6.004 Tutorial Problems
L04a – Boolean Algebra

Problem 1

Write the truth tables for each of the following expressions

A $\overline{A}$

B $A \cdot B$

C $\overline{A \cdot B}$
Hint: Consider DeMorgan's law!

D $A + B$

E $\overline{A + B}$

F $(A + B) \cdot (\overline{A \cdot B})$

G $(A \cdot S) + (B \cdot \overline{S})$

Problem 2

Consider the truth table on the right, which defines something called a full adder (more on that in a later lecture!). It has two functions C_{out} and S of three input variables (A, B, and C).

For each function, write it in **normal form,** then find a **minimal sum of products** (minimal SOP) expression.

A	B	C_{in}	C_{out}	S
0	0	0	0	0
0	0	1	0	1
0	1	0	0	1
0	1	1	1	0
1	0	0	0	1
1	0	1	1	0
1	1	0	1	0
1	1	1	1	1

Normal form for $C_{out}(A, B, C_{in})$ = _____

Minimal SOP for $C_{out}(A, B, C_{in})$ = _____

Normal form for $S(A, B, C_{in})$ = _____

Minimal SOP for $S(A, B, C_{in})$ = _____

Problem 3

Consider the 3-input Boolean function G(A,B,C) = $\overline{A} \cdot \overline{C} + A \cdot \overline{B} + \overline{B} \cdot \overline{C}$.

A How many 1's are there in the output column of G's 8-row truth table?

B Give a minimal sum-of-products expression for G.

C Can a sum-of-products expression involving 3 input variables with greater than 4 product terms *always* be simplified to a sum-of-products expression using fewer product terms?

Problem 4

Simplify the following Boolean expressions by finding a *minimal sum-of-products expression* for each one:

A $A \cdot C + B + C$

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

C $A \cdot (B + C) \cdot (B + A \cdot (B + C))$

D $A \cdot (B + C \cdot (D + E \cdot F))$