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Question 1 (Assignment 3)

```
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clc
clear all
close all
```

Part (A)

```
% Reading given image
rng(0);
img = imread("barbara256.png");
img=double(img);
[d1,d2] = size(img);

%Adding noise to the original image
img_n=img+sqrt(3)*randn(d1,d2);
% calculating matrices
phi = eye(64);
psi = kron(dctmtx(8)', dctmtx(8)');
A = phi*psi;
%setting parameters
img_rt = zeros(d1, d2, 'double');
img_ag = zeros(d1, d2, 'double');
alpha = floor(eigs(A'*A,1)) + 1;
lambda = 1;
iterations = 150;
% Iterate over all 8*8 patches
for i=1:d1-7
    for j=1:d2-7
        y = phi * reshape(img_n(i:i+7,j:j+7), [8*8 1]);
        t = zeros(size(A, 2), 1); %theta value
        limit = lambda/(2*alpha); %threshold limit
        %ISTA algorithm
        for k=1:iterations
            temp1=t + (A'*(y - A*t))/alpha;
            t=sign(temp1).*(max(0, abs(temp1)-limit));
        end
        img_rt(i:i+7,j:j+7) = img_rt(i:i+7,j:j+7) + reshape(psi * t, [8 8]);
        img_ag(i:i+7,j:j+7) = img_ag(i:i+7,j:j+7) + ones(8,8);
    end
end

% -----Displaying results-----

img_rt(:, :) = img_rt(:, :)./img_ag(:, :);
```

```

img_rt(img_rt < 0) = 0;
img_rt(img_rt > 255) = 255;

final_rmse=norm(img_rt(:,:) - img(:,:), 'fro')/norm(img(:,:), 'fro');
fprintf('RMSE (Part A) : %f\n', final_rmse );

figure();
subplot(1,3,1)
imshow(cast(img, 'uint8'));
title("Original Image")
subplot(1,3,2)
imshow(cast(img_n, 'uint8'));
title("Noisy Image")
subplot(1,3,3)
imshow(cast(img_rt(:,:), 'uint8'));
title("Reconstructed Image")

```

RMSE (Part A) : 0.011715



Part (B)

```

clear all
rng(0);
%
% Reading given image
img = imread("barbara256.png");
img=double(img);
[d1,d2] = size(img);
%
% % calculating matrices

```

```

phi = randn(32,64);
psi = kron(dctmtx(8)', dctmtx(8)');
A = phi*psi;
%setting parameters
img_rt = zeros(d1, d2, 'double');
img_ag = zeros(d1, d2, 'double');
alpha = floor(eigs(A'*A,1)) + 1;
lambda = 1;
iterations = 150;

% Iterate over all 8*8 patches
for i=1:d1-7
    for j=1:d2-7
        y = phi * reshape(img(i:i+7,j:j+7), [8*8 1]);
        t = zeros(size(A, 2), 1); %theta value
        limit = lambda/(2*alpha); %threshold limit
        %ISTA algorithm
        for k=1:iterations
            temp1=t + (A'*(y - A*t))/alpha;
            t=sign(temp1).*(max(0, abs(temp1)-limit));
        end
        img_rt(i:i+7,j:j+7) = img_rt(i:i+7,j:j+7) + reshape(psi * t, [8 8]);
        img_ag(i:i+7,j:j+7) = img_ag(i:i+7,j:j+7) + ones(8,8);
    end
end

% -----Displaying results-----
img_rt(:, :) = 2*img_rt(:, :)./img_ag(:, :);
img_rt(img_rt < 0) = 0;
img_rt(img_rt > 255) = 255;

final_rmse2=norm(img_rt(:, :) - img(:, :), 'fro')/norm(img(:, :), 'fro');
fprintf('RMSE (Part B) : %f\n', final_rmse2 );
figure();
subplot(1,2,1)
imshow(cast(img, 'uint8'));
title("Original Image")
subplot(1,2,2)
imshow(cast(img_rt(:, :), 'uint8'));
title("Reconstructed Image")

```

RMSE (Part B) : 0.061917

Original Image



Reconstructed Image



End (Question 1)
