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Octal

The **octal** numeral system, or **oct** for short, is the base-8 number system, and uses the digits 0 to 7. Octal numerals can be made from binary numerals by grouping consecutive binary digits into groups of three (starting from the right). For example, the binary representation for decimal 74 is 1001010. Two zeroes can be added at the left: (00)1 001 010, corresponding the octal digits 1 1 2, yielding the octal representation 112.

In the decimal system each decimal place is a power of ten. For example:

$$\mathbf{74}_{10} = \mathbf{7} \times 10^1 + \mathbf{4} \times 10^0$$

In the octal system each place is a power of eight. For example:

$$\mathbf{112}_8 = \mathbf{1} \times 8^2 + \mathbf{1} \times 8^1 + \mathbf{2} \times 8^0$$

By performing the calculation above in the familiar decimal system we see why 112 in octal is equal to 64+8+2 = 74 in decimal.

The octal multiplication table

×	1	2	3	4	5	6	7	10
1	1	2	3	4	5	6	7	10
2	2	4	6	10	12	14	16	20
3	3	6	11	14	17	22	25	30
4	4	10	14	20	24	30	34	40
5	5	12	17	24	31	36	43	50
6	6	14	22	30	36	44	52	60
7	7	16	25	34	43	52	61	70
10	10	20	30	40	50	60	70	100

Contents

Usage

By Native Americans

The Yuki language in California and the Pamean languages[1] in Mexico have octal systems because the speakers count using the spaces between their fingers rather than the fingers themselves.[2]

By Europeans

- It has been suggested that the reconstructed Proto-Indo-European word for "nine" might be related to the PIE word for "new". Based on this, some have speculated that proto-Indo-Europeans used an octal number system, though the evidence supporting this is slim.[3]
- In 1668 John Wilkins in *An Essay towards a Real Character, and a Philosophical Language* proposed use of base 8 instead of 10 "because the way of Dichotomy or Bipartition being the most natural and easie kind of Division, that Number is capable of this down to an Unite".[4]
- In 1716 King Charles XII of Sweden asked Emanuel Swedenborg to elaborate a number system based on 64 instead of 10. Swedenborg however argued that for people with less intelligence than the king such a big base would be too difficult and instead proposed 8 as the base. In 1718 Swedenborg wrote (but did not publish) a manuscript: "En ny rekenkonst som om vexlas wid Thalet 8 i stelle then wanliga wid Thalet 10" ("A new arithmetic (or art of counting) which changes at the Number 8 instead of the usual at the Number 10"). The numbers 1-7 are there denoted by the consonants l, s, n, m, t, f, u (v) and zero by the vowel o. Thus 8 = "lo", 16 = "so", 24 = "no", 64 = "loo", 512 = "looo" etc. Numbers with consecutive consonants are pronounced with vowel sounds between in accordance with a special rule.[5]
- Writing under the pseudonym "Hirossa Ap-Iccim" in *The Gentleman's Magazine*, (London) July 1745, Hugh Jones proposed an octal system for British coins, weights and measures. "Whereas reason and convenience indicate to us an uniform standard for all quantities; which I shall call the *Georgian standard*; and that is only to divide every integer in each *species* into eight equal parts, and every part again into 8 real or imaginary particles, as far as is necessary. For tho' all nations count universally by *tens* (originally occasioned by the number of digits on both hands) yet 8 is a far more complete and commodious number; since it is divisible into halves, quarters, and half quarters (or units) without a fraction, of which subdivision *ten* is uncapable...." In a later treatise on Octave computation (1753) Jones concluded: "Arithmetic by *Octaves* seems most agreeable to the Nature of Things, and therefore may be called Natural Arithmetic in Opposition to that now in Use, by Decades; which may be esteemed Artificial Arithmetic."[6]
- In 1801, James Anderson criticized the French for basing the Metric system on decimal arithmetic. He suggested base 8, for which he coined the term *octal*. His work was intended as recreational mathematics, but he suggested a purely octal system of weights and measures and observed that the existing system of English units was already, to a remarkable extent, an octal system.[7]
- In the mid 19th century, Alfred B. Taylor concluded that "Our octonary [base 8] radix is, therefore, beyond all comparison the "*best possible one*" for an arithmetical system." The proposal included a graphical notation for the digits and new names for the numbers, suggesting that we should count "*un*, *du*, *the*, *fo*, *pa*, *se*, *ki*, *unty*, *unty-un*, *unty-du*" and so on, with successive multiples of eight named "*unty*, *duty*, *thety*, *foty*, *paty*, *sety*, *kity* and *under*." So, for example, the number 65 (101 in octal) would be spoken in octonary as *under-un*.[8][9] Taylor also republished some of Swedenborg's work on octonary as an appendix to the above-cited publications.

In computers