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PS5 Programming Report

Source code:

Part A

```
%read in data and preprocess
source=imread('Bayesnoise_textbook.png');
%extract
extract_s=source(:,:,1);
extract_s=int8(extract_s);
%get greyscale for source
[r,c]=size(extract_s);
for i=1:r
    for j=1:c
        if extract_s(i,j)<119
            extract_s(i,j)=-1;
        else
            extract_s(i,j)=1;
        end
    end
end
gc=extract_s;
or=gc;
s=size(gc);
n=7;
yd=s(1);
xd=s(2);
h=-0.01;
fp=1;
c=0;
b=5;
while (fp)
    c=c+1;
    fp=0;
    for i=2:xd-1
        for j=2:yd-1
            fpe=(-gc(j,i))*(h-(b*(gc(j,i+1)+gc(j,i-
1)+gc(j+1,i)+gc(j-1,i)))-(n*gc(j,i)));
            nfpe=gc(j,i)*(h-(b*(gc(j,i+1)+gc(j,i-
1)+gc(j+1,i)+gc(j-1,i)))-(n*gc(j,i)));
            if nfpe>fpe
                gc(j,i)=-gc(j,i);
                fp=1;
            end
        end
    end
end
%correction read in and process
correction=imread('Bayes_textbook.png');
corr_coe=int8(correction(:,:,1));
%get greyscale for correction
[r,c]=size(corr_coe);
for i=1:r
    for j=1:c
        if corr_coe(i,j)<119
            corr_coe(i,j)=-1;
        else
            corr_coe(i,j)=1;
        end
    end
end
corr_b=corr_coe;
[r,c]=size(corr_b);
sum=r*c;
comparison=0;
for i=1:r
    for j=1:c
        if corr_b(i,j)==gc(i,j)
            comparison=comparison+1;
        end
    end
end
%report recovery rate
recovery=(comparison/sum)*100;
fprintf('The recovery is %.4f \n', recovery)
%get image
imshow(uint8(gc)*255);
figure();
imshow(uint8(or)*255);
```

Part B

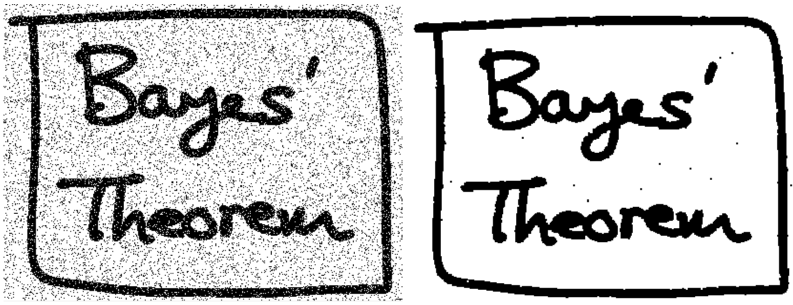
```
%read in data and preprocess
source=imread('Lenanoise.png');
source=int16(source);
src=source;
s=size(source);
yd=s(1);
xd=s(2);
form=@(x,N)(mod(x-1,N)+1);
d_lam=1;
```

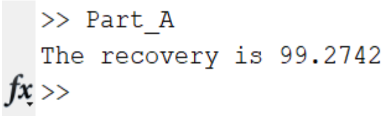
```
lam_s=1;
check=true;
procedure=1;
while(check)
    check=false;
    for i=1:xd
        for j=1:yd
            %1st case
            minu=(-d_lam*abs(max(0,source(j,i)-procedure)-
src(j,i)))-(lam_s*(abs(max(0,source(j,i)-procedure)-
source(form(j-1,yd),i))+abs(max(0,source(j,i)-procedure)-
source(j,form(i+1,xd)))+abs(max(0,source(j,i)-procedure)-
source(j,form(i-1,xd)))+abs(max(0,source(j,i)-procedure)-
source(form(j+1,yd),i))));
            %2nd case
            plus=(-d_lam*abs(min(255,source(j,i)+procedure)-
src(j,i)))-(lam_s*(abs(min(255,source(j,i)+procedure)-
source(form(j-1,yd),i))+abs(min(255,source(j,i)+procedure)-
source(j,form(i+1,xd)))+abs(min(255,source(j,i)+procedure)-
source(form(j+1,yd),i))+abs(min(255,source(j,i)+procedure)-
source(j,form(i-1,xd)))));
            %3rd case
            same=(-d_lam*abs(source(j,i)-src(j,i)))-
(lam_s*(abs(source(j,i)-source(form(j-1,yd),i))+abs(source(j,i)-
source(j,form(i+1,xd)))+abs(source(j,i)-
source(form(j+1,yd),i))+abs(source(j,i)-source(j,form(i-
1,xd)))));
            %variable and compare
            xi=source(j,i);
            if plus>same
                source(j,i)=min(255,xi+procedure);
                check=true;
            end
            if same<minu
                source(j,i)=max(0,xi-procedure);
                check=true;
            end
        end
    end

end
recover=imread('Lena.png');
%get image
imshow(uint8(source));
figure();
imshow(uint8(src));
```

Report:

Part A - the optimum values I have for h, β, η are 0.01, 5 and 7. The accuracy I get with these values is 99.2742%.





```
>> Part_A
The recovery is 99.2742
>>
```

Please run my part A to see the exact image outcomes and accuracy above.

The clean image is gotten from the noisy image. The image cannot be recovered exactly, but we have a pretty good result. Markov Random Frields are used.

Noise y_i is in {-1,1} orginal x_i is in {-1,1}

I write the Energy function:

E(x,y)=h$h\sum_i x_i - B\sum_{\{i,j\}} x_i x_j - n\sum_i x_i y_i$

and correction in my Part A so that they can be used directly in the file. Then I implement Coordinate-descent algorithm.

{x_i} (x_i=y_i)

For x_i if -x →E(x,y) decreases x=-x

I started with values 0.03, 15, 8. The accuracy started from around 94, then I adjust these values step by step and finally get to 99.2742% accuracy.

Part B – We still cannot recover Lena exactly. This part is harder than recovering the image in Part A.

Graph Model:

P(X|Y, lamda(d), lamda(s))=$\frac{1}{z}\exp\{lamda(d)\ \sum_i p(x_i - y_i) - lamda(s) \sum_{i,j\ is\ in\ \varepsilon} p(x_i - x_j)\}$

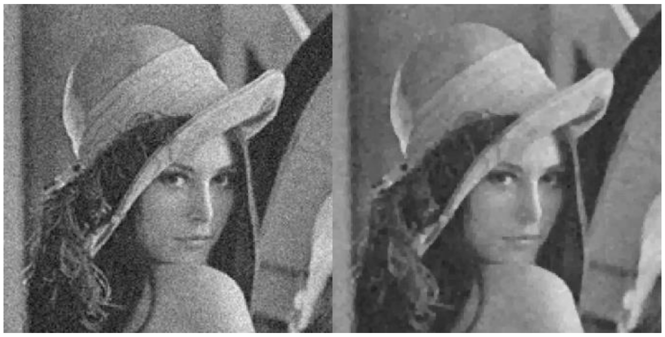
X=output clean, Y=input noise, 2 lambdas are weights

L_1 norm:P(z)=|z|, L_2norm P(z)=$|z|^2$

Max-sum alg→MAP→X

Argmax$_{\text{lamda(d), lamda(s)}}$p(X|Y,lamda(d),lamda(s))

Please see images below:



You can run my code to see the results above. The model is the extension of what we talked about.

p(X|Y, ,λ_d,λ_d)=$\frac{1}{Z}\exp\{-\lambda_d \sum_i p(x_i - y_i) - \lambda_s \sum_{(i,j) is\ in\ \varepsilon} p(x_i - x_j)\}$

X is to restore, Y is noisy Lena. Max sum is used to get MAP solution. I started from small values from 32 to 256. Then get multiple restore results. Then I chose the best case to report. Run my code to see the result.