Problem Set 13

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Announcements: Q7P will be on Friday, May 7
**CP18-20**

The problems in this problem set cover lecture [C17 = quiz review], C18, C19, C20

1. The operation $\oplus$ is defined for two Boolean variables A, B as follows:

   \[ A \oplus B = \overline{AB} + \overline{A}B \]

   Draw the truth table for $A \oplus B$.

2. What are the minterms in the expression $A \oplus B \oplus C$?

   **Hint**: Use a dummy variable $D$ for $A \oplus B$, apply the Boolean algebra theorems, then replace $D$ with $A \oplus B$ and repeat the process.

3. Convert the following English statements into formal propositions.
   - a. The killer touched both the candlestick and the wrench.
   - b. There are exactly 2 sets of fingerprints on the candlestick.
   - c. Joe touched either the candlestick or the wrench, but not both.
   - d. George only touched the candlestick.
   - e. George saw Hannah touch the wrench.
   - f. Hannah touched all the weapons that George touched.
   - g. Hannah saw Joe touch the candlestick.

   Given that there is only one killer, use resolution to identify the killer.

4. Provide a **Direct Proof** of the following, where $a$, $b$, and $c$ are integers:

   \[ \text{If } a \mid b \text{ and } b \mid c, \text{ then } a \mid c \]

   **Hint**: definition of “$\mid$” (Divisible) is given in lecture 20.

5. Prove using induction that $P(n) = P(n-1) + P(n-2)$, where $P(n)$ is a Fibonacci number.

   **Hint**: What are Fibonacci numbers? That will help you identify the base case.

6. Prove using induction that if $p$ does not divide any of the numbers $a_1$, $a_2$, $a_3$, ..., $a_n$ (i.e., $p$ is not a common divisor for $a_1$, $a_2$, $a_3$, ..., $a_n$) then $p$ does not divide $a_1*a_2*a_3*...*a_n$.
Problem S16 (Signals and Systems)

Do problem 8.8 from Openheim and Willksy, *Signals and Systems*.

Note that this system implements a type of single sideband amplitude modulation.
Problem S17 (Signals and Systems)

Problem S18 (Signals and Systems)