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Computational Thinking

1 message

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Here's what we got from you:

Computational Thinking

1. Please fill the required fields before attempting questions.
2. The duration of the test is 45 minutes.
3. Keep your audio and video on throughout the test.
4. Wherever you are unable to use mathematical notations, use English text. For instance, you may use square(n), sqrt(n), log n etc.

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1. Consider the following code and answer the question that follows.

The function prime(n) returns true if and only if n is a prime number. The values **start** and **end** have been initialized to some arbitrary values.

```
i = 0; j = 0; k = 0;
counter = start;
while (counter <= end) {
 if (prime(counter)){
   i = i + 1;
     k = k + 1;
 } else {
   j = j + 1;
     k = k + 1;
 }
 counter = counter + 1;
}
```

What relationship, if any, holds between i, j and k at the end of the loop? How does it depend on the values of **start** and **end**?

Above count all primes and non primes in the range of [start, end]. i = #prime numbers, j = #non prime numbers, k = size of range [start, end]

2. How many times is the comparison i >= n performed in the following block of code?

```
i = 200;
n = 80;
while (i >= n){
 i = i - 2;
 n = n + 1;
}
```

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3. Given a very large array as input, suggest an algorithm to efficiently find the 'k' largest elements in it.

put array in minheap and keep on deleting elements 'k' times. All such deleted elements will be k largest elements

4. You are given an unsorted array of size n consisting of numbers from 1 to n+1, with one number missing. If the array does not contain any duplicates, give an efficient algorithm to find the missing number.

missing number = (sum of all numbers from '1' to 'n+1')-(sum of elements of given array)

5. Arrange the following functions in increasing order of asymptotic complexity. (Sample answer format: c, d, e, a, b)

(a) 2^{2^n}

(b) $\log n$

(c) 2^{n^2}

(d) n^{2^n}

(e) $2^{\sqrt{n}}$

b, e, c, a, d

6. Give as efficient an algorithm as possible to find the LCM of two numbers x and y. Compute the running time of the algorithm. You may use symbols like square(n) or sqrt(n) to specify the complexity.

```
LCM(a,b)
{
return (a*b)/GCD(b,a%b)
}
GCD(a,b)
{
return GCD(b,a%b)
}
```

Complexity = O(max(log(a) , log(b)))

7. In a research institute, there are scientists who collaborate with each

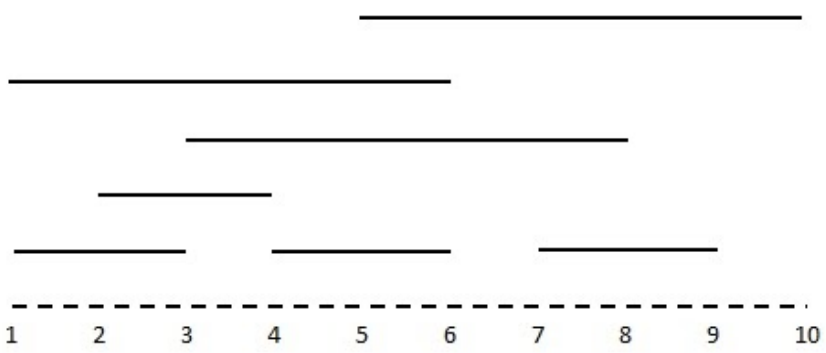
other. Suggest any data structure to model the collaboration. What are the limitations of using simple graphs to model the relationship between scientists who collaborate with each other? Hint: Suggest a data structure that models the collaboration involving three or more scientists. (You must answer the hint question too)

Matrix would take O(V*V). Adjacency list data structure will be good for above collaboration

8. Let A = {1,2,3,4,5,6,7,8,9,10} be a set of points on the line. Let a set of intervals be defined on the set A as shown in the figure. Each interval is of the form [x,y], where x, y ∈ A are the endpoints of [x,y]. As you can see in the example, [1,3], [3,8] etc are intervals.

a. We must find a set of points P ⊆ A on the line such that each interval has at least one point in P. Trivially, P could be A itself. Give an algorithm that minimizes the size of P.
b. What is the minimum number of elements that P should have?

(Your answer to both questions should be for the general case and not just for the example shown here.)



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