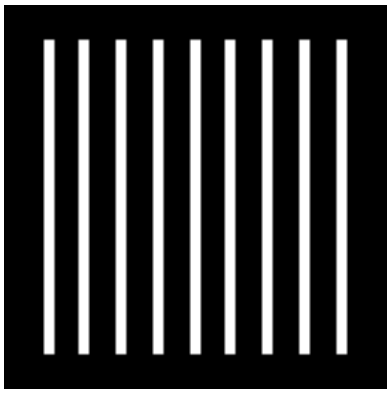
Digital Image Processing (1111)

Homework #3 (DUE: 2022.11.16)

(Please note that you have to upload your source codes (and a brief description about your codes or algorithms, optional) to the server before the deadline. Please check the course website for more details.)

1. The white bars in the test pattern shown below (BarTest.tif) are 7 pixels wide and 210 pixels high. The separation between bars is 17 pixels. Please apply the following filters to this image and show the results:
   (a) A 7x7 arithmetic mean filter?
   (b) A 3x3 arithmetic mean filter?
   (c) A 7x7 median filter?
   (d) A 3x3 median filter?



2. "Lenna" is a famous example for digital image processing. In order to have a further understanding of it, please do the following analyses:
   (a) Obtain the 2D-FFT of the image "Lenna.tif", display the spectrum image of log |F(u,v)|.
   (b) Magnitude and Phase images: Do 2D-FFT to obtain the magnitude and phase of the image. Display its "magnitude-only image" and "phase-only image" by applying inverse 2D FFT.

3. Consider the image below (DIP_image.tif). The image was processed by the following steps:
   (1) multiplying the image by $(-1)^{x+y}$;
   (2) computing the DFT;
   (3) taking the complex conjugate of the transform;
   (4) computing the inverse DFT;
   (5) multiplying the real part of the result by $(-1)^{x+y}$.
   (a) What would the processed image look like? Show the processed images from each step.
   (b) Explain mathematically why it appears as it does.

4. For the 24-bit color image: “Lenna_512_color.tiff”, please do the following processing with Python:
   (a) Display the original image.
   (b) Obtain its “Red component image”, “Green component image”, and “Blue component image” and display them as 24-bit color images respectively.
   (c) According to the definition of RGB model and HSI model, try to convert RGB to HSI model, and display its Hue, Saturation, and Intensity components as gray-level images respectively.
   (d) Do color complements to enhance the detail in the image by using RGB model.
   (e) Please do image smoothing with a 5x5 average kernel and sharping with the Laplacian to this “Lenna” image by using RGB and HSI models respectively. Display the results and also show the difference from original one. Please also show the difference between results obtained by RGB and HSI models.
   (f) Find some proper masks of saturation and hue component images to this “Lenna” image so that the feathers of the hat can be segmented by simple logical or arithmetic operation of these 2 images. Demonstration of images from each steps as well as final result is required.

   Bonus: to design a GUI or integrate all these functions to the one you constructed earlier is strongly encouraged.