CSCI 6367 Final Project

Number of Questions: 2
Max Points = 100
Due Date = Nov 20 @ 23:59
Read this.

- Please upload your code as well as a report for each problem. In the report.
- The report should be completed in word or latex in electronic edition (No Handwritten edition!)
- You should paste screenshot of the results for each step in your report.
- MATLAB or Python is recommended for you to complete the project since they work well with math computing.
- You may utilize different libraries/packages if necessary.
- Each group will give a short presentation on their final project. Each talk should be **20 minutes** in length, and time will be strictly enforced for each group. In your talk, you should (1) Explain how you approached and solved the assigned questions (including key parts of your code). (2) Present your results and processed images. (3) Provide a brief evaluation and discussion of your results (Valid results or not? Perfect results or not? Potential improvement).

Problem I, 50. A lung CT image (.jpg) has been uploaded here. Please complete the following tasks based on this lung CT image.
(1). Load and display this grey-scale lung CT image. Report the size of this image ($M \times N$).
(2). Compute the 2D FFT and display (a) magnitude and (b) phase images. Now apply fftshift and again display (c) magnitude and (d) phase. Use a log-scale for the magnitude display if this produces a more informative results.
(3). Down-sample the image to a half-size ($M/2 \times N/2$) image by discarding odd-numbered samples and display it.
(4). Get the frequency domain of the down-sampled image (Do 2D FFT on (3)). Then you write a program to interpolate the FFT result in the frequency domain to make it back to the original size ($M \times N$) by utilizing zeropadding method. Specifically, you need to FFT the down-sampled image, then zeropad in the frequency domain to interpolate, and then inverse 2D FFT. You need to figure out where the zero should be padded in so that you can retain conjugate symmetry in frequencies so that the resulting image is real. Display the

result after inverse 2D FFT. (Conjugate symmetry: We have shown in class that for an real image, the frequency should satisfy: $F(u,v) = F^*(-u,-v)$. $*$ means conjugate).
(5). Now you perform a spatial domain interpolation. Find a function to perform a linear interpolation of your image from the part (3). Display it.
(6). Compute the errors between the original image (1) and your two interpolation results (4) and (5) using the mean squared error.

$$error = \frac{\sum_{m,n}^{M,N} |F(m,n) - F_{inter}(m,n)|^2}{\sum_{m,n}^{M,N} |F(m,n)|^2}$$

Problem II, 50. Image denoising and edge detection.
(1) Choose any noisy image of your choice from website (in .jpg format).
(2) Apply a smoothing/denoising technique you learned from this course to denoise this image.
(3)Perform edge detection on the denoised image (Remember we discuss a few different edge detection methods, use one of them).
(4)Display and compare the original noisy image, the denoised image, and the final edge-detected image in your report.

For your information: You may use MATLAB, Python, or C++. You may use necessary library functions (e.g., OpenCV, NumPy, MATLAB built-in functions) which provide you different filters.