**UNIVERSITY OF TEXAS AT ARLINGTON**
**DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING**

**6367** **COMPUTER VISION** **SPRING 2020**

**ASSIGNMENT 3 (100 POINTS)**
**ASSIGNED: 2/27/2020 DUE: 3/17/2020**

This assignment constitutes 10% of the course grade. You must work on it individually and are required to submit a PDF report along with the MATLAB scripts described below. Your programs must not use computer vision functions provided by MATLAB unless otherwise specified.

The objective of these problems is to learn to how to implement basic image feature extraction operations.

# Edge Detection

**Problem 1 (60 points)**

**(a) (20 points)** Write a MATLAB script that implements the Roberts edge detector.

**(b) (20 points)** Write a MATLAB script that implements the Sobel edge detector.

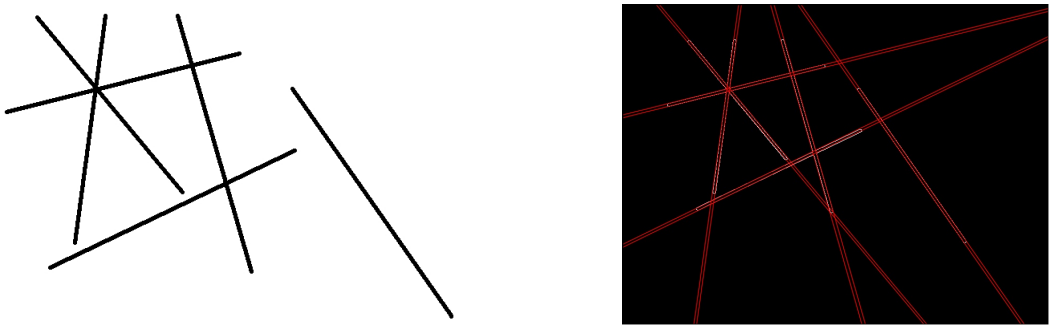
**(c) (20 points)** Write a MATLAB script that implements the Prewitt edge detector.

The results should be the gradient direction and the gradient magnitude. Make sure that the results are scaled. Test the methods on the image "umbrella_woman.jpg". Do not use the edge detection methods in MATLAB to implement your algorithms. You may use the `imgaussfilt` function to smooth the image before applying your edge detector.

**Submission Instructions:** *Submit the MATLAB scripts roberts.m, sobel.m, and prewitt.m that perform the operations stated above along with any other files necessary to run the scripts. For each edge detector, generate figures of the gradient magnitude and gradient direction from the input image. Please take care to generate all the figures in new windows. You are also required to embed all of the images in the report (do not submit the images separately). The MATLAB command* `print` *may be helpful in this regard.*

# Line Detection

**Problem 2 (40 points)**



(a) (b)

Figure 1: (a) A set of lines. (b) A set of (red) lines found by the Hough transform.

Write a MATLAB script that implements the Hough transform. It must compute the parameters for all the lines present in the accompanying image "lines.jpg" (shown in Figure 1a). Edge detection must be done before applying the Hough transform. To perform edge detection, use one of your methods implemented in Problem 1 (Roberts, Sobel, Prewitt). The MATLAB function `hough` cannot be used.

**Submission Instructions:** *Submit a MATLAB script, hough.m, that performs all the operations stated above, along with any other files necessary to run the script. Using the line parameters computed from your Hough transform, create a new image by overlaying the detected lines onto the lines in the original image as shown in Figure 1b. You are required to include this image by embedding it in the report (do not submit the image separately).*

**Extra Credit (20 points)**

Implement Otsu's method for performing automatic image thresholding. The function must take a grayscale image as input and return the threshold value that separates the pixels into foreground and background. Do not use the `graythresh` or `multithresh` functions in MATLAB.

**Submission Instructions:** *Submit a MATLAB script, otsu.m, that reads in an image and performs the operations stated above. Use the returned threshold value to convert the image "umbrella_woman.jpg", along with an image of your choice, into its binary representation. Please take care to generate all the figures in new windows. You are also required to embed all of the images in the report (do not submit the images separately). The MATLAB command* `print` *may be helpful in this regard.*