Number System

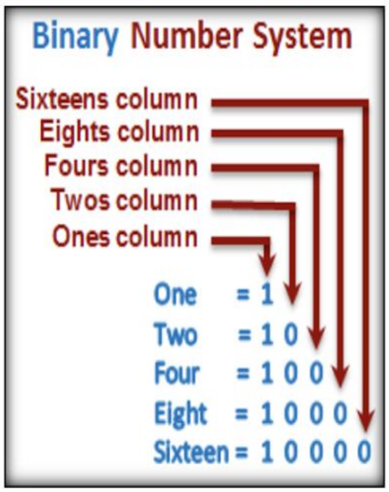
Binary Number System

It is necessary to review the decimal number system at first to understand more about binary number system. Decimal number system refers to base 10 positional notation. It uses ten different symbols (0, 1, 2, 3, 4, 5, 6, 7, 8, 9) arranged using positional notation. Positional notation is used when a number larger then 9 needs to be represented; each position of a digit signifies how many groups of 10, 100, 1000, etc. are contained in that number. For example,

4251

$4 \times 1000 + 2 \times 100 + 5 \times 10 + 1$

$4\times 10^3 + 2\times 10^2 + 5\times 10^1 + 4\times 10^2$



Binary number system

0 and 1 are used in binary number system which is arranged using positional notation (the digit 0 and 1 as a symbol). When a number larger than 1 needs to be represented, the positional notation is used to represent, the positional notation is used to represent how many groups of 2, 4, 8 are contained in the number. For example,

Let's consider the number 30

$30 \div 2 = 15$ Remainder 0

$15 \div 2 = 7$ Remainder 1

$7 \div 2 = 3$ Remainder 1

$3 \div 2 = 1$ Remainder 1

$1 \div 2 = 0$ Remainder 1

Quinary Number System

The quinary number system is a number system having five as the base. There are only five numerals in the quinary number system. They are 0, 1, 2, 3 and 4 in this system. This will represent any real numbers.

Quinary means base 5 so each place is a power of 5.

In this method five is written as 10, twenty-five is written as 100 and sixty is written as 220.

Consider the quinary number of 155_5

$155_5 = 1 \times 5^2 + 5 \times 5^1 + 5 \times 5^0$

$= 25 + 25 + 5$

$= 55$

While converting a decimal number into a quinary number, we must divide it by 5 repeatedly and write the remainders until the result of the division is 0. The quinary number is obtained by reading the sequence of the remainders in the reverse order. For example, let's consider the number 84_{10}

$84 \div 5 = 16$ Remainder 4

$16 \div 5 = 3$ Remainder 1

$3 \div 5 = 0$ Remainder 2

Addition of quinary numbers

Finding arithmetic in a base other than 10 is to understand the notation we use in base 10.

We write the number thirteen as 13, meaning 1 tens and 3 ones. It may help you to think about objects, like sticks. The idea is to make thirteen sticks and arrange them in the group of ten. You get 1 groups of ten and three extra.

Suppose, if you add 23 and 19 you put together the 3 ones with the 9 ones giving 12 ones, which is 1 ten and 2 extra. That is you get one more group of ten sticks. That is the "carry over". So, altogether you have 2 + 1 + 1 tens and 2 ones, for a sum of 42.

In base-5, you want to collect the objects in groups of five rather than tens. So if you have nine objects you can arrange them into one group of five and 4 ones.

Now to add 2 and 3 using base 5 notation, 2 + 3 = 10 in base 5.

Subtraction of quinary numbers

Subtraction in quinary number is straight forward as we are always subtracting a smaller digit from a large digit. Let's look at a base 10 problem first.

$$\begin{array}{r} 325 \\ \underline{-134} \\ 191 \end{array}$$

Starting in the right most column 5 - 4 = 1 but in the next column you need to borrow from the next column. Since this is base 10 notation you are borrowing ten so the 3 in the third column be 2 and adding to 10 to 2 you have 12 in the second column.

Now,

Let's try a base 5 problem

$$\begin{array}{r} 431 \\ \underline{-240} \\ 141 \end{array}$$

As in the base 10 problem, the first column is easy, 1 - 0 = 1. In the second you need to borrow from the third column. Since the numbers are written in base 5 notation you are borrowing five so the 4 in the third column becomes 3 and adding five to gives you eight in the second column.

Example:

Convert the following decimal number into a quinary number.

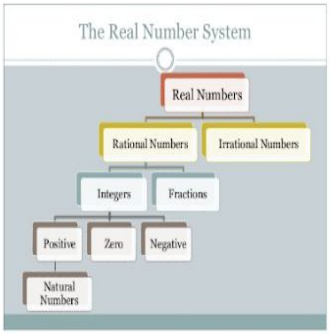
a) 425

Solution:

5	425	0
5	85	0
5	17	2
5	3	3
	0	

$\therefore 425_{10} = 3200_5$

A number is a mathematical object used to count, measure and label. The integers are the set of real numbers consisting of the natural numbers, their additive inverse and zero. The original examples are the natural (or counting) numbers are 1, 2, 3, 4, 5, etc. There are infinitely many natural numbers.



Binary Number System

To, understand more about Binary Number System. At first, it is necessary to review the decimal number system. The decimal number system uses ten different symbols (0, 1, 2, 3, 4, 5, 6, 7, 8, 9) arranged using positional notation. Positional notation is used when a number larger then 9 needs to be represented. each position of a digit signifies how many groups of 10, 100, 1000, etc are contained in that number. For example:

$2584 = 2 \times 1000 + 5 \times 100 + 8 \times 10 + 4 \times 1$

$= 2 \times 10^3 + 5 \times 10^2 + 8 \times 10^1 + 4 \times 10^\circ$

The binary number system always uses only two different symbols (the digit 0 and 1) that are arranged using positional notation. When a number larger than 1 needs to be represented, the positional notation is used to represent how many groups of 2, 4, 8 are contained in the number. For example:

Let's consider the number 30

$30 \div 2 = 15$ Remainder 0

$15 \div 2 = 7$ Remainder 1

$7 \div 2 = 3$ Remainder 1

$3 \div 2 = 1$ Remainder 1

$1 \div 2 = 0$ Remainder 1

Hence, $30 = 11110_2$ is reacted as one zero bases two.

Addition of binary numbers

Addition of a binary number is a very simple task, and similar to the longhand addition of decimal numbers. Unlike decimal addition, there is little to memorize in the way of rules for the addition of binary bites.

$0 + 0 = 0$

$1 + 0 = 1$

$1 + 1 = 10$

$1 + 1 + 1 = 11$

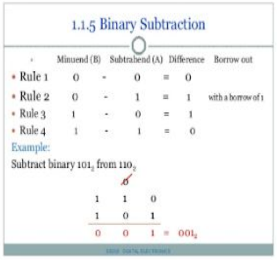
Subtraction of binary numbers

We can subtract a binary number from the another binary number. For this, line the two numbers up just like you are subtracting two decimal numbers, the first number on the top and the second number below it.

0 - 0 =0

1 - 0 =1

1 - 1 =0



Quinary Number System

The number system having base five is known as the quinary number system. There are only five numerals 0, 1, 2, 3, and 4, in this system.

Quinary means base 5 each place is a power of 5.

Consider the quinary number of 155_5

$155_5 = 1 \text{ X } 5^2 + 5 \text{ X } 5^1 + 5 \text{ X} 5^0$

= 25 + 25 + 5

= 55

To convert a decimal number into a quinary number, we must divide it by 5 repeatedly and write the remainders obtained until the result of the division is 0. The quinary number is obtained by reading the sequence of the remainders in the reverse order. For example, let's consider the number 84_{10}

84 ÷ 5 = 16 Remainder 4

16 ÷ 5 = Remainder 1

3 ÷ 5 = Remainder 0

Hence, $84_{10} = 214_5$

Additional of quinary numbers

The key to understanding arthematic in a base other than 10 is to understand the notation we use in base 10.We write the number thirteen as 13, meaning 1 tens and ones. It may help you to think about objects, like sticks. The idea is to make thirteen sticks and arrange them in a group of ten. You get 1 groups of ten and three extra.Suppose, if you add 23 and 19 you put together the 3 ones with the 9 ones giving 12 ones, which is 1 ten and 2 extra. That is you get one more group of ten sticks. That is the " carry". So, altogether you have 2 + 1 +1 tens and 2 ones, for a sum of 42.

In base-5, you want to collect the objects in groups of five rather than tens. So if you have nine objects you can arrange them into one group of five and 4 ones.

Now to add 2 and 3 using base 5 notation, 2 + 3 = 10 in base 5.

Subtraction of quinary numbers

Subtraction is Straight forward as you are always subtracting a smaller digit from a large digit.The challenge is to deal with borrowings. Let's look at a base 10 problem first.

3 2 5

<u>-1 3 4</u>

1 9 1

Straightening in the right most column 5 - 4 = 1 but in the next column you need to borrow from the next column. Since this is base 10 notation you are borrowing ten so the 3 in the third column be 2 and adding to 10 to 2 you have 12 in the second column.

Now let's try a base 5 problem

4 3 1

<u>- 2 4 0</u>

1 4 1

As in the base 10 problem, the first column is easy, 1 - 0 = 1. In the second you need to borrow from the third column.Since the numbers are written in base 5 notation you are borrowing five so the 4 in the third column becomes 3 and adding five to gives you eight in the second column.