IT101

## Binary, Hex and Colors

RGB Colors

- Computer screens create color by mixing varying amounts of red, green, and blue light. Combining them in different intensities creates the illusion of different colors. For example, black can be thought of as zero red light, zero green light, and zero blue light; white, on the other hand, is lots of all three colors of light. Any color that the screen can display can be specified as a mixture of just red, green, and blue light. This is called an additive color system.

- The following values specify full intensity red and all produce the same result:

    - red

    - rgb(255,0,0)

    - rgb(100%,0%,0%)

    - #ff0000

    - #f00

- Color picker: http://www.colorpicker.com

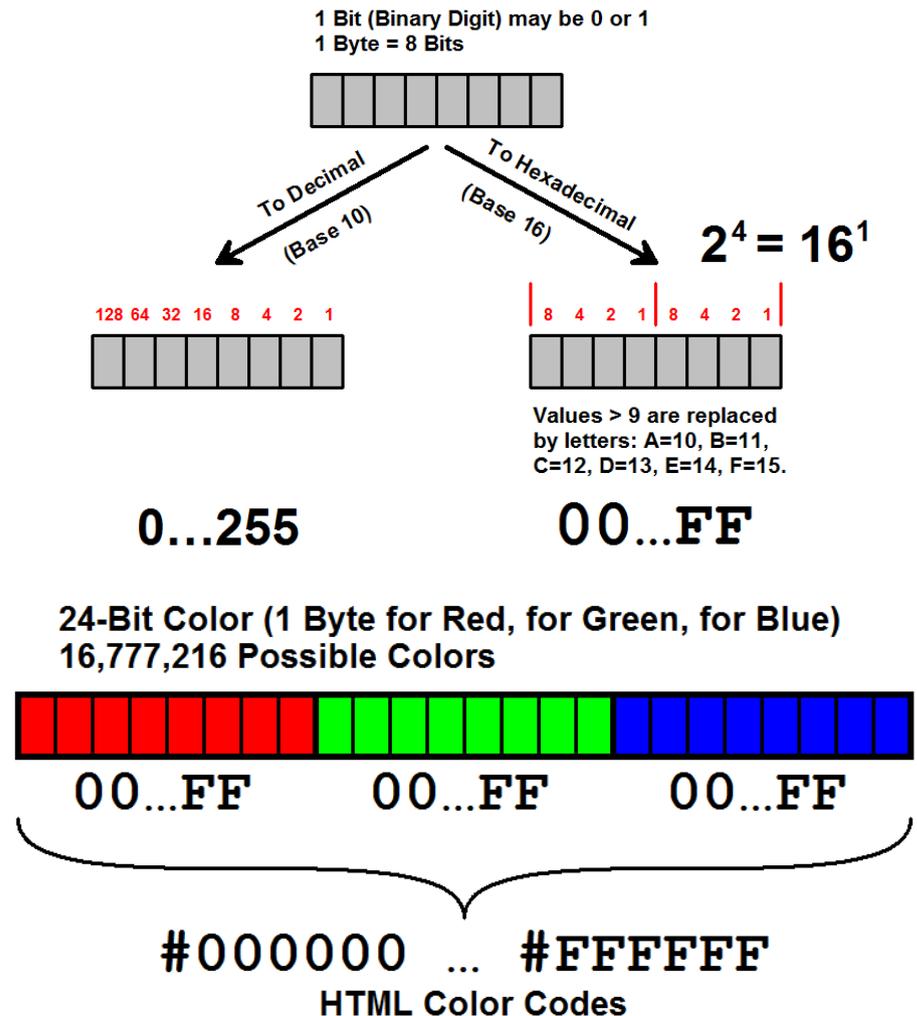http://www.eos.ncsu.edu/e115/text.php?ch=10&p=hex
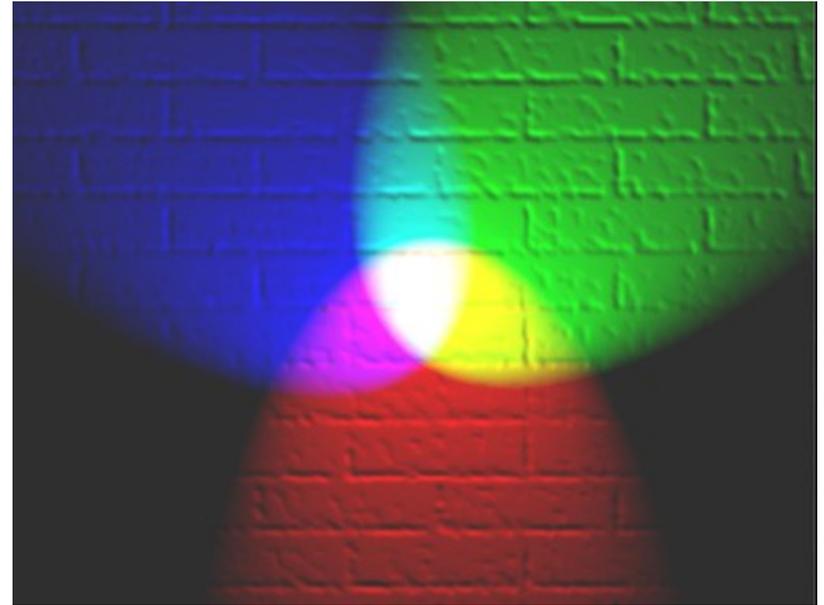
Binary System

- The word binary comes from "Bi-" meaning two. We see "bi-" in words such as "bicycle" (two wheels) or "binocular" (two eyes).

- A Binary Number is made up of only 0s and 1s, for example 110100

- There is no 2,3,4,5,6,7,8 or 9 in Binary!

- A single binary digit (like "0" or "1") is called a "bit". For example 11010 is five bits long. The word bit is made up from the words "binary digit"

	Binary	
	0	Start at 0
•	1	Then 1
••	10	Start back at 0 again, but add 1 on the left
•••	11	
••••	100	start back at 0 again, and add one to the number on the left... ... but that number is already at 1 so it also goes back to 0 ... ... and 1 is added to the *next position* on the left
•••••	101	
••••••	110	
•••••••	111	
••••••••	1000	Start back at 0 again (for all 3 digits), add 1 on the left
•••••••••	1001	And so on!

Decimal:	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Binary:	0	1	10	11	100	101	110	111	1000	1001	1010	1011	1100	1101	1110	1111

Hexadecimal System

- Colors are represented in hexadecimal format as **three bytes**: one byte for red, one for green, and another for blue. A byte (8 bits, coined by Werner Buchholz, IBM) can have a value between 0 and 255. Rather than specifying them as a triple of decimal numbers, each byte can be conveniently represented exactly as two hexadecimal digits. Hexadecimal, or hex, is, like decimal and binary, a positional number system; however hex digits are base **16**. They are written using 0-9 for the first 10 numerals, and A-F for the remaining 6 numerals. Decimal 10 becomes hexadecimal A, 12 becomes B, etc., up to F. The values 0 through 255 become 0 through FF.

- Computers use hex to specify colors. They begin with a hash followed by six hex digits. The first two hex digits represent the red intensity, the next two represent green, and the last two represent blue: #rrggbb. For example, a bright red color can be thought of as full red intensity with zero intensity green and blue, thus #FF0000. When red and green light are mixed, the result, #FFFF00, is yellow.

1 Bit (Binary Digit) may be 0 or 1
1 Byte = 8 Bits

To Decimal (Base 10)

To Hexadecimal (Base 16)

$2^4 = 16^1$

128 64 32 16 8 4 2 1

8 4 2 1   8 4 2 1

Values > 9 are replaced by letters: A=10, B=11, C=12, D=13, E=14, F=15.

0…255

00…FF

24-Bit Color (1 Byte for Red, for Green, for Blue)
16,777,216 Possible Colors

00…FF   00…FF   00…FF

#000000 … #FFFFFF
HTML Color Codes

http://people.cs.umass.edu/~verts/cmpsci120/cmpsci120.html

Exercises

- **Binary:**
  - Convert 129 to binary equivalent;
  - Convert 34 to binary equivalent;
  - Convert 47 to binary equivalent;
  - Convert 100110 to decimal equivalent;

- **Hex**
  - Convert E6 to decimal equivalent;
  - Convert A2 to decimal equivalent;
  - Convert 2 to hex equivalent;
  - Convert 255 to hex equivalent;
  - Convert 200 to hex equivalent.

Homework

- Convert 3 (decimal) to binary equivalent.

- Convert 7 (decimal) to binary equivalent.

- Convert 161 (decimal) to hexadecimal equivalent.

- Convert 49 (decimal) to hexadecimal equivalent.

- Convert F (hexadecimal) to decimal equivalent.

- Convert FA (hexadecimal) to decimal equivalent.