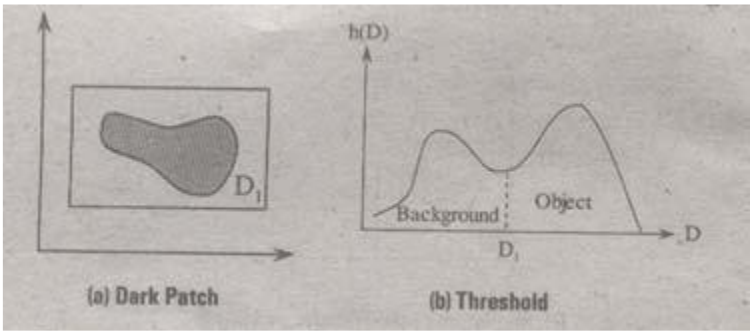
Department of Computer Science and Engineering (Data Science)
Image Processing and Computer Vision I (DJ19DSL603)
Lab 7: Histogram Equalisation

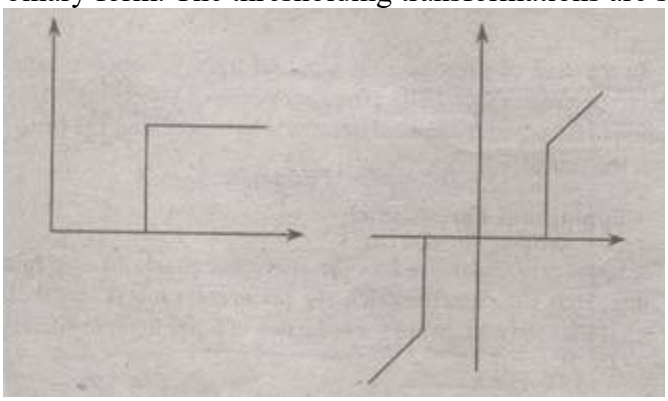
Aim: To Perform Gray Level slicing with and without background

Theory: Thresholding is a simple but effective image processing technique that is widely used in computervision and image analysis applications. The basic idea behind thresholding is to segment an image into foreground and background regions based on the intensity values of the pixels in the image

Clipping and Thresholding:
Clipping is considered as the special scenario of contrast stretching. It is the case in which the parameters are $\alpha = \gamma = 0$. Clipping is more advantageous for reduction of noise in input signals of range [a, b].
Threshold of an image is selected by means of its histogram. Let us take the image shown in the following figure.



(b) consists of two peaks i.e., background and object. At the abscissa of histogram minimum (D1) the threshold is selected. This selected threshold (D1) can separate background and object to convert the image into its respective binary form. The thresholding transformations are shown in figure



Intensity Level Slicing:
The images which consist of grey levels in between intensity at background and other objects require to reduce the intensity of the object. This process of changing intensity level is done with the help of intensity level slicing. They are expressed as

$$V = \begin{cases} L, & a \le u \le b \\ 0, & \text{elsewhere} \end{cases} \quad \text{without background}$$

$$\text{And} \quad V = \begin{cases} L, & a \le u \le b \\ u, & \text{elsewhere} \end{cases} \quad \text{with background}$$

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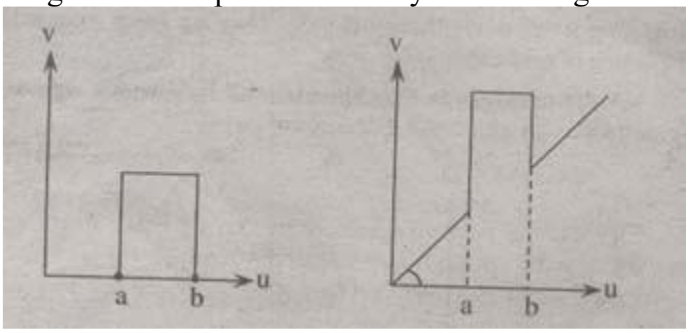
The histogram of input image and its respective intensity level slicing is shown in the figure



When an image is uniformly quantized then, the nth most significant bit can be extracted and displayed. Let, u = k1 2^B-1 + k2 2^B-2 +……..+ k^B-1 2 + kB Then, the output is expressed as

$$V = \begin{cases} L, & \text{for } k_n = 1 \\ 0, & \text{elsewhere} \end{cases}$$

Grey Level Slicing without background:

Grey level slicing is an image processing technique used to enhance the contrast of an image by selectively enhancing a range of pixel intensities. The basic idea behind grey level slicing is to setall pixel values within a specific intensity range to a maximum value, while leaving all other pixelvalues unchanged

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Lab Assignments to complete in this session

Problem Statement: Develop a Python program utilizing the OpenCV library to manipulate images. The program should address the following tasks:

1. Read random image(s) from MNIST dataset
2. Display the before & after image(s) used in the tasks below. Develop your own functions, do not use existing functions:
    a. Perform thresholding operation
    b. Perform gray level slicing with and without background intensity slicing.
3. Show the difference in the histograms of the images used and thus produced.
4. Note the difference and provide a conclusion of why the frequency distribution changed for the image(s) used.

The solution to the operations performed must be produced by scratch coding without the use of built in OpenCV methods.