

# American Computer Science League

2020-2021 • Contest 3: Solutions • Junior Division

## 1. Boolean Algebra

$$\begin{aligned} A(\overline{B+C}) + \overline{A}BC &= \overline{A}\overline{B}\overline{C} + \overline{A}BC \\ &= \overline{A}\overline{B}(\overline{C} + C) \\ &= \overline{A}\overline{B} \end{aligned}$$

1.  $\overline{A}\overline{B}$  (B)

## 2. Boolean Algebra

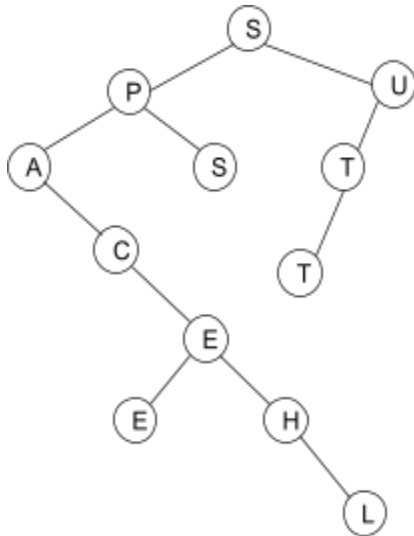
$$\begin{aligned} A(\overline{A+B})(\overline{AB}) &= A(\overline{A+B}) + \overline{AB} \\ &= AA + AB + AB \\ &= A + AB \\ &= A(1 + B) \\ &= A \end{aligned}$$

Therefore there are 2 ordered pairs that make the expression TRUE:  
(1, 1) and (1, 0) or (1, \*)

2. 2 (C)

## 3. Data Structures

The binary search tree for SPACESHUTTLE is:



There are 5 nodes with only one child: U, A, T, C, H

3. 5 (D)

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**4. Data Structures**

The queue is constructed using FIFO as follows:

H, HA, A, AN, ANS, NS, NSS, SS, SSO, SSOL, SOL, SOLO, OLO, LO.

The next item popped would be an L.

**4. L (A)**

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**5. What Does This Program Do? (Arrays)**

The original array is:

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

The first loop checks for numbers divisible by 2 and replaces the value in that location by the quotient if it is. It then checks if it is divisible by 3 and if it is, replaces the value in that location with the quotient. The resulting table is:

0	1	1	1
1	5	4	13
7	17	55	89
24	233	377	305

The last loop converts each number to its units digit and sums all the numbers. The final table is below and the sum of all of the values is 63.

0	1	1	1
1	5	4	3
7	7	5	9
4	3	7	5

**5. 63 (E)**

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