# Assignment 4

1. Take a centered 128 x 128 sub-image of the Given CT Image Data set (Pick a section with lots of good features):
   a. Obtain 180 Projections.
   b. Take 1-D Fourier Transform of all Projections.
   c. Assemble them in the 2-D Frequency Domain.
   d. Compare Result Direct 2-D FT of the 128 x 128 Image.
   e. Perform Inverse 2-D FT & Compare Both Images

Comment on what you have observed of displayed images (characteristics, differences, reasons)

- Started by extracting a 128x128 pixel section from the middle of a CT image.
- Then, using the Radon transform, I computed 180 projections of this section at angles ranging from 0 to 180 degrees.
- Applied the Inverse Radon Transform, which includes taking a 1-D Fourier Transform of these projections, performing the Inverse Fourier Transform, and Back-Projecting them.
- Additionally, I performed a direct 2-D Fourier Transform on the CT image and its Inverse Fourier Transform.
- To assess the quality of the reconstructions from both methods, I calculated the Mean Square Errors.
- Displayed the outputs, which include the original image, its 180 projections, the reconstruction from these projections, and the results of the 2-D Fourier Transform and its Inverse.
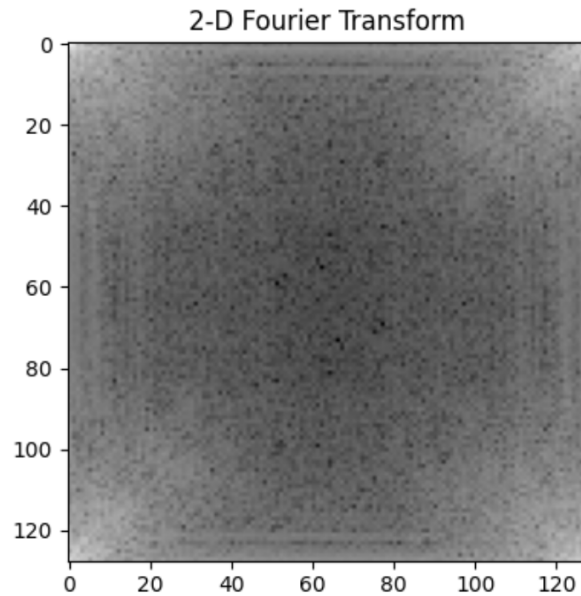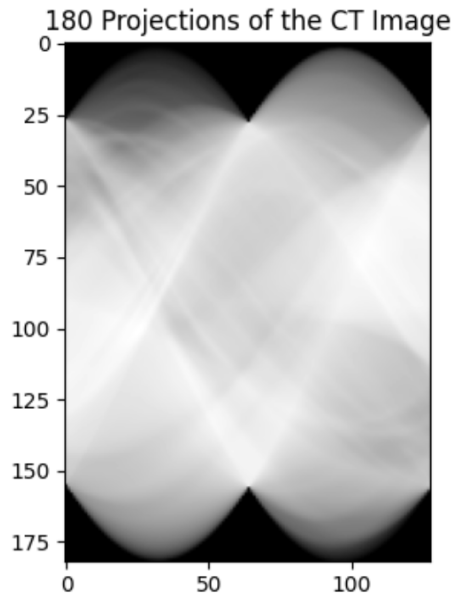
The projections form a sinogram. We can see X patterns being formed in the sinogram. The brighter areas mean high frequencies are found, whereas the duller areas mean low frequencies. The 2-D Fourier Transform has high-frequency components on its corners.
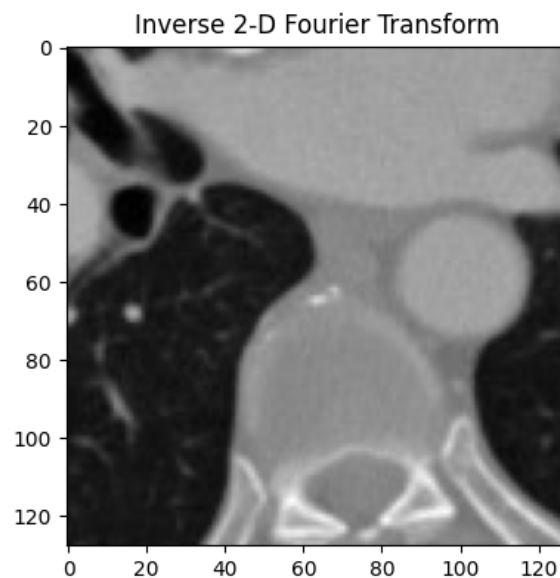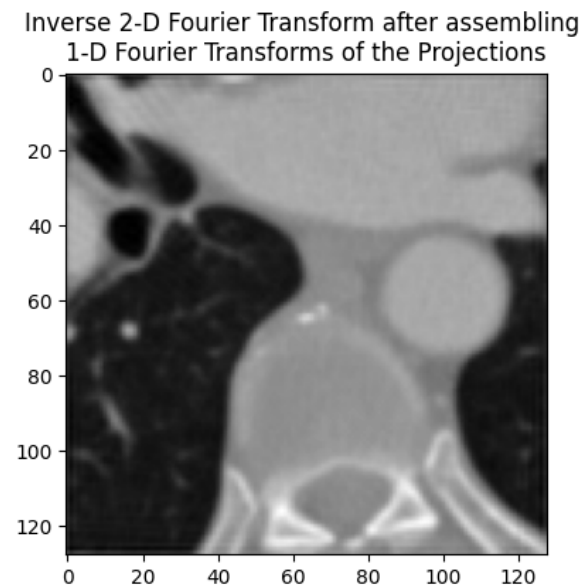
We can observe that the reconstructed image from assembling 1-D Fourier Transform projections is blurred on the 4 edges. The overall characteristics of the image look blurred compared to the Direct Inverse 2-D FT image. The sharpness of the reconstructed image from assembling 1-D Fourier Transform projections is less

compared to the Direct Inverse 2-D FT image. This could mean that the high-frequency components were lost during the process of gathering the projections and then back-projecting them to the 2-D domain.

This can also be seen in the Mean Square Errors between the reconstructed images and the Original Image. The error of the reconstructed image from assembling 1-D Fourier Transform projections is way higher compared to the Direct Inverse 2-D FT image.