

DSA
Alternate Base Systems
for Cross-Curricular Fun & Engineering Applications

OVERVIEW OF WHAT BASES ARE: BINARY

DESCRIPTION OF BINARY BASE:

Binary is base two, so it is extremely simple. The digits typically used in binary are “0” and “1”; these are called “bits,” short for “*binary digits*”. Arithmetic is remarkably easy in binary; however, even moderately large numbers become extremely long and cumbersome.

Example of how to count in binary: 0, 1 then 10, 11 then 100, 101, 110, 111 then 1000, 1001, 1010, 1011, 1100, 1101, 1110, 1111 then 10000, 10001, 10010, 10011, 10100, 10101, 10110, 10111, 11000, 11001, 11010, 11011 then 100000 etc.

HISTORY OF BINARY BASE:

Binary, as a modern base was first described at length by Gottfried Leibnitz, one of the co-inventors of calculus, in the seventeenth century. Before and after Leibnitz, number systems with traces of binary in them have been devised all over the world, from India to China to Europe. However, binary only became really widespread at the dawn of the digital age.

USE OF THE BINARY BASE:

Because its two digits “0” and “1” correspond to the two possible states of a normal transistor, “off” and “on,” binary is used internally by almost all digital computers. It is very rarely used directly by humans, however, though programmers do sometimes deal directly with “bit-flipping” and “bitwise” operations, especially for embedded applications and other devices with very limited resources. The computer language C, for example, has some facilities for dealing with “bit fields,” in which individual bits are flipped on or off directly to store data. Bits are also important when determining how many characters will be available, as well as some other applications.

EXAMPLES:

Here is a number in base-10: 201.

What does it mean? It means:

two one-hundreds,
zero tens, and
one one.

What does this base-10 number, 201, equal in base-2?

It is 11001001. What does it mean? It means

one one-hundred-twenty-eight,
one sixty-four,
zero thirty-twos,
zero sixteens,
one eight,
zero fours,
zero twos, and
one one.

QUESTIONS:

- 1.) Besides computers, can you think of any other uses for binary?
- 2.) Is binary a convenient base for daily human use? Why or why not?