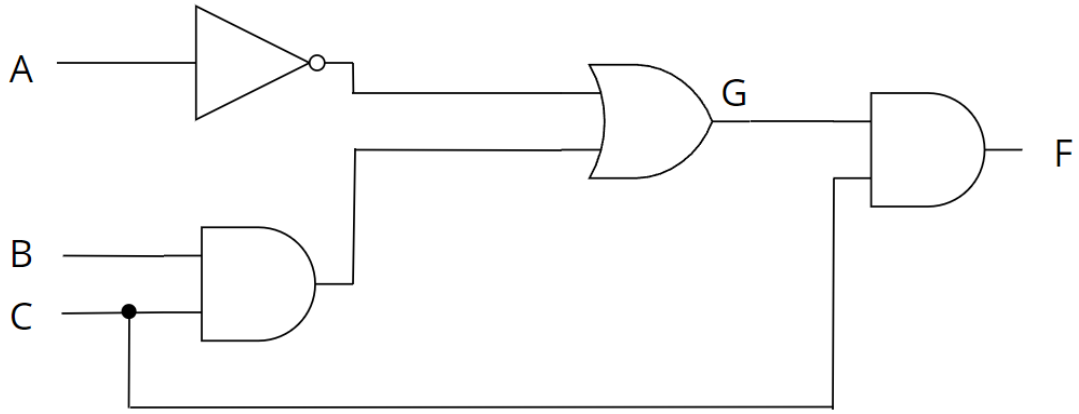
CprE 281 HW02

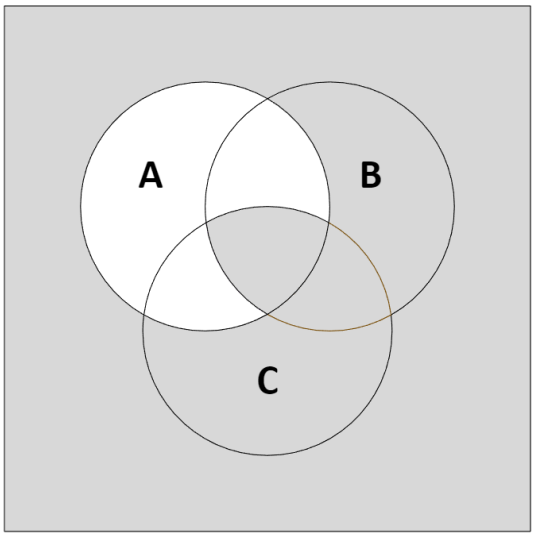
ELECTRICAL AND COMPUTER ENGINEERING
IOWA STATE UNIVERSITY

Boolean algebra, AND/OR/NAND/NOR gates
Assigned Date: Second Week
Finish by: Sep 6, 2023

P1. **(10 points**): For the circuit below, find the Boolean expression for both G and F in terms of A, B and C (do not simplify the expression):



P2. **(10 points)**: Given the following Venn Diagram for F, show the expression.



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P3 **(25 points)**: Given the following truth table, show the following:

A	B	C	F
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	0

A: Venn Diagram.
B: Canonical Products-of-Sum expressions:
C: Shorthand Notation for POS
D: Canonical Sum-of-Products expressions:
E: Shorthand Notation for SOP

P4. **(10 points):** Draw the following function using only NAND gates:

$$f = \bar{A}C + A\bar{B} + A$$

P5. **(10 points):** Draw the following function using only NOR gates:

$$f = (B + \bar{C})(A + C)\,\bar{B}$$

P6. **(10 points):** Use Boolean Algebra to verify the following expressions:

1. $A\bar{B} + \overline{\bar{A}C + \bar{B}C} = A + \bar{C}$
2. $A\bar{B}C + A\bar{B}\bar{C} + \bar{D}\bar{E}(B + G) + \bar{D} + (\bar{A} + B)D + A\bar{B}CDE + A\bar{B}DEG = 1$

P7. **(25 points):** Consider the logic function $f(A, B, C) = (AB\bar{C} + \overline{A\bar{B}}C + \bar{A}BC + \overline{B\bar{C}})$

A. Draw the logic circuit for the function given above (do not use NAND gates or NOR gates).
B. Let the cost of a logic circuit be the total number of gates plus the total number of inputs to all gates in the circuit. What is the cost of the circuit in A?
C. Simplify f to only one term by using Boolean algebra.
D. Draw the logic circuit for the simplified version of f in C.
E. What is the cost of the circuit in D?