

DAYS ARE NUMBERS

- STARS ARE NUMBERS • COLORS ARE NUMBERS • NUMBERS ARE NUMBERS.

BINARY

"BINARY" REFERS TO TWO STATES

"BITS" ARE BINARY DIGITS

0	1	0	1
2^3	2^2	2^1	2^0

$$= 0 \times 2^3 + 1 \times 2^2 + 0 \times 2^1 + 1 \times 2^0$$

$$= 0 + 4 + 0 + 1$$

$$= 5$$

TWO STATES

ON	OFF
1	0
TRUE	FALSE

BASE 10 TO BINARY: REPEATED DIVISION

$$13_{10} = 1101_2$$

1) DIVIDE REPEATEDLY BY 2

2) REMAINDER IS A BIT

$$13/2 - 6 \text{ REMAINDER } 1 - 2^0$$

$$6/2 - 3 \text{ REMAINDER } 0 - 2^1$$

$$3/2 - 1 \text{ REMAINDER } 1 - 2^2$$

$$1/2 - 0 \text{ REMAINDER } 1 - 2^3$$

$$13_{10} = 1101_2$$

Hexadecimal

• BASE 16

F	0	1	3
16^3	16^2	16^1	16^0

$$= 15 \times 16^3 + 0 \times 16^2 + 1 \times 16^1 + 3 \times 16^0$$

$$= 61,440 + 0 + 16 + 3$$

$$= 61,459$$

BINARY	DECIMAL	HEXA
0000	0	0
0001	1	1
0010	2	2
0011	3	3
0100	4	4
0101	5	5
0110	6	6
0111	7	7
1000	8	8
1001	9	9
1010	10	A
1011	11	B
1100	12	C
1101	13	D
1110	14	E
1111	15	F

COLOR CODES:

#RRGGBB

EACH COLOR HAS 8 BITS RANGING FROM 0-255

0-255 IS THE INTENSITY OF THAT COLOR

#000000 = BLACK = 0, 0, 0

#FFFFFF = WHITE = 255, 255, 255

#FF0000 = RED = 255, 0, 0

#FFA500 = ORANGE = 255, 175, 0

#FFFF00 = YELLOW = 255, 255, 0

#00FF00 = GREEN = 0, 255, 0

#0000FF = BLUE = 0, 0, 255

#FF00FF = PURPLE = 255, 0, 255

Two's Complement

1) INVERT ALL THE BITS

2) ADD 1

	POSITIVE #		INVERT BITS		ADD 1
-5 :	00101	→	11010	→	11011
-8 :	01000	→	10111	→	11000
-15 :	01111	→	10000	→	10001
-16 :	10000	→	01111	→	10000

INTEGER RANGES

BITS	UNSIGNED	SIGNED
8	0-255	-128 - 127
16	0 - 65,535	-32,768 - 32,767
32	0-4,294,967,295	-2,147,483,648 - 2,147,483,647
64	0 - 16×10^{18} approx	$\pm 8 \times 10^{18}$ approx

addition

carry	1	0	1	1	0	0
	13	0	0	0	1	1
	+ 28	+	0	0	1	1
	<u>41</u>		0	1	0	0
			0	1	0	1

subtraction

NEGATE AND ADD

$$28 + -13 = 15$$

$$-13 = 1110010 + 1110011$$

	11
-13	1110011
+28	0011100
<u>15</u>	1000111

overflow

IN 8 BITS $96 + 65$ WILL CAUSE AN OVERFLOW ERROR

$$96_{10} + 65_{10} = 01100000_2 + 01000001_2 = 10100001_2$$

$$\text{IN 2'S COMPLEMENT } 10100001_2 = -95_{10}$$

WHEN OVERFLOW OCCURS AND THERE AREN'T ENOUGH BITS TO CREATE A HIGH ENOUGH NUMBER, IT STARTS AT THE LOWEST NEGATIVE NUMBER

ASCII

AMERICAN STANDARD CODE FOR INFORMATION INTERCHANGE

7 BIT CODE FOR REPRESENTING CHARACTERS

LETTER	ASCII CODE	BINARY
A	065	01000001
B	066	01000010
C	067	01000011
D	068	01000100
etc.	etc.	etc.

UNICODE & UTF-8

UNICODE IS LIKE AN EXTENDED ASCII ALPHABET
FIRST 128 codepoints are the same as ASCII
INCLUDES CHARACTERS FROM OTHER LANGUAGES,
EMOTIONS + CHESS PIECES.

FRACTIONAL BINARY

1	1	0	0	1	0	1	1	0
2^4	2^3	2^2	2^1	2^0	2^{-1}	2^{-2}	2^{-3}	2^{-4}
16	8	4	2	1	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{8}$	$\frac{1}{16}$

$$= 16 + 8 + 0 + 0 + 1 + 0 + \frac{1}{4} + \frac{1}{8} + 0$$

$$= 25.375$$