ASSIGNMENT 1

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1 Part 1

1.1 All dataFields in a DICOM file (one slice)

I choose Patient "0a0c32c9e08cc2ea76a71649de56be6d" and slice "0a67f9edb4915467ac16a565955898d3.dcm" to print its dataFields. The result is shown below.

```
-------------------- part 1-1 [ print dicom dataFields ] ----------------------
(0008, 0005) Specific Character Set             CS: 'ISO_IR 100'
(0008, 0016) SOP Class UID                      UI: CT Image Storage
(0008, 0018) SOP Instance UID                   UI: 1.2.840.113654.2.55.240087524148038410985780799448670801102
(0008, 0060) Modality                           CS: 'CT'
(0008, 103e) Series Description                 LO: 'Axial'
(0010, 0010) Patient's Name                     PN: '0a0c32c9e08cc2ea76a71649de56be6d'
(0010, 0020) Patient ID                         LO: '0a0c32c9e08cc2ea76a71649de56be6d'
(0010, 0030) Patient's Birth Date               DA: '19000101'
(0018, 0060) KVP                                DS: None
(0020, 000d) Study Instance UID                 UI: 2.25.60037070027156423276159501017920151735078954137544798194660
(0020, 000e) Series Instance UID                UI: 2.25.58703274222857573910779974742342423982066946347485459782406
(0020, 0011) Series Number                      IS: "1"
(0020, 0012) Acquisition Number                 IS: "1"
(0020, 0013) Instance Number                    IS: "45"
(0020, 0020) Patient Orientation                CS: ''
(0020, 0032) Image Position (Patient)           DS: [-160.100006, -142.500000, -93.410004]
(0020, 0037) Image Orientation (Patient)        DS: [1, 0, 0, 0, 1, 0]
(0020, 0052) Frame of Reference UID             UI: 2.25.108164247919496335220585254710613811374002699175185374855 73
(0020, 1040) Position Reference Indicator       LO: 'SN'
(0020, 1041) Slice Location                     DS: "-93.410004"
(0028, 0002) Samples per Pixel                  US: 1
(0028, 0004) Photometric Interpretation         CS: 'MONOCHROME2'
(0028, 0006) Planar Configuration               US: 0
(0028, 0010) Rows                               US: 512
(0028, 0011) Columns                            US: 512
(0028, 0030) Pixel Spacing                      DS: [0.664062, 0.664062]
(0028, 0100) Bits Allocated                     US: 16
(0028, 0101) Bits Stored                        US: 12
(0028, 0102) High Bit                           US: 11
(0028, 0103) Pixel Representation               US: 0
(0028, 0120) Pixel Padding Value                US: 0
(0028, 1050) Window Center                      DS: "40.0"
(0028, 1051) Window Width                       DS: "400.0"
(0028, 1052) Rescale Intercept                  DS: "-1024.0"
(0028, 1053) Rescale Slope                      DS: "1.0"
(0028, 1054) Rescale Type                       LO: 'HU'
(7fe0, 0010) Pixel Data                         OW: Array of 524288 elements
```

1.2 Data statistics (raw data and hounsfield units data)

I use the formula on ppt to convert raw data to hounsfield units, where because RescaleSlope is 1 and RescaleIntercept is -1024, basically the entire distribution only shifts to the left by 1024 units.

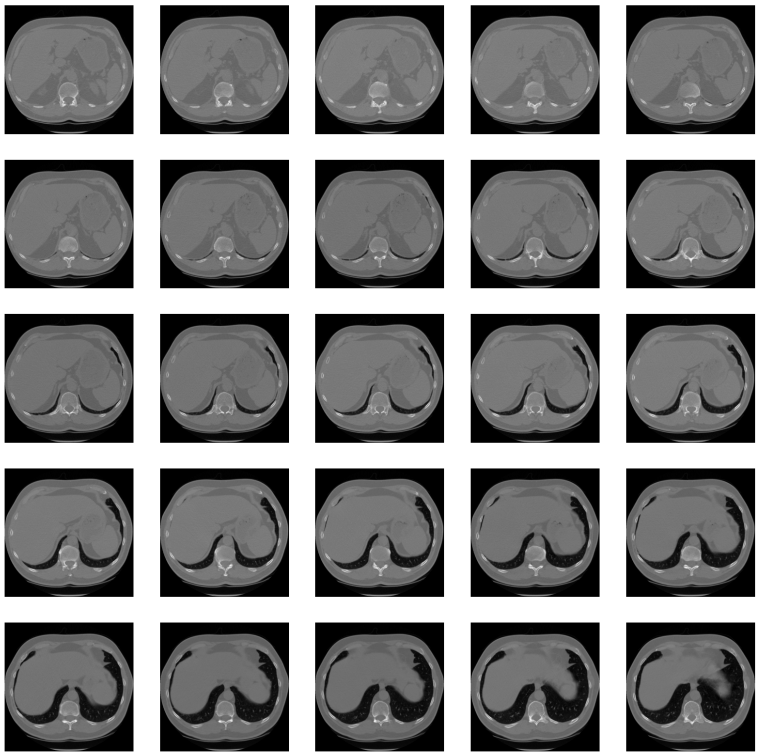
```
-------------------- part 1-2  [ print data statistics ] ----------------------
raw data             |   min: 0          max: 2362       mean: 471.449    std: 495.317
housefield data      |   min: -1024.0    max: 1338.0     mean: -552.551   std: 495.317
```

2 Part 2

2.1 Sort all the slices

I found that the ImagePositionPatient in the dataField has three dimensions, the first two dimensions are the same in each slice, and only the third dimension is different. Later, I found the third dimension represents the z-axis, so I sort slices by ImagePositionPatient[2] from small to large.

2.2 Display 25 slices (normalized Hounsfield Units))



3 Part 3

I tried two methods, "local mean" and "local median", to segment the lung. I applied "skimage.filters.threshold_local" to calculate the thresholds of each slice, and finally got a two-dimensional array. I averaged the two-dimensional array to get a float number, which is the red line drawn in the histogram of the figure 1-2 below.

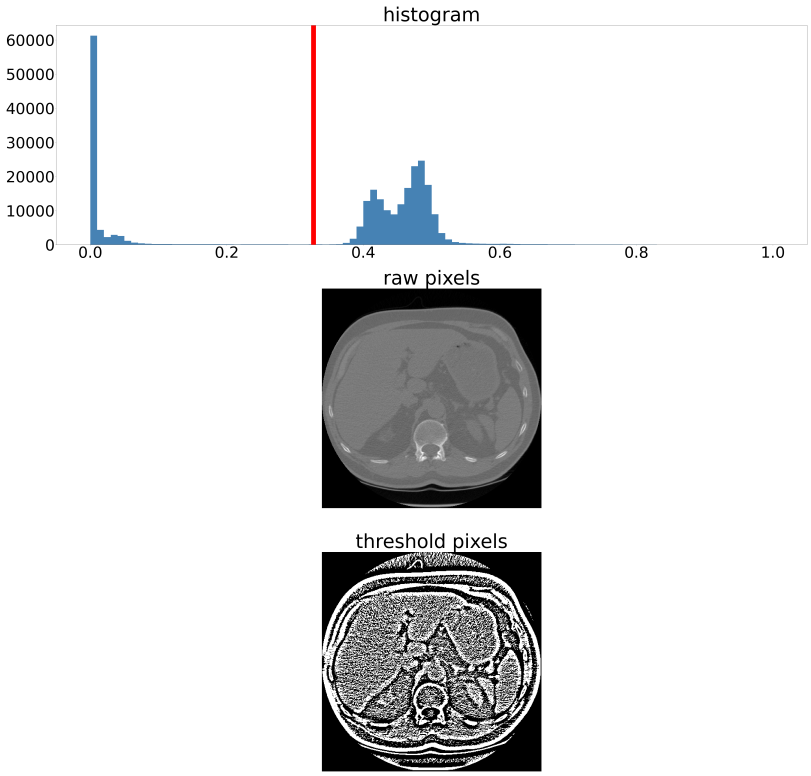


Figure 1: Histogram and threshold pixels results of the local mean algorithm.

4 Bonus

I applied "mpl_toolkits.mplot3d.art3d.Poly3DCollection" to plot 3d image. I compared the three differences between using mean, median segment algorithm and not using segment. The results are shown in figure 3-5. It is worth noting that each slice has a threshold return, and I finally averaged these thresholds as the overall threshold.

5 Question and Summary

This assignment made me to learn to process DICOM data, and exposed to different threshold algorithms, and how to draw 3D figures with "matplotlib". In addition, this is the first time I have written a Latex file using overleaf, which is quite new.

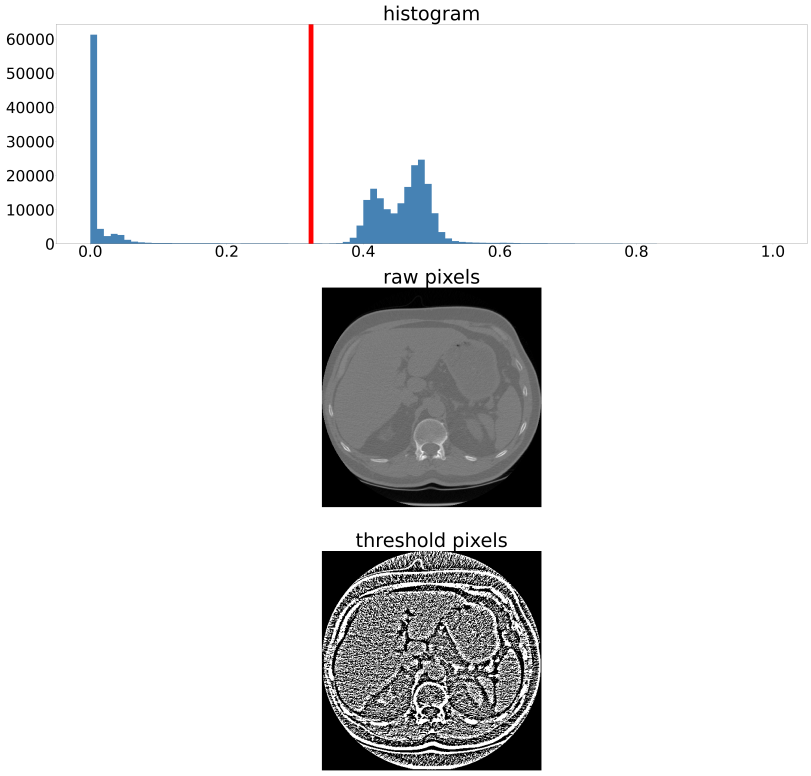


Figure 2: Histogram and threshold pixels results of the local median algorithm.

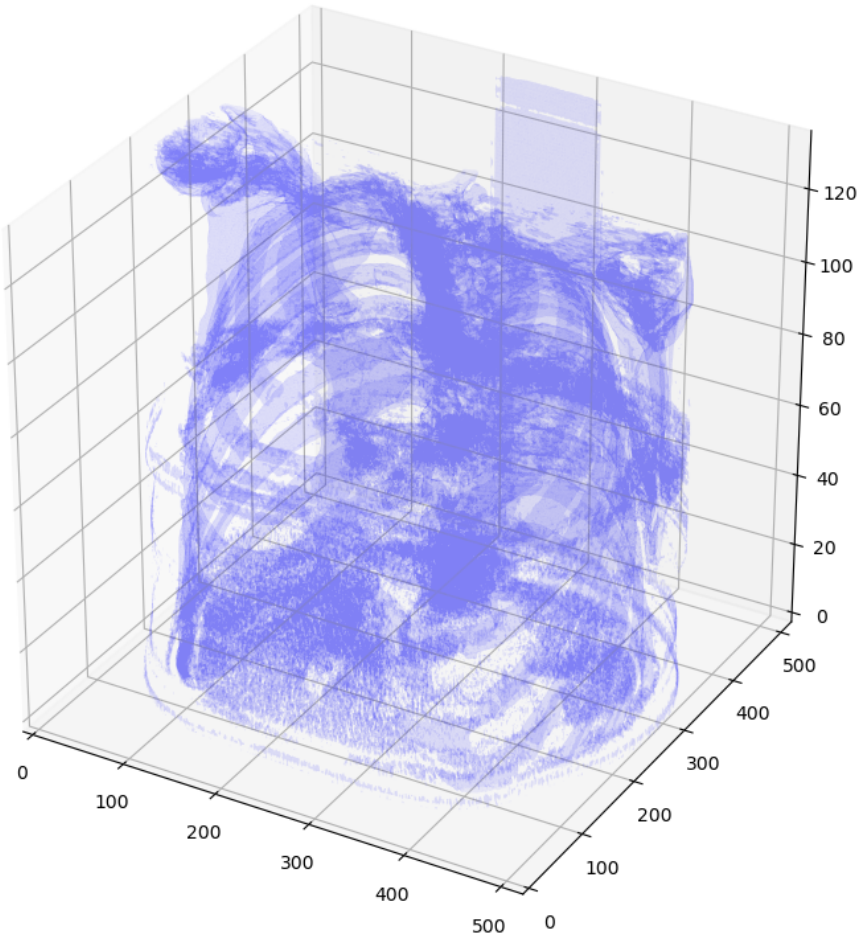


Figure 3: CT-chest-scan without slices segmentation.

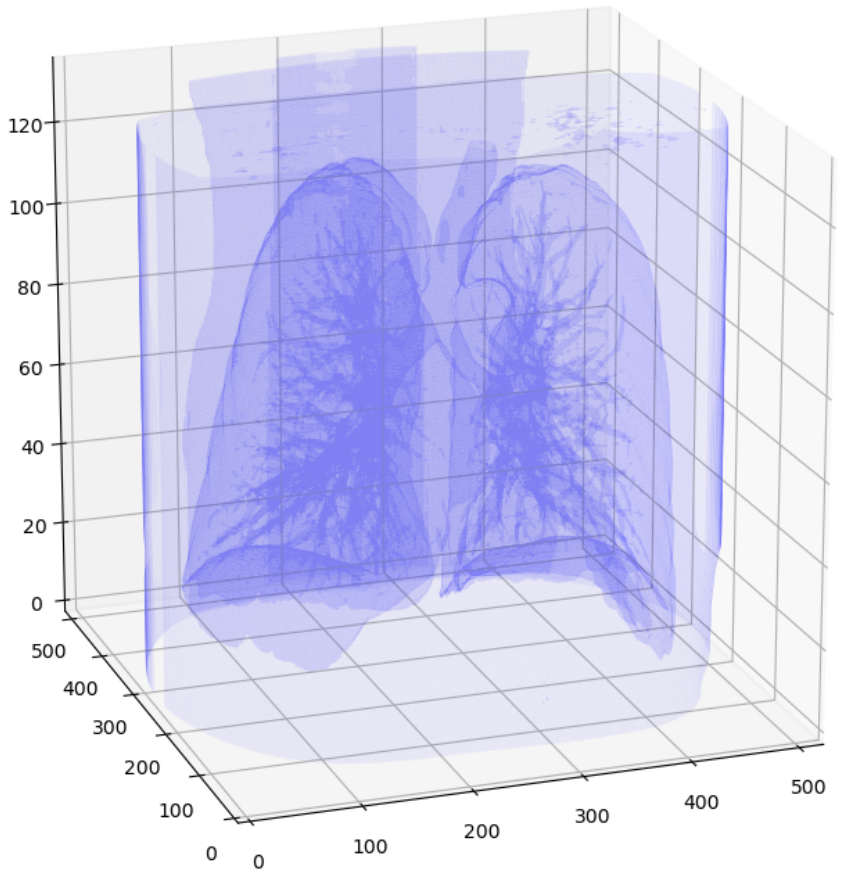


Figure 4: CT-chest-scan with slices segmented by local mean.

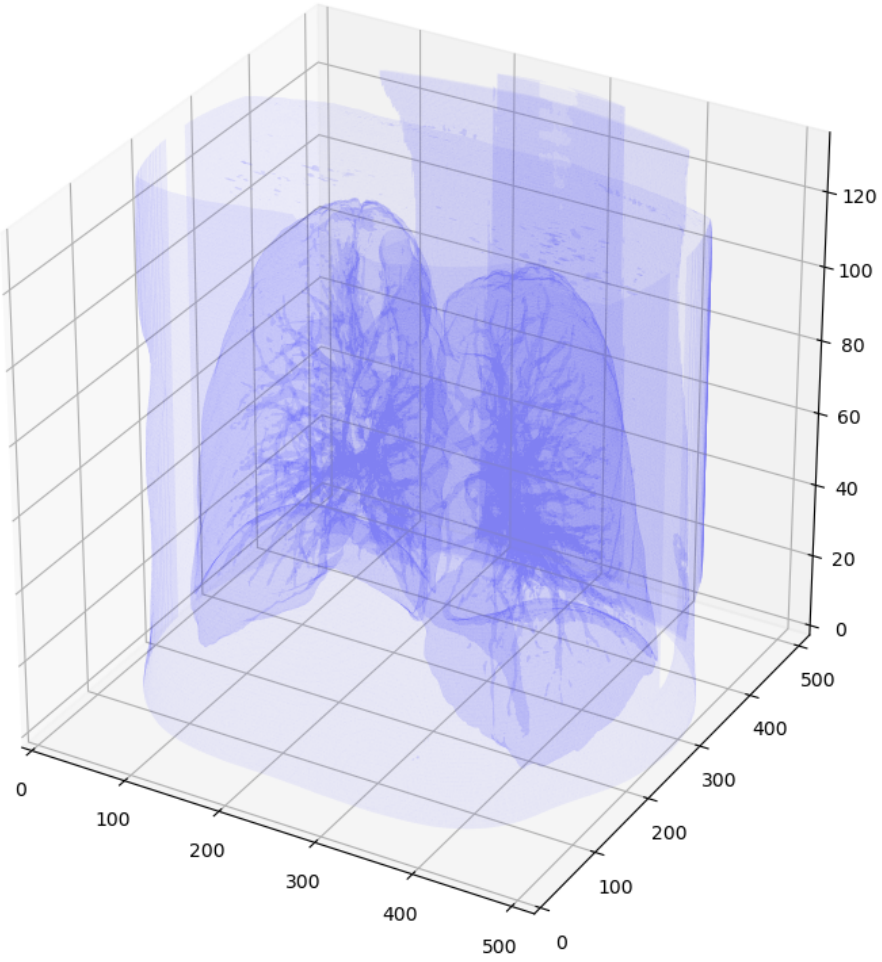


Figure 5: CT-chest-scan with slices segmented by local median.