Image Processing and Computer Vision

Piecewise Linear Transformation Functions

The principal advantage of piecewise linear functions over the types of functions which we have discussed thus far is that the form of piecewise functions can be arbitrarily complex.

The principal disadvantage of piecewise functions is that their specification requires considerably more user input.

a)Contrast stretching

b) Gray-level slicing

c) Bit-plane slicing

Piecewise Linear Transformation Functions

Contrast stretching

1) One of the simplest piecewise linear functions is a contrast-stretching transformation.

2) Low-contrast images can result from
- poor illumination
- lack of dynamic range in the imaging sensor, or
- even wrong setting of a lens aperture during image acquisition.

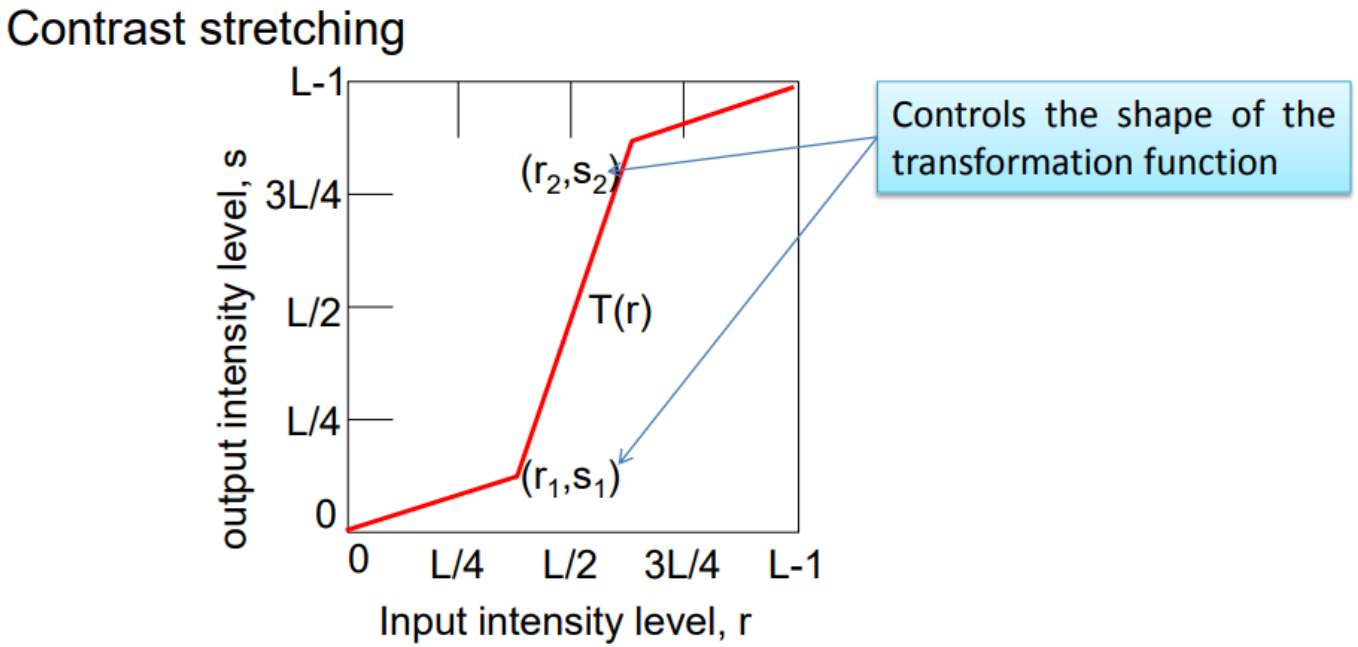
3) The idea behind contrast stretching is to increase the **dynamic range** of the gray levels in the image being processed.

4) Is a process that expands the range of intensity levels in an image so that it spans the full intensity range of the display device.

Piecewise Linear Transformation Functions

contrast stretching, which means that the bright pixels in the image will become brighter and the dark pixels will become darker, this means : higher contrast image.

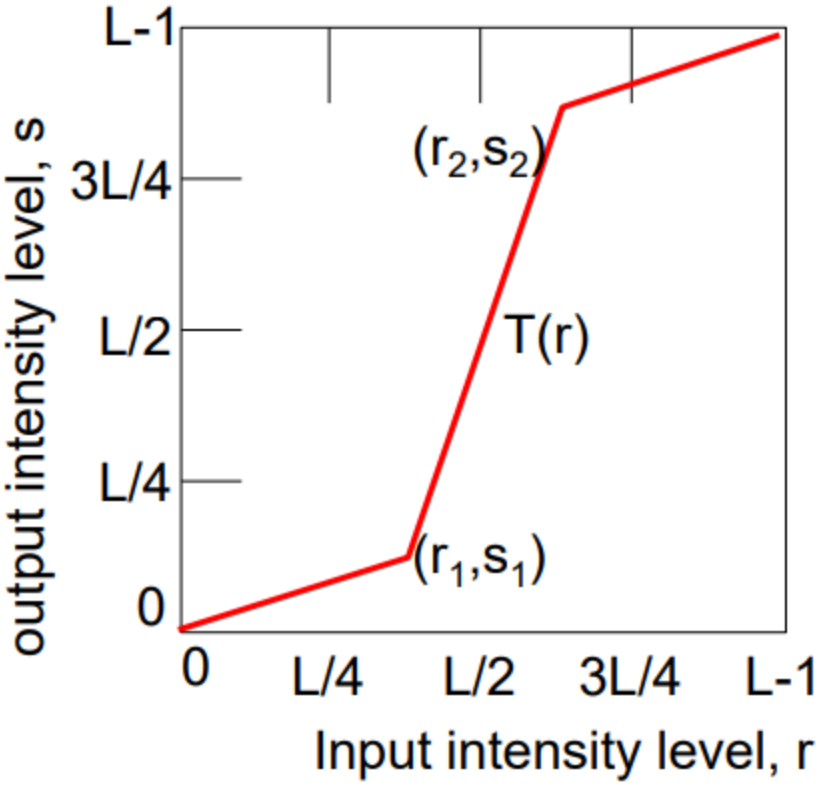
The locations of points (r1, s1) and (r2, s2) control the shape of the transformation Function.

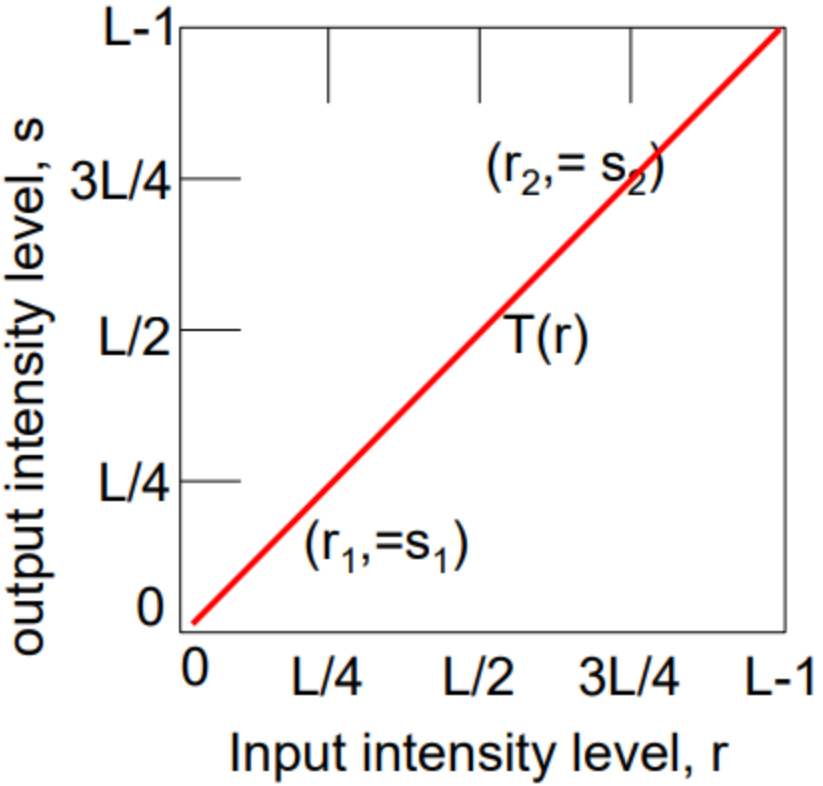


Piecewise Linear Transformation Functions

Contrast stretching

Suppose $r_1=s_1$ and $r_2=s_2$

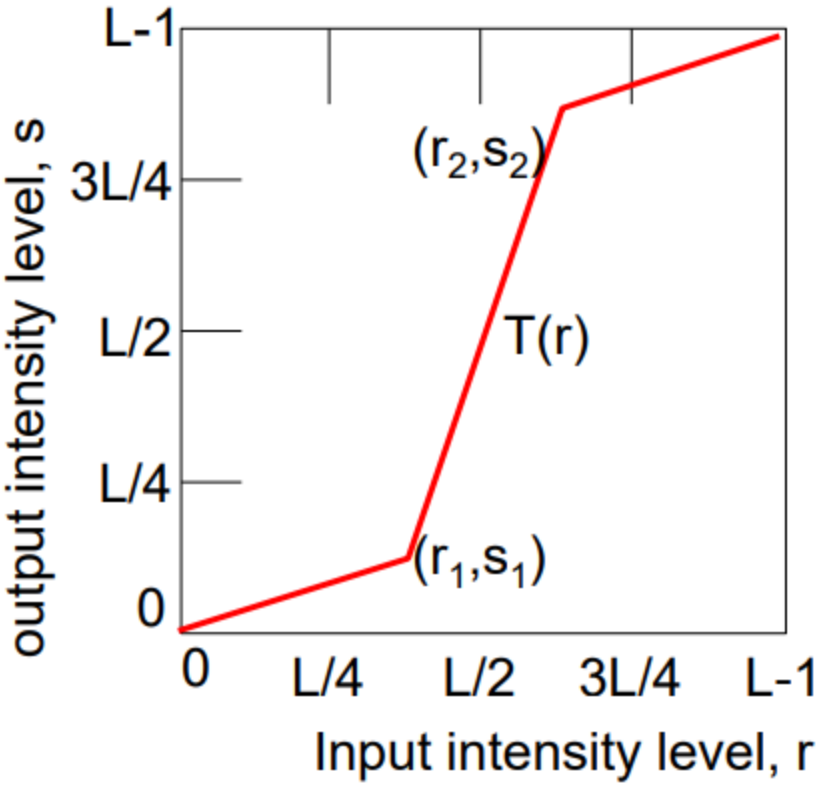


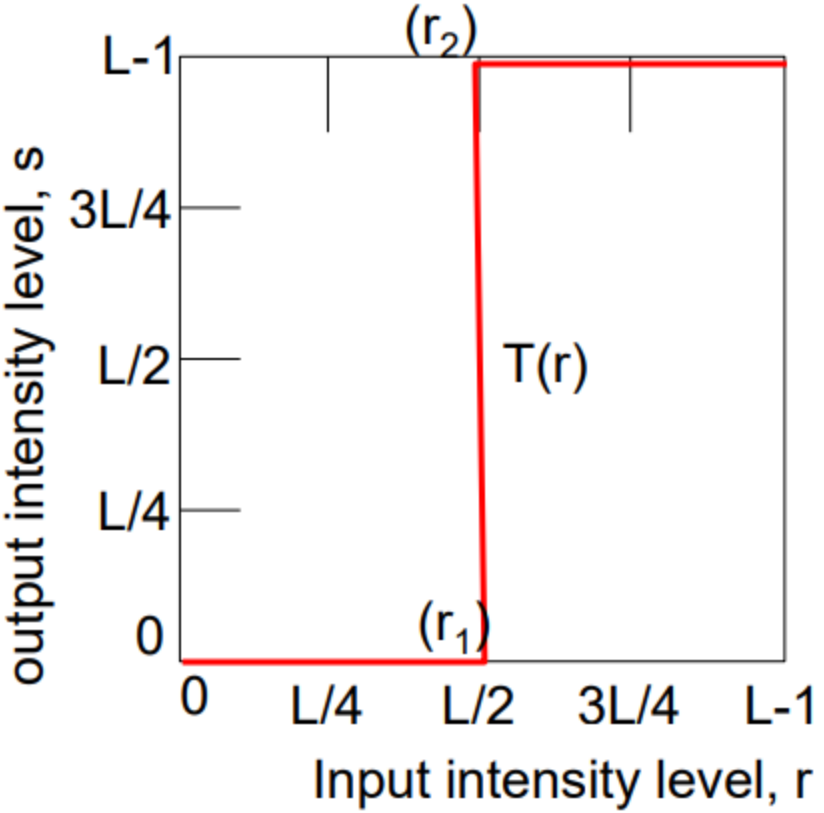


Piecewise Linear Transformation Functions

Contrast stretching

Suppose $r_1=r_2$ and $s_1=0$ and $s_2=L-1$

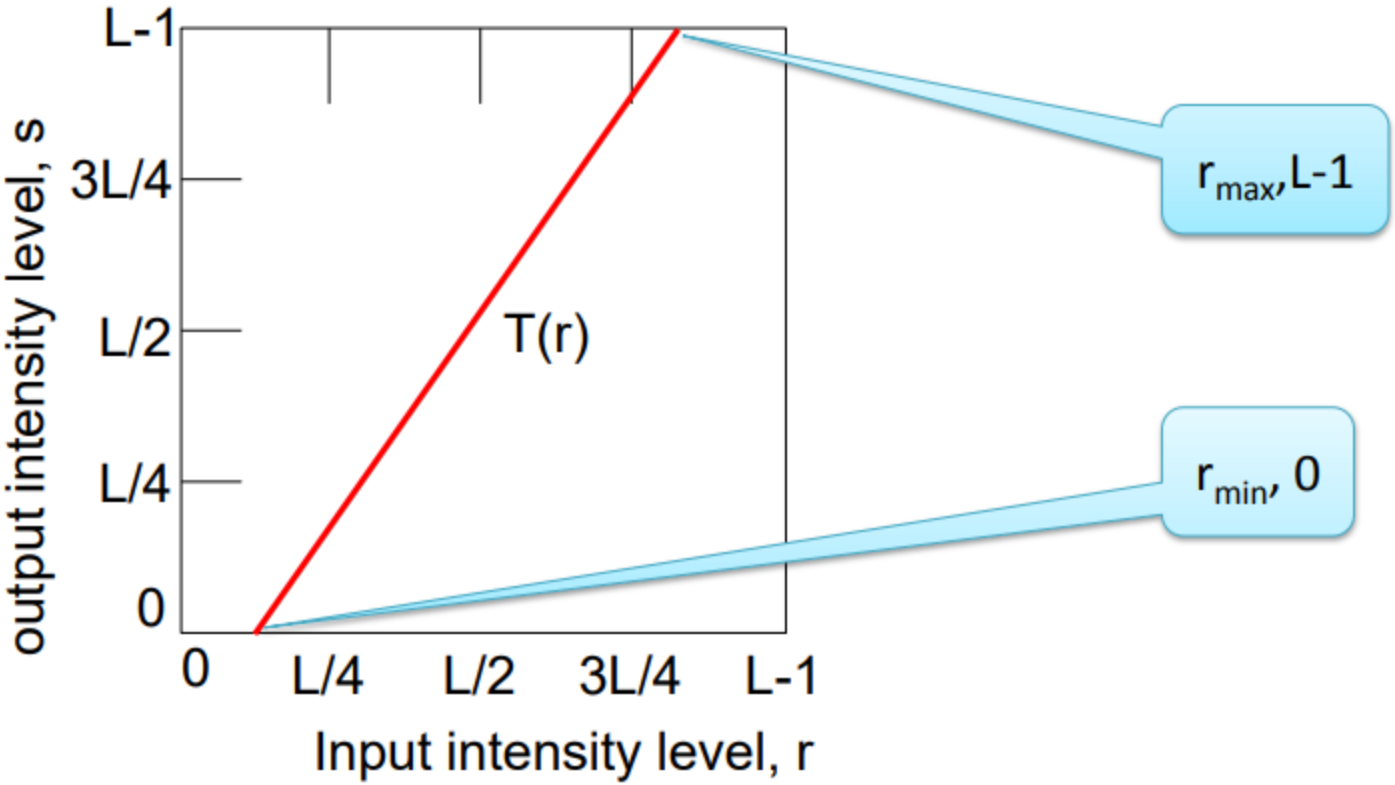




Piecewise Linear Transformation Functions

Contrast stretching (Example)

$(r_1,s_1)=(r_{min}, 0)$ and $(r_2,s_2)=(r_{max},L-1)$



Piecewise Linear Transformation Functions

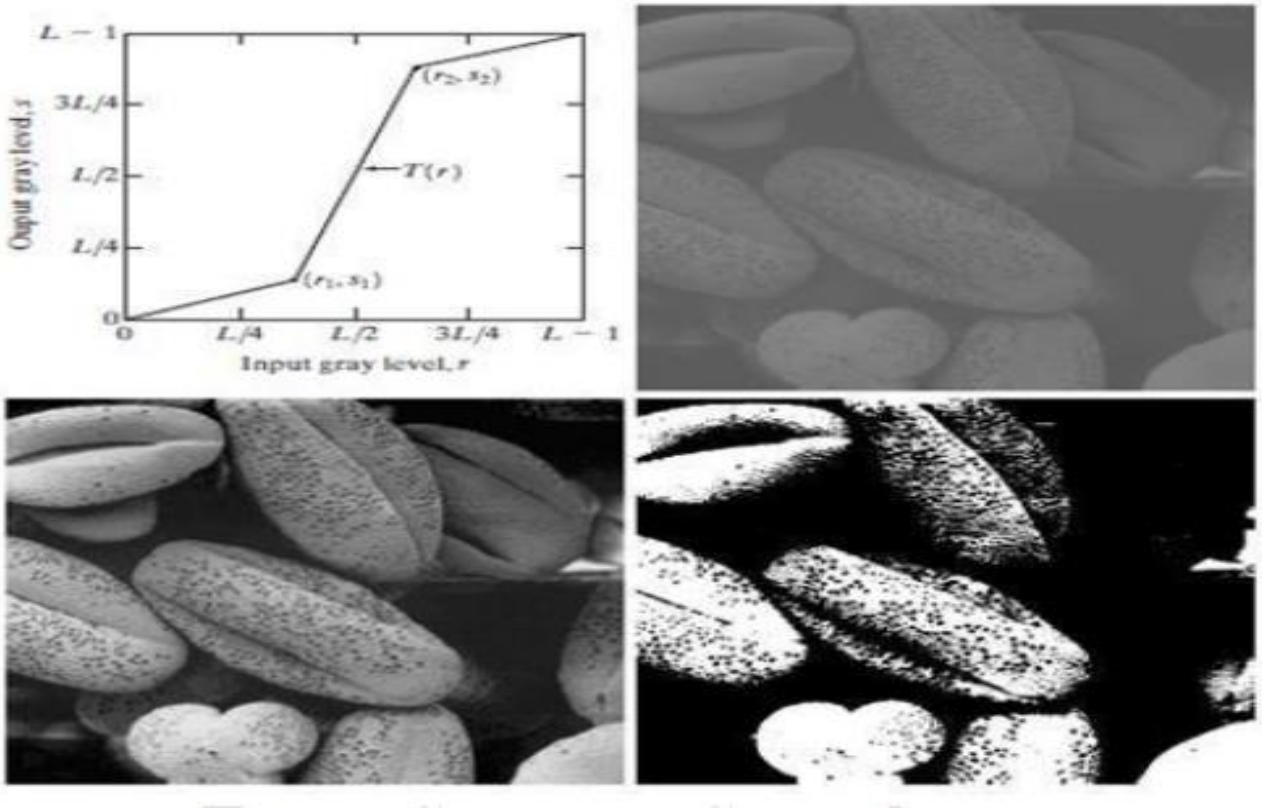


Fig. (a) Form of transformation function, (b) A low-contrast stretching, (c) Result of contrast stretching, (d) Result of thresholding

Piecewise Linear Transformation Functions

Gray level slicing

1) It is a point operation in the spatial domain. It is also known as intensity slicing.
2) Highlighting a specific range of gray levels in an image often is desired. Applications include enhancing features such as masses of water in satellite imagery and enhancing flaws in X-ray images.
3) There are several ways of doing level slicing, but most of them are variations of two basic themes.
4) One approach is to display a high value for all gray levels in the range of interest and a low value for all other gray levels. This transformation, shown in Fig. y(a), produces a binary image.
5) The second approach, based on the transformation shown in Fig.y (b), brightens the desired range of gray levels but preserves the background and gray-level tonalities in the image.
6) Figure y (c) shows a gray-scale image, and Fig. y(d) shows the result of using the transformation in Fig. y(a).Variations of the two transformations shown in Fig. are easy to formulate.

Piecewise Linear Transformation Functions

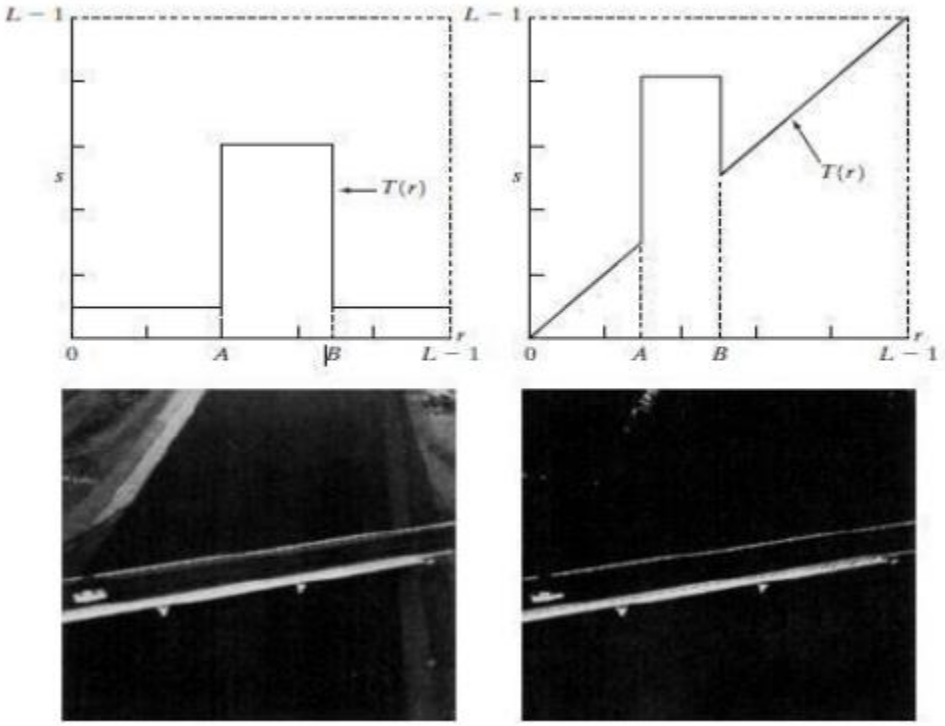
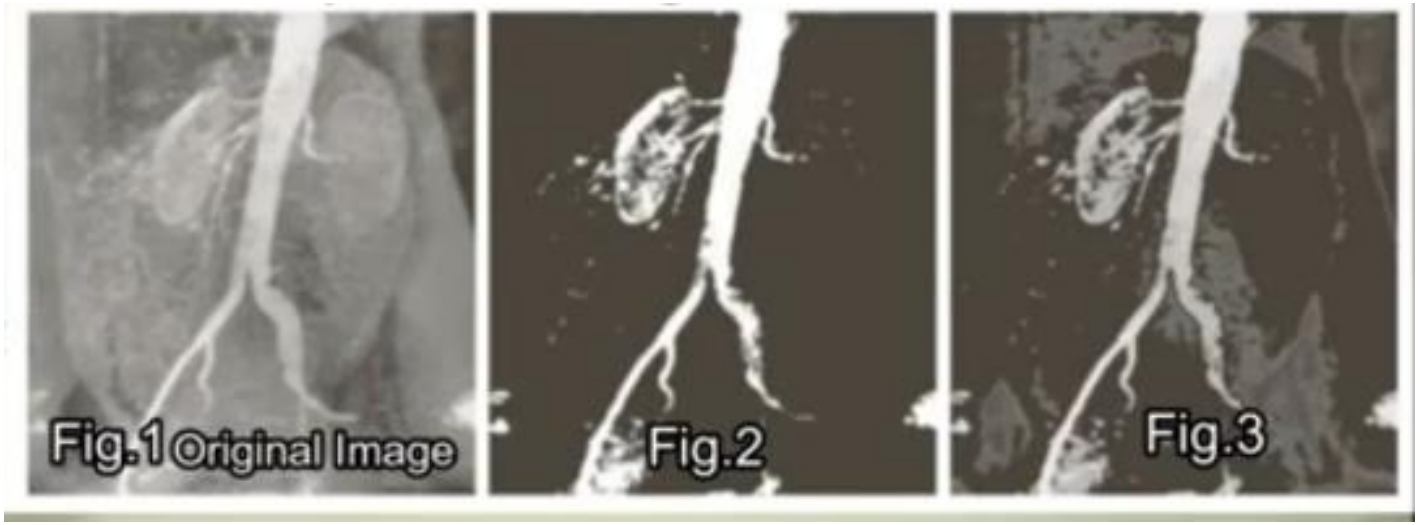


Fig. y (a)This transformation highlights range [A,B] of gray levels and reduces all others to a constant level (b) This transformation highlights range [A,B] but preserves all other levels. (c) An image . (d) Result of using the transformation in (a)

Piecewise Linear Transformation Functions



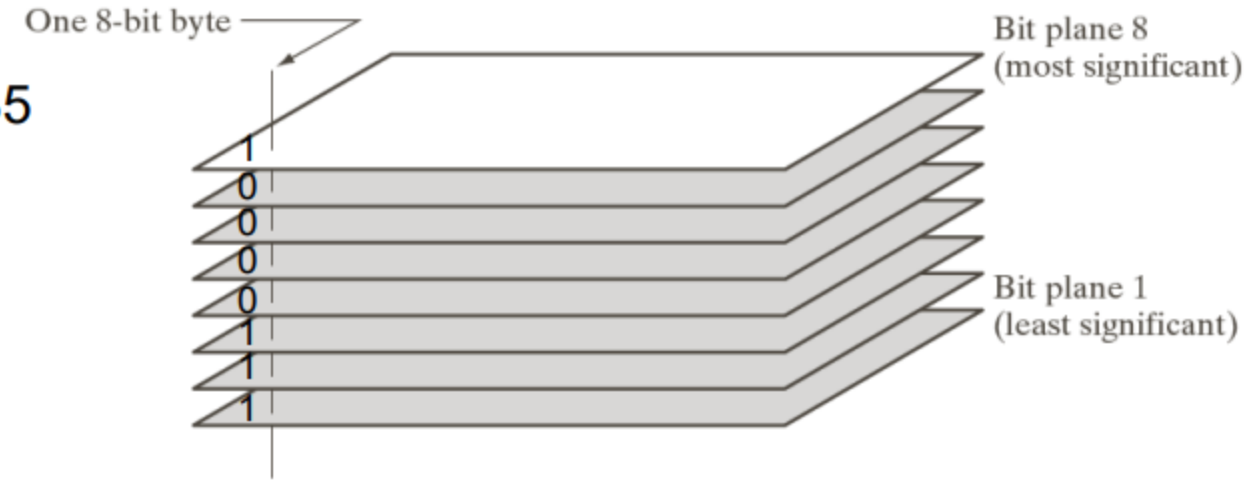
Piecewise Linear Transformation Functions

Bit Plane slicing (Example)

- Each pixels are digital number comprising of bits
- For a 256 level gray-scale image there are 8 bits for each pixel
- We can highlight the contribution of these bits to total image appearance

Example pixel value =135

1 0 0 0 0 1 1 1



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