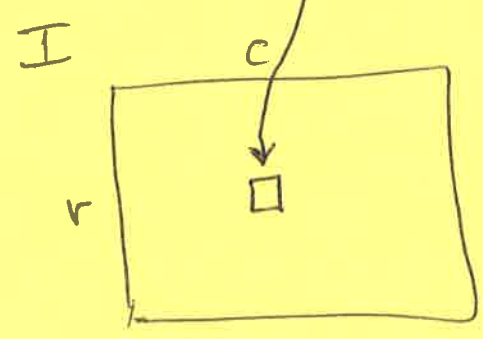


pixel : picture element



row, col : (r, c)

x, y [upper left] : (x, y)

we have discussed values & meanings

operations on images A, B

$\neg A$

binary inverse
negative image

$A + B$

sum

$A - B$

difference

$A * B$

product (pixel-wise)

A / B

quotient (")

$A + \checkmark$

↑ value (positive)

brightens

$A - \checkmark$

↑ value (positive)

darkens

Matlab

imadd
imsubtract
imabsdiff

} truncate to range

immultiply
imdivide

increase contrast
compare image differences

imcomplement

Thresholding

im2bw

look at cell image
look at trees

Point operations = improve contrast for human viewing

logarithmic

$$I' = c \ln(1 + (e^\sigma - 1) I)$$

↑ scales output ↙ scales input
 ↘ avoids ln(0)

$$c = \frac{255}{\log(1 + \max(I))}$$

$(e^\sigma - 1)$ missing in book

* increase dynamic range in dark regions
 decrease camera man → "brighter"

exponential transform

3/3

$$I' = c [(1 + \alpha)^I - 1]$$

$$c = \frac{255}{((1 + \alpha)^{\max(I)} - 1)}$$

may enhance brighter regions

plot log + exp values

gamma transform

$$I' = c I^\gamma$$

enhances contrast of brighter parts of image

corrects for non-linear (analog) brightness sent to monitor.

see `imadjust`

Histograms : relative frequency of a gray level

normalized : sums to 1

imhist

thresholding :

`coins > 80`

`combo (mat2gray(coins), coins < 80);`

`graythresh(1/26)` too high

Adaptive Thresholding

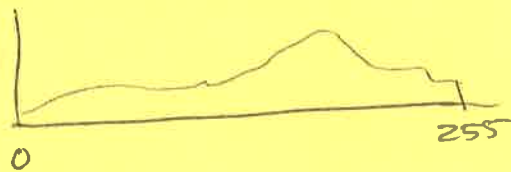
local threshold

CS4640 - adapt

Histogram Equalization

view histogram as probability of a gray level

Then:



Converting image so that all gray levels are equally likely will increase local contrast

gives



Look at tom

im hist
histeq

Histogram matching

convert image to match histogram which characterizes a "type" of image or scene

look at autumn & tom
histeq (tom, imhist (autumn))