Natural Numbers - Common counting numbers.

Prime Number - A natural number greater than 1 which has only 1 and itself as factors.

Composite Number - A natural number greater than 1 which has more factors than 1 and itself.

Whole Numbers - The set of Natural Numbers with the number 0 adjoined.

Integers - Whole Numbers with their opposites (negative numbers) adjoined.

Rational Numbers - All numbers which can be written as fractions.

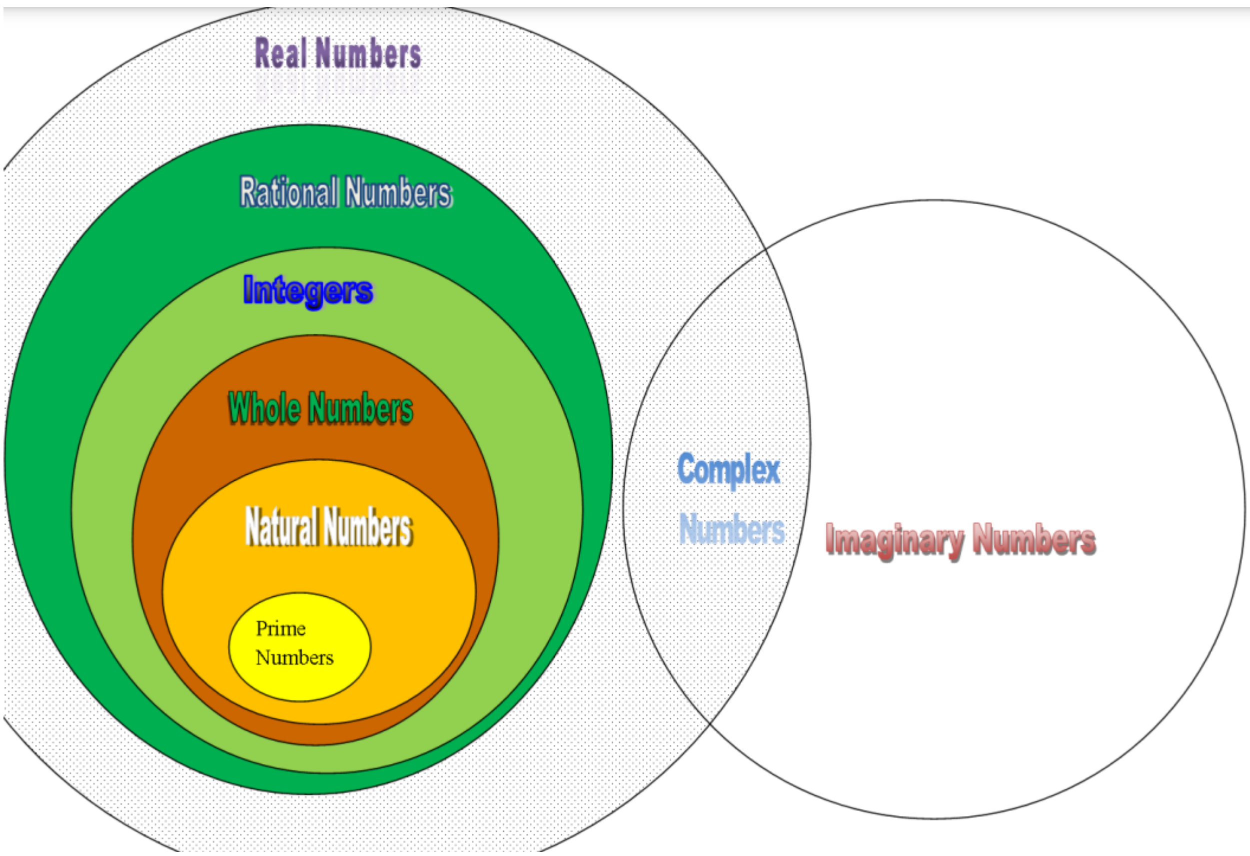
Irrational Numbers - All numbers which cannot be written as fractions.

Real Numbers - The set of Rational Numbers with the set of Irrational Numbers adjoined.

Complex Number - A number which can be written in the form a + bi where a and b are real numbers and i is the square root of -1.

Type of Number	**Example**
Natural Numbers	$N=1,2,3,4,\ldots$
Prime Number	$P=2,3,5,7,11,13,17,\ldots$
Composite Number	$4,6,8,9,10,12,\ldots$
Whole Numbers	$W=0,1,2,3,4,\ldots$
Integers	$Z=\ldots,-3,-2,-1,0,1,2,3,\ldots$
Rational Numbers	$Q=-12,0.33333\ldots,52,1110,\ldots,\ldots$
Irrational Numbers	$F=\ldots,\pi,2-\sqrt{},0.121221222\ldots$

Real Numbers	R=…,−3,−1,0,15,1.1,2−√,2,3,π,…
Complex Number	C=…,−3+2i,0,1+3i,…



Permutation: A permutation is an arrangement in a definite order of several objects taken some or all at a time. Let us take 10 numbers: 0, 1, 2, 3, 4, 5, 6, 7, 8 and 9. The number of different 4-digit-PIN which can be formed using these 10 numbers is 5040. P(10,4) = 5040.

Formula: nPr=n!/(n−r)!

Combination: A combination is all about grouping. The number of different groups which can be formed from the available things can be calculated using combinations. Let us try to understand this with a simple example. A team of 2 is formed from 5 students(William, James, Noah, Logan, and Oliver). This the combination of 'r' persons from the available 'n' persons is given as nCr=n!r!.(n−r)!nCr=n!r!.(n−r)! The combinations can happen in the following 10 ways by which the team of 2 could be formed.

- William James
- William Noah
- William Logan
- William Oliver
- James Noah
- James Logan
- James Oliver
- Logan Noah
- Logan Oliver
- Oliver Noah

This is a simple example of combinations. C(5,2) = 10.

Use combination when order does not matter.

Recursion:

$$^{n}C_{1} = \frac{n!}{(n-1)!*1!} \qquad \left\{ {}^{n}C_{r} = n!/r!*(n-r)! \right.$$

Simplification:

$$^nC_1 = \frac{n!}{(n-1)!*1!}$$

$$^nC_1 = \frac{n*\cancel{(n-1)}!}{\cancel{(n-1)}!*1}$$

$$^nC_1 = n$$

We can write generic function for this (recurrence relation to find the factorial)

$$^nC_1 = \frac{n!}{(n-1)!*1!}$$

$$\left.\begin{aligned} {}^nC_1 &= \frac{n*\cancel{(n-1)}!}{\cancel{(n-1)}!*1} \end{aligned}\right\} n!=n*(n-1)! \Rightarrow f(n)=n*f(n-1)$$

$$^nC_1 = n$$

$$f(n-1)=(n-1)*f(n-2)$$

$$f(n-2)=(n-2)*f(n-3)$$

$$\vdots$$

If we keep doing this, will go infinite loop. To break this, we should have Base case.

$$\boxed{f(1)=1}$$

Mathematical Def:

$$f(n) = \begin{cases} n*f(n-1) & \text{If } n>1 \\ \boxed{1 \quad \text{If } n=1} \end{cases}$$

$$^{n}C_1 = \frac{n!}{(n-1)!*1!}$$

$$^{n}C_1 = \frac{n*\cancel{(n-1)}!}{\cancel{(n-1)}!*1} \quad \Big\} \; n! = n*(n-1)! \Rightarrow f(n) = n*f(n-1)$$

$$^{n}C_1 = n$$

$$f(1) = 1$$

Recursive case

$$f(n) = \begin{cases} \boxed{n*f(n-1)} & \text{If } n>1 \\ \boxed{1} & \text{If } n=1 \end{cases}$$

When a function calls itself directly or indirectly it is called recursive function and the proce
is called Recursion.

OR

It is a powerful, problem solving technique where solution of a larger problem defined in terms of smaller instances of itself.

$\Sigma(n) = 1+2+3+4 \ldots\ldots n$

$\Sigma(n-1) = 1+2+3+4 \ldots\ldots +(n-2)+(n-1)$

$\Sigma(n) = (1+2+3+4 \ldots\ldots +n-1)+ n$

$\Sigma(n) = \Sigma(n-1) + n$

$$\Sigma(n) = \begin{cases} \Sigma(n-1) + n & \text{If } n>1 \\ 1 & \text{If } n=1 \end{cases}$$

OR

$$\boxed{sum(n)} = \begin{cases} sum(n-1) + n & \text{If } n>1 \\ 1 & \text{If } n=1 \end{cases}$$