Data Structures

SYBTech(CSE)

Unit - 1

Introduction

PPT-4

Prof. Ms. Manisha A. Bhusa Dept. Of CSE COE Ambajogai

Unit 1 [6 hrs] Introduction:

Data,
Data types,
Data structure,
Abstract Data Type (ADT),
Representation of Information,

Characteristics of algorithm, Program,

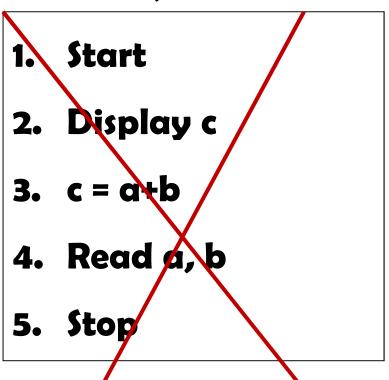
Analyzing programs.

Objective

Be familiar with basics of Algorithm and its criteria.

Algorithm:

This word comes from name of the Persian author, who wrote a book on Mathematics.



- 1. Start
- 2. Read a, b
- 3. c = a+b
- 4. Display c
- 5. Stop

Definition:

An Algorithm is a set of instructions if accomplishes, perform a specified task.

All algorithms should satisfy following criterion:

1. Input:

Zero or more

2. Output:

At least one

3. Definiteness:

Instruction should be clear & unambiguous.

Ex: Add 6 or 7 to x

Compute 5/0

4. Finiteness:

Terminate after a finite number of steps.

Ex: Chess

5. Effectiveness:

Instruction must be very basic enough so that it can be solved by a person using only pencil and paper.

Data: integer

Program Analysis:

- 1. Space Complexity
- 2. Time Complexity
- 1. Space complexity: Amount of memory algorithm needs to run for completion.
- 2. Time complexity: Amount of computer time algorithm needs to run for completion.

Space Complexity:

- Space = Fixed part + Variable part
 of an algorithm.
 - 1. Fixed part: Independent of characteristics of the I/Ps and O/Ps.
 - It includes space for
 - a. Code.
 - b. Simple variables and fixed size component variables.
 - c. Constants.

- 2. Variable part consists of space needed by component variables whose size is dependent on:
 - a. Particular problem instance being solved.
 - b. Space needed by referenced variables.
 - c. Recursion stack space.

Space requirement for algorithm P is:

$$S(P) = C + Sp$$

where, C: Constant

Sp: Instance characteristics

```
Algorithm abc (a, b, c)
{
    return a + b + b * c + (a + b - c) / (a + b) + 4.0;
}
```

- Characterized by 1 constant, 4.0 & values of a, b & c
- Assume each value require 1 word space.
- No instance characteristics.

$$S(abc) = C + Sabc$$
Therefore
$$Sabc = 0$$

$$C = 4$$

$$S(abc) >= 4 + 0$$

Sum of n numbers. (Iterative Method) Algorithm Sum (a, n) s := 0.0; for i:= 1 to n step 1 do s:= s + a[i];return s Characterized by n and a. n: number of elements a: array of floating point numbers. Variables: n, i, s (3 words) n words for a[] S(Sum) >= n + 3

Sum of n numbers. (Recursive) Algorithm RSum (a, n) if (n<=0) then return 0.0; else return a[n] + RSum(a, n-1);

```
n = 3 \ \alpha = \{3, 5, 4\}
                              Rsum(a,1)
Rsum(a,3)
                               if(1<=0)
 if(3<=0)
                                    False
                 12
   False
                                else
                                 return a[1]+Rsum(a,0)
  else
  return a[3]+Rsum(a,2)|}
                             Rsum(a,0)
Rsum(a,2)
                               if(0<=0)
  if(2<=0)
                                 return O
   False
  else
  return a[2]+Rsum(a,1)
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                                                         15
```

The recursion stack space includes:

Space for 1. formal parameters.

- 2. local variables.
- 3. return address.
- Assume return addr. requires 1 word of memory.
- RSum requires 3 words: 1. Space for the value of n
 - 2. Return address
 - 3. A pointer to a[]
- The depth of the recursion is n+1.

Therefore, S(RSum) >= 3(n+1)