

INTERMEDIATE DIVISION SOLUTIONS

1. Boolean Algebra

$$\begin{aligned}
 AB + \bar{A}(B + A) + A &= AB + \bar{A}\bar{B} + \bar{A}A + A \\
 &= AB + \bar{A}\bar{B} + A \\
 &= B(A + \bar{A}) + A \\
 &= A + B
 \end{aligned}$$

1. $A + B$

2. Boolean Algebra

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

If $A(\bar{B} + \bar{B}C) = 1$, then $1 + 0\bar{C} = 1$.

If $B = 1$, then $0 + \bar{C} = 1$. So $C = 0$. (1, 1, 0)

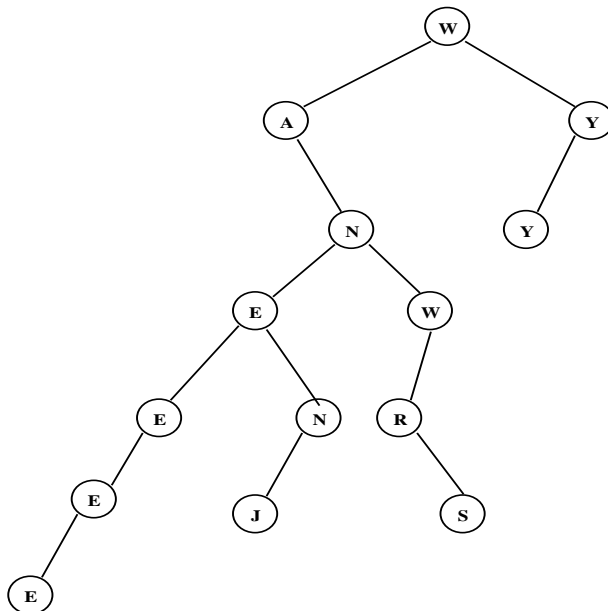
If $B = 0$, then $1 + 0\bar{C} = 1$. So $C = *$. (1, 0, 0) and (1, 0, 1)

2. (1, 1, 0), (1, 0, 0)
and (1, 0, 1)

or

(1, 1, 0) and (1, 0, *)

3. Data Structures



The nodes with only one child are: A, Y, W, E, N, R, and E. There are 7 of them.

3. 7

American Computer Science League

2018-2019

Contest #3

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4. Data Structures

The stack is constructed using LIFO as follows: S, SU, SUN, SU, US, U, UR, URA, URAI, URAIN, NIARU, NIAR, NIA, AIN, AI, AIW, AIWI, AIWIN, AIWIND, AIWIN, NIWIA, NIWI, NIWIC, NIWICL, NIWICLO, NIWICLOU, NIWICLOUD, NIWICLOUDS, SDUOLCIWIN, SDUOLCIWI, SDUOLCIW, WICLOUDS, WICLOUD, DUOLCIW, DUOLCI, DUOLC, CLOUD.
The next item popped from the stack is D.

4. D

5. FSA/Regular Expressions

$$ab^*ba(ab \cup a^*b)a(b \cup ab^*)a(ab \cup (a \cup b))$$

To minimize the length, repeat * zero times. This reduces the expression to:

$$aba(ab \cup ab)a(b \cup aa)a(ab \cup (a \cup b))$$

In the first union choose either and in the second choose b and in the third choose the union and then either. This gives a string of length 9.
An example would be: abaababaa

5. 9