

Assignment - I

1) Define Algorithm. Explain properties of algorithm.

Ans:

⇒ It is a step by step process to solve any problem.

⇒ An algorithm is a sequence of instructions that act on input data to produce some output in a finite number of steps.

⇒ Algorithm is independent of any programming languages.

Properties of Algorithm :-

1) Input :- An algorithm must receive 0 or more data supplied externally.

2) Output :- An algorithm must produce at least 1 output as result.

3) Finiteness :- The algorithm must terminate after a finite number of steps.

4) Definiteness :- The steps of the algorithm must be clear & unambiguous having only one interpretation.

5) Effectiveness :- Without applying any intelligence, all can solve algorithm using pen and paper.

2) Explain, how to design an algorithm? (explain the steps need to be followed to design an algorithm?)

Ans:

- => In computer science, developing an algorithm is an art or a skill. And we can have mastery on algorithm development process only when we follow certain method. Before actual implementation of the program, designing an algorithm is very important step.
- => suppose if we want to build a house we do not directly start constructing the house. Instead we consult an architect, we put our ideas and suggestions, accordingly he draws a plan of the house, and he discuss it with us.
- => If we have some suggestion, the architect notes it down and makes the necessary changes accordingly in the plan. This process continues till we are happy.
- => Finally the blueprint of house get ready. once design process is over actual construction activity starts.
- => Now it becomes very easy and systematic for construction of desired house. In this example, you will find that all designing is just a paper work and at that instance if we want some changes to be done then those can be easily carried out on the paper.

- ⇒ After a satisfactory design the construction activities start. Same is program development process.
- ⇒ If we could follow same kind of approach while designing and analyzing the algorithm then we can have successful implementation for complex problems also.
- ⇒ Let us list the "What are the steps that needs to be followed?" while designing an algorithm.

Understand the problem

Decision making on

⇒ Capabilities of computational devices

⇒ Select exact / approximate method

⇒ Data structures

⇒ Algorithmic strategies

Specification of Algorithm /

Design of Algorithm

Verification

Analysis

Coding

Fig. Algorithm design steps

3) Define following terms.

1) Power Set :- The power set is a set of all the subsets of its elements.

For example :- $A = \{30, 6\}$

then power set is,

$$P(A) = \{\emptyset, \{30\}, \{6\}, \{30, 6\}\}$$

The number of elements are always equal to 2^n where n is numbers of elements in original set.

2) Empty Set :- The set having no element in it is called empty set. It is denoted by $A = \{\}$ and it can be written as \emptyset .

3) Equal Set :- The two sets are said to be equal ($A = B$) if $A \subseteq B$ and $B \subseteq A$ i.e. every element of set A is an element of B and every element of B is an element of A.

For example :- $A = \{30, 6\}$
 $B = \{30, 6\}$

here, $A \subseteq B$ and $B \subseteq A$ so,
 $A = B$ proved.

4) Sub Set :- The subset A is called subset of set B if every element of set A is present in set B but reverse is not true. It is denoted by $A \subseteq B$.

For example :- $A = \{30, 6\}$
 $B = \{1, 2, 6, 30\}$

then $A \subseteq B$

5) Cardinality of Set :- The cardinality of a set denotes the number of elements in a set. The cardinality of a set S is denoted by $n(S)$ or $|S|$.

For example :-

1) set of english alphabets then,
 $n(S) = |S| = 26$

2) The cardinality of infinite set X denoted by $|X| = \infty$

3) The empty set denoted as \emptyset is the unique set whose cardinality is 0.

4) Explain Vector and Matrix in brief.

Ans:

Vector :- A vector A is a collection of n tuples.

For examples :-

$$A = (a_1, a_2, a_3, \dots, a_n)$$

Where a_i are called the components of A .

Matrix :- A matrix means a rectangular array of numbers

For example :-

$$A = \begin{vmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{vmatrix}$$

5) What is Linear Inequalities and Linear Equation ?
explain with example.

Ans:

Linear Inequalities :- The term inequality is applied to any statement involving one of the symbols $<$, $>$, \leq , \geq .

- example :-
- 1) $x \geq 1$
 - 2) $3x + 2y > 16$
 - 3) $x + 2y \leq 12$
 - 4) $x < 10$

Linear Equations :- The linear equation is an equation containing n unknowns.

Ex:-

A linear equation with one unknown can be given in standard form:

$$ax = b$$

where x is unknown and a, b are constants.
The solution of such equation will be,

$$x = b/a$$

example :- $2x = 10$

$$x = 5$$

6) Explain function and Relation in detail. state difference between function and Relation.

Ans:

Function :- function can be defined as the relationship between two sets. That means using function we can map one element of one set to some other element of another set. A function is a relation but relation is not necessarily a function

function can be denoted by f . suppose we have $f(x) = x^3$ then,

$$f(2) = 8$$

$$f(5) = 125$$

$$f(-1) = -1$$

and so on.

Relation :- Relationship is a major aspect between two objects even this is true in our real life one object can be related with the other object by a 'mode of relation'. Then those two objects form a pair based on this certain relationship.

The relation R is a collection for the set S which represents the pairs of elements.

(a,b) is in R . we can represent their relation as $a R b$.

first component of each pair is chosen from a set called domain and second component of each pair is chosen from a set called range.

Difference between function and Relation :-

Relations

Functions

- | | |
|---|---|
| 1) A Relation is a relationship between sets of values. Or, it is a subset of the Cartesian product | 1) A function is a relation in which there is only one output for each input. |
| 2) A Relation is denoted by "R". | 2) A function is denoted by "F" or "f". |
| 3) Every relation is not a function | 3) Every function is a relation. |
| 4) examples | 4) examples |

$$R = \{(2,x), (9,y), (2,z)\}$$

$$F = \{(2,x), (9,y), (5,x)\}$$

7) Explain following terms.

1) Zero Vector :- Let $A = (a_1, a_2, a_3, \dots, a_n)$ be a vector and if all $a_i = 0$ then vector A is called zero vector.

2) Zero Matrix :- A zero matrix is a matrix with all its entries being zero

example :- $A = \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$

3) Identity Matrix :- The identity matrix or unit matrix having of size n is a square matrix having 1's on the main diagonal, and 0's elsewhere.

example :-

$$I_1 = \begin{bmatrix} 1 \end{bmatrix}$$

$$I_2 = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

$$I_3 = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

4) Transpose of Matrix :- The transpose of matrix A is obtained by interchanging row and column.

The transposed matrix is denoted by A^T . If matrix A is of size $m \times n$ then A^T is $n \times m$

example:-

$$A = \begin{bmatrix} 10 & 20 \\ 30 & 40 \\ 50 & 60 \end{bmatrix} \text{ then, } A^T = \begin{bmatrix} 10 & 30 & 50 \\ 20 & 40 & 60 \end{bmatrix}$$

5) Determinant of Matrix :- The determinant of matrix A is a specific number. It is denoted by $|A|$.

\Rightarrow The determinant of order one matrix is

$$|c_{11}| = c_{11}$$

\Rightarrow The determinant of order two matrix is

$$\begin{vmatrix} c_{11} & c_{12} \\ c_{21} & c_{22} \end{vmatrix} = c_{11}c_{22} - c_{12}c_{21}$$

\Rightarrow For any two n square matrices A and B,
 $\det(AB) = \det(A) \cdot \det(B)$ "

8) Write a program to find GCD using recursion.

Ans:

```

import java.util.*;
public class GCD {
    static int logic(int num1, int num2) {
        if (num1 == 0)
            return num2;
        if (num2 == 0)
            return num1;
        if (num1 == num2)
            return num1;
        else if (num1 > num2)
            return logic(num1 - num2, num2);
        else
            return logic(num1, num2 - num1);
    }
}
  
```

```

public static void main(String[] args) {
    Scanner sc = new Scanner(System.in);
    System.out.print("Enter number-1:");
    int num1 = sc.nextInt();
    System.out.print("Enter number-2:");
    int num2 = sc.nextInt();
    System.out.println("GCD:" + logic(num1, num2));
}
  
```

}

Output: Enter number-1: 15
 Enter number-2: 12
 GCD: 3

9) Write a program to find fibonacci series using recursion.

Ans:

```
import java.util.*;  
  
public class Factorial {  
  
    static int logic (int num) {  
        if (num == 0)  
            return 0;  
        else if (num == 1)  
            return 1;  
        else  
            return logic (num-1) + logic (num-2);  
    }  
}
```

```
public static void main (String [] args) {  
    Scanner sc = new Scanner (System.in);  
    System.out.print ("Enter Range : ");  
    int num = sc.nextInt ();  
    System.out.print ("Fibonacci series : ");  
    for (int i=0; i<num; i++) {  
        System.out.print (logic (i) + " ");  
    }  
}
```

Output : Enter Range : 6
Fibonacci series : 0 1 1 2 3 5