



Bhoj Reddy Engineering College for Women

(Sponsored by Sangam Laxmibai Vidyapeet, Approved by AICTE and Affiliated to JNTUH)

Accredited by NAAC with A Grade, Recognized under section 2(f) of the UGC act, 1956

Vinaynagar, I S Sadan X Roads, Saidabad, Hyderabad - 500 059, Telangana

Telephone: 040-2453 1725/7282, Email: principal@brecw.ac.in, Website: www.brecw.ac.in



Question Bank

Subject Name: Design and Analysis of Algorithm

Subject Code: CS501PC

UNIT –I (2 Marks Questions)

1. Define Space complexity and time Complexity?

The space complexity of an algorithm is the amount of memory it needs to run to completion. The time complexity of an algorithm is the amount of computer time it needs to run to completion.

2. What is Algorithm specification?

3. Define big-oh and Big-Omega notation?

A function $t(n)$ is said to be in $O(g(n))$, denoted $t(n) = O(g(n))$, if $t(n)$ is bounded above by some constant multiple of $g(n)$ for all large n , i.e., if there exist some positive constant c and some nonnegative integers n_0 such that $t(n) \leq cg(n)$ for all $n \geq n_0$

4. State the weighing, collapse rules in sets?

Weighted Union. A low-cost approach to reducing the height is to be smart about how two trees are joined together. One simple technique, called the weighted union rule, joins the tree with fewer nodes to the tree with more nodes by making the smaller tree's root point to the root of the bigger tree.

The main idea of collapsing find is: if the immediate parent of an element isn't the head of the subset, then find the subset and collapse the element by setting its immediate parent to the head of the subset

5. What is asymptotic notation?

Asymptotic notations are used to represent the complexities of algorithms for asymptotic analysis. These notations are mathematical tools to represent the complexities. There are three notations that are commonly used.

9. What is an algorithm?

An algorithm is a sequence of unambiguous instructions for solving a problem. i.e., for obtaining a required output for any legitimate input in a finite amount of time

10. What do you mean by Amortized Analysis?

Amortized analysis finds the average running time per operation over a worst case sequence of operations. Amortized analysis differs from average-case performance in that probability is not involved; amortized analysis guarantees the time per operation over worst-case performance.

11. What are algorithm design techniques?

Algorithm design techniques (or strategies or paradigms) are general approaches to solving problems algorithmically, applicable to a variety of problems from different areas of computing. General design techniques are:

- (i) Brute force (ii) divide and conquer
- (iii) decrease and conquer (iv) transform and conquer
- (v) greedy technique (vi) dynamic programming
- (vii) backtracking (viii) branch and bound



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12. How is an algorithm's time efficiency measured?

Time efficiency indicates how fast the algorithm runs. An algorithm's time efficiency is measured as a function of its input size by counting the number of times its basic operation (running time) is executed. Basic operation is the most time consuming operation in the algorithm's innermost loop.

13. Give the two major phases of performance evaluation

Performance evaluation can be loosely divided into two major phases:

- (i) a prior estimates (performance analysis)
- (ii) a Posterior testing (performance measurement)

14. Define order of an algorithm

Measuring the performance of an algorithm in relation with the input size n is known as order of growth.

15. How is the efficiency of the algorithm defined?

The efficiency of an algorithm is defined with the components.

- (i) Time efficiency - indicates how fast the algorithm runs
- (ii) Space efficiency - indicates how much extra memory the algorithm needs

16. What are the characteristics of an algorithm?

Every algorithm should have the following five characteristics

- (i) Input
- (ii) Output
- (iii) Definiteness
- (iv) Effectiveness
- (v) Termination

Therefore, an algorithm can be defined as a sequence of definite and effective instructions, which terminates with the production of correct output from the given input. In other words, viewed little more formally, an algorithm is a step by step formalization of a mapping function to map input set onto an output set.

17. What do you mean by time complexity and space complexity of an algorithm?

Time complexity indicates how fast the algorithm runs. Space complexity deals with extra memory it require. Time efficiency is analyzed by determining the number of repetitions of the basic operation as a function of input size. Basic operation: the operation that contributes most towards the running time of the algorithm The running time of an algorithm is the function defined by the number of steps (or amount of memory) required to solve input instances of size n .

18. Define Big Omega Notations

A function $t(n)$ is said to be in $\Omega(g(n))$, denoted $t(n) \in \Omega(g(n))$, if $t(n)$ is bounded below by some positive constant multiple of $g(n)$ for all large n , i.e., if there exist some positive constant c and some nonnegative integer n_0 such that $t(n) \geq cg(n)$ for all $n \geq n_0$

19. What are the different criteria used to improve the effectiveness of algorithm?

- (i) The effectiveness of algorithm is improved, when the design, satisfies the following constraints to be minimum.

Time efficiency - how fast an algorithm in question runs.

Space efficiency – an extra space the algorithm requires

- (ii) The algorithm has to provide result for all valid inputs.



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20. Analyze the time complexity of the following segment:

```
for(i=0;i<N;i++)  
for(j=N/2;j>0;j--)  
sum++;  
Time Complexity= N * N/2  
= N2 / 2  
∈ O(N2)
```

21. Define Big Theta Notations

A function $t(n)$ is said to be in $\Theta(g(n))$, denoted $t(n) \in \Theta(g(n))$, if $t(n)$ is bounded both above and below by some positive constant multiple of $g(n)$ for all large n , i.e., if there exist some positive constants c_1 and c_2 and some nonnegative integer n_0 such that $c_1 g(n) \leq t(n) \leq c_2 g(n)$ for all $n \geq n_0$

22. What is performance measurement?

Performance measurement is concerned with obtaining the space and the time requirements of a particular algorithm.

23. What is an algorithm?

An algorithm is a finite set of instructions that, if followed, accomplishes a particular task. In addition, all algorithms must satisfy the following criteria:

- 1) input
- 2) Output
- 3) Definiteness
- 4) Finiteness
- 5) Effectiveness.

1. Define the divide and conquer method or Discuss divide and conquer method?

Given a function to compute on 'n' inputs the divide-and-conquer strategy suggests splitting the inputs into 'k' distinct subsets, $1 < k < n$, yielding 'k' subproblems. The subproblems must be solved, and then a method must be found to combine subsolutions into a solution of the whole. If the subproblems are still relatively large, then the divide-and-conquer strategy can possibly be reapplied.

2. Define control abstraction of DAC

A control abstraction we mean a procedure whose flow of control is clear but whose primary operations are by other procedures whose precise meanings are left undefined.

Write the Control abstraction for Divide-and-conquer.

Algorithm DAndC(P)

```
{  
if small(p) then return S(P);  
else  
{  
divide P into smaller instance p1,p2,...pk, k ≥ 1;  
Apply DAndC to each of these subproblems  
Return combine (DAnd C(p1) DAnd C(p2),---, DAnd (pk));  
}  
}
```

3. Write Analysis for the quick sort?



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4. Define Binary search?

5. What is the substitution method?

One of the methods for solving any such recurrence relation is called the substitution method.

6. What is the binary search?

If 'q' is always chosen such that 'aq' is the middle element (that is, $q = \lfloor (n+1)/2 \rfloor$), then the resulting search algorithm is known as binary search.

7. Give computing time for Binary search?

In conclusion we are now able to completely describe the computing time of binary search by giving formulas that describe the best, average and worst cases.

Successful searches

$\Theta(1)$ $\Theta(\log n)$ $\Theta(\log n)$

best average worst

Unsuccessful searches

$\Theta(\log n)$

best, average, worst

8. What is the maximum and minimum problem?

The problem is to find the maximum and minimum items in a set of 'n' elements. Though this problem may look so simple as to be contrived, it allows us to demonstrate divide-and-conquer in simple setting.

9. What is the Quick sort?

Quicksort is divide and conquer strategy that works by partitioning its input elements according to their value relative to some preselected element (pivot). It uses recursion and the method is also called partition-exchange sort.

10. Write the Analysis for the Quick sort.

$O(n \log n)$ in average and best cases

$O(n^2)$ in worst case

11. What is Merge sort? and Is insertion sort better than the merge sort?

Merge sort is divide and conquer strategy that works by dividing an input array into two halves, sorting them recursively and then merging the two sorted halves to get the original array sorted.

Insertion sort works exceedingly fast on arrays of less than 16 elements, though for large 'n' its computing time is $O(n^2)$.

12. Write an algorithm for straightforward maximum and minimum?

Algorithm straight MaxMin(a, n, max, min)

//set max to the maximum and min to the minimum of a[1:n]

```
{
max := min = a[1];
for i = 2 to n do
{
if(a[i] > max) then max = a[i];
if(a[i] < min) then min = a[i];
}
}
```



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13. What is general divide and conquer recurrence?

Time efficiency $T(n)$ of many divide and conquer algorithms satisfies the equation

$T(n) = a.T(n/b) + f(n)$. This is the general recurrence relation.

14.. Write the algorithm for Iterative binary search?

Algorithm BinSearch(a,n,x)

// Given an array a[1:n] of elements in nondecreasing

// order, $n > 0$, determine whether x is present

```
{
low := 1;
high := n;
while (low < high) do
{
mid := [(low+high)/2];
if (x < a[mid]) then high := mid-1;
else if (x > a[mid]) then low := mid + 1;
else return mid;
}
return 0;
}
```

15. Describe the recurrence relation for merge sort?

If the time for the merging operation is proportional to n, then the computing time of merge sort is described by the recurrence relation

$T(n) = a, n = 1$, a a constant

$2T(n/2) + n, n > 1$, c a constant

UNIT –I (Essay Questions)

1. Explain the properties of an algorithm with an example.
2. Define an algorithm and write the characteristics of the algorithm.
3. Explain the process of designing an algorithm. Give characteristics of an algorithm.
4. List out the steps that need to design an algorithm?
5. Distinguish between Algorithm and Pseudocode
6. Define time complexity and space complexity. Write an algorithm for adding n natural numbers and find the time required by that algorithm?
7. Define time and space complexity. Explain with examples.
8. Describe performance analysis, space complexity and time complexity.
9. Differentiate between Bigoh and Omega notation with example.
10. Differentiate between Best, average and worst-case efficiency?
11. Discuss the concepts of asymptotic notations and its properties?
12. Explain asymptotic notations.



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1. Write Short notes on divide and conquer?
2. Write Divide – And – Conquer recursive Merge sort algorithm and derive the time.
3. complexity of this algorithm?
4. Define Merge sort with example.
5. Describe Quick Sort with suitable example?
6. Illustrate Merge sort algorithm and discuss its time complexity.
7. Describe merge sort algorithm and explain with an example?
8. Sort the keys using merge sort (100,300,150,450,250,350,200,400,500)
9. Simulate Quick sort algorithm for the following example 25,36,12,4,5,16,58,54,24,16,9,65,78
10. Give the general procedure of divide and conquer method.
11. Write about quick sort method with example.
12. Illustrate the general method of divide and conquer technique.
13. Write an algorithm for Binary search and discuss its complexity.
14. Write binary search algorithm and analyse its time complexity?