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Counting

Mathematics for Computing – IT1030

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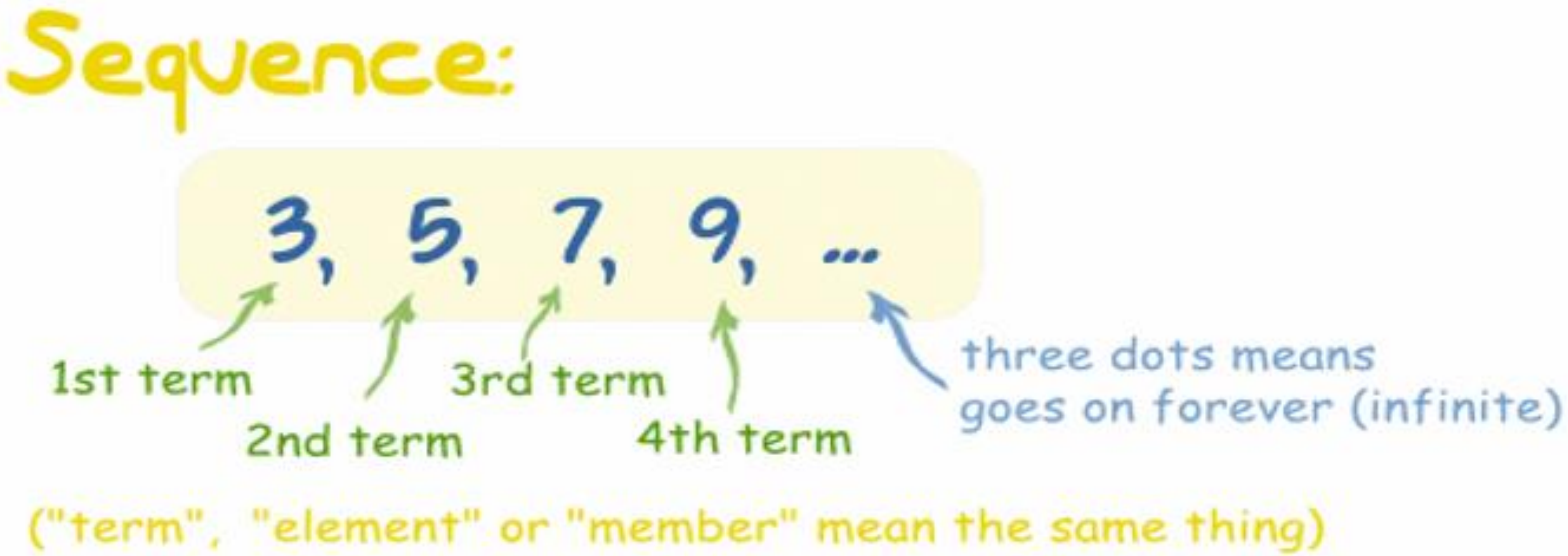
SEQUENCES

- A Sequence is a list of things (usually numbers) that are in order; Infinite or Finite



INFINITE OR FINITE SEQUENCES

- When the sequence goes on forever it is called an infinite sequence, otherwise it is a finite sequence.

Eg: {1,2,3,4,…} is an infinite sequence {2,4,6} is a finite sequence with 3 terms

SET VS. SEQUENCE

Set	Sequence
Terms need not to be in order	Terms must be in order
Values cannot repeat	Values can repeat

- Eg: {0, 1, 0, 1, 0, 1, ...} is the sequence of alternating 0s and 1s. The set is just {0,1}   or {1,0} .

ARITHMETIC SEQUENCE

- It has a common difference between successive terms.

Eg: 2, 4, 6, 8, …

Q: Find the 10th term and the sum of first 10 terms of the following sequence An. An : {3, 8, 13, 18, 23,…}

term position

$$a_n = a_1 + (n-1)d$$

n^{th} term

first term

common difference

Sum of nth terms =

$$\frac{n}{2}(2a + (n - 1)d)$$

GEOMETRIC SEQUENCE

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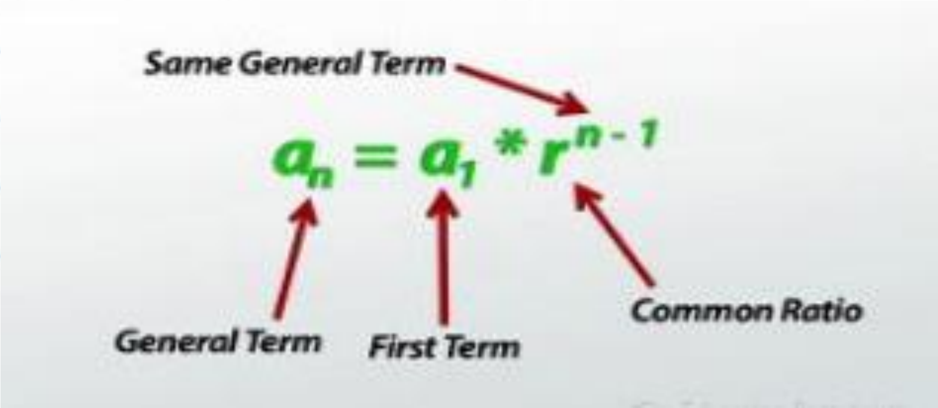
- It has a common ratio between successive terms.

Eg: 2, 4, 8, 16, …

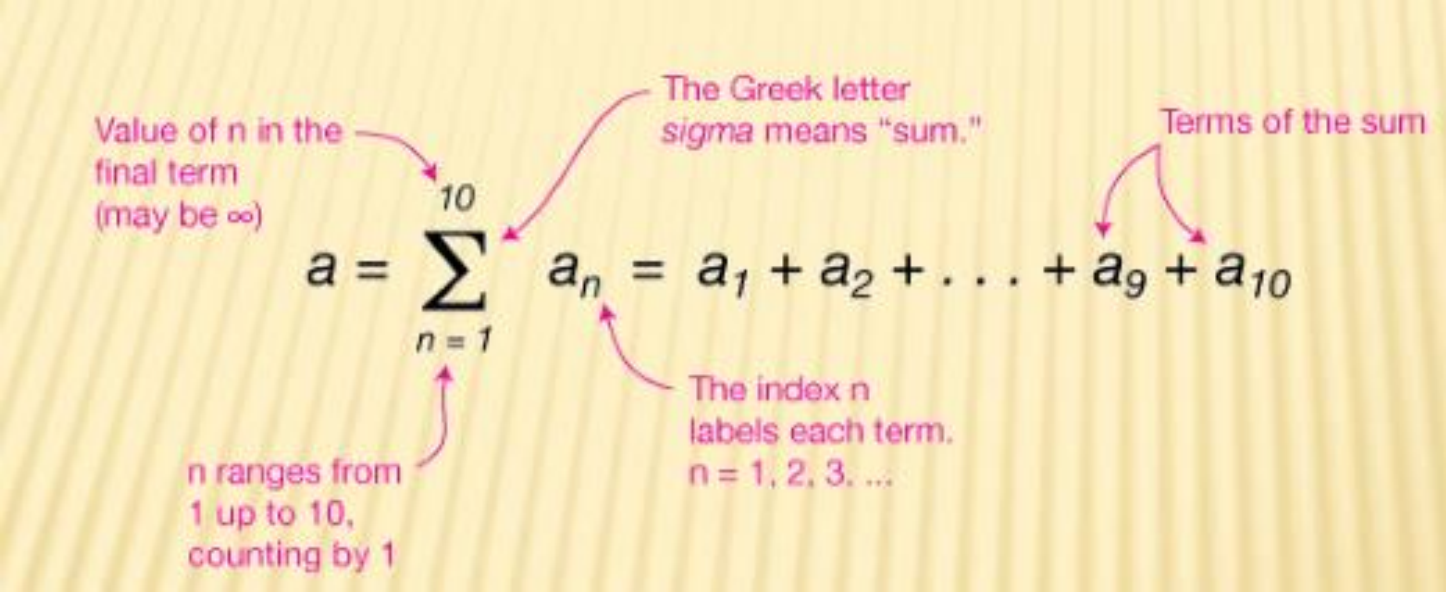
Q: Find the 11th term and the sum of first 11 terms of the following sequence An. An : {3, 6, 12, 24,…}



$$S_n = \frac{a_1(1-r^n)}{1-r}$$

SIGMA NOTATION

- It represents summation of many similar terms.



FACTORIAL of N

$$n! = 1 * 2 * 3 * \; \ldots \; n$$

$$0! = 1! = 1$$

Number

5

The Factorial of 5 is

$5 \times 4 \times 3 \times 2 \times 1 = 120$

n_{C_r} and n_{P_r} Notations

$$nCr = \frac{n!}{r!\ (n-r)!}$$

$$nPr = \frac{n!}{(n-r)!}$$

PERMUTATIONS

- A permutation is an arrangement of objects in specific order.
- The order of the arrangement is important.

Example: How many distinct, 3 letter words can be arranged using {a, b, c} ?? (6 arrangements)

- For any integer $n \geq 1$, the number of permutation of n elements is $n!$

EXAMPLE

(i) How many ways can the letters in the word COMPUTER be arranged in a row?

All the eight letters are in the word COMPUTER are distinct, so the number of ways,

$8! = 8 \times 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1 = 40{,}320$

(ii) How many ways can the letters in the word COMPUTER be arranged if the letters "CO" must remain next to each other (in order) as a unit?

$7! = 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1 = 5040.$

PERMUTATIONS OF SELECTED ELEMENTS

- If n and r are integers and $1 \leq r \geq n$, then the number of r permutations of a set of n elements is given by the formula

Example: A license plate begins with three letters. If the possible letters are A, B, C, D and E, how many different permutations of these letters can be made if no letter is used more than once? (Ans: 60)

COMBINATIONS

- The number of combinations of n things taken r at a time is given by:

$$ {}^{n}C_{r} = \frac{n!}{r!(n-r)!} $$

- The order of the arrangement is not important. Example: In how many ways can a coach choose three swimmers from among five swimmers? (10 ways)

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EXAMPLE

- (i) 16 teams enter a competition. They are divided up into four Pools (A, B, C and D) of four teams each.Every team plays one match against the other teams in its Pool.

After the Pool matches are completed:

- the winner of Pool A plays the second placed team of Pool B
- the winner of Pool B plays the second placed team of Pool A
- the winner of Pool C plays the second placed team of Pool D
- the winner of Pool D plays the second placed team of Pool C

The winners of these four matches then play semi-finals, and the winners of the semi-finals play in the final.

How many matches are played altogether?

QUESTION

- How many “Mahajana sampatha” Tickets can be printed in a single draw ?? (numbers are selected from 0 to 9 and it can repeat)

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End of Lecture 07

Next Lecture: Graph Theory