Assignment 4

Instructions

- No plagiarism. You will be awarded a straight ZERO for the entire assignment or even more.
- Do not use the functions from the modules for applying filters or generating kernels. The aim of the assignments is that you learn how they work. If you are unsure, ask on Moodle.
- Assume that the operations are on grayscale images, unless specified otherwise.
- Refer to table 4.1 for Images mentioned in the assignment and the corresponding filenames.

Table 4.1

Image	File Name
IMG1	1024_1024.jpg
IMG2	lakeside.jpg
IMG3	cart.jpg

Question 1

NOTE: You can use numpy's fftshift/ifftshift to display the results in the following tasks.

1. Write a function `dft1()` that calculates the DFT of a 1D array of arbitrary size.
2. Write a function `dft2()` that computes the 2D-DFT of a 2D array, using `dft1()`.
3. Write a function `fft1()` that computes the DFT of a 1D array using the FFT algorithm. (You may pad the array with extra values to make its length a power of 2).
4. Write a function `fft2()` that computes the 2D-DFT of a 2D array using `fft1()` and handle padding.
5. Compute the DFT of arrays of different lengths say [128, 256, 512, 1024] using `dft1()`. Repeat the same using `fft1()` . Make a plot showing how the run-time changes with the array size, and comment on the differences observed in the two cases.

6. Assuming the center pixel of the image as origin (0,0). Plot the 2D-DFTs of the images whose pixel intensities are :
    a. I = 0.5 * (1 + sin(x))
    b. I = 0.5 * (1 + sin(x) * sin(y))
    c. I = 0.5 * (1 + sin(x^2 + y^2))
7. Compute the 2D-DFT of IMG1 and display the result. Compute the 2D-DFT of the result and display. Write your observations.
8. Write a function `ifft2()` that computes the 2D-InverseDFT of a 2D array.

Question 2

1. Write a function `idealLPF()` that applies Ideal Low-Pass filter on an image, given the cut-off frequency D_0
2. Apply the ideal LowPassFilter with different D_0 values on IMG2.
3. Write a function `gaussianLPF()` that applies Gaussian Low -Pass filter on an image, with cut-off frequency D_0 and test with different values of D_0 .
4. Compare the differences between the results of applying a Gaussian Low Pass Filter vs Gaussian Smoothening Filter from the previous assignment, by varying the parameters that determine the effects of these filters on IMG2.

Question 3

1. Use your knowledge from the DIP course to remove the pattern that is obstructing you enjoy the beautiful image underlying on IMG3.
