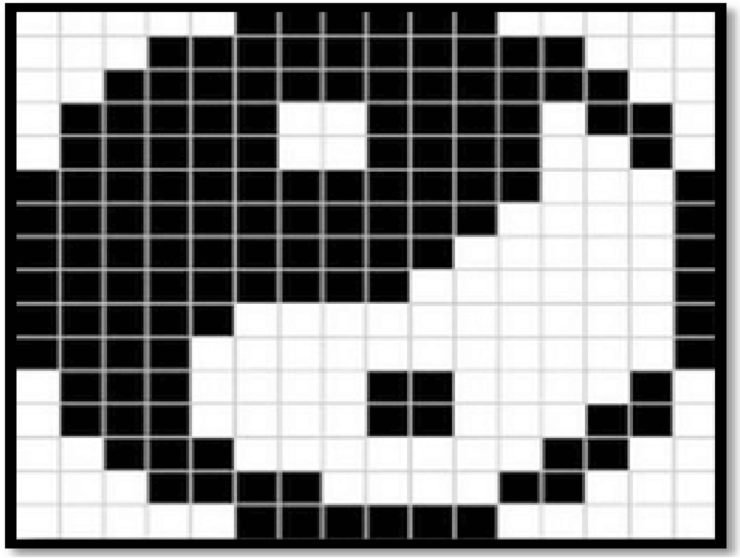
Types of images

- There are many type of images, and we will look in detail about different types of images, and the color distribution in them.

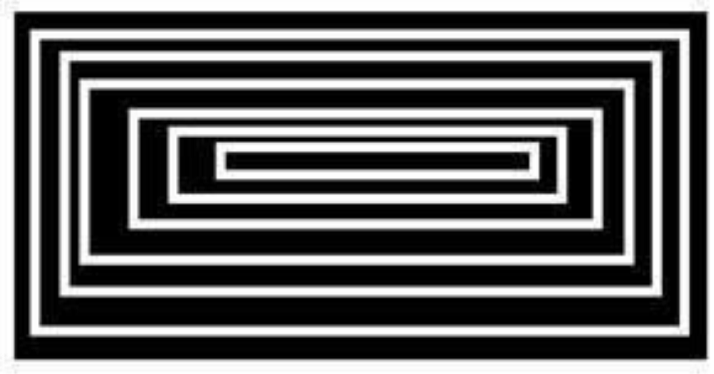
The binary image

- The binary image as it name states, contain only two pixel values. 0 and 1.



Black and white image:

- The resulting image that is formed hence consist of only black and white color and thus can also be called as Black and White image.



No gray level

- One of the interesting this about this binary image that there is no gray level in it. Only two colors that are black and white are found in it.

Format

- Binary images have a format of PBM (Portable bit map)

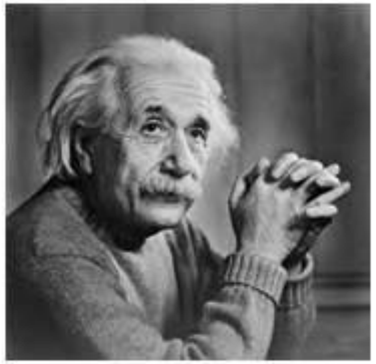
2, 3, 4,5, 6 bit color format

- The images with a color format of 2, 3, 4, 5 and 6 bit are not widely used today. They were used in old times for old TV displays, or monitor displays.

- In a 2 bit 4, in a 3 bit 8, in a 4 bit 16, in a 5 bit 32, in a 6 bit 64 different colors are present.

8 bit color format

- 8 bit color format is one of the most famous image format. It has 256 different shades of colors in it. It is commonly known as Grayscale image.
- The range of the colors in 8 bit vary from 0-255. Where 0 stands for black, and 255 stands for white, and 127 stands for gray color.



Format

- The format of these images are PGM (Portable Gray Map).
- This format is not supported by default from windows. In order to see gray scale image, you need to have an image viewer or image processing toolbox such as Matlab,etc.

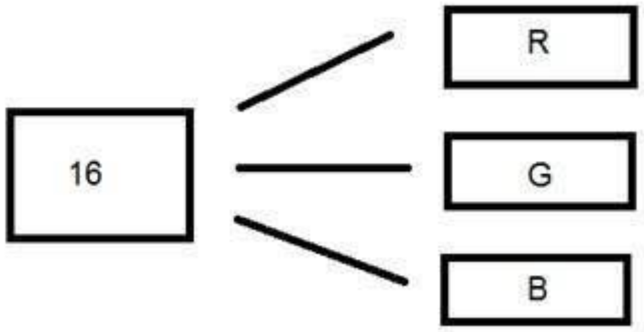
Behind gray scale image:

- As we have explained it several times in the previous lectures, that an image is nothing but a two dimensional function, and can be represented by a two dimensional array or matrix. So in the case of the image of Einstein shown above, there would be two dimensional matrix in behind with values ranging between 0 and 255.

16 bit color format

- It is a color image format. It has 65,536 different colors in it. It is also known as High color format.
- The distribution of color in a color image is not as simple as it was in grayscale image.
- A 16 bit format is actually divided into three further formats which are Red , Green and Blue. The famous (RGB) format.

- It is pictorially represented in the image below



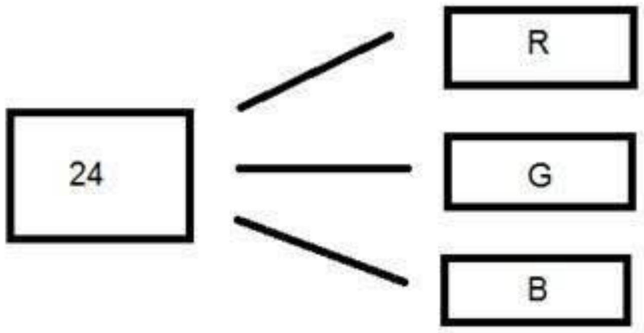
- Now the question arises, that how would you distribute 16 into three. If you do it like this,
- 5 bits for R, 5 bits for G, 5 bits for B
- Then there is one bit remains in the end.
- So the distribution of 16 bit has been done like this.
- 5 bits for R, 6 bits for G, 5 bits for B.

Another distribution of 16 bit format is like this:

- 4 bits for R, 4 bits for G, 4 bits for B, 4 bits for alpha channel.Or some distribute it like this ,5 bits for R, 5 bits for G, 5 bits for B, 1 bits for alpha channel.

24 bit color format

- 24 bit color format also known as true color format. Like 16 bit color format, in a 24 bit color format, the 24 bits are again distributed in three different formats of Red, Green and Blue.



- Since 24 is equally divided on 8, so it has been distributed equally between three different color channels.
- Their distribution is like this.
- 8 bits for R, 8 bits for G, 8 bits for B.

Behind a 24 bit image.

- Unlike a 8 bit gray scale image, which has one matrix behind it, a 24 bit image has three different matrices of R, G, B.

Format

- It is the most common used format. Its format is PPM (Portable pixMap) which is supported by Linux operating system. The famous windows has its own format for it which is BMP (Bitmap).

Color Codes Conversion

Different color codes

- All the colors here are of the 24 bit format, that means each color has 8 bits of red, 8 bits of green, 8 bits of blue, in it. Or we can say each color has three different portions. You just have to change the quantity of these three portions to make any color.

Binary color format

- **Color:Black**
- **Image:**

- **Decimal Code:**

  (0,0,0)

- **Color: White**

- **Image:**

- **Decimal Code:**

  (255,255,255)

RGB color model:

- **Color:Red**
- **Image:**

- **Decimal Code:**

  (255,0,0)

- **Color: Green**
- **Image:** 🟩
- **Decimal Code:**
  (0,255,0)

- **Color: Blue**
- **Image:** 🟦
- **Decimal Code:**
  (0,0,255)

- **Color: Gray**
- **Image:** ▬
- **Decimal Code:**
  (128,128,128)

CMYK color model:

- CMYK is another color model where c stands for cyan, m stands for magenta, y stands for yellow, and k for black.
- The colors of CMY can also made from changing the quantity or portion of red, green and blue.
  - **Color: Cyan**
  - **Image:**

  - **Decimal Code:**

    (0,255,255)

  - **Color: Magenta**
  - **Image:**

  - **Decimal Code:**

    (255,0,255)

- **Color: Yellow**
- Image:

- Decimal Code:

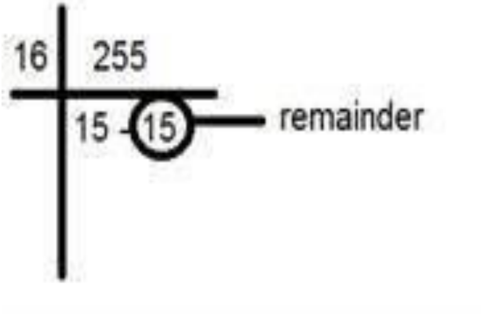
  (255,255,0)

Conversion

- Now we will see that how color are converted from one format to another.

Conversion from RGB to Hex code:

- Conversion from Hex to rgb is done through this method:
- Take a color. E.g: White = (255, 255, 255).
- Take the first portion e.g 255.
- Divide it by 16. Like this:



Conversion from Hex to RGB:

Conversion from hex code to rgb decimal format is done in this way.

- Take a hex number. E.g: #FFFFFF
- Break this number into 3 parts: FF FF FF
- Take the first part and separate its components: F F
- Convert each of the part separately into binary: (1111) (1111)
- Now combine the individual binaries into one: 11111111
- Convert this binary into decimal: 255
- Now repeat step 2, two more times.
- The value comes in the first step is R, second one is G, and the third one belongs to B.

Common colors and their Hex code has been given in this table

Color	Hex Code
Black	#000000
White	#FFFFFF
Gray	#808080
Red	#FF0000
Green	#00FF00
Blue	#0000FF
Cyan	#00FFFF
Magenta	#FF00FF
Yellow	#FFFF00

Grayscale to RGB Conversion

- There are two methods to convert it. Both has their own merits and demerits. The methods are:
- Average method
- Weighted method or luminosity method

1) Average method

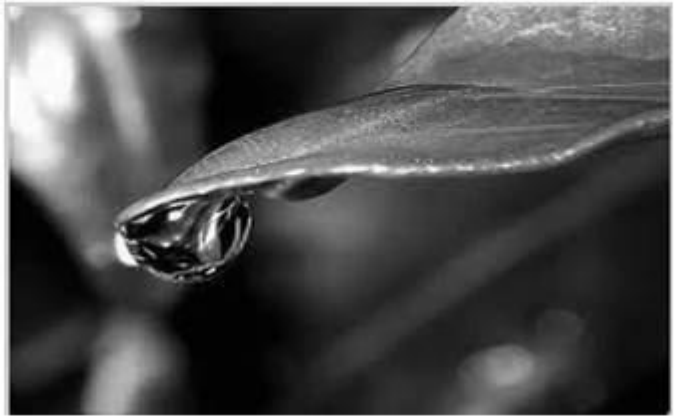
- Average method is the most simple one. You just have to take the average of three colors. Since its an RGB image, so it means that you have add r with g with b and then divide it by 3 to get your desired grayscale image.
- Its done in this way.
- Grayscale = (R + G + B / 3)

2) Weighted method or luminosity method

- Weighted method has a solution to that problem. Since red color has more wavelength of all the three colors, and green is the color that has not only less wavelength then red color but also green is the color that gives more soothing effect to the eyes.
- It means that we have to decrease the contribution of red color, and increase the contribution of the green color, and put blue color contribution in between these two.
- So the new equation that form is:
- New grayscale image = ((0.3 * R) + (0.59 * G) + (0.11 * B)).

- Original image

Grayscale Image



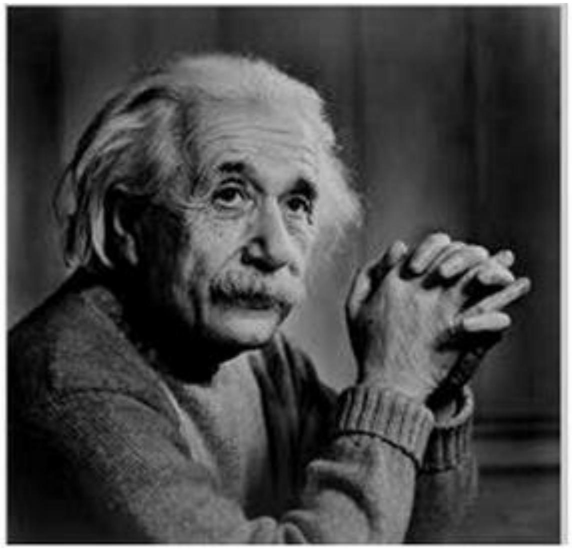
Brightness and Contrast

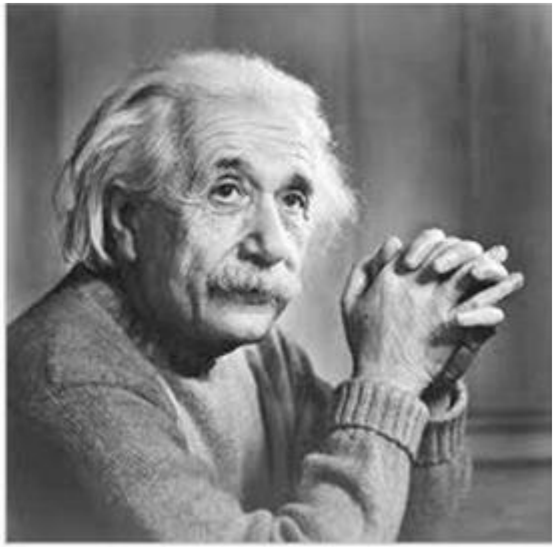
Brightness

- It depends on your visual perception. Since brightness is a relative term, so brightness can be defined as the amount of energy output by a source of light relative to the source we are comparing it to

For example

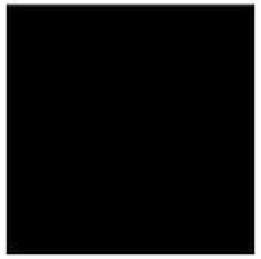
- Just have a look at both of these images, and compare which one is brighter.





How to make an image brighter.

- Brightness can be simply increased or decreased by simple addition or subtraction, to the image matrix.
- Consider this black image of 5 rows and 5 columns



0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0

Image 1

[redacted]

Image 2

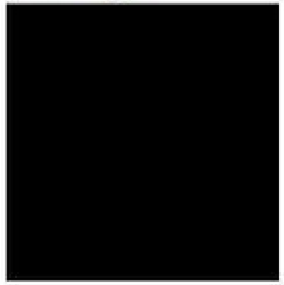
[redacted]

[redacted]

[redacted]

Image 1

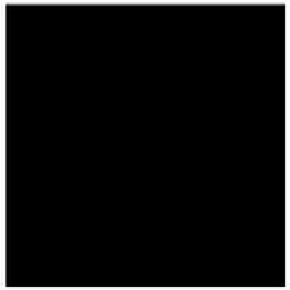
Image 2



Now you can see that the image 1 is slightly brighter than the image 2. We go on, and add another 45 value to its matrix of image 1, and this time we compare again both images.

Image 1

Image 2



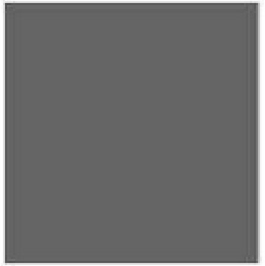
Now when you compare it, you can see that this image1 is clearly brighter than the image 2.

Contrast

- Contrast can be simply explained as the difference between maximum and minimum pixel intensity in an image.

For example.

- Consider the final image1 in brightness.



100	100	100	100	100
100	100	100	100	100
100	100	100	100	100
100	100	100	100	100
100	100	100	100	100