ECE172A HW3
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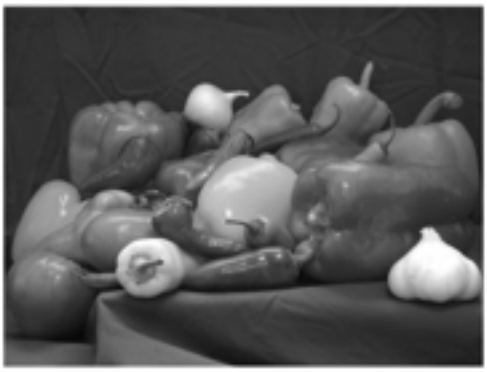
Problem1
original picture:



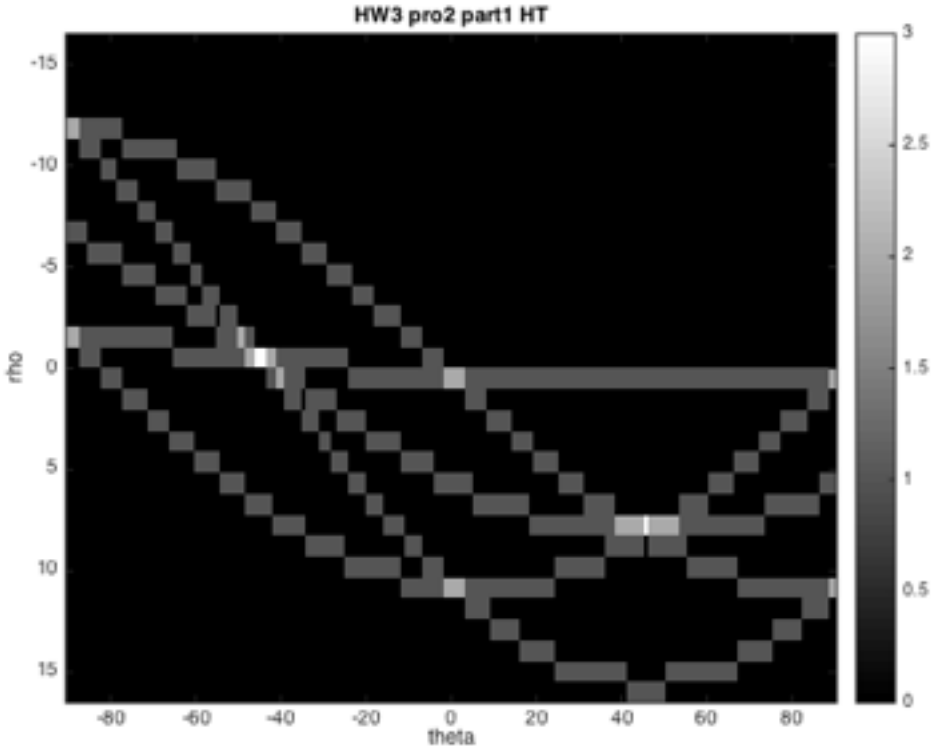
Sampled(left) and quantized(right) pictures:

How would the above function be of use in image compression?

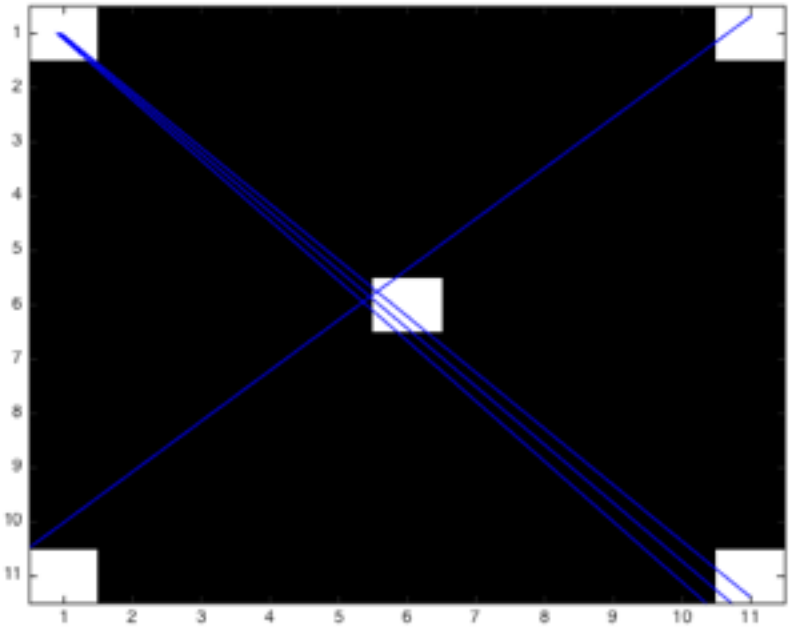
First, sampling means picking “sample” pixels from the original image, which will reduce the image matrix that we need to process.
Also, uniform quantization will map the 0-255 grayscale values into 5 sets, which will reduce the range of values for colors.
Therefore, there would be less data of the image for MATLAB to process and the image is more compressible.

Problem 2
(i),(ii). orignal:

Hough Transform (theta from -90 to 90):



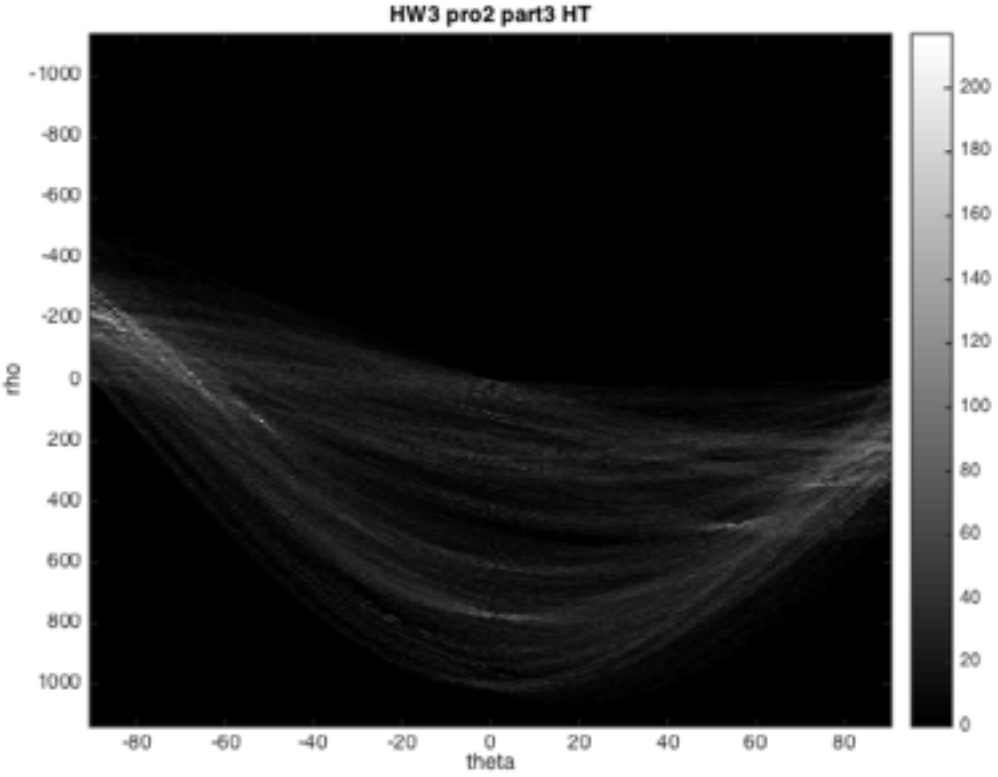
line on the original picture:



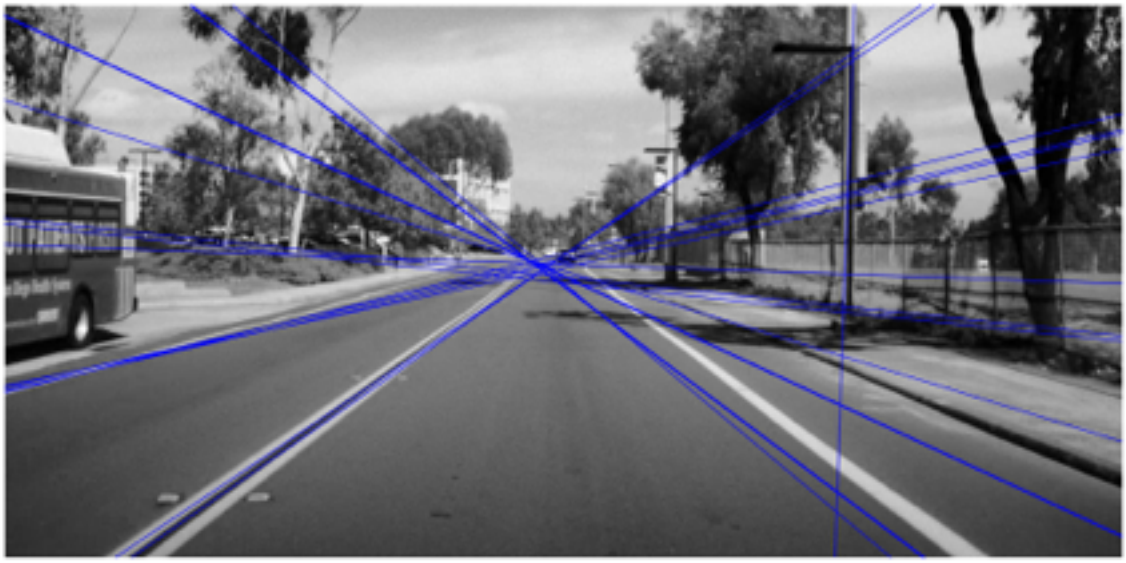
(iii).
original picture:

binary edge picture:

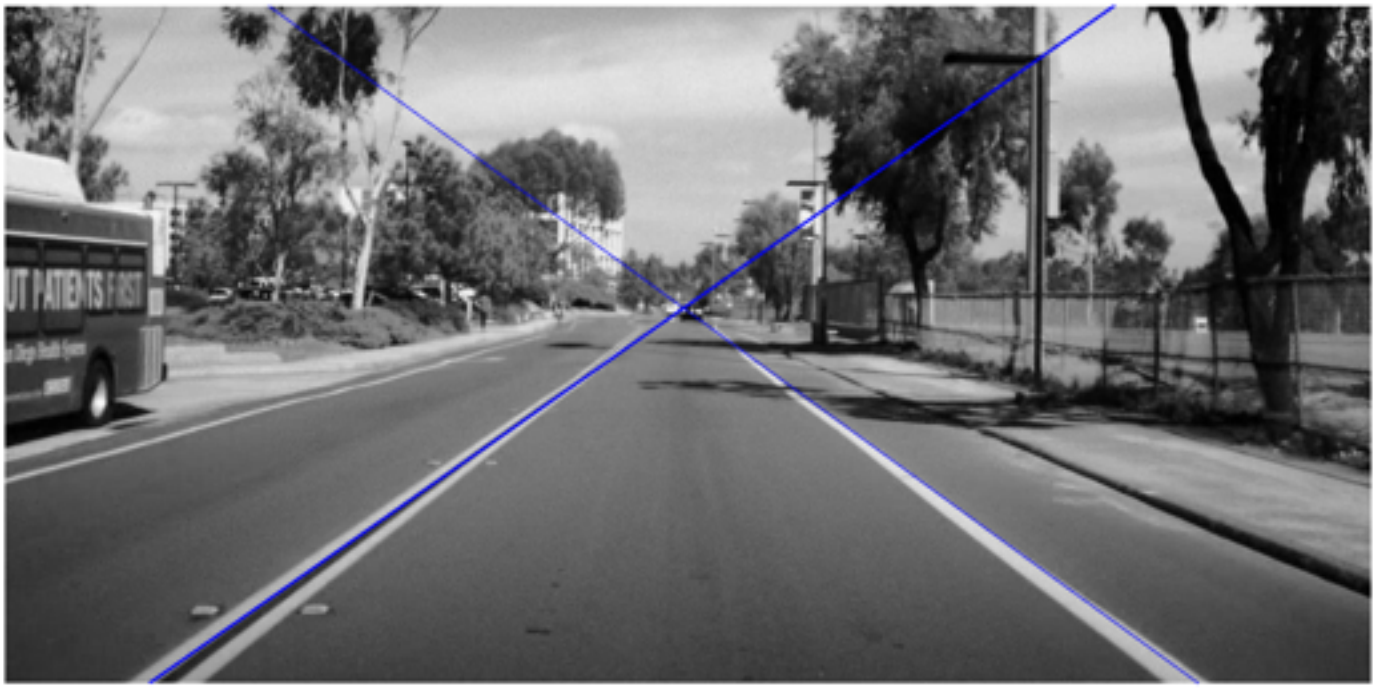
HT:



lines on original picture:



(iv). After trying different ranges of theta, I found that when theta are around -54 and -125, the lines will exactly follow the lane.



Appendix:

Problem1:

```
function [sampling,newImage] = HW3_pro1(filename) %the newImage is the sampled and
quantized image


pepper = imread(filename);
%subplot(1,3,1);
imshow(pepper); %this line will print the original image;
%since this function should only return sampled and quantized images, I did
%not add this image to the output

[H,W] = size(pepper);

sampling = pepper(1,1);
for i = 1:H/10
   for j = 1:W/10
       sampling(i,j)=pepper(i*10,j*10);

   end

end
 subplot(1,2,1);
imshow(sampling);
k=0;
newImage = uint8(zeros(size(sampling)));
[sampleH,sampleW]=size(sampling);
while(k<255)

  for m = 1:sampleH
   for n = 1:sampleW
      if(k<sampling(m,n)&&sampling(m,n)<=k+51)
          newImage(m,n)=round((k+(k+51))/2);
      end
    end
   end
   k=k+51;
end
```

```
subplot(1,2,2);
imshow(newImage);
```

Problem 2
(ii).
the original 11*11 image:

```
tryimage = zeros(11);
tryimage(1,1)=1;
tryimage(11,11)=1;
tryimage(1,11)=1;
tryimage(11,1)=1;
tryimage(6,6)=1;
imagesc(tryimage);hold on
colormap gray;
```

HT:

```
% "tryimage" is the 11*11 image with five non-zero values
tryimage = zeros(11);
tryimage(1,1)=1;
tryimage(11,11)=1;
tryimage(1,11)=1;
tryimage(11,1)=1;
tryimage(6,6)=1;
% imagesc(tryimage);
% hold on
% colormap gray;
%these three lines above  will show original 11*11 image


[W,H]=size(tryimage);
[yEdge,xEdge]=find(tryimage);

A = zeros(round(2*sqrt(H^2+W^2))+1,180);


for i=1:numel(xEdge)
     theta=-90:89;
    rho = cos(theta*pi/180)*xEdge(i)+sin(theta*pi/180)*yEdge(i);


for j=1:180
    a=round(sqrt(H^2+W^2));
    A(round(rho(j))+a,j)=A(round(rho(j))+a,j)+1;
```

```
    x = linspace(-90,90,9);
    y = linspace(-a,a,5);
    imagesc(x,y,A)
    colormap gray;hold on

end

[maxRho,maxtheta] = find(A>2);

end
title('HW3 pro2 part1 HT');
colorbar
xlabel('theta');
ylabel('rho');
```

(the following part shows how lines on the original picture)

```
line=zeros(4,2);
for k=1:numel(maxRho)
    x1 = ((maxRho(k)-a)-1*sin((maxtheta(k)-89)*pi/180))/cos((maxtheta(k)-89)*pi/180);
    x2 = ((maxRho(k)-a)-H*sin((maxtheta(k)-89)*pi/180))/cos((maxtheta(k)-89)*pi/180);
    y1 = ((maxRho(k)-a)-1*cos((maxtheta(k)-89)*pi/180))/sin((maxtheta(k)-89)*pi/180);
    y2 = ((maxRho(k)-a)-W*cos((maxtheta(k)-89)*pi/180))/sin((maxtheta(k)-89)*pi/180);
    line(1,:)=[x1,1];
    line(3,:)=[x2,H];
    line(2,:)=[1,y1];
    line(4,:)=[W,y2];
    plot(line(:,1),line(:,2),'b');

end
```

(iii)
show the original image:

```
lane = imread('lane.png');
lane = rgb2gray(lane);
imshow(lane);  hold on
```

show the binary edge image:

```
lane = imread('lane.png');
lane = rgb2gray(lane);
 E= edge(lane,'sobel');
 imshow(E);hold on
```

lines on the original image:

```
%Ruomei Ye A99074215
%plot the lines on the original image


lane = imread('lane.png');
lane = rgb2gray(lane);


 E= edge(lane,'sobel');
% imshow(E);hold on
% this line is used to show the binary edge image of 'lane'

[H,W]=size(E);
[yEdge,xEdge]=find(E);
imshow(lane);  hold on  %this line will plot the original picture
A = zeros(round(2*round(sqrt(H^2+W^2))),180);


theta=-90:89;
for i=1:numel(xEdge)
    rho = cos(theta*pi/180)*xEdge(i)+sin(theta*pi/180)*yEdge(i);


for j=1:180
    a=round(sqrt(H^2+W^2));
    A(round(rho(j))+a,j)=A(round(rho(j))+a,j)+1;

%     imagesc(A)
%     colormap gray;
end

[maxRho,maxtheta] = find(A>0.75*(max(A(:))));

end

line=zeros(4,2);
for k=1:numel(maxRho)
    x1 = ((maxRho(k)-a)-1*sin((maxtheta(k)-89)*pi/180))/cos((maxtheta(k)-89)*pi/180);
    x2 = ((maxRho(k)-a)-H*sin((maxtheta(k)-89)*pi/180))/cos((maxtheta(k)-89)*pi/180);
    y1 = ((maxRho(k)-a)-1*cos((maxtheta(k)-89)*pi/180))/sin((maxtheta(k)-89)*pi/180);
    y2 = ((maxRho(k)-a)-W*cos((maxtheta(k)-89)*pi/180))/sin((maxtheta(k)-89)*pi/180);
    line(1,:)=[x1,1];
    line(3,:)=[x2,H];
    line(2,:)=[1,y1];
    line(4,:)=[W,y2];
    plot(line(:,1),line(:,2),'b');
```

```
end
```

HT:

```
%Ruomei Ye A99074215
%plot the lines on the original image


lane = imread('lane.png');
lane = rgb2gray(lane);


 E= edge(lane,'sobel');
% imshow(E);hold on
% this line is used to show the binary edge image of 'lane'

[H,W]=size(E);
[yEdge,xEdge]=find(E);
% imshow(lane);  hold on  %this line will plot the original picture
A = zeros(round(2*round(sqrt(H^2+W^2))),180);


theta=-90:89;
for i=1:numel(xEdge)
    rho = cos(theta*pi/180)*xEdge(i)+sin(theta*pi/180)*yEdge(i);


for j=1:180
    a=round(sqrt(H^2+W^2));
    A(round(rho(j))+a,j)=A(round(rho(j))+a,j)+1;


end

% [maxRho,maxtheta] = find(A>0.75*(max(A(:))));

end
   x = linspace(-90,90,9);
    y = linspace(-a,a,100);
    imagesc(x,y,A)
    colormap gray;
title('HW3 pro2 part3 HT');
colorbar
xlabel('theta');
ylabel('rho');
```

(iv).

```
%Ruomei Ye A99074215

lane = imread('lane.png');
 lane = rgb2gray(lane);


 E= edge(lane,'sobel');

[H,W]=size(E);
[yEdge,xEdge]=find(E);
 imshow(lane); hold on
A = zeros(round(2*round(sqrt(H^2+W^2))),30);


theta=-54;  %detect the right side of the lane "\"
%theta=-54:-40;
for i=1:numel(xEdge)
    rho = cos(theta*pi/180)*xEdge(i)+sin(theta*pi/180)*yEdge(i);


for j=1:1
    a=round(sqrt(H^2+W^2));
    A(round(rho(j))+a,j)=A(round(rho(j))+a,j)+1;

%     imagesc(A)
%     colormap gray;
end

[maxRho,maxtheta] = find(A>0.75*(max(A(:))));

end

line=zeros(4,2);
for k=1:numel(maxRho)
    th = (maxtheta(k)-55)*pi/180;
    x1 = ((maxRho(k)-a)-1*sin(th))/cos(th);
    x2 = ((maxRho(k)-a)-H*sin(th))/cos(th);
    y1 = ((maxRho(k)-a)-1*cos(th))/sin(th);
    y2 = ((maxRho(k)-a)-W*cos(th))/sin(th);


      line(1,:)=[x1,1];

      line(3,:)=[x2,H];
```

```
      line(2,:)=[1,y1];

      line(4,:)=[W,y2];

     plot(line(:,1),line(:,2),'b');hold on


end



theta2=-125;  % find the left side of lane "/"
for i=1:numel(xEdge)
    rho = cos(theta2*pi/180)*xEdge(i)+sin(theta2*pi/180)*yEdge(i);


for j=1:1;
    a=round(sqrt(H^2+W^2));
    A(round(rho(j))+a,j)=A(round(rho(j))+a,j)+1;


end

[maxRho,maxtheta] = find(A>0.75*(max(A(:))));

end

line=zeros(4,2);
for k=1:numel(maxRho)
    th = (maxtheta(k)-126)*pi/180;
    x1 = ((maxRho(k)-a)-1*sin(th))/cos(th);
    x2 = ((maxRho(k)-a)-H*sin(th))/cos(th);
    y1 = ((maxRho(k)-a)-1*cos(th))/sin(th);
    y2 = ((maxRho(k)-a)-W*cos(th))/sin(th);

      line(1,:)=[x1,1];

      line(3,:)=[x2,H];

      line(2,:)=[1,y1];

      line(4,:)=[W,y2];

     plot(line(:,1),line(:,2),'b'); hold on


end
```