This is a summary and explanation of the matlab code in my project.

```
fileFolder = 'C:\Users\LHUANG37\Documents\MATLAB\RegionGrowingProject\'

dirOutput = dir(fullfile(fileFolder,'R_*.dcm'));

fileNames = {dirOutput.name}'

for p=1:12

  filename = fileNames{p};

  I = dicomread(filename);

  figure, imshow(I,[]);

end

%the images shows 'R_036_33.dcm', 'R_043_16.dcm', 'R_020_29.dcm' have clear tumor that could be segmentated and display. I am going to explore on one image 'R_036_33.dcm'.

%S=dicomread('R_043_16.dcm');


S=dicomread('R_036_33.dcm');

imshow(S,[]);

I = im2double(S);% FOR MEAN CALCULATION LATER


%Part 1:
% user-choose based on knowledge
% smooth and contrast the image

new_I=medfilt2(I,[7,7]);
subplot(1,2,1); imshow(I,[]);title('original image');
subplot(1,2,2); imshow(new_I,[]);title('smoothed image');

% FOR TUMOR SEGMENTATION
imshow(I,[]);

uiwait(msgbox('Locate the point'));

[x0,y0] = ginput(1);

hold on; % Prevent image from being blown away.

plot(x0,y0,'r+', 'MarkerSize', 50);


x=round(y0);%256
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```
y=round(x0);%148


figure, imshow(I+regiongrowing(new_I, x, y , 0.2)); # would give the tumor spot. we are applying histogram equalization here as the difference is too small to be captured by the region growing if we do not use it.

compare with: figure, imshow(I+regiongrowing(I, x, y , 0.008)); % have more details


A= I+regiongrowing(new_I, x, y , 0.008);

figure, imshow(A);

A_edge= edge(A,'sobel');

figure, imshow(A_edge)

% change color of edge to red

bin= A_edge;

R   = 1; G   = 0; B   = 0;

A_edge_colored = cat(3, bin * R, bin * G, bin * B);

figure, imshow(A_edge_colored);


%FOR LUNG SEGMENTATION

%LEFT LUNG

imshow(I,[]);

uiwait(msgbox('Locate the point'));

[x0,y0] = ginput(1);

hold on; % Prevent image from being blown away.

plot(x0,y0,'r+', 'MarkerSize', 50);


x=round(y0); %296

y=round(x0);%152

B1= I+regiongrowing(new_I, x, y , 0.2);

figure, imshow(B1);

% as B1 has many holes, need to fill it before get edges
```

```
SE = strel('disk',5); %if we use 10 would eliminate the holes, but would also distort the shape

afterOpening = imopen(B1,SE);
figure, imshow(afterOpening,[]);
B1_edge= edge(afterOpening,'sobel');

figure, imshow(B1_edge)

bin= B1_edge;

R   = 0; G   = 1; B   = 0;

B1_edge_colored = cat(3, bin * R, bin * G, bin * B);

figure, imshow(B1_edge_colored);



for I = 1:512:

    j=1:512:

      if A(I,j)==1 & B(I,J)==1:



%RIGHT LUNG

imshow(I,[]);

uiwait(msgbox('Locate the point'));

[x0,y0] = ginput(1);

hold on; % Prevent image from being blown away.

plot(x0,y0,'r+', 'MarkerSize', 50);


x=round(y0);%327

y=round(x0);%375


B2= I+regiongrowing(new_I, x, y , 0.008);

figure, imshow(B2);

B2_edge= edge(B2,'sobel');

figure, imshow(B2_edge)
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```
bin= B2_edge;
R   = 0; G   = 0; B   = 1;
B2_edge_colored = cat(3, bin * R, bin * G, bin * B);
figure, imshow(B2_edge_colored);


% FOR BODY SEGMENTATION
imshow(I,[]);
uiwait(msgbox('Locate the point'));
[x0,y0] = ginput(1);
hold on; % Prevent image from being blown away.
plot(x0,y0,'r+', 'MarkerSize', 50);

x=round(y0);%271
y=round(x0);%265

C= I+regiongrowing(new_I, x, y , 0.008);
figure, imshow(C);
C_edge= edge(C,'sobel');
figure, imshow(C_edge)

figure, imshow(A_edge_colored+B1_edge_colored +B2_edge_colored +C_edge);
E = imread('peppercorn_hill.png'); %ORIGINAL IMAGE
imshow(E, 'InitialMag', 'fit')
I = imread('peppercorn_hill_influence_map.png');%EDGE
imshow(I, 'InitialMag', 'fit')
imshow(E, 'InitialMag', 'fit')
% Make a truecolor all-green image.
green = cat(3, zeros(size(B1_edge)), ones(size(B1_edge)), zeros(size(B1_edge)));
```

```
green = cat(3, zeros(size(B1)), ones(size(B1)), zeros(size(B1)));
hold on
h = imshow(green);
hold off
% Use our influence map image as the AlphaData for the solid green image.
set(h, 'AlphaData', A_edge)

% plot the four marked seed together:
% tumor(256,148), left lung(296,152), right lung(327,375), body(271,265)

imshow(I,[]);
hold on; % Prevent image from being blown away.
plot(148, 256,'r+', 'MarkerSize', 50);
plot(152, 296,'r+', 'MarkerSize', 50);
plot(375, 327,'r+', 'MarkerSize', 50);
plot(265, 271,'r+', 'MarkerSize', 50);
```

%Part 2: histogram

```
S=dicomread('R_036_33.dcm');
imshow(S,[]);
I = im2double(S);% FOR MEAN CALCULATION LATER
new_I=medfilt2(I,[7,7]);
imhist(new_I);xlim([0 0.03]);

% segment the image by thresholding based on the histogram

B3=255*((new_I>0.01)&(new_I<=0.02)); imshow(B3);

% get centroid of a segmented area
Ilabel =bwlabel(B3,4);
stat = regionprops(Ilabel,'centroid');
```

```
imshow(B3); hold on;
for x = 1: numel(stat)
   plot(stat(x).Centroid(1),stat(x).Centroid(2),'ro');text(stat(x).Centroid(1),stat(x).Centroid(2), int2str(x));
end
```

```
x=round(stat(15).Centroid(1)); y=round(stat(15).Centroid(2)); % tumor
x=round(stat(4).Centroid(1)); y=round(stat(4).Centroid(2)); % body


% region growing on tumor
x=round(stat(15).Centroid(1)); y=round(stat(15).Centroid(2)); % tumor
A= I+regiongrowing(new_I, y ,x, 0.008);
figure, imshow(A);
A_edge= edge(A,'sobel');
figure, imshow(A_edge)
% change color of edge to red
bin= A_edge;
R   = 1; G   = 0; B   = 0;
A_edge_colored = cat(3, bin * R, bin * G, bin * B);
figure, imshow(A_edge_colored);

%region growing on body
x=round(stat(4).Centroid(1)); y=round(stat(4).Centroid(2)); % body
C= I+regiongrowing(new_I, y ,x, 0.008);
```

```
figure, imshow(C);

C_edge= edge(C,'sobel');

figure, imshow(C_edge)


% NOW FOR lungs
B3=255*((new_I>=0)&(new_I<0.01)); imshow(B3);
% get centroid of a segmented area
Ilabel =bwlabel(B3,4);

stat = regionprops(Ilabel,'centroid');

imshow(B3); hold on;

for x = 1: numel(stat)

   plot(stat(x).Centroid(1),stat(x).Centroid(2),'ro');text(stat(x).Centroid(1),stat(x).Centroid(2), int2str(x));

end


% FOR LEFT LUNG
x=round(stat(2).Centroid(1)); y=round(stat(2).Centroid(2)); % LEFT LUNG

B1= I+regiongrowing(new_I, y ,x, 0.008);

figure, imshow(B1);

% as B1 has many holes, need to fill it before get edges

SE = strel('disk',5); %if we use 10 would eliminate the holes, but would also distort the shape

afterOpening = imopen(B1,SE);
figure, imshow(afterOpening,[]);
B1_edge= edge(afterOpening,'sobel');

figure, imshow(B1_edge)

bin= B1_edge;

R   = 0; G   = 1; B   = 0;

B1_edge_colored = cat(3, bin * R, bin * G, bin * B);

figure, imshow(B1_edge_colored);



% FOR RIGHT LUNG
x=round(stat(1).Centroid(1)); y=round(stat(1).Centroid(2)); % RIGHT LUNG
```

```
B2= I+regiongrowing(new_I, y ,x, 0.008);

figure, imshow(B2);

SE = strel('disk',5); %if we use 10 would eliminate the holes, but would also distort the shape

afterOpening = imopen(B2,SE);
figure, imshow(afterOpening,[]);
B2_edge= edge(afterOpening,'sobel');

figure, imshow(B2_edge)

bin= B2_edge;

R   = 0; G   = 0; B   = 1;

B2_edge_colored = cat(3, bin * R, bin * G, bin * B);

figure, imshow(B2_edge_colored);


% EDGE OF ALL SEGMENTATION

figure, imshow(A_edge_colored+B1_edge_colored +B2_edge_colored +C_edge);



%seed selected:

%tumor(148,258), body(262,268), left lung(157,306), right lung(362,365)

imshow(I,[]);

hold on; % Prevent image from being blown away.

plot(148, 258,'r+', 'MarkerSize', 50);

plot(262,268,'r+', 'MarkerSize', 50);

plot(157,306,'r+', 'MarkerSize', 50);

plot(362,365,'r+', 'MarkerSize', 50);



%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% clustering
% candidate seeds positions and its intensity values are extracted as
% features to represent the training set, which in this case the candidate
% seeds are the patterns of the training set, and apply it for clustering via
% machine learning technique; in this work K-mean clustering technique has
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```
% been used

[rows, columns] = size(new_I);
features = zeros(numel(new_I), 3);
counter = 1;
for x = 1 : columns
   for y = 1 : rows
      features(counter, :) = [new_I(y, x), x, y];
      counter  = counter  + 1;
   end
end
%xlswrite(filename, array2D);



mn = mean(features);
sd = std(features);
ynV = bsxfun(@minus, features,mn);
ynV = bsxfun(@rdivide,ynV,sd);
[idx,C] = kmeans(ynV,5);


for i = 1 : 5
      strcat('x',num2str(i)) = C(i,2)*sd(2)+mn(2);
      strcat('y',num2str(i)) = C(i,3)*sd(3)+mn(3);
      round(strcat('x',num2str(i)))
      round(strcat('y',num2str(i)))
end

(403,374)  (352,277), (109,354), (262,69), (136,262)
imshow(I,[]);

hold on; % Prevent image from being blown away.

plot(403,374,'r+', 'MarkerSize', 50);

plot(352,277,'r+', 'MarkerSize', 50);

plot(136,262,'r+', 'MarkerSize', 50);

plot(109,354,'r+', 'MarkerSize', 50);

plot(262,69,'r+', 'MarkerSize', 50);



C= I+regiongrowing(new_I, 374, 403,0.008);

figure, imshow(C);
```

```
C= I+regiongrowing(new_I,277, 352,0.008);

figure, imshow(C);

C= I+regiongrowing(new_I, 354, 109,0.008);

figure, imshow(C);

C= I+regiongrowing(new_I, 69, 262,0.008);

figure, imshow(C);

C= I+regiongrowing(new_I, 262, 136,0.008);

figure, imshow(C);


% NOW TRY K=6

 [idx,C] = kmeans(ynV,6);


for i = 1 : 6
      strcat('x',num2str(i)) = C(i,2)*sd(2)+mn(2);
      strcat('y',num2str(i)) = C(i,3)*sd(3)+mn(3);
      round(strcat('x',num2str(i)))
      round(strcat('y',num2str(i)))
end

(119,392) (352,276) (396,89) (397,396) (136,261) (117,101)

imshow(I,[]);

hold on; % Prevent image from being blown away.

plot(119,392,'r+', 'MarkerSize', 50);

plot(352,276,'r+', 'MarkerSize', 50);

plot(396,89,'r+', 'MarkerSize', 50);

plot(397,396,'r+', 'MarkerSize', 50);

plot(136,261,'r+', 'MarkerSize', 50);

plot(117,101,'r+', 'MarkerSize', 50);
```

```
% LEFT LUNG

B1= I+regiongrowing(new_I, 392, 119,0.008);

figure, imshow(B1);

SE = strel('disk',5); %if we use 10 would eliminate the holes, but would also distort the shape

afterOpening = imopen(B1,SE);
figure, imshow(afterOpening,[]);
B1_edge= edge(afterOpening,'sobel');

figure, imshow(B1_edge)

bin= B1_edge;

R   = 0; G   = 1; B   = 0;

B1_edge_colored = cat(3, bin * R, bin * G, bin * B);

figure, imshow(B1_edge_colored);


%RIGHT LUNG

B2= I+regiongrowing(new_I, 276,352,0.008);

figure, imshow(B2);

SE = strel('disk',5); %if we use 10 would eliminate the holes, but would also distort the shape

afterOpening = imopen(B2,SE);
figure, imshow(afterOpening,[]);
B2_edge= edge(afterOpening,'sobel');

figure, imshow(B2_edge)

bin= B2_edge;

R   = 0; G   = 0; B   = 1;

B2_edge_colored = cat(3, bin * R, bin * G, bin * B);

figure, imshow(B2_edge_colored);



%BODY

C= I+regiongrowing(new_I, 396,397,0.008);

figure, imshow(C);
```

```
C_edge= edge(C,'sobel');
figure, imshow(C_edge)

% TUMOR
A= I+regiongrowing(new_I, 261, 136,0.008);
figure, imshow(A);
A_edge= edge(A,'sobel');
figure, imshow(A_edge)
% change color of edge to red
bin= A_edge;
R   = 1; G   = 0; B   = 0;
A_edge_colored = cat(3, bin * R, bin * G, bin * B);
figure, imshow(A_edge_colored);

% EDGE OF ALL SEGMENTATION
figure, imshow(A_edge_colored+B1_edge_colored +B2_edge_colored +C_edge);
```