BASES

Kai
2025

binary / base 2

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	max:	notation:
128	64	32	16	8	4	2	1	255	X_2
0					1				

Context: (optional)
This 225 might be familiar to anyone who has interacted with RGB colours in art programs, colour pickers, CSS, or other digital medias. In RGB we represent each colour with a value ranging from 0 to 225. This is called 32 bit color, typically with 24 bits to RGB and the remaining 8 to an alpha channel(transparency). Each channel, Red Green and Blue, holds 8 bits of information. We say this because we use 8 digits to store this data, each digit is one bit.

hexadecimal / hex / base 16

16^7	16^6	16^5	16^4	16^3	16^2	16^1	16^0	max:	notation:
268435456 (4026531840)	16777216 (251658240)	1048576 (15728640)	65536 (983040)	4096 (61440)	256 (4095)	16 (240)	1 (15)	4294967295	X_{16}

0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F

Context: (optional)
hex is also frequently used for colours, you may have seen something like #FF403A or #FF403A65. These are representations of the binary RGB colours, except all in one number rather than having to write out a number for each channel. Every pair of two digits represents another channel. The brackets above represent the maximum value one can represent in that place value, wheras the regular numbers represent the minimum value(besides zero) which can be represented at that place value. (this does not apply to binary as there are only two options, zero or 2^x, therefore it is redundant to specify a max.)

decimal / denary / decanary / base 10

10^9	10^8	10^7	10^6	10^5	10^4	10^3	10^2	10^1	10^0	notation:
0	1	2	3	4	5	6	7	8	9	X_{10}

1. Here is a message encoded in ASCII using 8 bits per symbol. What does it say? (See Appendix A)

   01000011 01101111 01101101 01110000 01110101 01110100 01100101 01110010 00100000 01010011 01100011 01101001 01100101 01101110 01100011 01100101

8. An alternative to hexadecimal notation for representing bit patterns is **dotted decimal notation** in which each byte in the pattern is represented by its base 10 equivalent. In turn, these byte representations are separated by periods. For example, 12.5 represents the pattern 0000110000000101 (the byte 00001100 is represented by 12, and 00000101 is represented by 5), and the pattern 100010000001000000000111 is represented by 136.16.7. Represent each of the following bit patterns in dotted decimal notation.

   a. 0000111100001111
   b. 001100110000000010000000
   c. 0000101010100000

4. Describe a device from everyday life that can be in either of two states, such as a flag on a flagpole that is either up or down. Assign the symbol 1 to one of the states and 0 to the other, and show how the ASCII representation for the letter b would appear when stored with such bits.

5. Convert each of the following binary representations to its equivalent base 10 form:

a. 0101	b. 1001	c. 1011
d. 0110	e. 10000	f. 10010

6. Convert each of the following base 10 representations to its equivalent binary form:

a. 6	b. 13	c. 11
d. 18	e. 27	f. 4

7. What is the largest numeric value that could be represented with three bytes if each digit were encoded using one ASCII pattern per byte? What if binary notation were used?

1. Convert each of the following binary representations to its equivalent base 10 form:

   a. 101010 b. 100001 c. 10111 d. 0110 e. 11111

2. Convert each of the following base 10 representations to its equivalent binary form:

   a. 32 b. 64 c. 96 d. 15 e. 27

3. Convert each of the following binary representations to its equivalent base 10 form:

   a. 11.01 b. 101.111 c. 10.1 d. 110.011 e. 0.101

4. Express the following values in binary notation:

   a. $4\frac{1}{2}$ b. $2\frac{3}{4}$ c. $1\frac{1}{8}$ d. $\frac{5}{16}$ e. $5\frac{5}{8}$

5. Perform the following additions in binary notation:

   a. $\begin{array}{r} 11011 \\ +1100 \\ \hline \end{array}$ b. $\begin{array}{r} 1010.001 \\ +\quad 1.101 \\ \hline \end{array}$ c. $\begin{array}{r} 11111 \\ +0001 \\ \hline \end{array}$ d. $\begin{array}{r} 111.11 \\ +00.01 \\ \hline \end{array}$

Question 7

The 8-bit binary representation for the ASCII character *K* is shown below.
Convert this binary number to hexadecimal notation.

0100 1011

(b) Express the hexadecimal number 1F44D as a binary number. The first four bits have been completed for you.

1F44D

0	0	0	1																