1 As A Decimal

Decimal

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The decimal numeral system (also called the base-ten positional numeral system and denary or decanary) is the standard system for denoting integer and non-integer numbers. It is the extension to non-integer numbers (decimal fractions) of the Hindu–Arabic numeral system. The way of denoting numbers in the decimal system is often referred to as decimal notation.

A decimal numeral (also often just decimal or, less correctly, decimal number), refers generally to the notation of a number in the decimal numeral system. Decimals may sometimes be identified by a decimal separator (usually "." or "," as in 25.9703 or 3,1415).

Decimal may also refer specifically to the digits after the decimal separator, such as in "3.14 is the approximation of ? to two decimals".

The numbers that may be represented exactly by a decimal of finite length are the decimal fractions. That is, fractions of the form a/10n, where a is an integer, and n is a non-negative integer. Decimal fractions also result from the addition of an integer and a fractional part; the resulting sum sometimes is called a fractional number.

Decimals are commonly used to approximate real numbers. By increasing the number of digits after the decimal separator, one can make the approximation errors as small as one wants, when one has a method for computing the new digits. In the sciences, the number of decimal places given generally gives an indication of the precision to which a quantity is known; for example, if a mass is given as 1.32 milligrams, it usually means there is reasonable confidence that the true mass is somewhere between 1.315 milligrams and 1.325 milligrams, whereas if it is given as 1.320 milligrams, then it is likely between 1.3195 and 1.3205 milligrams. The same holds in pure mathematics; for example, if one computes the square root of 22 to two digits past the decimal point, the answer is 4.69, whereas computing it to three digits, the answer is 4.690. The extra 0 at the end is meaningful, in spite of the fact that 4.69 and 4.690 are the same real number.

In principle, the decimal expansion of any real number can be carried out as far as desired past the decimal point. If the expansion reaches a point where all remaining digits are zero, then the remainder can be omitted, and such an expansion is called a terminating decimal. A repeating decimal is an infinite decimal that, after some place, repeats indefinitely the same sequence of digits (e.g., 5.123144144144144... = 5.123144). An infinite decimal represents a rational number, the quotient of two integers, if and only if it is a repeating decimal or has a finite number of non-zero digits.

Decimal separator

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A decimal separator is a symbol that separates the integer part from the fractional part of a number written in decimal form. Different countries officially designate different symbols for use as the separator. The choice of symbol can also affect the choice of symbol for the thousands separator used in digit grouping.

Any such symbol can be called a decimal mark, decimal marker, or decimal sign. Symbol-specific names are also used; decimal point and decimal comma refer to a dot (either baseline or middle) and comma respectively, when it is used as a decimal separator; these are the usual terms used in English, with the aforementioned generic terms reserved for abstract usage.

In many contexts, when a number is spoken, the function of the separator is assumed by the spoken name of the symbol: comma or point in most cases. In some specialized contexts, the word decimal is instead used for this purpose (such as in International Civil Aviation Organization-regulated air traffic control communications). In mathematics, the decimal separator is a type of radix point, a term that also applies to number systems with bases other than ten.

Decimal time

10 decimal hours, each decimal hour into 100 decimal minutes and each decimal minute into 100 decimal seconds (100,000 decimal seconds per day), as opposed

Decimal time is the representation of the time of day using units which are decimally related. This term is often used specifically to refer to the French Republican calendar time system used in France from 1794 to 1800, during the French Revolution, which divided the day into 10 decimal hours, each decimal hour into 100 decimal minutes and each decimal minute into 100 decimal seconds (100,000 decimal seconds per day), as opposed to the more familiar standard time, which divides the day into 24 hours, each hour into 60 minutes and each minute into 60 seconds (86,400 SI seconds per day).

The main advantage of a decimal time system is that, since the base used to divide the time is the same as the one used to represent it, the representation of hours, minutes and seconds can be handled as a unified value. Therefore, it becomes simpler to interpret a timestamp and to perform conversions. For instance, 1h23m45s is 1 decimal hour, 23 decimal minutes, and 45 decimal seconds, or 1.2345 decimal hours, or 123.45 decimal minutes or 12345 decimal seconds; 3 hours is 300 minutes or 30,000 seconds.

This property also makes it straightforward to represent a timestamp as a fractional day, so that 2025-08-26.54321 can be interpreted as five decimal hours, 43 decimal minutes and 21 decimal seconds after the start of that day, or a fraction of 0.54321 (54.321%) through that day (which is shortly after traditional 13:00). It also adjusts well to digital time representation using epochs, in that the internal time representation can be used directly both for computation and for user-facing display.

Repeating decimal

A repeating decimal or recurring decimal is a decimal representation of a number whose digits are eventually periodic (that is, after some place, the

A repeating decimal or recurring decimal is a decimal representation of a number whose digits are eventually periodic (that is, after some place, the same sequence of digits is repeated forever); if this sequence consists only of zeros (that is if there is only a finite number of nonzero digits), the decimal is said to be terminating, and is not considered as repeating.

It can be shown that a number is rational if and only if its decimal representation is repeating or terminating. For example, the decimal representation of ?1/3? becomes periodic just after the decimal point, repeating the single digit "3" forever, i.e. 0.333.... A more complicated example is ?3227/555?, whose decimal becomes periodic at the second digit following the decimal point and then repeats the sequence "144" forever, i.e. 5.8144144144.... Another example of this is ?593/53?, which becomes periodic after the decimal point, repeating the 13-digit pattern "1886792452830" forever, i.e. 11.18867924528301886792452830....

The infinitely repeated digit sequence is called the repetend or reptend. If the repetend is a zero, this decimal representation is called a terminating decimal rather than a repeating decimal, since the zeros can be omitted and the decimal terminates before these zeros. Every terminating decimal representation can be written as a decimal fraction, a fraction whose denominator is a power of 10 (e.g. 1.585 = ?1585/1000?); it may also be written as a ratio of the form ?k/2n·5m? (e.g. 1.585 = ?317/23·52?). However, every number with a terminating decimal representation also trivially has a second, alternative representation as a repeating decimal whose repetend is the digit "9". This is obtained by decreasing the final (rightmost) non-zero digit by one and appending a repetend of 9. Two examples of this are 1.000... = 0.999... and 1.585000... = 1.584999.... (This type of repeating decimal can be obtained by long division if one uses a modified form of the usual division algorithm.)

Any number that cannot be expressed as a ratio of two integers is said to be irrational. Their decimal representation neither terminates nor infinitely repeats, but extends forever without repetition (see § Every rational number is either a terminating or repeating decimal). Examples of such irrational numbers are ?2 and ?.

Halfpenny (British decimal coin)

transactions, which were carried out in units of 1p. The decimal halfpenny had the same value as 1.2 pre-decimal pence, and was introduced to enable the prices

The British decimal halfpenny (1?2p) coin was a denomination of sterling coinage introduced in February 1971, at the time of decimalisation, and was worth 1?200 of one pound. It was ignored in banking transactions, which were carried out in units of 1p.

The decimal halfpenny had the same value as 1.2 pre-decimal pence, and was introduced to enable the prices of some low-value items to be more accurately translated to the new decimal currency. The possibility of setting prices including an odd half penny also made it more practical to retain the pre-decimal sixpence in circulation (with a value of ?2+1/2? new pence) alongside the new decimal coinage.

The halfpenny coin's obverse featured the profile of Queen Elizabeth II; the reverse featured an image of St Edward's Crown. It was minted in bronze (like the 1p and 2p coins). It was the smallest decimal coin in both size and value, the size being in proportion to 1p and 2p coins.

The halfpenny soon became Britain's least favourite coin. The UK Treasury argued the halfpenny was important in the fight against inflation, as it prevented prices from being rounded up. Nevertheless, the coin was demonetised and withdrawn from circulation in December 1984.

Decimal representation

A decimal representation of a non-negative real number r is its expression as a sequence of symbols consisting of decimal digits traditionally written

A decimal representation of a non-negative real number r is its expression as a sequence of symbols consisting of decimal digits traditionally written with a single separator:

r

=

b

k

b

k

?

1

?

b

0

.

a

1

a

2

?

{\displaystyle r=b_{k}b_{k-1}\cdots b_{0}.a_{1}a_{2}\cdots }

Here . is the decimal separator, k is a nonnegative integer, and

b

0

,

?

,

b

k

,

a

1

,

a

2

,

?

{\displaystyle b_{0},\cdots ,b_{k},a_{1},a_{2},\cdots }

are digits, which are symbols representing integers in the range 0, ..., 9.

Commonly,

b

k

?

0

{\displaystyle b_{k}\neq 0}

if

k

?

1.

{\displaystyle k\geq 1.}

The sequence of the

a

i

{\displaystyle a_{i}}

—the digits after the dot—is generally infinite. If it is finite, the lacking digits are assumed to be 0. If all

a

i

{\displaystyle a_{i}}

are 0, the separator is also omitted, resulting in a finite sequence of digits, which represents a natural number.

The decimal representation represents the infinite sum:

r

=

?

i

=

0

k

b

i

10

i

+

?

i

=

1

?

a

i

10

i

.

{\displaystyle r=\sum _{i=0}^{k}b_{i}10^{i}+\sum _{i=1}^{\infty }{\frac {a_{i}}{10^{i}}}.}

Every nonnegative real number has at least one such representation; it has two such representations (with

b

k

?

0

{\displaystyle b_{k}\neq 0}

if

k

>

0

{\displaystyle k>0}

) if and only if one has a trailing infinite sequence of 0, and the other has a trailing infinite sequence of 9. For having a one-to-one correspondence between nonnegative real numbers and decimal representations, decimal representations with a trailing infinite sequence of 9 are sometimes excluded.

Gray code

eight: 1 1 1 1 1 0 0 0 0 1 1 1 1 1 1 0 0 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0 1 1 1 1 1 1 0 0 0 1 1 0 0 0 1 1 0 0 1 1 1 0 0

The reflected binary code (RBC), also known as reflected binary (RB) or Gray code after Frank Gray, is an ordering of the binary numeral system such that two successive values differ in only one bit (binary digit).

For example, the representation of the decimal value "1" in binary would normally be "001", and "2" would be "010". In Gray code, these values are represented as "001" and "011". That way, incrementing a value from 1 to 2 requires only one bit to change, instead of two.

Gray codes are widely used to prevent spurious output from electromechanical switches and to facilitate error correction in digital communications such as digital terrestrial television and some cable TV systems. The use of Gray code in these devices helps simplify logic operations and reduce errors in practice.

Binary-coded decimal

electronic systems, binary-coded decimal (BCD) is a class of binary encodings of decimal numbers where each digit is represented by a fixed number of bits, usually

In computing and electronic systems, binary-coded decimal (BCD) is a class of binary encodings of decimal numbers where each digit is represented by a fixed number of bits, usually four or eight. Sometimes, special bit patterns are used for a sign or other indications (e.g. error or overflow).

In byte-oriented systems (i.e. most modern computers), the term unpacked BCD usually implies a full byte for each digit (often including a sign), whereas packed BCD typically encodes two digits within a single byte by taking advantage of the fact that four bits are enough to represent the range 0 to 9. The precise four-bit encoding, however, may vary for technical reasons (e.g. Excess-3).

The ten states representing a BCD digit are sometimes called tetrades (the nibble typically needed to hold them is also known as a tetrade) while the unused, don't care-states are named pseudo-tetrad(e)s[de], pseudo-decimals, or pseudo-decimal digits.

BCD's main virtue, in comparison to binary positional systems, is its more accurate representation and rounding of decimal quantities, as well as its ease of conversion into conventional human-readable representations. Its principal drawbacks are a slight increase in the complexity of the circuits needed to implement basic arithmetic as well as slightly less dense storage.

BCD was used in many early decimal computers, and is implemented in the instruction set of machines such as the IBM System/360 series and its descendants, Digital Equipment Corporation's VAX, the Burroughs B1700, and the Motorola 68000-series processors.

BCD per se is not as widely used as in the past, and is unavailable or limited in newer instruction sets (e.g., ARM; x86 in long mode). However, decimal fixed-point and decimal floating-point formats are still important and continue to be used in financial, commercial, and industrial computing, where the subtle conversion and fractional rounding errors that are inherent in binary floating point formats cannot be tolerated.

Dewey Decimal Classification

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The Dewey Decimal Classification (DDC) (pronounced DOO-ee) colloquially known as the Dewey Decimal System, is a proprietary library classification system which allows new books to be added to a library in their appropriate location based on subject.

It was first published in the United States by Melvil Dewey in 1876. Originally described in a 44-page pamphlet, it has been expanded to multiple volumes and revised through 23 major editions, the latest printed in 2011. It is also available in an abridged version suitable for smaller libraries. OCLC, a non-profit cooperative that serves libraries, currently maintains the system and licenses online access to WebDewey, a continuously updated version for catalogers.

The decimal number classification introduced the concepts of relative location and relative index. Libraries previously had given books permanent shelf locations that were related to the order of acquisition rather than topic. The classification's notation makes use of three-digit numbers for main classes, with fractional decimals allowing expansion for further detail. Numbers are flexible to the degree that they can be expanded in linear fashion to cover special aspects of general subjects. A library assigns a classification number that unambiguously locates a particular volume in a position relative to other books in the library, on the basis of its subject. The number makes it possible to find any book and to return it to its proper place on the library shelves. The classification system is used in 200,000 libraries in at least 135 countries.

Significant figures

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Significant figures, also referred to as significant digits, are specific digits within a number that is written in positional notation that carry both reliability and necessity in conveying a particular quantity. When presenting the outcome of a measurement (such as length, pressure, volume, or mass), if the number of digits exceeds what the measurement instrument can resolve, only the digits that are determined by the resolution are dependable and therefore considered significant.

For instance, if a length measurement yields 114.8 mm, using a ruler with the smallest interval between marks at 1 mm, the first three digits (1, 1, and 4, representing 114 mm) are certain and constitute significant figures. Further, digits that are uncertain yet meaningful are also included in the significant figures. In this example, the last digit (8, contributing 0.8 mm) is likewise considered significant despite its uncertainty. Therefore, this measurement contains four significant figures.

Another example involves a volume measurement of 2.98 L with an uncertainty of ± 0.05 L. The actual volume falls between 2.93 L and 3.03 L. Even if certain digits are not completely known, they are still significant if they are meaningful, as they indicate the actual volume within an acceptable range of uncertainty. In this case, the actual volume might be 2.94 L or possibly 3.02 L, so all three digits are considered significant. Thus, there are three significant figures in this example.

The following types of digits are not considered significant:

Leading zeros. For instance, 013 kg has two significant figures—1 and 3—while the leading zero is insignificant since it does not impact the mass indication; 013 kg is equivalent to 13 kg, rendering the zero unnecessary. Similarly, in the case of 0.056 m, there are two insignificant leading zeros since 0.056 m is the same as 56 mm, thus the leading zeros do not contribute to the length indication.

Trailing zeros when they serve as placeholders. In the measurement 1500 m, when the measurement resolution is 100 m, the trailing zeros are insignificant as they simply stand for the tens and ones places. In this instance, 1500 m indicates the length is approximately 1500 m rather than an exact value of 1500 m.

Spurious digits that arise from calculations resulting in a higher precision than the original data or a measurement reported with greater precision than the instrument's resolution.

A zero after a decimal (e.g., 1.0) is significant, and care should be used when appending such a decimal of zero. Thus, in the case of 1.0, there are two significant figures, whereas 1 (without a decimal) has one significant figure.

Among a number's significant digits, the most significant digit is the one with the greatest exponent value (the leftmost significant digit/figure), while the least significant digit is the one with the lowest exponent value (the rightmost significant digit/figure). For example, in the number "123" the "1" is the most significant digit, representing hundreds (102), while the "3" is the least significant digit, representing ones (100).

To avoid conveying a misleading level of precision, numbers are often rounded. For instance, it would create false precision to present a measurement as 12.34525 kg when the measuring instrument only provides accuracy to the nearest gram (0.001 kg). In this case, the significant figures are the first five digits (1, 2, 3, 4, and 5) from the leftmost digit, and the number should be rounded to these significant figures, resulting in 12.345 kg as the accurate value. The rounding error (in this example, 0.00025 kg = 0.25 g) approximates the numerical resolution or precision. Numbers can also be rounded for simplicity, not necessarily to indicate measurement precision, such as for the sake of expediency in news broadcasts.

Significance arithmetic encompasses a set of approximate rules for preserving significance through calculations. More advanced scientific rules are known as the propagation of uncertainty.

Radix 10 (base-10, decimal numbers) is assumed in the following. (See Unit in the last place for extending these concepts to other bases.)