American Computer Science League

2020-2021 ● Contest 3: Shorts ● Junior Division

1. Boolean Algebra

Simplify the following boolean expression:

$A(\overline{B + C}) + A\overline{B}C$

A. $\overline{A}B$
B. $A\overline{B}$
C. $A + \overline{B}$
D. $\overline{AB}$
E. $\overline{A + B}$

2. Boolean Algebra

How many ordered pairs make the following expression TRUE?

$A\ (\overline{\overline{A\ +\ B}})(\overline{AB})$

A. 0
B. 1
C. 2
D. 3
E. 4

3. Data Structures

Find the number of nodes that have only one child in the binary search tree for:

SPACESHUTTLE

A. 2
B. 3
C. 4
D. 5
E. 6

4. Data Structures

Given an initially empty queue and the following commands on the queue, what will the next popped item be?

PUSH(H), PUSH(A), POP(X), PUSH(N), PUSH(S), POP(X), PUSH(S), POP(X), PUSH(O), PUSH(L), POP(X), PUSH(O), POP(X), POP(X)

A. L
B. S
C. A
D. O
E. N

5. What Does This Program Do? (Arrays)

You are given an initial 4 x 4 array filled in using row-major order with the first 16 terms of the Fibonacci Sequence:

0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, 233, 377, 610

For example, a(0,0) = 0 and a(3,2) = 377.

What is printed when the program is executed?

```
for i = 0 to 3
        for j = 0 to 3
                if a(i,j) % 2 == 0 then a(i,j) = a(i,j) / 2
                if a(i,j) % 3 == 0 then a(i,j) = a(i,j) / 3
        next j
next i
t = 0
for i = 0 to 3
        for j = 0 to 3
                a(i,j) = a(i,j) % 10
                t = t + a(i,j)
        next j
next i
output t
```

A. 48
B. 49
C. 51
D. 58
E. 63

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1. Boolean Algebra

化简下述布尔表达式:

$A(\overline{B+C}) + A\overline{B}C$

A. $\overline{A}B$
B. $A\overline{B}$
C. $A+\overline{B}$
D. $\overline{AB}$
E. $\overline{A+B}$

2. Boolean Algebra

有多少个有序对能使下述表达式为真？

$A\ (\overline{\overline{A}+B})(\overline{AB})$

A. 0
B. 1
C. 2
D. 3
E. 4

3. Data Structures

在下述二叉搜索树中，有多少个节点只有一个子节点？

SPACESHUTTLE

A. 2
B. 3
C. 4
D. 5
E. 6

4. Data Structures

给定一个初始为空的队列，在该队列中执行下述操作后，下一个即将出队的元素是哪个？

PUSH(H), PUSH(A), POP(X), PUSH(N), PUSH(S), POP(X), PUSH(S), POP(X), PUSH(O), PUSH(L), POP(X), PUSH(O), POP(X), POP(X)

A. L
B. S
C. A
D. O
E. N

5. What Does This Program Do? (Arrays)

给定一个初始大小为 4 x 4 的数组，现将斐波那契数列的前 16 项以行优先的形式依次填入数组：

0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, 233, 377, 610

比如, a(0,0) = 0 and a(3,2) = 377.

执行此程序时，会输出什么？

```
for i = 0 to 3
        for j = 0 to 3
                if a(i,j) % 2 == 0 then a(i,j) = a(i,j) / 2
                if a(i,j) % 3 == 0 then a(i,j) = a(i,j) / 3
        next j
next i
t = 0
for i = 0 to 3
        for j = 0 to 3
                a(i,j) = a(i,j) % 10
                t = t + a(i,j)
        next j
next i
output t
```

A. 48
B. 49
C. 51
D. 58
E. 63