/2+1:size(im,1)-win_size/2
    for y=(win_size)/2+1:size(im,2)-win_size/2
        rank=0;
        contextual_region =im(x-win_size/2:x+win_size/2,y-
win_size/2:y+win_size/2);
        for i=1:size(contextual_region,1)
```

```

        for j=1:size(contextual_region,2)
            if im(x,y)>contextual_region(i,j)
                rank=rank+1;
                output(x,y)=rank*255/(win_size*win_size);
            end
        end

    end

end

end
figure;
imshow(output);
end

```

### Problem 3

```

test_image=zeros(11,11);
test_image(1,1)=1;
test_image(1,11)=1;
test_image(6,6)=1;
test_image(11,1)=1;
test_image(11,11)=1;
test_image(2,2)=1;
[H,theta,rho] = hough(test_image);
figure;
subplot(2,2,1);
imagesc(test_image);
title("test image")
subplot(2,2,[3,4]);
imagesc(H);
colorbar;
title("Hough Transform")
xlabel('\theta(degrees)');
ylabel('\rho');
axis on, axis normal;
[rho_index,theta_index]=find(H>2);
rho_thres=rho(rho_index);
theta_thres=theta(theta_index);
slope =-cosd(theta_thres)./sind(theta_thres);
b=rho_thres./sind(theta_thres);
subplot(2,2,2);
colormap gray;
imagesc(test_image);
hold on
for i=1:size(slope,2)
    x=0:0.1:11;
    y=slope(i)*x+b(i);
    plot(x,y,'r');
end

```

```

title("lines more than 2 votes");
clear;
I=imread('/Users/wugaotong/Downloads/WI19/ECE172/data3/Problem_3/lane.png');
figure;
imagesc(I);
colormap gray;
title("Original Image");
Iedge= edge(I,'sobel');
figure;
imagesc(Iedge);
colormap gray ;
title('Binary Edge Image');
[H,theta,rho]=hough(Iedge);
figure;
imagesc(H);
colormap gray ;
colorbar;
xlabel('\theta(degrees)');
ylabel('\rho');
title('Hough Transform');
[rho_index,theta_index]=find(H>0.7*max(H(:)));
rho_thres=rho(rho_index);
theta_thres=theta(theta_index);
slope =-cosd(theta_thres)./sind(theta_thres);
b=rho_thres./sind(theta_thres);
figure;
colormap gray;
imagesc(I);
hold on
for i=1:size(slope,2)
    if theta_thres(i)>=60 && theta_thres(i)<=70 || theta_thres(i)>=-40 &&
theta_thres(i)<=30
        x=0:0.1:1000;
        y=slope(i)*x+b(i);
        plot(x,y,"r");
    end
end
title('Priginal Image with lines');
figure;
colormap gray;
imagesc(I);
hold on
for i=1:size(slope,2)
    x=0:0.1:1000;
    y=slope(i)*x+b(i);
    plot(x,y,"r");
end
title('Priginal Image with lines');

```

