



BCSE0012

Design & Analysis of Algorithms (DAA)

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Objectives of the Study

- This subject is made of three different words Design , Analysis and Algorithm.
- Algorithm is a sequence of finite steps to solve a particular problem.
- Designing anything is an art or it gives a principle or plan for designing anything/algorithm.

- Analysis means to measure or calculate the performance of algorithm. The performance of an algorithm is basically depend on two parameter Time and Memory.
- Therefore the meaning of this subject is to “Design an algorithm which can solve a particular problem efficiently”.
- Objective of DAA is to “Develop or Design Fast Algorithms”.



Example

Problem- Find the Greatest Common Divisor (GCD) of two integers.

Simple Factorization Algorithm

- Input : Two integer m, n .
- Output : Largest Integer that divide both m, n .
- Algorithm:
 1. Factorize m : find prime $m_1, m_2 \dots$ such that $m = m_1 * m_2 * \dots$
 2. Factorize n : Find prime $n_1, n_2 \dots$ such that $n = n_1 * n_2 * \dots$
 3. Identify common factors multiply and return result

Euclid Algorithm

- Input : Two integer m, n .
- Output : Largest Integer that divide both m, n .
- Algorithm:

Euclid (m, n)

{ while m does not divide n

$r = n \bmod m$

$n = m$

$m = r$

end

return m

}

- Algorithm are generally developed independent of programming languages.

Characteristics of Algorithms

- Each instruction should be unique and concise.
- Each instruction should be relative in nature and should not be repeated infinitely.
- After the algorithm terminates result should be generated



Properties of an Algorithm

- **Input:** A number of quantities are provided to an algorithm initially before the algorithm begins. These quantities are inputs.
- **Definiteness :** Each step must be clear and unambiguous.
- **Effectiveness:** Each Step must be carried out in finite time.

- **Finiteness:** Algorithm must terminate after finite steps.
- **Output:** An algorithm must have output.
- **Correctness:** Correct set of out values must be produced for each set of inputs.



Example- Write an algorithm to find the greatest number among three number

- Step 1:start
- step 2:input a, b, c
- step 3:if $a > b$ go to step 4,otherwise go to step 5
- step 4:if $a > c$ go to step 6,otherwise go to step 8
- step 5:if $b > c$ go to step 7,otherwise go to step 8
- step 6:output "a is the largest ",go to step 9
- Start 7 : Output "b is the largest", go to step 9
- Start 8 : Output " c is the largest", go to step 9
- Start 9 : Stop



Complexity

- Given a particular problem of size n . The time required by any algorithm for solving this problem is denoted by a function such as $f(n)$.
- $f(n)$ is largest time needed by the algorithm to solve the problem size n .
- Therefore for analysis of the program requires two types of complexity Time and Space (Memory) complexity

- Time complexity defines the total amount of time an algorithm needs to execute all its key statements and in generating the output.
- Space complexity is essentially the number of memory cells which an algorithm needs.
- A good algorithm is that can solve a problem and have less amount of time or space complexity or both



Designing Techniques

- Some of Algorithm Designing Techniques that are discussed or given in our syllabus are
- Divide and Conquer
- Greedy Approach
- Dynamic Programming
- Backtracking
- Brute Force Techniques



Analysis of Algorithm

- Algorithm 1

$a=a+1$

- In an algorithm 1 we may find that the statement $a=a+1$ is independent and not contained any loop.
- Therefore the number of times this shall executed is 1 and frequency count is 1.

- Algorithm 2

For $x=1$ to n

 step 1 : $a=a+1$

for loop end

- In this algorithm the frequency count of statement $a=a+1$ is depend on the value of n .
- If value is n then loop is executed n time and statement $a=a+1$ executed n time and frequency count is n .

- Algorithm 3
For x=1 to n
For y=1 to n
 a=a+1
 y for loop end
x for loop end
- In this algorithm the frequency count of statement a=a+1 is depend on the value x and y of n .
- If value is n then both loop is executed n time and statement a=a+1 executed $n*n$ time and frequency count is $n*n$.

Thank you