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TOPICWISE : ALGORITHMS -1 (GATE - 2019) - REPORTS

OVERALL ANALYSIS COMPARISON REPORT SOLUTION REPORT

ALL(17) CORRECT(8) INCORRECT(7) SKIPPED(2)

Q. 1

What of the following sorting algorithms has the highest best case time complexity using array data structure?

Solution Video | Have any Doubt ?

A
Insertion sort

Your answer is **Wrong**

B
Bubble sort

C
Heap sort

D
Selection sort

Correct Option

Solution :
(d)

Algorithm	Best case time complexity
Insertion sort	$O(n)$
Bubble sort	$O(n)$
Selection sort	$O(n^2)$
Heap sort	$O(n \log n)$

So, selection sort has highest best case time complexity.

QUESTION ANALYTICS

Q. 2

Which one of the following is the recurrence equation for the worst case time complexity of finding K^{th} smallest element in an array of size 'n' using partition function? Assume 'c' is constant.

FAQ | Solution Video | Have any Doubt ?

A
$T(n) = 2T(n/2) + c \cdot n$

B
$T(n) = 2T(n-1) + c$

C
$T(n) = T(n-1) + c \cdot n$

Correct Option

Solution :
(c)
Worst case for finding K^{th} smallest element in array of size 'n' using partition function is when every time partition function split array into two part one with $n-1$ elements and other with 1 element i.e., $T(n-1)$ and we have to do at most n comparison for one partition i.e.
$T(n) = T(n-1) + n$

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QUESTION ANALYTICS

Q. 3

Which one of the following correctly determines the solution of the recurrence relation with $T(1) = 1$?

$$T(n) = 2T(n/4) + \sqrt{n}$$

Solution Video | Have any Doubt ?

A
$O(n)$

B
$O(\sqrt{n}\log n)$

Correct Option

Solution :
(b)

Apply Master Theorem:

$$T(n) = aT(n/b) + f(n)$$
$$f(n) = n^{1/2}$$
and here $a = 2, b = 4$
So, $(n^{\log_b a}) = (n^{\log_4 2})$
Will gives $(n^{1/2})$
So, $f(n) = \theta(n^{1/2})$
So, $T(n) = O(\sqrt{n}\log n)$

C
$O(n^2)$

Your answer is **Wrong**

D
$O(\log n)$

QUESTION ANALYTICS

Q. 4

Which of the following input will give best case time for selection sort?

FAQ | Solution Video | Have any Doubt ?

A
1 2 3 4 5 6 7 8 9 10

B
2 3 1 5 9 7 8 6 10

C
10 9 8 7 6 5 4 3 2 1

D
All of above take same amount of time

Your answer is **Correct**

Solution :
(d)
Selection sort in worst and best case take same time i.e., $O(n^2)$. So all the input take same time.

QUESTION ANALYTICS

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For merging two unsorted list of size m and n into sorted list of size $m + n$. The time complexity in terms of number of comparison for this is

Solution Video | Have any Doubt ?

A
$O(\log m + \log n)$

B
$O(m \log m + n \log n)$

Correct Option

Solution :
(b)
Before merging blindly, we have to sort both array individually which will take $O(m \log m)$ $O(n \log n)$ time respectively. Then merging will take $O(m + n)$ in worst case.
Total number of comparisions = $m \log m + n \log n + m + n$
$= O(m \log m + n \log n)$

C
$O(n + m)$

Your answer is **Wrong**

D
$O(\log n^2 + m^2)$

QUESTION ANALYTICS

Q. 6

Suppose there are 4 sorted list of 16 elements each. If we merge these lists into a single sorted list of 64 elements. The key comparisons that are needed in the worst case using an efficient algorithm are _____.

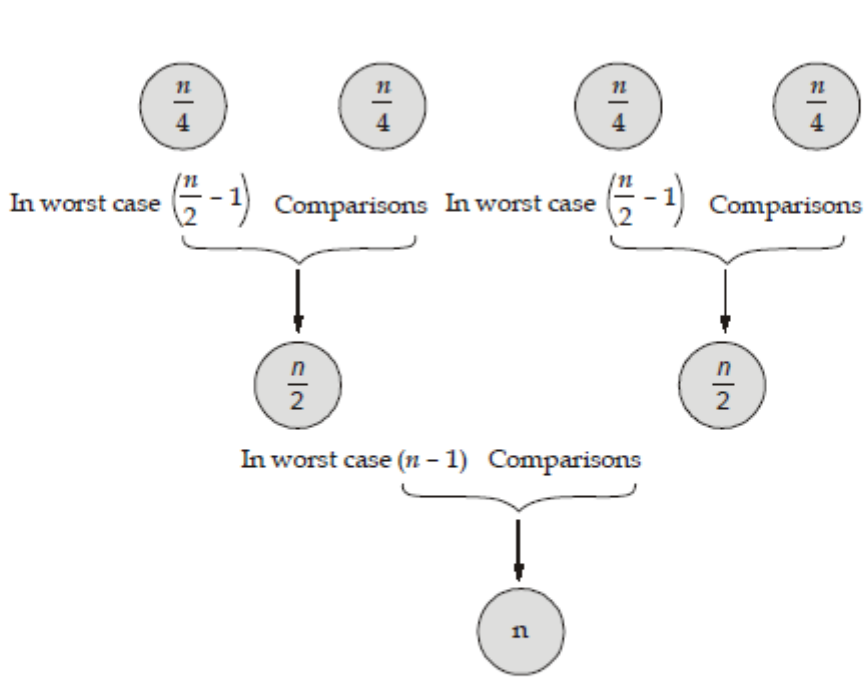
FAQ | Solution Video | Have any Doubt ?

125

Correct Option

Solution :
125

List us consider the scenario of n-elements where each of the 4 list are having $\frac{n}{4}$ elements



Total comparisons $= \left(\frac{n}{2}-1\right)+\left(\frac{n}{2}-1\right)+n-1 = 2n-3$

Substituting the value of n, we get
$2 \times 64 - 3 = 125$

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QUESTION ANALYTICS

Q. 7

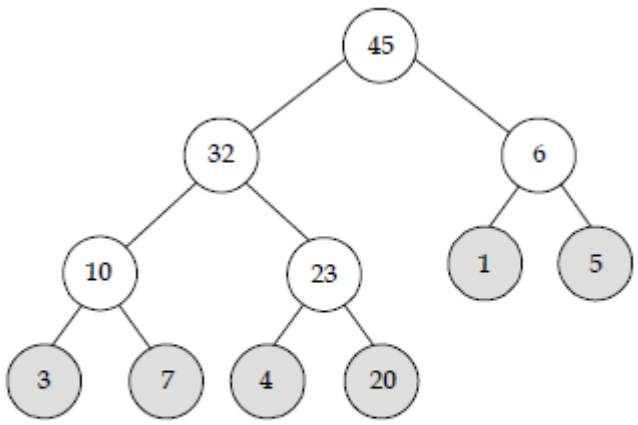
Max-heap is constructed by inserting the following integer in the given order into an empty tree.The sum of integer values present at the leafs of max heap tree is _____.
20, 32, 1, 3, 4, 5, 6, 7, 10, 23, 45

Solution Video | Have any Doubt ?

40

Correct Option

Solution :
40



Integers at leaf of max heap tree are : 3, 7, 4, 20, 1, 5

$$\text{Sum} = 1 + 3 + 4 + 5 + 7 + 20$$
$$= 40$$

Your Answer is 43

QUESTION ANALYTICS

Q. 8

The difference between maximum possible profit for 0/1 Knapsack and fractional Knapsack problem with capacity (W) = 200.

Item	a	b	c	d	e	f	g	h	i	j
Weight	30	50	20	10	120	100	90	90	40	10
Profit	70	95	30	30	260	190	180	170	50	40

FAQ | Solution Video | Have any Doubt ?

30

Correct Option

Solution :
30

Item	a	b	c	d	e	f	g	h	i	j
Weight	30	50	20	10	120	100	90	90	40	10
Profit	70	95	30	30	260	190	180	170	50	40
Per Unit Profit	2.33	1.9	1.5	3	2.16	1.9	2	1.88	1.25	4

Fractional Knapsack problem:
Select all of item '*a*', '*d*', '*e*', '*j*' and 1/3 of item '*g*'

$$\text{Total weight} = 30 + 10 + 120 + 10 + 1/3 \times 90 = 200$$
$$\text{Total profit} = 70 + 30 + 260 + 40 + 1/3 \times 180 = 460$$

0/1 Knapsack problem:
Select all of item *j*, *d*, *a*, *e* and *c*.

$$\text{Total weight} = 30 + 10 + 120 + 10 + 20 = 190$$

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QUESTION ANALYTICS

Q. 9

Consider implementations of two sorting algorithms named Sort-A and Sort-B on same machine.For input size n, Sort-A takes $8n^2$ steps, while Sort-B takes 32 $n\log n$ steps. The minimum value of n for which both algorithm take same number of steps is _____.

Solution Video | Have any Doubt ?

16

Your answer is **Correct**16

Solution :
16

So, both algorithm take same steps:

$$8n^2 = 32\ n\log n$$
$$n^2 = 4\ n\log n$$
$$n = 4\ \log n$$

So, when $n = 16$

$$16 = 4\ \log_2 16$$
$$\Rightarrow \quad 16 = 4 \times 4$$
$$\Rightarrow \quad 16 = 16$$

So, when $n = 16$, both algorithms take same number of steps.

QUESTION ANALYTICS

Q. 10

Consider the following functions:

$f(n) = 2^{\log_2 n}$
$g(n) = n^{\log_2 n}$
$h(n) = n^{1/\log_2 n}$

Which of the following statements about the asymptotic behaviour of $f(n)$, $g(n)$ and $h(n)$ is true?

FAQ | Solution Video | Have any Doubt ?

A
$f(n) = \Omega(g(n))$ and $g(n) = O(h(n))$

B
$g(n) = \Omega(h(n))$ and $f(n) = O(f(n))$

C
$f(n) = O(g(n))$ and $g(n) = \Omega(h(n))$

Your answer is **Correct**

Solution :
(c)

$$f(n) = 2^{\log_2 n} = n^{\log_2 2} = n$$
$$g(n) = n^{\log n}$$
$$h(n) = n^{1/\log n} = \sqrt[\log n]{n}\left[n > \sqrt[\log n]{n} \text{ for all large value of } n\right]$$

[It is less than n since max power of n is always less than 1 for large value of n]
So, $g(n) \geq f(n \geq h(n)$
So, $f(n) = O(g(n))$ and $g(n) = \Omega(h(n))$

D
$g(n) = O(h(n))$ and $h(n) = O(g(n))$

QUESTION ANALYTICS

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Let $f(n) = \Omega(n)$, $g(n) = O(n)$ and $h(n) = \theta(n)$. Then $[f(n) \cdot g(n)] + h(n)$ is _____.

FAQ | Solution Video | Have any Doubt ?

A
$\Omega(n)$

Your answer is **Correct**

Solution :
(a)

$$f(n) = \Omega(n) \Rightarrow f(n) \geq c \cdot n$$
$$g(n) = O(n) \Rightarrow g(n) \leq c \cdot n$$
$$h(n) = \theta(n) \Rightarrow c_1 \cdot n \leq h(n) \leq c_2 \cdot n$$
$$f(n) \cdot g(n) = c \cdot n \quad [\because f(n) \geq c \cdot n \ \& \ g(n) \leq c \cdot n]$$
$$\underbrace{f(n).g(n)}_{\geq c.n} + \underbrace{h(n)}_{\theta(n)} = \Omega(n)$$

So, option (a) is correct.

B
$O(n)$

C
$\theta(n)$

D
None of these

QUESTION ANALYTICS

Q. 12

Consider an array containing 'n' elements. The elements present in an array are in arithmetic progression, but one element is missing in that order. What is the time complexity to find the position of the missing element using divide and conquer?

FAQ | Solution Video | Have any Doubt ?

A
$O(n)$

B
$O(n^2)$

C
$O(\log n)$

Your answer is **Correct**

Solution :
(c)
The time complexity is $O(\log n)$ using binary search.
The idea is to go to the middle element at index $n/2$ calculate $a_{n/2} = a + [n/2 - 1] \times d$ and ch
$a[n/2] = a_{n/2}$ or not if equal check on RHS only otherwise LHS.

D
$O(n \log n)$

QUESTION ANALYTICS

Q. 13

What is time complexity of fun ( )?

```
int fun (int n)
```

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```
        for (int j = 0; j < i; j++)
            count + = 1;
    return count;
}
```

FAQ | Solution Video | Have any Doubt ?

A

$O(n^2)$

B

$O(n)$

Correct Option

Solution :
(b)

For n time, inner loop will execute for n times.

For $\frac{n}{2}$ time, inner loop will execute for $\frac{n}{2}$ times.

For $\frac{n}{4}$ time, inner loop will execute for $\frac{n}{4}$ times.

and do on .....

So time complexity: $T(n) = O\left(n+\frac{n}{2}+\frac{n}{4}+.....+1\right)$

$= O(n)$

C

$O(n \log n)$

Your answer is **Wrong**

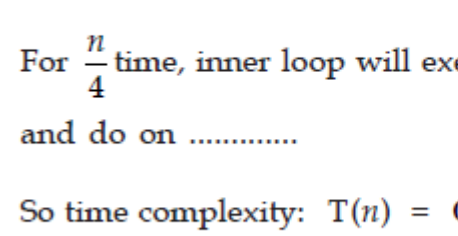
D

$O(n (\log n)^2)$

QUESTION ANALYTICS

Q. 14

Consider the following graph:



Which one of the following represents the sequence of edges added in order to make a minimum spanning tree using Prim's algorithm?

FAQ | Solution Video | Have any Doubt ?

A

(b – d), (b – e), (e – c), (a – c), (d – f), (c – h), (e – g)

Your answer is **Correct**

Solution :
(a)

Since by looking through options, we get to know 'b' will be the start vertex.

	a	b	c	d	e	f	g	h
	∞	0	∞	∞	∞	∞	∞	∞
b	5	–	∞	1	3	∞	∞	∞
(b – d) d	5	–	∞	–	3	6	∞	∞
(d – e) e	5	–	4	–	–	6	9	∞
(e – c) c	4	–	–	–	–	6	9	7
(c – a) a	–	–	–	–	–	6	9	7
(d – f) f	–	–	–	–	–	–	9	7
(c – h) h	–	–	–	–	–	–	9	–

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B
(b – d), (c – e), (b – e), (a – c), (c – h), (d – f), (e – g)

C
(b – e), (a – c), (b – d), (e – c), (d – f), (c – b), (e – g)

D
(b – e), (b – d), (a – c), (e – c), (c – b), (d – f), (e – g)

QUESTION ANALYTICS

Q. 15

A message is made up entirely of characters from the set P = {W, X, Y, Z}. The table of probability for each characters given below:

Character	Probability
W	0.01
X	0.30
Y	0.34
Z	0.35

The expected length of the encoded message in bits, if a message of 200 characters over set P encoded using Huffman coding _____ in bits.

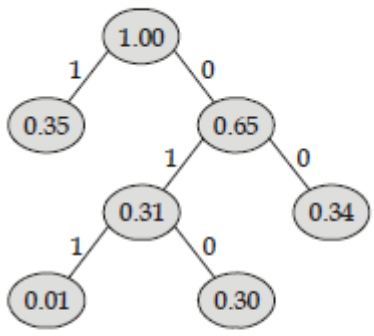
Solution Video | Have any Doubt ?

392

Your answer is **Correct**392

Solution :
392

Using min heap data structure:



Expected length: $[0.35 \times 1 + 0.34 \times 2 + 0.30 \times 3 + 0.01 \times 3] \times 200$
$= [0.35 + 0.68 + 0.90 + 0.03] \times 200$
$= [1.96] \times 200$
$= 392$

QUESTION ANALYTICS

Q. 16

A certain permutations of integers stored in an array is provided as an input to the procedure of quicksort. After one pass of the algorithm the status of the array is as follows:
9, 6, 11, 13, 18, 15, 17, 24
The sum of all the possible values that could have been used as a pivot is _____.

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48

Your answer is **Correct**48

Solution :
48

Property of the output of each pass of quicksort:

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Comparing both it can be observed that elements 11, 13 and 19 are on their correct posit
Besides that they are satisfying II property also.
Hence, possible pivots, 11, 13, 24
Sum, $11 + 13 + 24 = 48$

QUESTION ANALYTICS

Q. 17

A min heap having 1024 distinct elements with keys ranging from 0 to 1023 is stored in array of 1024 indices. The maximum difference between element 512 present at maximum level and minimum level is _____. [Assume root is present at level-1]

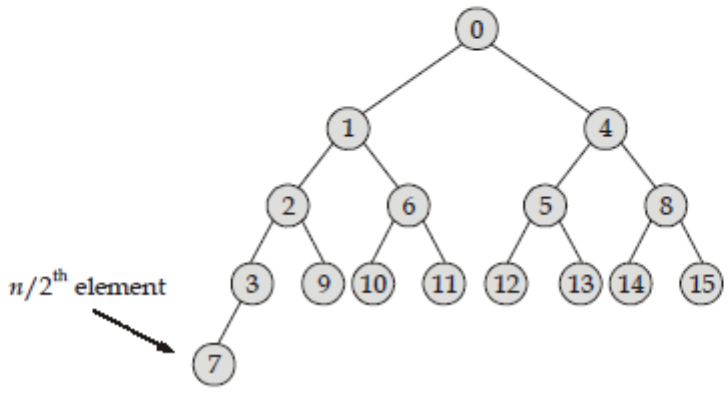
FAQ | Solution Video | Have any Doubt ?

9

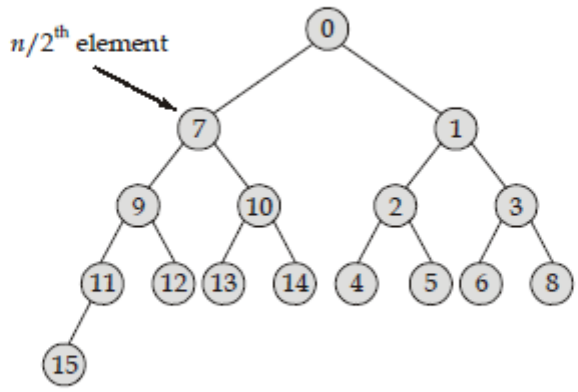
Correct Option

Solution :
9

Since there are total 1024 elements hence there will be total 11 levels of the heap. $(n/2)^{th}$ e
can be present at last level in worst case i.e. 11^{th} level.
$(n/2)^{th}$ element can also be present in best case level i.e. 2^{nd} level
Assume for $n = 16$
In worst case:



$(n/2)^{th}$ element is at last level.
In best case:



$(n/2)^{th}$ element is at second level.
So, difference = [11 – 2] = 9

QUESTION ANALYTICS