01. INTRODUCTION TO DIGITAL IMAGES

M4U4P1

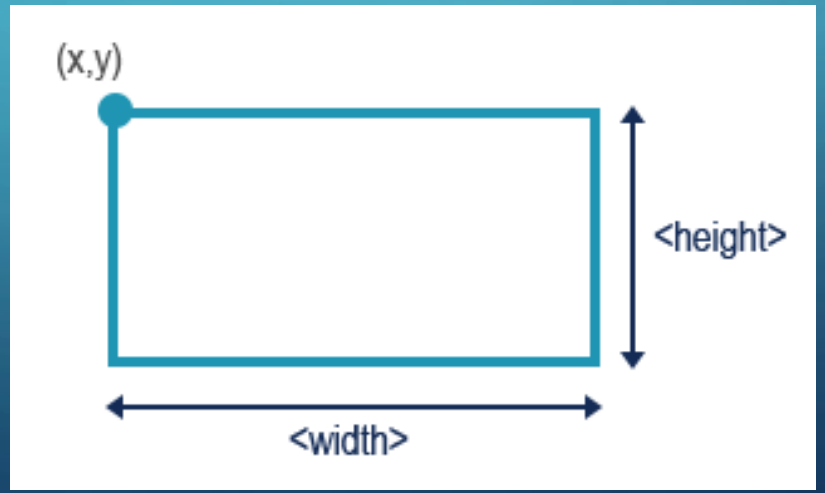
WHAT IS A DIGITAL IMAGE?

DIGITAL IMAGE

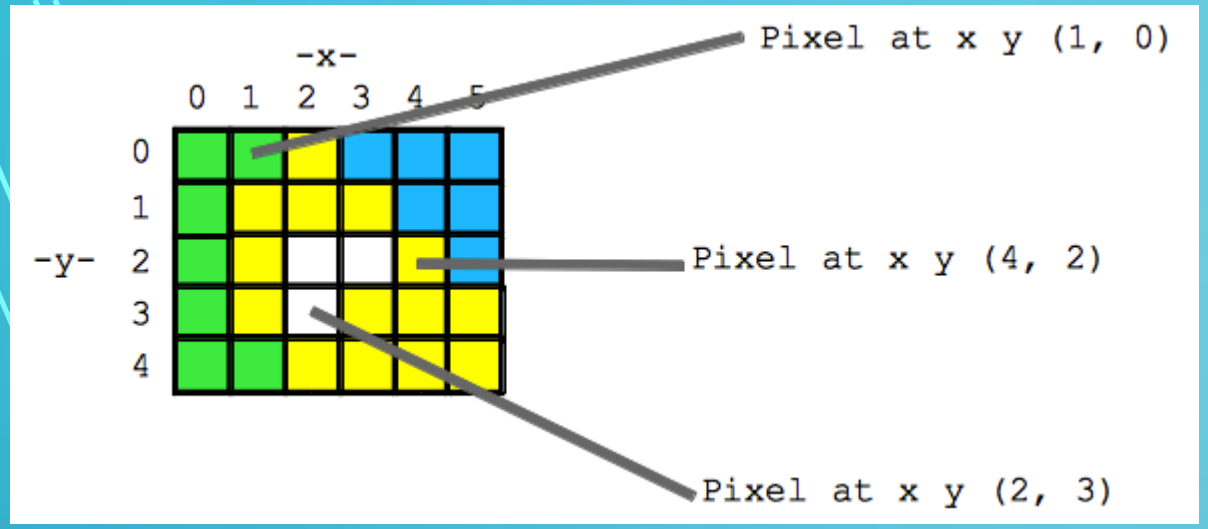
- A **digital image** is a numeric representation, normaly binary, of a two-dimensional image
- They are made out of elements called **pixels**
- The size of an image is determined by the dimensions of the pixel array

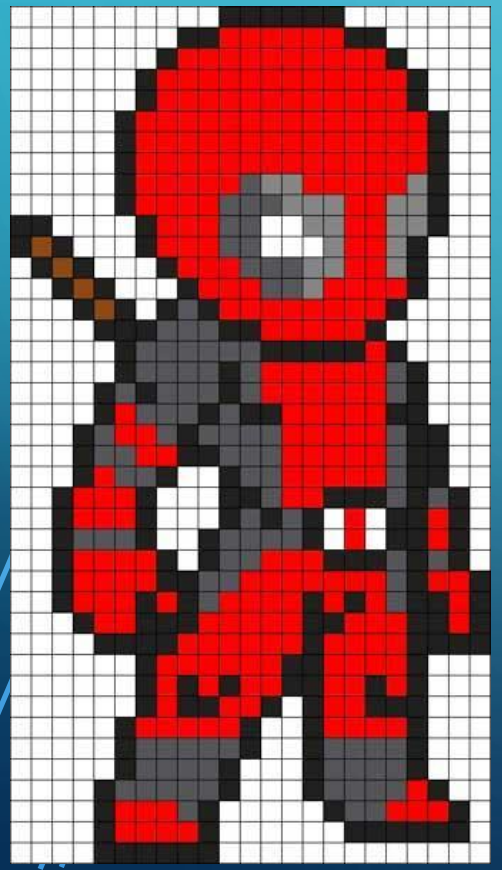
SIZE OF THE IMAGE

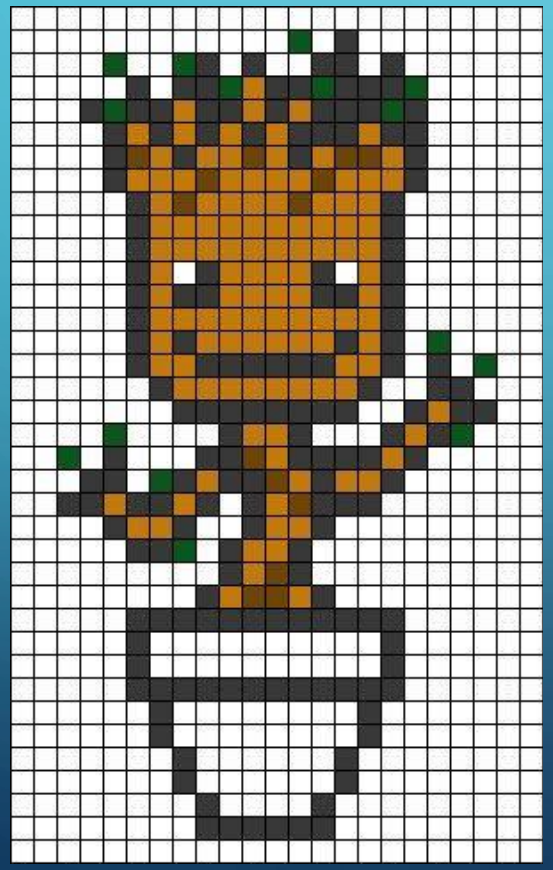
- The image width is determined by the number of columns and the image height is the number of rows in the array
- The pixel array is is a matrix of M columns x N rows



- Zooming in on the photo of a flower, we can see that it is actually made of many square "pixels", each showing one color







- Pixels are organized as a x/y grid
- x=0, y=0 "origin" **upper left corner** - aka (0, 0)
- X grows going to the right
- Y grows going down
- Just like typing a page of text
- x=0, y=0 "origin" at upper left - (0, 0)
- x=1, y=0 neighbor to the right of origin - (1, 0)
- x=0, y=1 neighbor below the origin - (0, 1)

- A pixel does not need to be rendered as a small square. This image shows alternative ways of reconstructing an image from a set of pixel values, using dots, lines, or smooth filtering.

- Image size should not be confused with the size of real world representation of an image
- Image size **specifically** describes the number of pixels within a digital image
- The real world representation of a digital image requires one aditional factor called **resolution**

WHAT IS RESOLUTION?

- Resolution is the spatial scale of the image pixels
- In other words it's how many pixels there are per inch (ppi)
- Image of 3300x2550 pixels with reslution 300ppi would be real world image size 11" x 8.5" or 27.94x21.59cm

ARE WE MISSING SOMETHING?

- When we defined the number of pixels and resolution we are still missing one information

INTENSITY / BRIGHTNESS

INTENSITY

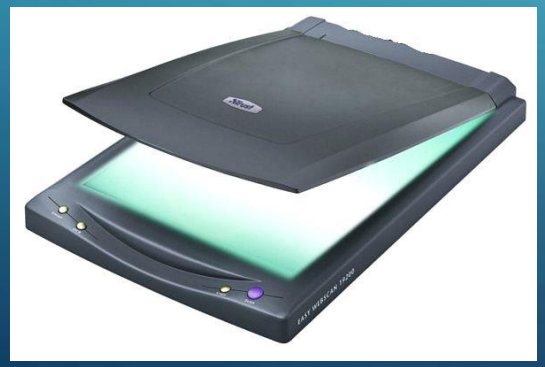
- Each pixel has its own intensity or brightness
- If all pixels had same intensity value the image would be a uniform shade (all black, white, gray...)
- Intensity values in digital images are defined by bits
- One bit has 2 values(0/1)
- Most images use 8bit values for intensity which gives us 256 possible values
- $2^{(\#\ \text{of bits})}$.
- Every image uses 3 colors RGB which gives us 16.7million different colors

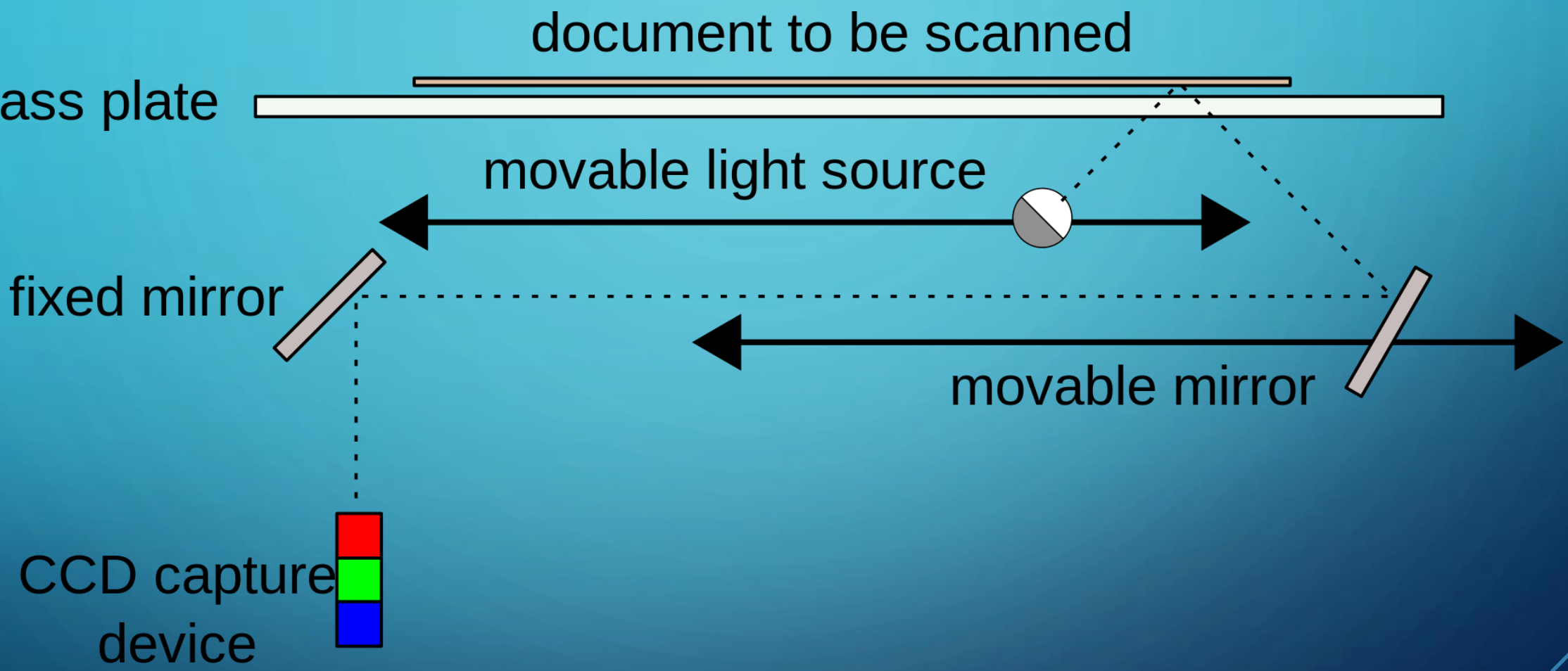
PRODUCTION OF DIGITAL IMAGES

- Digital images can be produced in a number of ways
- Most used are scanner and digital camera

SCANNING

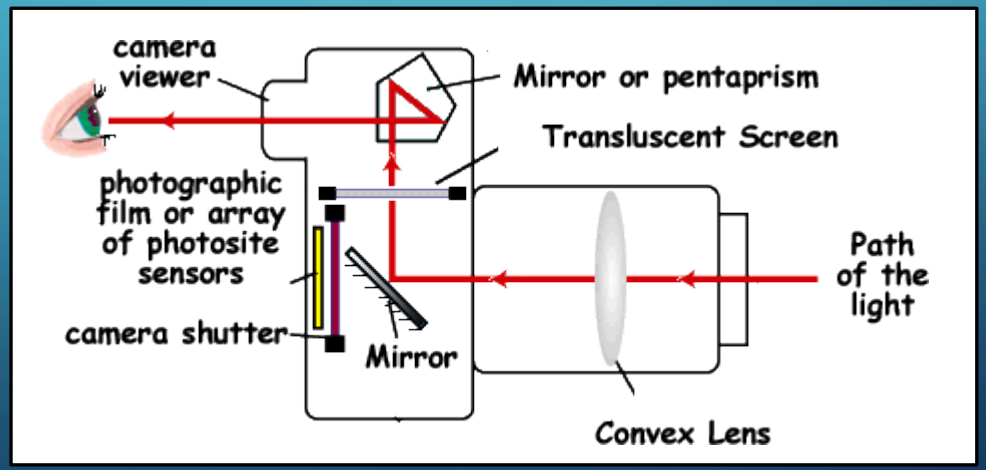
- **Scanning is** a function that digitizes printed documents and pictures and sends the files to your computer or outputs a duplicate copy of the items via the printer.
- We can take any printed material and scan it to obtain a digital copy
- Many scanners are just „plug&play”




document to be scanned
glass plate
movable light source
fixed mirror
movable mirror
CCD capture device

DIGITAL CAMERA

- Digital camera is a camera that captures photographs in digital memory
- Most cameras are now digital
- Optical system
- Uses a lense with variable diaphragm to focus light on the image pickup device



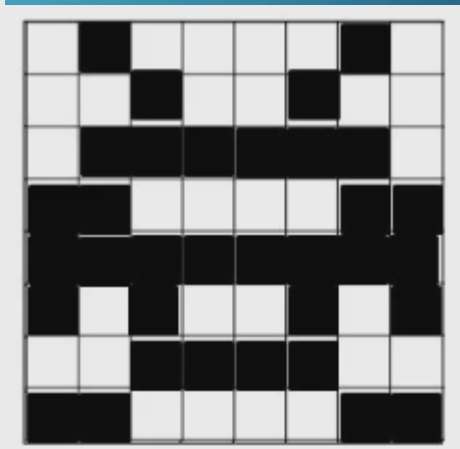
REPRESENTING IMAGES

- We already know that computers only work with 0 and 1
- Computer represents everything in binary (0 and 1)
- Same goes for images
- Images are saved stored in bitmaps

0	1	0	0	0	0	1	0
0	0	1	0	0	1	0	0
0	1	1	1	1	1	1	0
1	1	0	0	0	0	1	1
1	1	1	1	1	1	1	1
1	0	1	0	0	1	0	1
0	0	1	1	1	1	0	0
1	1	0	0	0	0	1	1

Black = 1

White = 0



- Digital image can be divided into 2 types
- 1. Vector type
- 2. Raster type

WE WILL LEARN ABOUT THEM IN NEXT LESSONS

ANY QUESTIONS?

SUBMIT THE WORKSHEET ONLINE

THE END