

American Computer Science League

2020-2021 • Contest 3: Solutions • Intermediate Division

1. Boolean Algebra

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

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

To be TRUE, $A = 1$ and $\overline{B} + \overline{C} + BC = 1$.

If $B = 1$, then $0 + \overline{C} + C = 1 \Rightarrow C = *$

If $B = 0$, then $1 + \overline{C} + C = 1 \Rightarrow C = *$

Therefore $(1, 1, *)$ and $(1, 0, *)$ satisfy the expression or $(1, *, *)$.

1. $(1, *, *)$ (C)

2. Boolean Algebra

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

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

$$= \overline{B} + \overline{C}$$

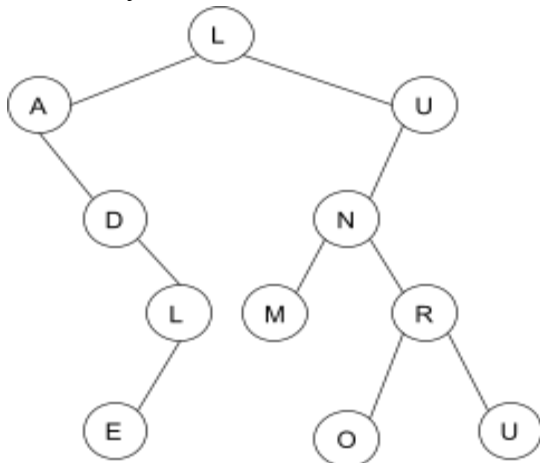
To be TRUE, $\overline{B} + \overline{C} = 1$ which is TRUE unless $B = 1$ and $C = 1$.

Therefore, only $(0,1,1)$ and $(1,1,1)$ make it FALSE so 6 ordered triples make the expression TRUE.

2. 6 (B)

3. Data Structures

The binary search tree for LUNARMODULE is:



The nodes with only one child are: A, U, D, L

3. 4 (D)

4. Data Structures

The queue is constructed using FIFO as follows:

D, DA, DAR, AR, ART, ARTH, RTH, RTHV, RTHVA, RTHVAD, THVAD, HVAD, HVADE, HVADER, VADER, ADER, DER

The next item popped is D.

4. D (B)

5. FSAs & Regular Expressions

The Regular Expression is: `[^s][aeiou][p-t]*(s|er)`

- A. tater - valid
- B. sorts - string cannot begin with an s
- C. faster - valid
- D. plaques - string cannot start with 2 non-vowels
- E. deer - valid
- F. rooster - second o is not in p-t range for third letter
- G. hits - valid
- H. bursts - valid

5. B, D, F (E)
