DESIGN & ANALYSIS OF ALGORITHM

PCC-CS402

CREDIT - 3

PRE-REQUISITES

- PROGRAMMING
- DATA STRUCTURE & ALGORITHM
- DISCRETE MATHEMATICS

DESIGN & ANALYSIS OF ALGORITHM
SCHEDULE ----TOPIC WISE

	Topic	Sub Topic
1	INTRODUCTION	DESIGN OF ALGORITHM ,ANALYSIS OF ALGORITHM, ALGORITHM PROPERTIES
2	FRAMEWORK FOR ALGORITHM ANALYSIS	HOW TO COUNT EXECUTION TIME OF ALGORITHM,INPUT INSTANCES
3	ASYMPTOTIC NOTATION	BEST CASE,AVERAGE CASE, WORST CASE
4	SOLVING RECURRENCE RELATION	SUBSTITUTION METHOD, MASTER THEOREM
5	ALGORITHM DESIGN TECHNIQUES	DIVIDE & CONQUER, GREEDY,DYNAMIC PROGRAMMING, BACKTRACKING,
6	DISJOINT SET MANIPULATION	UNION ,FIND ALGORITHM & CYCLE DETCETION
7	NETWORK FLOW PROBLEM	FORD FULKERSON ALGORITHM
8	NP COMPLETENESS	NP,NP HARD……ALGORITHM
9	APPROXIMATION ALGORITHM	COMPLEXITY ANALYSIS OF NP COMPETE PROBLEM

BOOK

- **Introduction to Algorithms,** Thomas H. Cormen ,Charles E. Leiserson, Ronald L. Rivest,Clifford Stein ,MIT Press.
- “Fundamentals of Computer Algorithms(second edition)” by Sahni Horowitz
- “Design and Analysis of Computer Algorithms” by AHO

ALGORITHM

- A sequence of computational steps that transform the input into the output.
- ***Example - sorting problem***:
- **Input:** A sequence of n numbers a1; a2; : : : ;an.
- **Output:** A permutation (reordering) (a'1; a'2; …….. a'n) of the input sequence such that

  a'1<= a'2<=a'3……<=a'n.

ALGORITHM AND PROGRAM

ALGORITHM	PROGRAM
Design Phase	Implementation Phase
Domain Knowledge	Programming Concept/ Domain knowledge is optional
No specific language	Specific Programming language
System independent	System Dependent
Analyse	Testing

HOW TO WRITE AN ALGORITHM

- GCD PROBLEM
- Algorithm: GCD(M,N) // following algorithm calculates the gcd of m,n
- {
- while(N % M !=0)
- R := N%M // R ← N%M
- N := M
- M := R
- end while
- Return N
- }

PROPERTIES OF ALGORITHM

- Input
- Output
- Finiteness
- Definiteness
- Efficiency

PROPERTIES OF ALGORITHM GCD(M,N)

- Euclidean Algorithm
- Step 1 : r ⟶ N mod M
- Step 2: N ⟶ M
- Step 3: M ⟶ r
- Step 4: Repeat step 1 to 3 while M doesn't divide N
- Step 5: return N

- Input------ ---- M,N numerical type
- Output---- ---- gcd of M,N numerical type
- Finiteness-- ---- for 36,48 it is 3
- Definiteness- ---- steps are definite
- Efficiency ----------O(Log min(a, b))

ALGORITHM : GREATEST COMMON DIVISOR

- Algorithm 1: Simple level, School level
- Algorithm 2: Euclid's

ALGORITHM 1 : GREATEST COMMON DIVISOR (M,N)

OBJECTIVE- Following algorithm will calculate the Greatest common divisor of M and N

Begin

- Step 1 : Factorize M i.e M :=m1 * m2 * m3…….
- Step 2: Factorize N i.e N ← n1 * n2 * n3……..
- Step 3: Identify the common factor/factors.
- Step 4: GCD:= multiplication of common factors.
- Step 5: return GCD

End

- N.B- Simple level, School level

ALGORITHM 1 : GREATEST COMMON DIVISOR (M,N)

- GCD(36,48)
- Step 1 : M= 2*2*3*3
- Step 2: N= 2*2*2*2*3
- Step 3: Common Factor=2*2*3
- Step 4: GCD=12

Step 1 : Factorize M i.e M=m1 * m2 * m3.....

Step 2: Factorize N i.e N=n1 * n2 * n3.....

Step 3: Identify the common factor/factors.

Step 4: GCD= multiplication of common factors.

Step 5: return GCD

ALGORITHM 2 : GREATEST COMMON DIVISOR (M,N) N>=M

OBJECTIVE- Following algorithm will calculate the Greatest common divisor of M and N

Begin

- Step 1 : r ⟵ N mod M
- Step 2: N ⟵ M
- Step 3: M ⟵ r
- Step 4: Repeat step 1to 3 while M doesn't divide N
- Step 5: return N

End

N.B- Euclidean Algorithm

ALGORITHM 2 : GREATEST COMMON DIVISOR (M,N)

- Euclidean Algorithm GCD(36,48)
- Iteration 1: GCD(36,48) r=12 N=36 M=12
- Iteration 2: GCD(12,36) r=0 N=12 M=0
- Iteration 3: GCD=12

- Step 1 : r ⟵ N mod M
- Step 2: N ⟵ M
- Step 3: M ⟵ r
- Step 4: Repeat step 1 to 3 while M doesn't divide N
- Step 5: return N

ANALYSIS OF ALGORITHM 1 & 2
GREATEST COMMON DIVISOR (M,N)

- Euclidean Algorithm GCD(36,48)
- Iteration 1: GCD(36,48) r=12 N=36 M=12
- Iteration 2: GCD(12,36) r=0 N=12 M=0
- Iteration 3: GCD=12

- GCD(36,48)
- Step 1 : M := 2*2*3*3
- Step 2: N := 2*2*2*2*3
- Step 3: Common Factor :=2,2,3
- Step 4: GCD=12

QUESTION

- GCD(434,966)
- Step 1 : M= 2*7*31
- Step 2: N= 2*7*139
- Step 3: Common Factor=2,7
- Step 4: GCD=2*7=14

- **Number of division? a) 6 b) 7 c) 8 d) many**

NEXT CLASS TOPIC-

- Frame work for Algorithm Analysis.