Digital Image Processing
ECE 4501/6782

Instructions: ***Please submit 1 PDF document with your answers***. *Handwritten notes can be scanned with apps such as CamScanner. Typing the answers out is recommended, wherever possible.* ***Include any code if attempted.***

Learning Objectives

1. *Understand Histogram Equalization, Full Scale Contrast Stretching, and utilize functions for programming (MATLAB/Python)*
2. *Understand Histogram based thresholding, Binary Morphological Processing.*

Question 1

Part 1 – 10 points

You are a fantastic programmer and can't wait to show off your new skills. So you shall write a function for this question!

Write a function in MATLAB/Python which takes in an image as an input, and displays the Histogram Equalized image as an output. **Do the histogram equalization manually.** Compare your result with the built-in MATLAB function *histeq (histeq* is available via the cv2 library in Python). State your observations.

Input to your function : Please download 'homosapiens.png' and 'cityscape.png' provided on Collab.
Output of your function : Histogram Equalized images of your inputs.

Also display the Histograms of the 'cityscape.png' image before and after histogram equalization.

Part 2 – 5 points

Perform a Full Scale Contrast stretch on the image 'homosapiens.png'. State your observations when you compare this output with the histogram equalized output from Part 1.

Hint : While utilizing the FSCS formula, note that the highest and lowest pixel in this case need not be 255 and 0. Observe from the histogram and take lowest and highest pixels to be around 5th and 95th percentile in the distribution. This ensures your FSCS is not affected by data outliers!
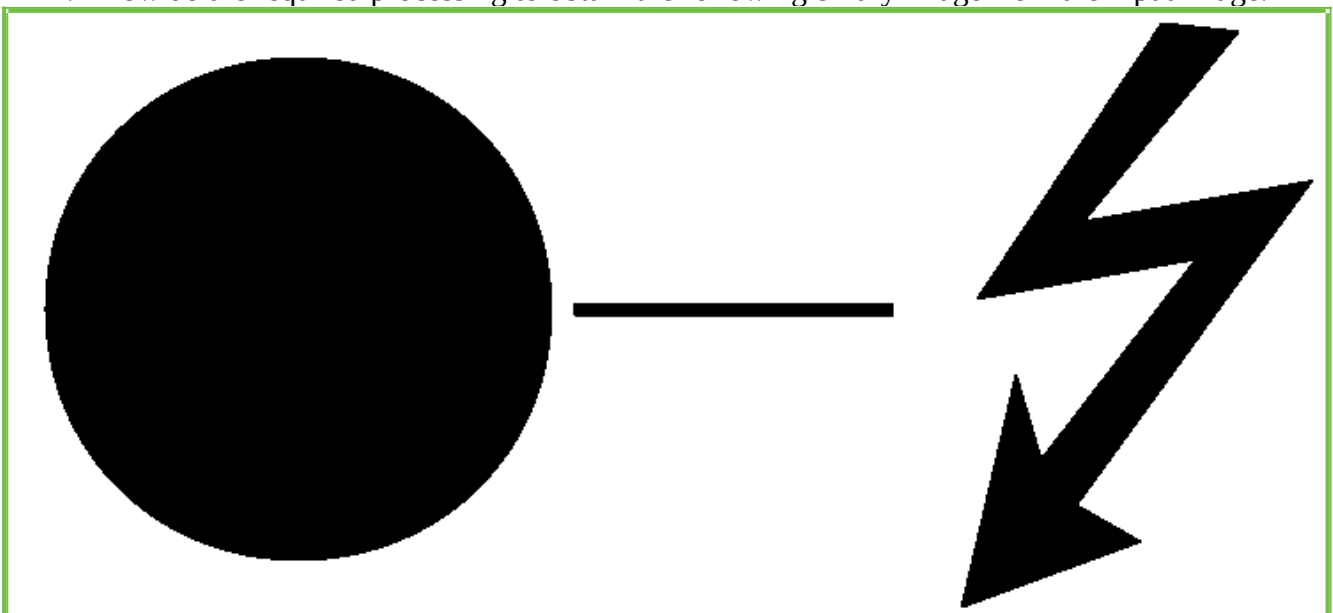
Question 2 – *15 points*

Now that you have proven your programming skills, you shall perform some Binary Morphological Operations to further cement your status!
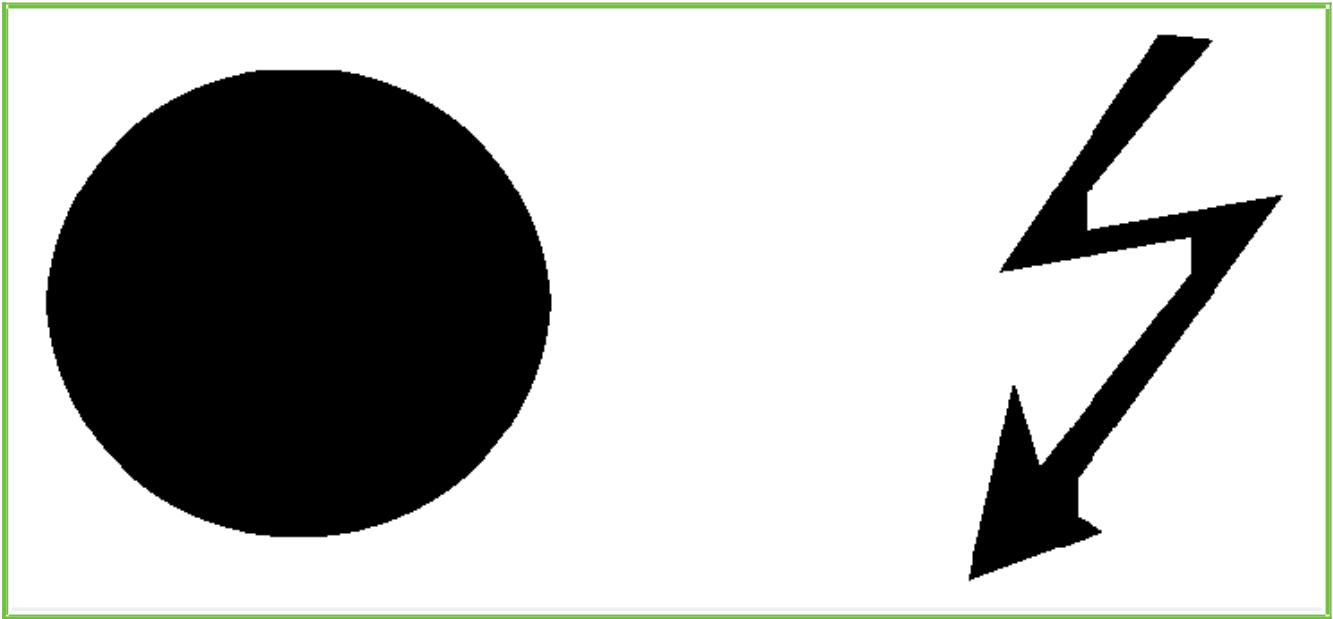
Please download 'funny.png'.

1. Do required processing on the input image to obtain the following as a binary image.
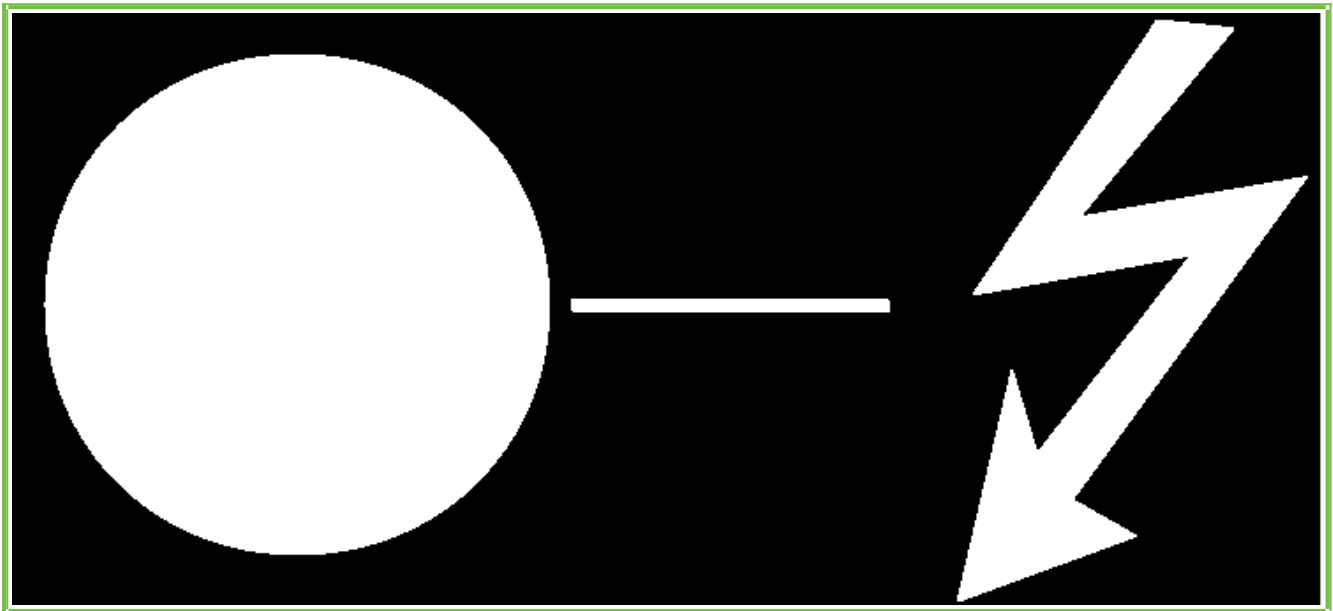
2. Now do the required processing to obtain the following binary image from the input image.

3. Final Task! Make that annoying central line disappear. Your final image must look something like below .

Hint: Utilize thresholding, understand creating binary images from grayscale images, and exploit your class knowledge to see which of the Morphological Operators will guide you in your path towards the answer!