American Computer Science League

2001-2002 **Contest #3**

Classroom Division Short Problem Solutions

1. The last time the 2 loops are executed prior to ending, J has a value of 1 and K has a value of 9 since K assumes values of 3,5,7 and 9. Therefore, B(1,9) is the last element modified	1. B(1,9)
2. Without any simplification, the circuit translates as follows: $$A(\overline{A} + \overline{B})$$	2. $A(\overline{A} + \overline{B})$
3. The circuit translates as follows : $$\overline{A + \overline{B}C}$$ Using DeMorgan's Theroem gives: $\overline{A}(\overline{\overline{B}C})$. To be TRUE, both factors must be TRUE. A must always be 0. The second factor must be FALSE since the negation will make it true. Two possibilities exist. Either ($\overline{B}$, C) equals (*****, 0) or (1, 1). There are 3 ordered triples that make the circuit TRUE.	3. (0,0,0), (0,1,0) and (0,1,1)
4. The squaring the adjacency matrix produces all the paths of length 2. Summing the elements gives 9 paths of length 2. $$\begin{vmatrix} 1 & 1 & 1 \\ 0 & 0 & 1 \\ 1 & 0 & 0 \end{vmatrix}^2 = \begin{vmatrix} 2 & 1 & 2 \\ 1 & 0 & 0 \\ 1 & 1 & 1 \end{vmatrix}$$	4. 9
5. The cycles in the graph are: ABCA, ABCDA, ACA and ACDA	5. 4

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Classroom Division **Solutions**

6. The circuit translates as follows: $(A + B)\overline{B}$. To be TRUE both factors must be TRUE. B must be equal to 0. Therefore, A must be equal to 1.	6. (1,0)
7. The circuit translates as follows: $(\overline{\overline{X}\,Y})(Y \oplus \overline{Z})$. It simplifies to: $(X + \overline{Y})(YZ + \overline{Y}\,\overline{Z}) = XYZ + X\overline{Y}\,\overline{Z} + \overline{Y}YZ + \overline{Y}\,\overline{Y}\,\overline{Z} =$ $XYZ + X\overline{Y}\,\overline{Z} + \overline{Y}\,\overline{Z} = XYZ + \overline{Y}\,\overline{Z}(X + 1) = XYZ + \overline{Y}\,\overline{Z}$	7. $XYZ + \overline{Y}\,\overline{Z}$
8. The expression simplifies as follows: $\overline{A}B + \overline{A}\,\overline{C} + \overline{A}\,\overline{B} + \overline{B}C + A\overline{C} + \overline{B}\,\overline{C} =$ $(\overline{A}B + \overline{A}\,\overline{B}) + (\overline{B}C + \overline{B}\,\overline{C}) + (A\overline{C} + \overline{A}\,\overline{C}) =$ $\overline{A}(B + \overline{B}) + \overline{B}(C + \overline{C}) + \overline{C}(A + \overline{A}) =$ $\overline{A} + \overline{B} + \overline{C} = \overline{ABC}$ (*note that* $A\ B\ C$ *is not equivalent*)	8. $\overline{ABC}$
9. By definition a simple path is a path with no vertex repeated. Choice A is not a valid path. Choice B has vertex B repeated. Choice C is a simple path. Choice D is not a valid path.	9. C
10. A "1" is placed in the matrix when a path exists. Otherwise, the matrix contains a " 0".	10. The matrix as shown at the left.

	A	B	C	D
A	1	1	0	1
B	1	0	1	1
C	0	0	0	1
D	0	0	1	0