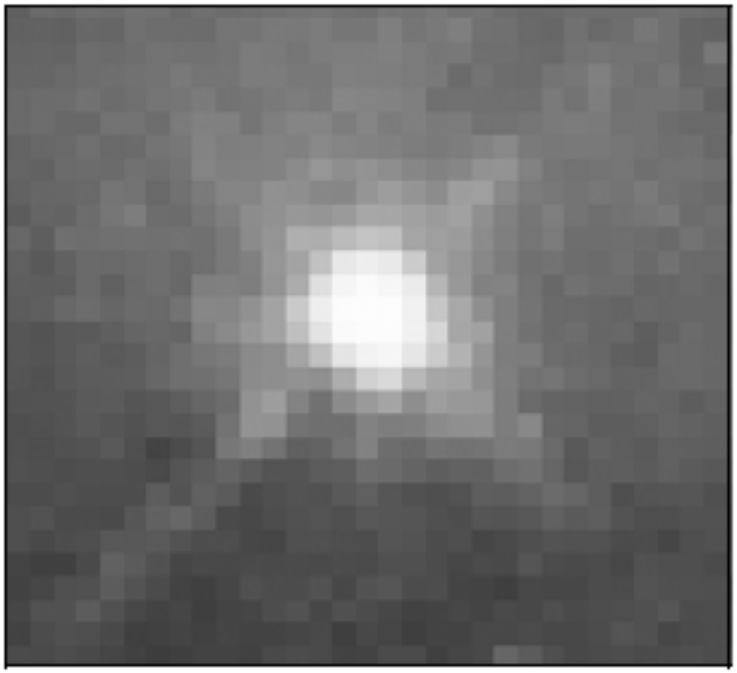
# COGS 119/219
# MATLAB for Experimental Research

Fall 2014

Basics of Image Processing

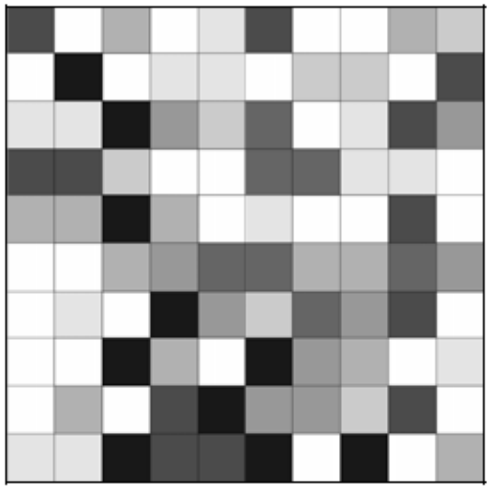
# What is an image?

- An image is an array, or a matrix of square pixels (picture elements) arranged in rows and columns.



# 8-bit grey scale image

- In a (8-bit) grey scale image, each picture element has an assigned intensity that ranges from 0 to 255.
- A grey scale image includes many shades of grey.

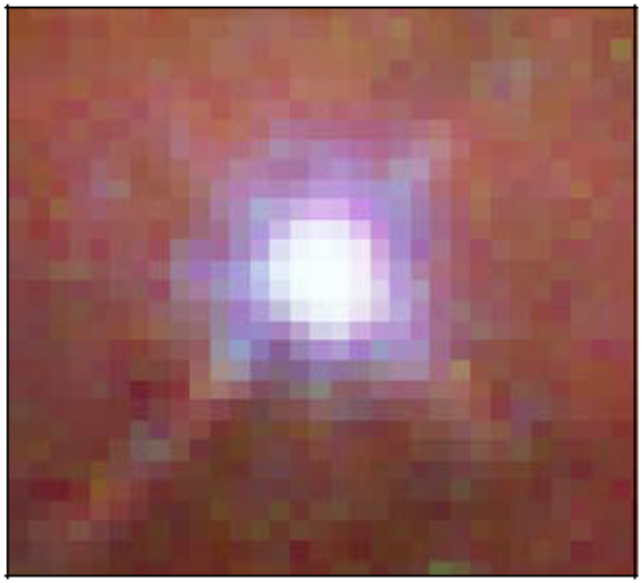


| | |
|---|---|
| 254 | 107 |
| 255 | 165 |

- Each pixel has a value from 0 (black) to 255 (white). The possible range of the pixel values depend on the color depth of the image, here 8-bit = 256 tones or grey scales.

# True-color

- A true-color image has 24 bit color depth ~= 16 million colors.



- A true color image assembled from three grey scale images colored red, green and blue.

# 16 bit grey scale image

- Some grey scale images have more grey scales, e.g. 16 bits = 65536 grey scales.

- In principle, three grey scale images can be combined to form an image with 281,474,976,710,656 grey scales ( = 65536 x 65536 x 65536)

# Image formats

- There are two general groups of images: vector graphics (or line art) and bitmaps (pixel-based).
- Some of the most common file formats are:

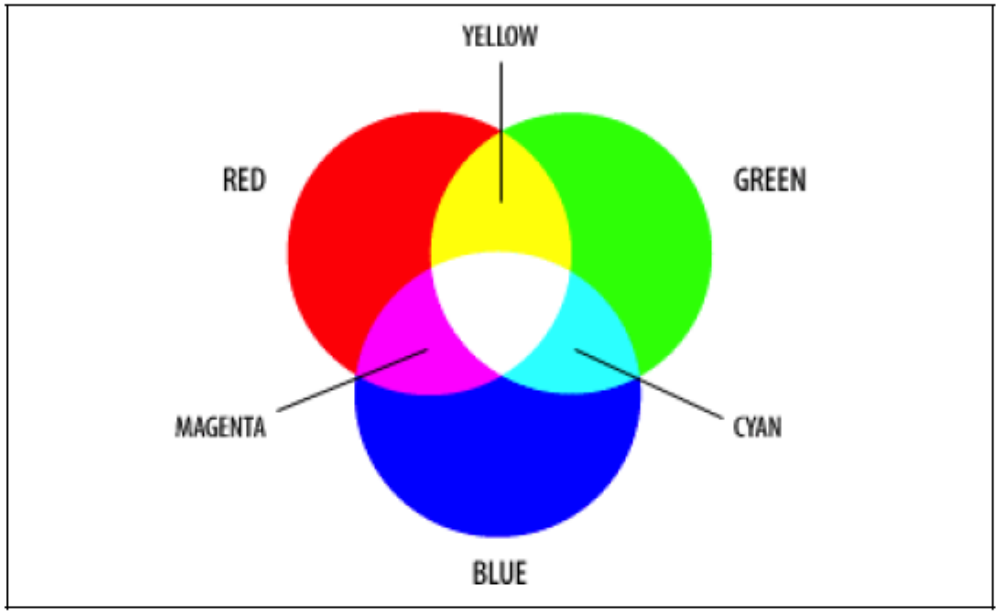
GIF — an 8-bit (256 colour), non-destructively compressed bitmap format. Mostly used for web. Has several sub-standards one of which is the animated GIF.
JPEG — a very efficient (i.e. much information per byte) destructively compressed 24 bit (16 million colours) bitmap format. Widely used, especially for web and Internet (bandwidth-limited).
TIFF — the standard 24 bit publication bitmap format. Compresses non-destructively with, for instance, Lempel-Ziv-Welch (LZW) compression.
PS — Postscript, a standard vector format. Has numerous sub-standards and can be difficult to transport across platforms and operating systems.
PSD – a dedicated Photoshop format that keeps all the information in an image including all the layers.

# Colors - RGB

- The RGB color model relates very closely to the way we perceive color with the r, g and b receptors in or retinas.
- RGB uses additive color mixing.
- RGB is the basic color model used in television, computers, for web graphics, and in any medium that projects color with light.
- The secondary colors of RGB – cyan, magenta and yellow – are formed by mixing the two of the primary colors (red, green or blue) and excluding the third color.

# RGB

- Red and green combine to make yellow, green and blue to make cyan, blue and red form magenta. The combination of red, green and blue in full intensity makes white.



# CMYK

- The 4-color CMYK model used in printing lays down overlapping layers of varying percentages of transparent cyan (C), magenta (M), and yellow (Y) inks.
- In addition, a layer of black (B) ink can be added.
- CMYK color model uses subtractive color model.