American Computer Science League

2020-2021 ● Contest 3: Solutions ● Senior Division

1. Boolean Algebra

$$A\overline{B} + \overline{BC} + \overline{A}C = A\overline{B} + (\overline{B} + \overline{C}) + \overline{A}C$$
$$= \overline{B}(A + 1) + \overline{C} + \overline{A}C$$
$$= \overline{B} + \overline{C} + \overline{A}C$$

To be FALSE, each term must be 0.

$\overline{B} = 0 \Rightarrow B = 1$ and $\overline{C} = 0 \Rightarrow C = 1$
$\overline{A}C = 0$, $C = 1 \Rightarrow \overline{A} = 0 \Rightarrow A = 1$
Therefore (1, 1, 1) makes it FALSE.

1. (1, 1, 1) (A)

2. Boolean Algebra

$$\overline{A\,\overline{AB}}\;\overline{BC} + \overline{C} = (\overline{A} + \overline{\overline{AB}})(\overline{B} + \overline{C}) + \overline{C}$$
$$= \overline{A}\,\overline{B} + \overline{A}\,\overline{C} + A\,\overline{B}\,B + A\,B\,\overline{C} + \overline{C}$$
$$= \overline{A}\,\overline{B} + (\overline{A}\,\overline{C} + A\,B\,\overline{C} + \overline{C})$$
$$= \overline{A}\,\overline{B} + \overline{C}$$

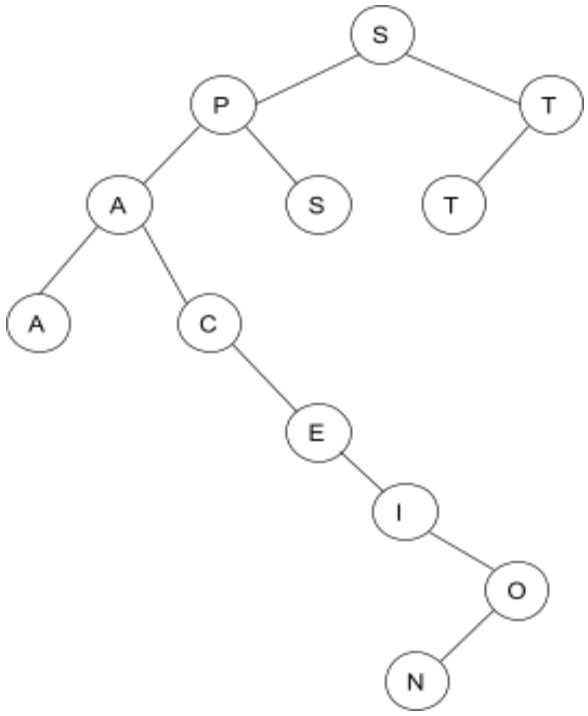
To be TRUE, at least one term is TRUE.

If $\overline{C} = 1$, then $C = 0$, $A = *$, $B = *$ $\Rightarrow$ 4 triples
If $\overline{C} = 0$, then $C = 1$, $\overline{A}\,\overline{B} = 1 \Rightarrow \overline{A} = 1, \overline{B} = 1$
$\Rightarrow A = 0, B = 0 \Rightarrow$ 1 triple

2. 5 (D)

3. Data Structures

The binary search tree for SPACESTATION is:



The internal path length is:

2*1 + 3*2 + 2*3 + 1*4 + 1*5 + 1*6 + 1*7
= 2 + 6 + 6 + 4 + 5 + 6 + 7
= 36

3. 36 (C)

4. Data Structures

The stack is constructed using LIFO and the additional rule as follows:

A, AT, AT~~T~~, A, A~~A~~, AC, ACK, AC, A, AO. AOF, AOFT, AOF, AOFH, AOFHE, AOFHE~~E~~, AOFHEM, AOFHEMP, AOFHEM, AOFHE, AOFHEI, AOFHEIR, AOFHEI, AOFHE, AOFHE~~E~~, AOFH, AOF

The next item popped would be an F.

4. F (B)

5. FSA's & Regular Expressions

The regular expression is: **`[^dkp]*[aeiou][a-el-t]?(s|es|er)`**

Choices A. D, E and G cannot be accepted based on the following:

A. dahlias - string cannot start with d
B. r o s es - valid
C. lil i es - valid
D. aster - s and t cannot both come from **`[a-el-t]?`**
E. azal e a s - valid
F. ir i s es - valid
G. cl o ver - v is not in **`[a-el-t]?`**
H. lil a c s - valid
I. viol e t s - valid

5. A, D, G (E)