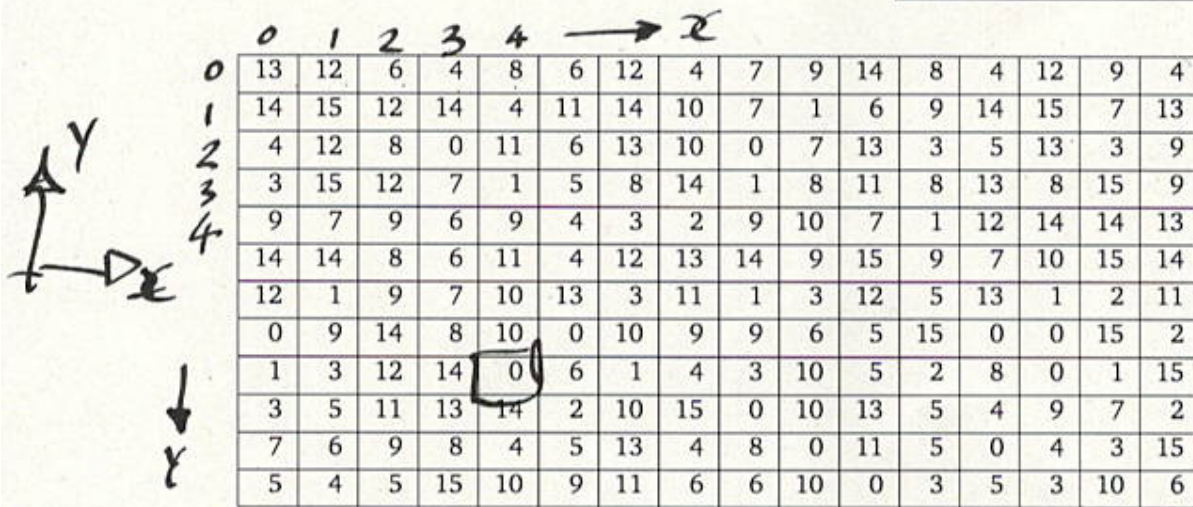


Worksheet on Histograms

Name:

Adrian



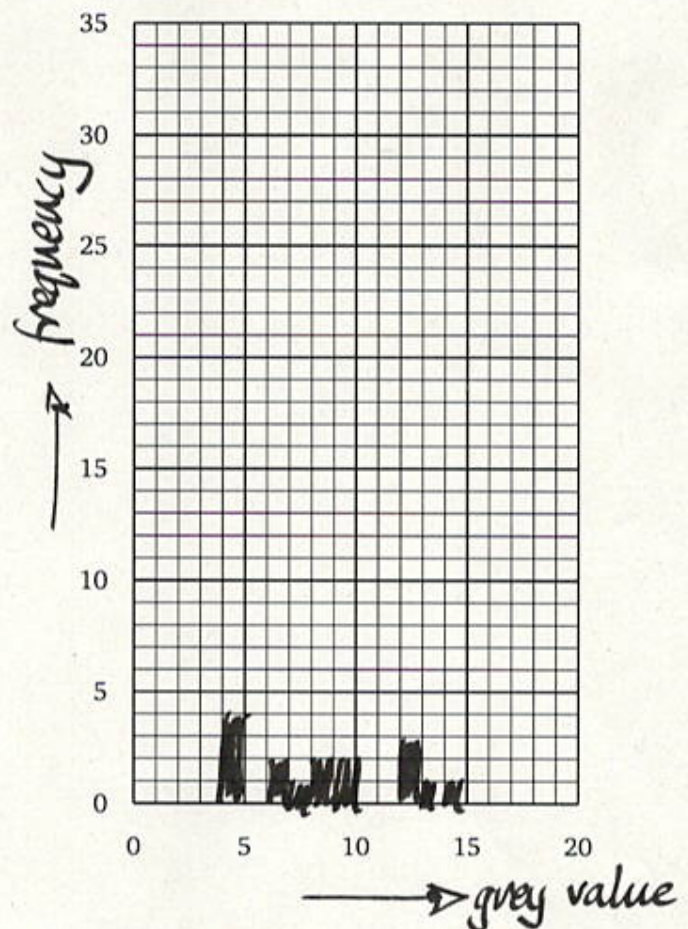
Handwritten coordinate system (x, y) and a small 3x3 region highlighted in the center of the grid.

| | | | | | | | | | | | | | | | | |
|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| 0 | 13 | 12 | 6 | 4 | 8 | 6 | 12 | 4 | 7 | 9 | 14 | 8 | 4 | 12 | 9 | 4 |
| 1 | 14 | 15 | 12 | 14 | 4 | 11 | 14 | 10 | 7 | 1 | 6 | 9 | 14 | 15 | 7 | 13 |
| 2 | 4 | 12 | 8 | 0 | 11 | 6 | 13 | 10 | 0 | 7 | 13 | 3 | 5 | 13 | 3 | 9 |
| 3 | 3 | 15 | 12 | 7 | 1 | 5 | 8 | 14 | 1 | 8 | 11 | 8 | 13 | 8 | 15 | 9 |
| 4 | 9 | 7 | 9 | 6 | 9 | 4 | 3 | 2 | 9 | 10 | 7 | 1 | 12 | 14 | 14 | 13 |
| | 14 | 14 | 8 | 6 | 11 | 4 | 12 | 13 | 14 | 9 | 15 | 9 | 7 | 10 | 15 | 14 |
| | 12 | 1 | 9 | 7 | 10 | 13 | 3 | 11 | 1 | 3 | 12 | 5 | 13 | 1 | 2 | 11 |
| | 0 | 9 | 14 | 8 | 10 | 0 | 10 | 9 | 9 | 6 | 5 | 15 | 0 | 0 | 15 | 2 |
| | 1 | 3 | 12 | 14 | 0 | 6 | 1 | 4 | 3 | 10 | 5 | 2 | 8 | 0 | 1 | 15 |
| | 3 | 5 | 11 | 13 | 14 | 2 | 10 | 15 | 0 | 10 | 13 | 5 | 4 | 9 | 7 | 2 |
| | 7 | 6 | 9 | 8 | 4 | 5 | 13 | 4 | 8 | 0 | 11 | 5 | 0 | 4 | 3 | 15 |
| | 5 | 4 | 5 | 15 | 10 | 9 | 11 | 6 | 6 | 10 | 0 | 3 | 5 | 3 | 10 | 6 |

Seed: 0

Above is a simulated image which contains a small range of grey levels. Your task is to determine the number of pixels that occupy each grey level and hence to draw the histogram of the image. You should use the region to the left below for recording the grey level frequency and the squared region below right for drawing your histogram. Marks are awarded as shown in the table at the foot of the page.

| | | |
|----|--|---|
| 0 | | |
| 1 | | |
| 2 | | |
| 3 | | |
| 4 | | 4 |
| 5 | | |
| 6 | | 2 |
| 7 | | 1 |
| 8 | | 2 |
| 9 | | 2 |
| 10 | | |
| 11 | | |
| 12 | | 3 |
| 13 | | 1 |
| 14 | | 1 |
| 15 | | |



TODAY'S TOPICS

1. histograms by hand
2. Colour models home-grown routine
3. Colour in OpenCV OpenCV
4. Maths and code
5. Correlation

COLOUR MODELS

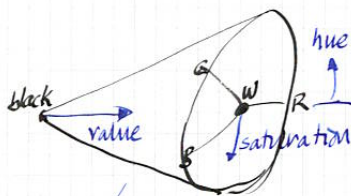
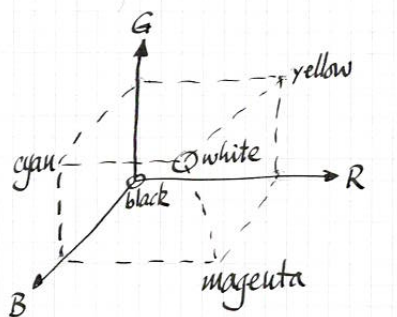
$R, G, B[A]$ R, G, B + "this pixel is not fully filled"



CMYK - the converse of RGB, how paint works

CMY - Cyan Magenta Yellow
 - mix to get other colours
 - mix in black where possible as it's cheaper

1



Hue
 Saturation
 Value
 or HSV
 widely used in vision

COLOUR IN OPENCV

...because it's weird.

We talk about RGB images, so we expect

| | | |
|-------|---|---|
| red | 0 | 2 |
| green | 1 | 1 |
| blue | 2 | 0 |

in the RGB colour model ↑ what we expect ↑ in OpenCV

channel number, c , in most of my programs

There is a routine in OpenCV which converts between colour models

2

Maths and code

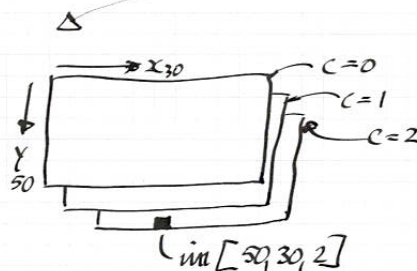
$$\text{mean}, \mu = \frac{1}{N} \sum_{i=1}^N x_i \longrightarrow$$

$$\mu = \frac{1}{N_c} \frac{1}{N_x} \frac{1}{N_y} \sum_{y=1}^{N_y} \sum_{x=1}^{N_x} \sum_{c=1}^{N_c} x_{yxc}$$

```

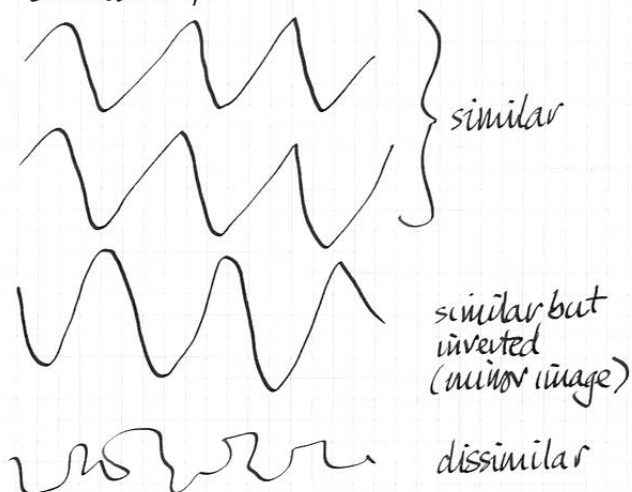
sum = 0
for y ...
  for x ...
    for c ...
      sum = sum + in[y,x,c]
return sum/(ny * nx * nc)

```



3

Correlation, r



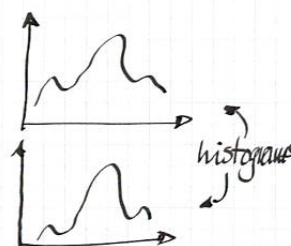
How can we measure how similar the signals are?

correlation value

$$r \approx 1$$

$$r \approx -1$$

$$r \approx 0$$



If histograms of two images are similar, we might say that the images themselves are similar

this is what the second experiment explores

this doesn't work very well

4