American Computer Science League

2018-2019 **Contest #4**

SENIOR DIVISION SOLUTIONS

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1. Graph Theory

Cubing an adjacency matrix yields the number of paths of length 3. There are none from B to E.

$$\begin{vmatrix} 0 & 1 & 1 & 1 & 0 \\ 0 & 0 & 1 & 1 & 0 \\ 1 & 0 & 0 & 0 & 0 \\ 1 & 1 & 0 & 0 & 1 \\ 1 & 0 & 0 & 0 & 0 \end{vmatrix}^3 = \begin{vmatrix} 3 & 3 & 3 & 3 & 1 \\ 1 & 2 & 3 & 3 & 0 \\ 2 & 1 & 1 & 1 & 1 \\ 4 & 3 & 2 & 2 & 2 \\ 2 & 1 & 1 & 1 & 1 \end{vmatrix}$$

1. 1

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2. Graph Theory

There are 8 cycles from vertex A: ABA, ABCEA, ACEA, ACEDBA, ADBA, ADBCEA, ADCEA, ADEA

There are 7 cycles from vertex C: CEABC, CEAC, CEADC, CEADBC, CEDC, CEDBC, CEDBAC

A has 1 more cycle than C.

2. 1

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3. Digital Electronics

The circuit translates to: $\overline{(A+(\overline{A+\overline{\overline{BC}}})C)C}$

Note: operands may be commuted.

3. As shown

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4. Digital Electronics

The circuit translates to: $\overline{\overline{AB}+(B+C)C}$

$\overline{\overline{AB}+(B+C)C} = \overline{\overline{AB}}(\overline{B+C})C = \overline{\overline{AB}}\,\overline{B}\,\overline{C}C = AB\overline{B}\,\overline{C}C = 0$

Therefore since the circuit is always FALSE, 8 make it FALSE.

4. 8

SENIOR DIVISION SOLUTIONS

5. Assembly Language

This program counts the number of 3-digit palindromes: 101, 111, 121, 131, 141, 151, 161, 171, 181, 191, 202, 212, … There are 90
An equivalent pseudocode program would be:

```
A = 0
FOR B = 100 TO 999
    C = INT(B/10)
    F = C * 10
    D = B – F
    E = INT(B/100)
    G = E − D
    IF G = 0 THEN
        A = A + 1
    END IF
NEXT B
PRINT A
END
```

5. 90