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Lecture 3
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Temporal sampling:

Amount of time screen is visible – Shutter speed
- ↳ Fast speed → Clear, darker image
- ↳ Slow speed: Bright, blurred

Aperture controls how much light is let in
- ↳ How much depth in scene is in focus, can't have more depth with high aperture.

ISO: Controls over light sensitivity
- Less ISO: Noise free images, less sensitivity
- More ISO: More light, more noise

In a pin wheel, with higher shutter speed (1/160) → can see all colors clearly
with low shutter speed (1sec) → blurred white image

Intensity Transforms, Histogram Processing

→ Directly manipulating pixels in spatial domain:

1) Point to point:

Convert from one color to another using functi.

$$z = a(x, y)$$
$$z' = b(x, y) = T(z)$$
$$z' = T(a(x, y))$$

Intensity levels $r : [0, L-1]$

↳ Manipulation of mammogram - Taking negative i.e if pixel has 'r', then we do '$255 - r$' for better visibility of tumors

$$s = T(r) = L - 1 - r$$

↑ Transform

$L = 2^n$ where n = No. of bits

Storage v/s Display

If you get 4-bit image to display on 8-bit hardware, values could be correct but on normal visualisation, it won't be visible, so we need to transform $(r+1)*15$ ⇒ Standard form: $(r+1)*[2^n - 1]$ where n = No. of bits used to display

⇒ Above examples are linear intensity transforms.

Data visualisation:

→ Normalisation:

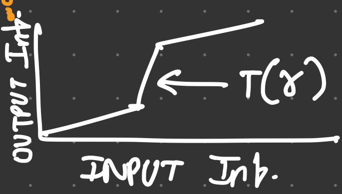
$$J = \text{round}\left(255 * \frac{I - \min(I)}{\max(I) - \min(I)}\right)$$ ⇒ New range: $[0 - 255]$

Shades of grey:

0 - Black
255 - White

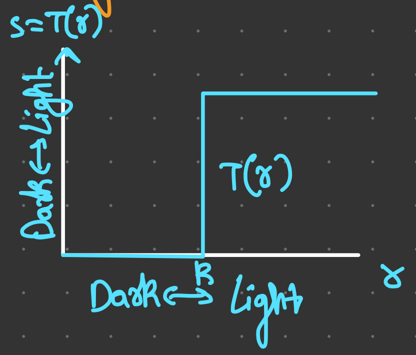
Piecewise linear transform:

→ Can be complex
→ Finer control



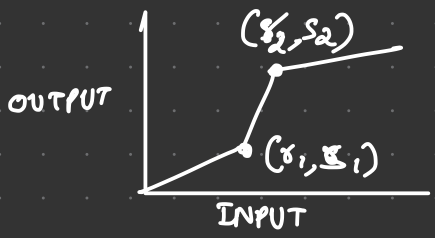
→ Combo of 3 linear functions with specific range

Thresholding:



{ Less than k ⟹ 0 output
{ More than k ⟹ high output

Contrast Stretching:



Has to be
→ Monotonically increasing or decreasing for
One-one mapping

Non-linear intensity transform:

→ To visualise very high value spectrum images we use log transformations and other non-linear transformation.

$$s = T(r) = c\log(1+r)$$

↳ To avoid zero, 1 is added

Other non-linear examples:

↳ Power-Law Transformation: $s = T(r) = cr^{\gamma}$

when $\gamma > 1$: Reduce brightness [for overexposed pic]
$\gamma < 1$: Increase brightness [for under exposed pic]

Intensity Slicing:

Interested only for a range: Increase/Decrease for a small part

Examples of intensity slicing

Bit plane slicing:

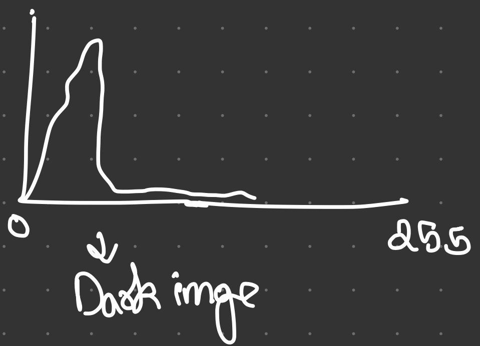
Each bit plane is a binary image
LSB → Minor Details MSB → Major Details

Histogram:

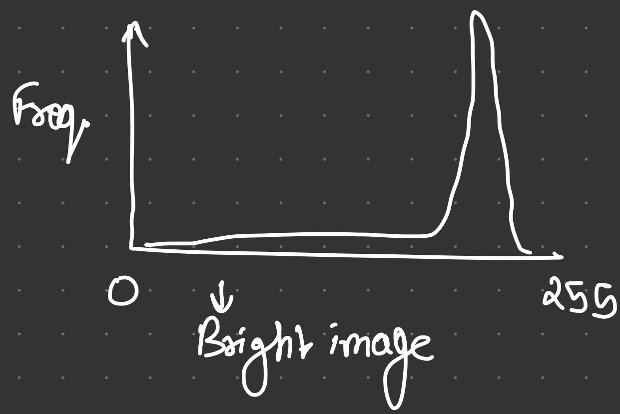
$h_g(i) = n_i$ → i → intensity value $[0, L-1]$
n_i → No. of pixels with intensity i

→ Describes frequency of pixels for each intensity value
→ Diff images with same histogram
→ No info on spatial distribution
→ Info on whether image is too dark / bright

Underexposure:



Overexposure:



→ Good images are usually well distributed similar to a gaussian/normal distribution

→ Better contrast could imply better distribution in histogram