

# American Computer Science League

2023-2024 • Contest 3: Short Problems Solutions • Intermediate Division

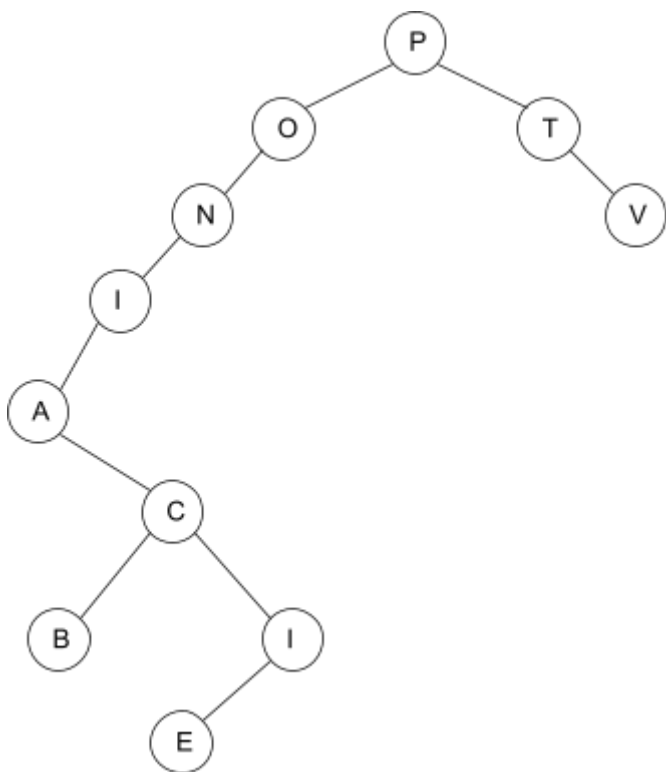
## 1. Boolean Algebra

$$\begin{aligned} A(\overline{B} + C)(\overline{AB} + \overline{BC}) &= A \overline{\overline{B} + C} \overline{\overline{AB} + \overline{BC}} \\ &= A B \overline{C} (\overline{A} + \overline{B}) (\overline{B} + \overline{C}) \\ &= (A B \overline{C} \overline{A} + A B \overline{C} \overline{B}) (\overline{B} + \overline{C}) \\ &= (0 + 0) (\overline{B} + \overline{C}) \\ &= 0 \end{aligned}$$

A. 0

## 2. Data Structures

The binary search tree for PONTIACVIBE is:



C. 6

The nodes with only one child are: T, O, N, I, A, I. There are 6.

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## 3. Data Structures

The stack from top to bottom is A, AL, APL, AHPL, AAHPL, ABAHPL, EABAHPL, ETABAHPL, ESTABAHPL. It puts the letters that are between each vowel in the reverse order of how they appear in the string.

B. ESTABAHPL

## 4. FSAs

Each of them is parsed as follows:

- a. 1101011010 - top path - fails at 5th 1
- b. 11010 - top path - fails at 2nd 0
- c. 1111111 - fails to reach either path
- d. 1010101 - top path - valid
- e. 1100110 - bottom path - valid
- f. 1001110 - bottom path - valid

Therefore, 3 of the strings are valid.

C. 3

## 5. Regular Expressions

The regular expression:  $[b-j][aeiou][^k]^*$

Coffees:

- regular - failed at r in  $[b-j]$
- dark - failed at k in  $[^k]^*$
- espresso - failed at s in  $[aeiou]$
- decaf - valid
- drip - failed at r in  $[aeiou]$
- black - failed at l in  $[aeiou]$
- latte - failed at l in  $[b-j]$
- iced - failed at c in  $[aeiou]$
- cappuccino - valid

Only 2 match: decaf and cappuccino

A. 2