Everything is digital…

Coding Text

Bit, Byte, ASCII, UTF-8,...

- **Bit**: BInary digiT, a flag that can assume two values, 0 or 1.

- **Byte**: 8 bits, the "atom" of the information on PCs.

- **ASCII**: a way to code char with 7 bits, ex:
  010.0000 means <space>
  100.0000 means '@'
  100.0100 100.1111 100.0111 means "DOG"
    - try on google "ASCII TABLE"

- **UTF-8**: a way to code a lot of char with 1 to 4 bytes:
    - try on google "UTF-8"
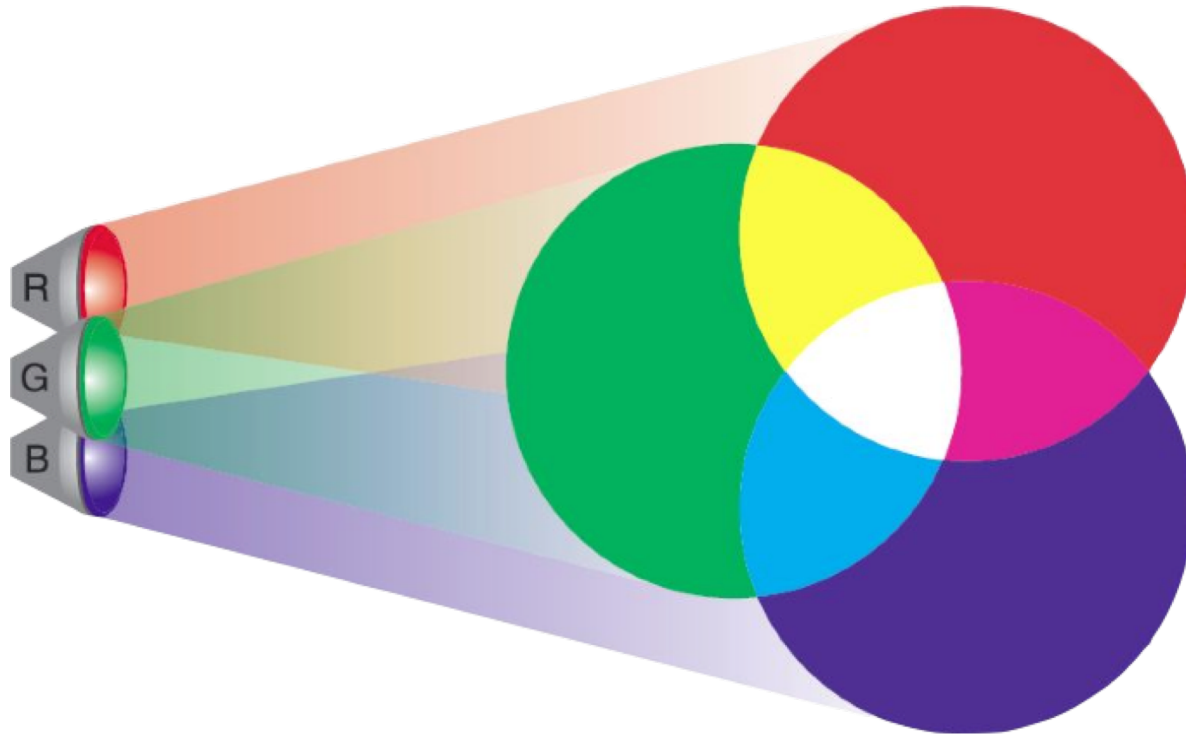
Coding Images

From pixels to images

bitmap

From pixels to images

bitmap

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

Coloring is Addictive

- All (visible) colors are combination of Red, Green, Blue

RGB Color Channels

RGB image

red dominant

blue dominant

Red Chanel

Green Chanel

Blue Chanel

Resolution and Color Depth

- Resolution: number of pixel composing the image:
  - 1024 column x 768 rows = 786.432 pixel

- Color Depth: number of bit used for pixel color:
  - Black And White: 1 bit/pixel
    - 1=black ■
    - 0=white □
  - True color: 24bit/pixel (8 for red, 8 for green, 8 for blue)
    - 0000.0000 0000.0000 0000.0000 = black ■
    - 0000.0000 1111.1111 0000.0000 = green ■
    - 1111.1111 1111.1111 1111.1111 = white □

Coding color with RGB

- **RGB**: color is a combination of **R**ed, **G**reen and **B**lue, (notation based on human perception and oriented to monitor devices)

- Each visible color can be obtained by addictively mix the basic color components Red, Green and Blue with a given ratio.

- The combination ratio can be expressed by 3-ple of numbers: <red_component, green_component, blue_component>
  - try: https://www.w3schools.com/colors/colors_rgb.asp

- The set of the possible component values defines our capacity to express color variations (color depth)

HTML Web Safe Colors — www.beginnersguidetohtml.com

♦ Try on Google: "RGB table"

Color Depth vs Size

- An example of B/W image with different gray-scale palette
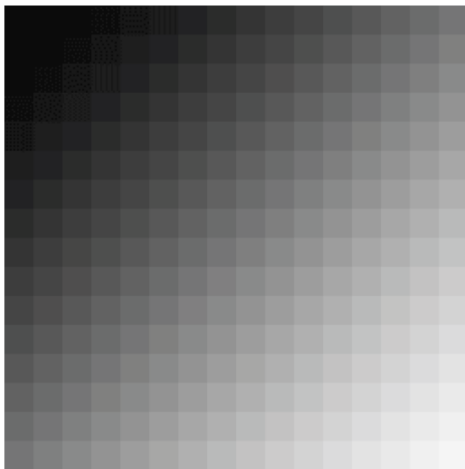
Resolution:512x512
Color depth: 8bit
Image size: 262144 bytes
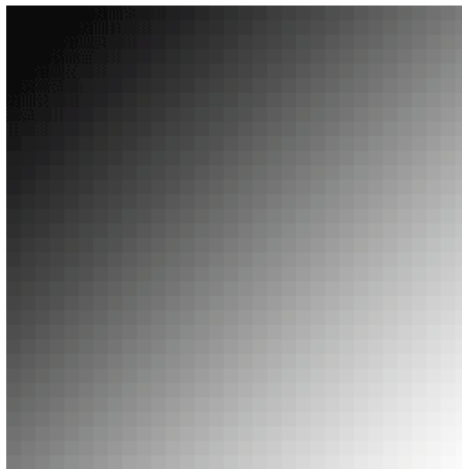
Resolution:512x512
Color depth: 10 bit
Image Size: 327680 bytes

Resolution:512x512
Color depth: 16bit
Image size: 524288 bytes

Other Color Spaces

- There are other many way to "code" colors; a short list:
  - **HSV** and HSL: color is a combination of **H**ue, **S**aturation and (**V**)brightness/**L** uminance (notation oriented to color perception, image manipulation)
  - **CMYK**: color is a combination of **C**yan, **M**agenta, **Y**ellow, blac**K,** oriented to print process by ink.
  - **RAL**: used in industries.

Reference: https://en.wikipedia.org/wiki/List_of_color_spaces_and_their_uses

Coding Sounds

Sampling and the Nyquist rule
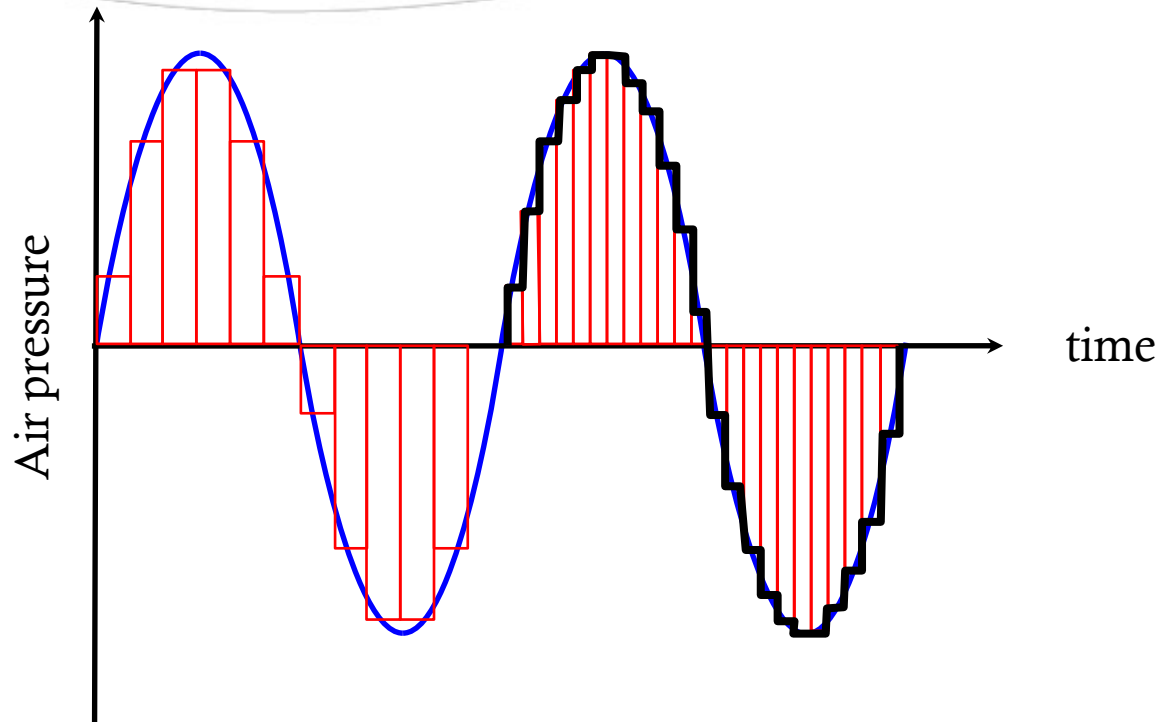
Nyquist rule

"In order to sample a looped signal, it is necessary to use a sampling rate of at least twice the maximum signal frequency"

Example:

- sampling at CD quality: 44khz

- Max audible frequency: 20khz

Coding Codes

Coding for humans

- Hi-Level language programs can be coded as text:

```
/* Hello World C-Language program */
#include<stdio.h>
main()
{
    printf("Hello World\n");
}
```

Coding for (not so) humans

- Low-Level language Language programs are also text:

```
/* Disassembled piece from hello.c */
/* in Assembly Language
....
4000561: sub %r12,%rbp
       : xor %ebx,%ebx
       : sar $0x3,%rbp
       : sub $0x8,%rbp
....
```

Coding for CPU

- CPU languages are made by sequence of bytes:

```
/* Byte Code piece from hello.c */
....
4000561: 4c 29 e5
       : 31 db
       : 48 c1 fd 03
       : 48 83 ec 08
....
```