A number N is shown in Figure 1. Components of the number include the *integer-portion*, the *radix point*, the *fractional-portion*, and the *radix*.

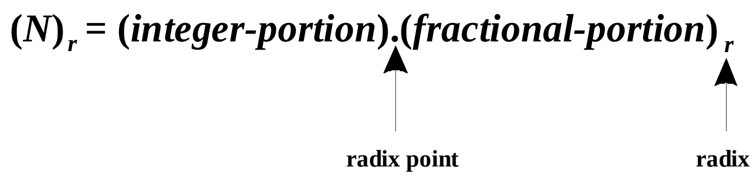

Figure 1. A Number *N*.

Example 1 shows a decimal number.

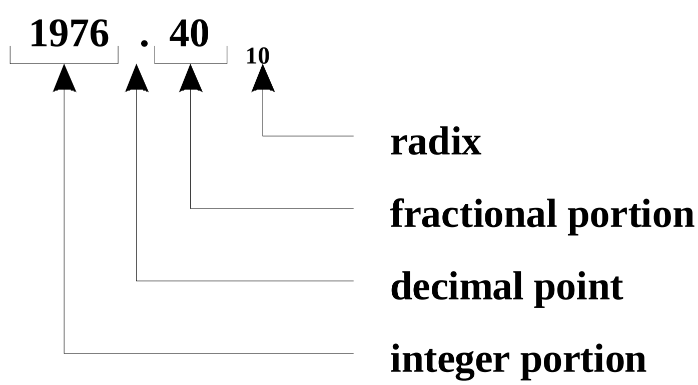

Figure 2. A decimal number.

Example 2 shows a binary number.

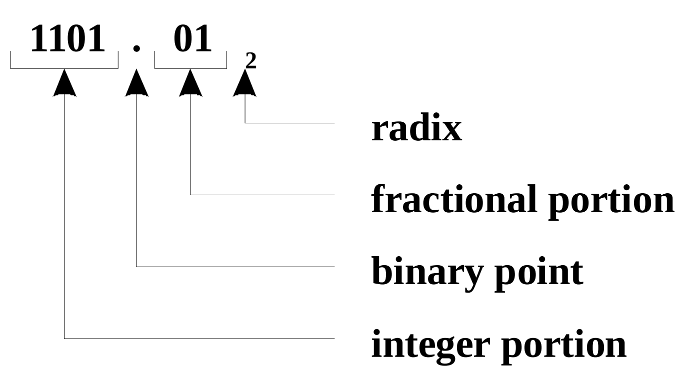

Figure 3. A binary number.

Juxtaposition Notation

Juxtaposition means next to, or side by side

$(N)_r = (a_{n-1}a_{n-2}\cdots a_1a_0)\bullet(a_{-1}a_{-2}\cdots a_{-m})_r$

r : is the radix of the number *N*.
a: is a digit in the set of digits defined for radix *r*.
n: is the number of digits in the integer portion.
m: is the number of digits in the fractional portion.
a_{n-1} : is the most significant digit
a_{-m} : is the least significant digit

Example: 1976.4_{10}

r: 10 (radix)
$a_j \in D, D = \{0,1,2,3,4,5,6,7,8,9\}$
$a_3 = 1, a_2 = 9.a_1 = 7, a_0 = 6, a_{-1} = 4$
n: number of digits in the integer portion (4).
m: number of digits in the fractional portion (1).
a_3 :is the most significant digit (1).
a_{-1} : is the least significant digit (4).

Example: 1101.01_2
r: 2 (radix)
$a_j \in D, D = \{0,1\}$
$a_3 = 1, a_2 = 1, a_1 = 0, a_0 = 1, a_{-1} = 0, a_{-2} = 1$
n: number of digits in the integer portion (4).
m: number of digits in the fractional portion (2).
a_3 :is the most significant digit (1).
a_{-2} : is the least significant digit (1).

Radixes

A radix is a number base. For example, we are familiar with the decimal number system – a number system having the radix ten (10). Number systems have a unique symbol for every digit in the radix. Again, referring to the decimal number system, the set of digits, $D = \{0,1,2,3,4,5,6,7,8,9\}$. Note that there are ten (10) digits in the decimal number system. In the same way there are two (2) digits in the set of digits for the *binary* number system, $D_2 = \{0,1\}$. For number systems 2 – 10, we use Arabic digits. For number systems greater than ten, we use Arabic digits and English letters. For example, the set of digits in the hexadecimal (base 16) number system is $D_{16} = \{0,1,2,3,4,5,6,7,8,9,A,B,C,D,E,F\}$ $A_{16} = 10_{10}, B_{16} = 11_{10}, \cdots, F_{16} = 15_{10}$. The letters used to extend Arabic digits are case independent. For example, the hexadecimal number 2bad = 2BAD. By extending the Arabic digits we can easily represent numbers in any base, b, where $2 \le b \le 36$.

Can you think of a way to express a number in base 37? Can you think of a way to express a number in base 1?

Practice Problems

1. Count to ten in binary, octal, and hexadecimal.
2. Convert 34567_8 to decimal.
3. Convert 10011001.1001_2 to decimal.
4. Convert $2bad_{16}$ to decimal
5. Convert $quiz_{36}$ to decimal