

American Computer Science League

2020-2021 • Contest 3: Shorts • Junior Division

1. Boolean Algebra

Simplify the following boolean expression:

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

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

2. Boolean Algebra

How many ordered pairs make the following expression TRUE?

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

- 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
