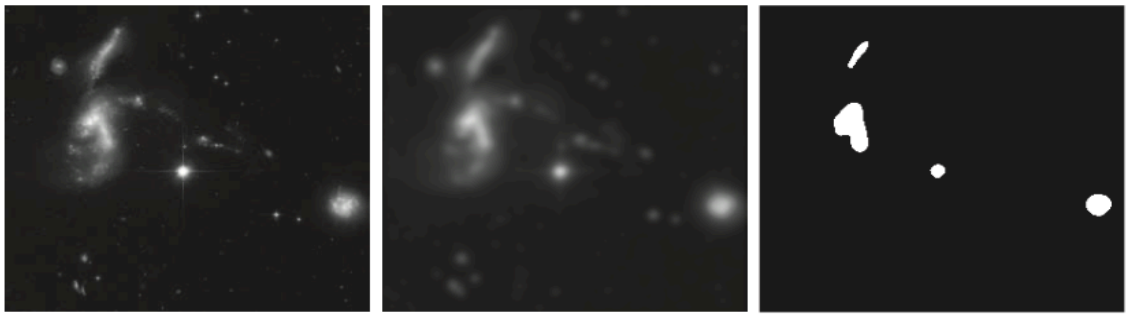
Georgia State University
CSC 4520/6520
Homework 1

Please submit your assignment by 11:59 pm on February 18th , including:
1-A program file, adequately commented for clarity.
2-A work report in PDF format, encompassing program codes and showcasing the output images.

Problem 1. (30 points)
Develop a program in either Python or Java to replicate the processes outlined in Figure 3.41 using **2 different lowpass filters**, maintaining the same order of execution.
Display the resulting images with consistent formatting.
Input Image: HW_Image1.tiff from Icollege

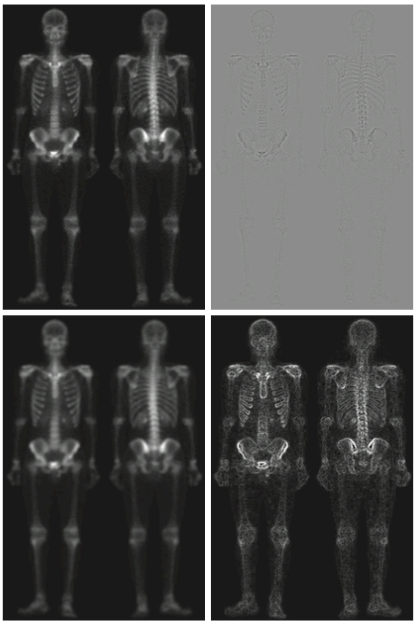


a b c

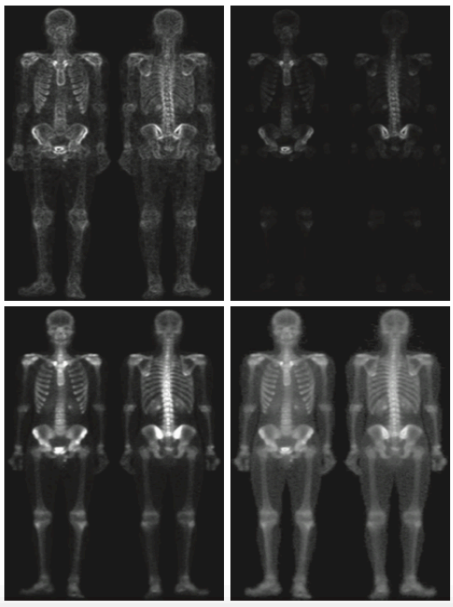
FIGURE 3.41 (a) A 2566 × 2758 Hubble Telescope image of the *Hickson Compact Group*. (b) Result of lowpass filtering with a Gaussian kernel. (c) Result of thresholding the filtered image (intensities were scaled to the range [0, 1]). The Hickson Compact Group contains dwarf galaxies that have come together, setting off thousands of new star clusters. (Original image courtesy of NASA.)

Problem 2.(40 points)
Develop a program in either Python or Java to replicate the processes outlined in Figure 3.57, maintaining the same order of execution. Display the resulting images with consistent formatting.
Input Image: HW_Image2.tiff from Icollege

a b
c d
FIGURE 3.57
(a) Image of whole body bone scan. (b) Laplacian of (a). (c) Sharpened image obtained by adding (a) and (b). (d) Sobel gradient of image (a). (Original image courtesy of G.E. Medical Systems.)



e f
g h
FIGURE 3.57 *(Continued)*
(e) Sobel image smoothed with a 5 × 5 box filter. (f) Mask image formed by the product of (b) and (e). (g) Sharpened image obtained by the adding images (a) and (f). (h) Final result obtained by applying a power-law transformation to (g). Compare images (g) and (h) with (a). (Original image courtesy of G.E. Medical Systems.)



Problem 3. (30 points)
Develop a program in either Python or Java to replicate the processes outlined in Figure 4.49 using **Butterworth low-pass filter in the frequency domain with D_0 values set to 140 and 120**, maintaining the same order of execution.
Display the resulting images with consistent formatting.
Input Image: HW_Image3.tiff from Icollege

a b c

FIGURE 4.49 (a) Original 785×732 image. (b) Result of filtering using a GLPF with $D_0 = 150$. (c) Result of filtering using a GLPF with $D_0 = 130$. Note the reduction in fine skin lines in the magnified sections in (b) and (c).