LP-VI Image Processing (2023-24) **Experiment 3:** Read any image. Display the outputs of contrast stretching, intensity level slicing.	
Student Name:	**Roll No. :**
Batch:	**Division :**

Title: Display the outputs of Contrast Stretching and Intensity Level Slicing.

Aim: Implementation of Contrast Stretching and Intensity Level Slicing on an image.

Prerequisites: Contrast Stretching, Intensity Level Slicing.

Theory:

Contrast Stretching:

Contrast stretching as the name suggests is an image enhancement technique that tries to improve the contrast by stretching the intensity values of an image to fill the entire dynamic range. The transformation function used is always linear and monotonically increasing.

Below figure shows a typical transformation function used for Contrast Stretching.

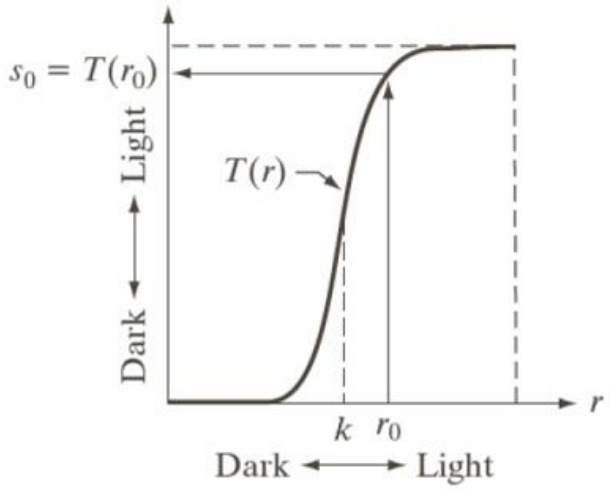


Figure 1: Contrast Stretching

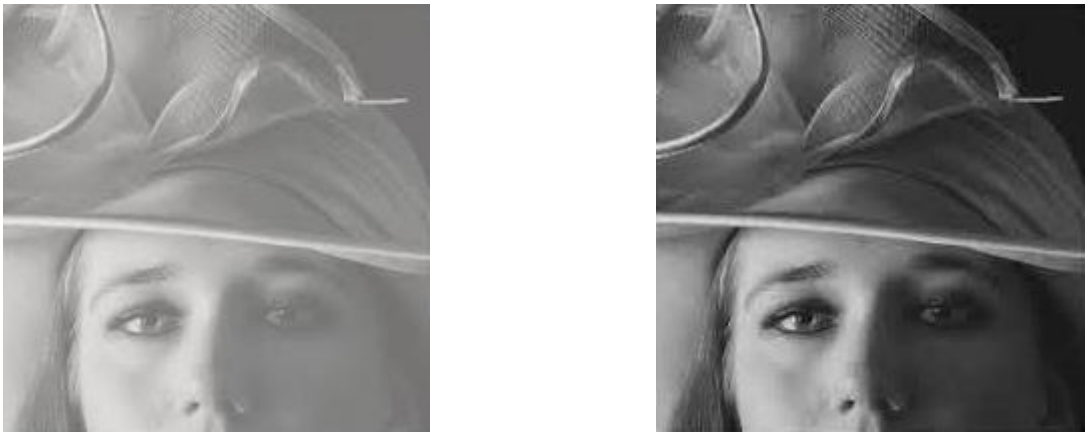
By changing the location of points (r1, s1) and (r2, s2), we can control the shape of the transformation function. For example,

1. When r1 =s1 and r2=s2, transformation becomes a **Linear function**.
2. When r1=r2, s1=0 and s2=L-1, transformation becomes a **thresholding function**.
3. When (r1, s1) = (r_{min}, 0) and (r2, s2) = (r_{max}, L-1), this is known as **Min-Max Stretching.**
4. When (r1, s1) = (r_{min} + c, 0) and (r2, s2) = (r_{max} – c, L-1), this is known as **Percentile Stretching**.

In **Min-Max Stretching**, the lower and upper values of the input image are made to span the full dynamic range. In other words, Lower value of the input image is mapped to 0 and the upper value is mapped to 255. All other intermediate values are reassigned new intensity values according to the following formulae.

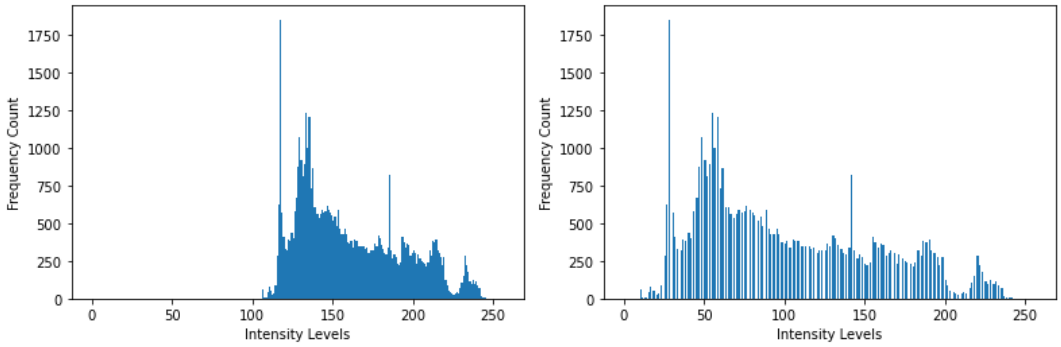
$$Xnew = \frac{Xinput - Xmin}{Xmax - Xmin} \times 255$$

Sometimes, when Min-Max is performed, the tail ends of the histogram becomes long resulting in no improvement in the image quality. So, it is better to clip a certain percentage like 1%, 2% of the data from the tail ends of the input image histogram. This is known as **Percentile Stretching**. The formulae is same as Min-Max but now the X_{max} and X_{min} are the clipped values.



(a) **(b)**

Figure 2: Contrast Stretching (a) Original Input Grayscale Image, (b) Contrast Stretched Image



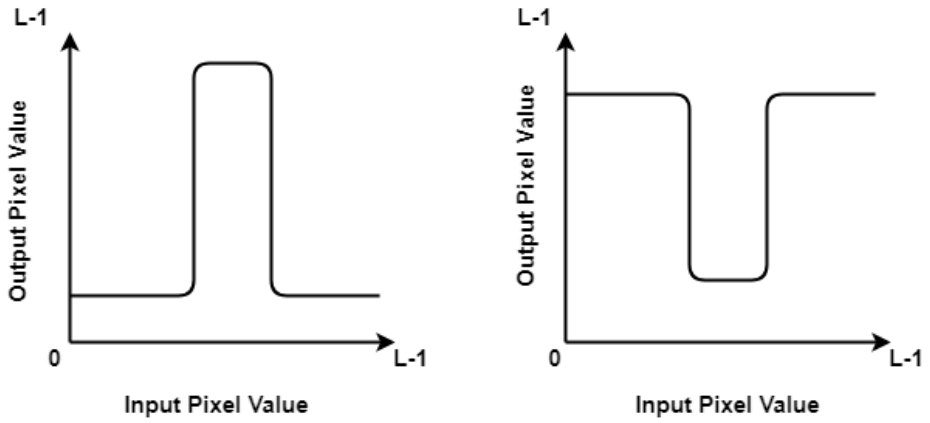
(a) **(b)**

Figure 3: Contrast Stretching (Histogram) (a) Histogram of Original Input Grayscale Image, (b) Histogram of Contrast Stretched Image

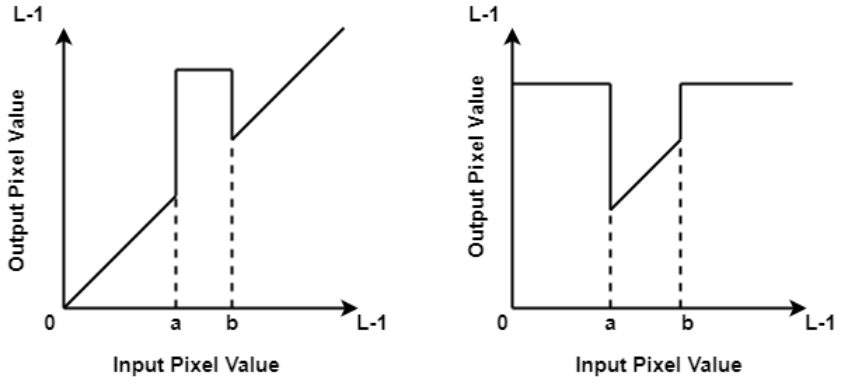
Intensity Level Slicing:

Intensity level slicing means highlighting a specific range of intensities in an image. In other words, we segment certain gray level regions from the rest of the image. Suppose in an image, your region of interest always take value between say 80 to 150. So, intensity level slicing highlights this range and now instead of looking at the whole image, one can now focus on the highlighted region of interest. Since, one can think of it as piecewise linear transformation function so this can be implemented in several ways. Here, we will discuss the two basic type of slicing that is more often used.

- In the first type, we display the desired range of intensities in white and suppress all other intensities to black or vice versa. This results in a binary image. The transformation function for both the cases is shown below.



- In the second type, we brighten or darken the desired range of intensities(a to b as shown below) and leave other intensities unchanged or vice versa. The transformation function for both the cases, first where the desired range is changed and second where it is unchanged, is shown below.



(a)

(b)

Figure 3: Intensity Level Slicing (a) Original Input Image, (b) Intensity Level Slicing (max-min pixel range: 80 and 120)

Conclusion: We have implemented contrast stretching and intensity level slicing operation on an image.

Questions:

1. What is Intensity Transformation?
2. What is Contrast Stretching?
3. Explain Grayscale level Slicing?
4. Explain use of numpy package?
5. Which functions are used for displaying image height, width, number of pixels in an image, data type of an image?