CSCI 4301 Final Project

Number of Questions: 2
Max Points = 100

Please upload your code as well as a report for each problem. 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 a few libraries such as numpy, PIL etc.

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. U-Net is a significant deep learning model in computer vision studies. I provide the link of this paper here `https://arxiv.org/pdf/1505.04597.pdf`. You should

carefully read and understand this paper and write a report based on your understanding. You report should clearly list the follow items one by one:
(1). Write a brief summary of this paper.
(2). Motivation or the question they want to solve in this work.
(3). How do they solve the question? Summary of the method and experiment results.
(4). Provide an evaluation on their experimental results.
(5). List a few disadvantages of their work and potential future directions.
Strict page limit of this problem: 2.