Digital Logic Design 3441 – Spring 2021

Lab #3: The Digital Design Process with SimUAid II

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Overview: Goals of the Lab

In this lab we explored a specific boolean function in depth in order to practice performing important algebraic tasks and to become familiar physically constructing these circuits. We performed a minterm expansion and simplified the boolean expression algebraically to get familiar with our assigned function. We also simulated it in SimUAid to verify our findings and confirm that the truth table we obtained matched up with our calculated expectations. We also physically built the circuit to get hands on practice using and implementing the 74LS chips.

Part 1: Minterm Expansion

1. **Unique function:** BCD + ABCD' + C'D + AB'D

BCD + ABCD` + C`D + AB`D

(1)BCD + ABCD` + (1)(1)C`D + AB`(1)D operation w/ 1

(A+A`)BCD + ABCD` + (A+A`)(B+B`)C`D + AB`(C+C`)D op w/ 1

ABCD + A`BCD + ABCD` + A(B+B`)C`D + A`(B+B`)C`D + AB`CD + AB`C`D 1st DL

ABCD + A`BCD + ABCD` + ABC`D + AB`C`D + A`BC`D + A`B`C`D + AB`CD + AB`C`D 1st DL

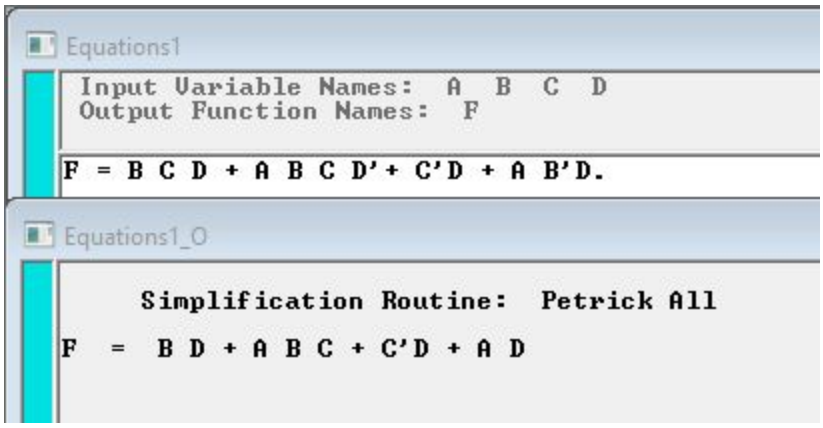
ABCD + A`BCD + ABCD` + ABC`D + AB`C`D + A`BC`D + A`B`C`D + AB`CD Idempotent

F(A,B,C,D) = ABCD + A'BCD + ABCD' ABC'D + AB'C'D + A'BC'D + A'B'C'D + AB'CD

2. Our function has 8 minterms.

Part 2: Simplifying your Boolean Function algebraically

LogicAid Minimum SOP



3. Algebraically Simplified SOP

BCD + ABCD' + C`D + AB`D

BC(D + AD`) + C`D + AB`D 1st DL

BC(D+A) + C`D + AB`D elimination

BCD + BCA + C`D + AB`D 1st DL

D(BC + C` + AB`) + BCA 1st DL

D(B + C` + AB`) + BCA elimination

D(B + A + C`) + BCA elimination

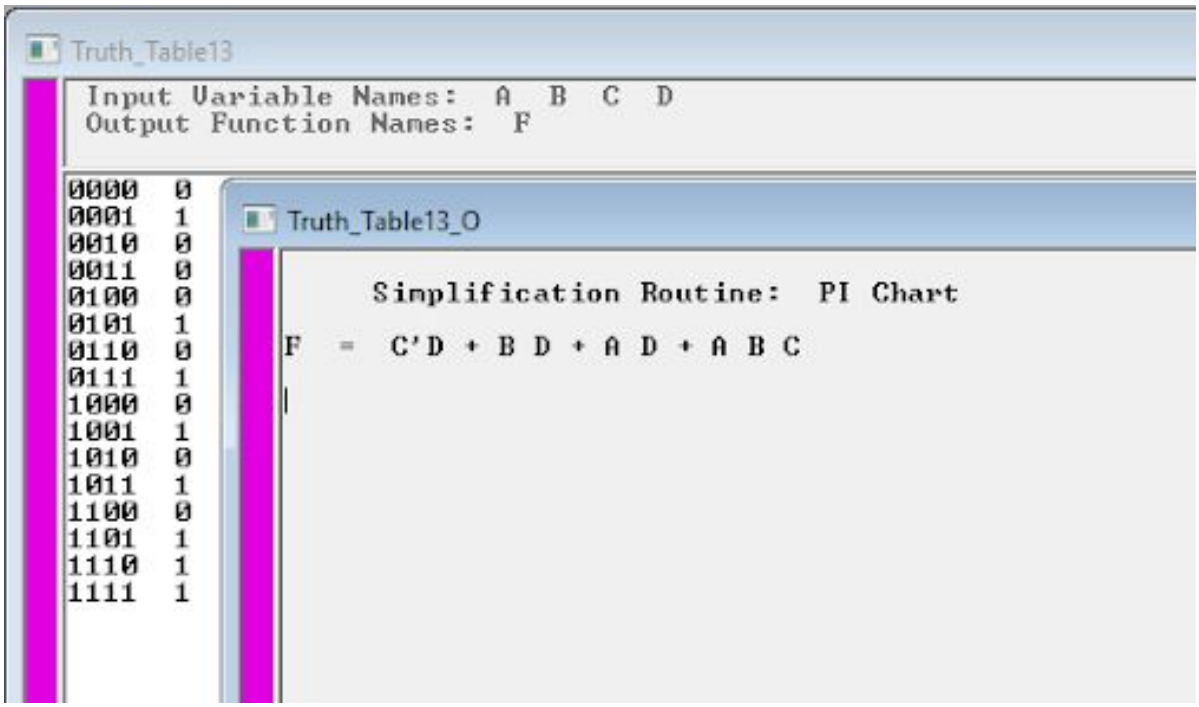
DB + DA + DC` + BCA 1st DL

F(A,B,C,D) = ABC + BD + AD + C'D

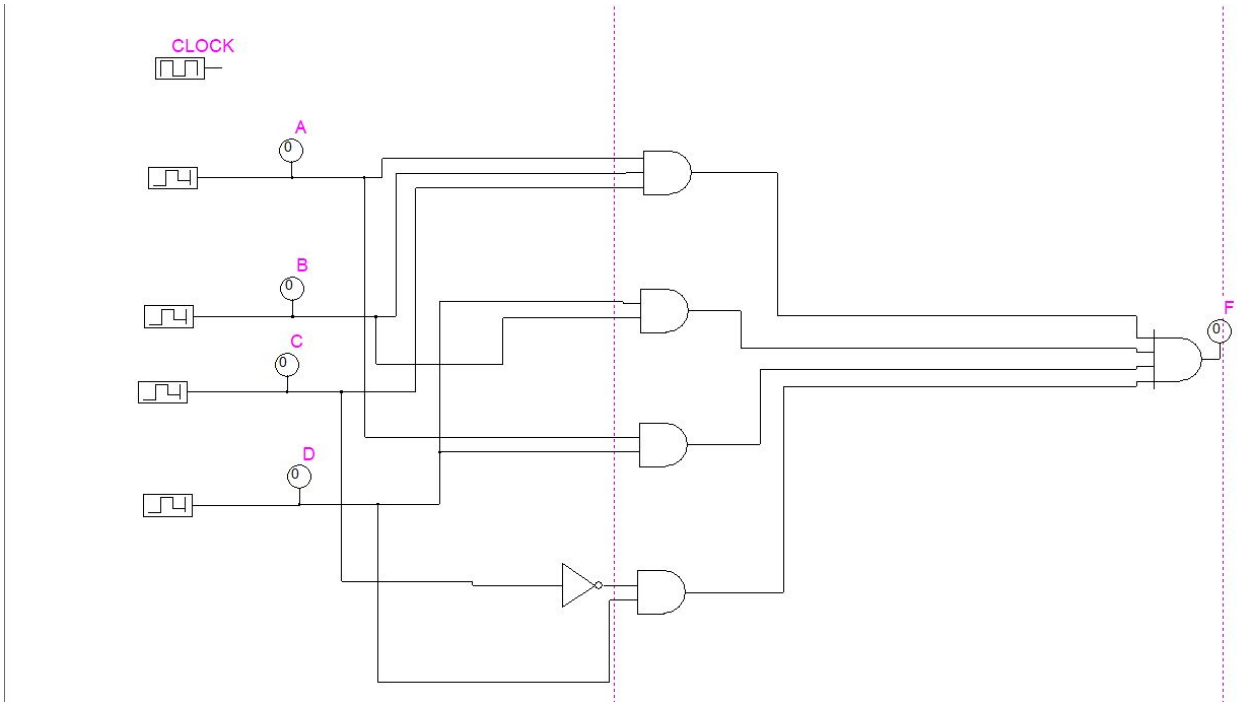
4. The number of input combinations is given by 2^4 for this function. 16 combinations of inputs are needed for this logic circuit.

Part 3: Creating your Boolean function in SimUAid using the clock and input signal

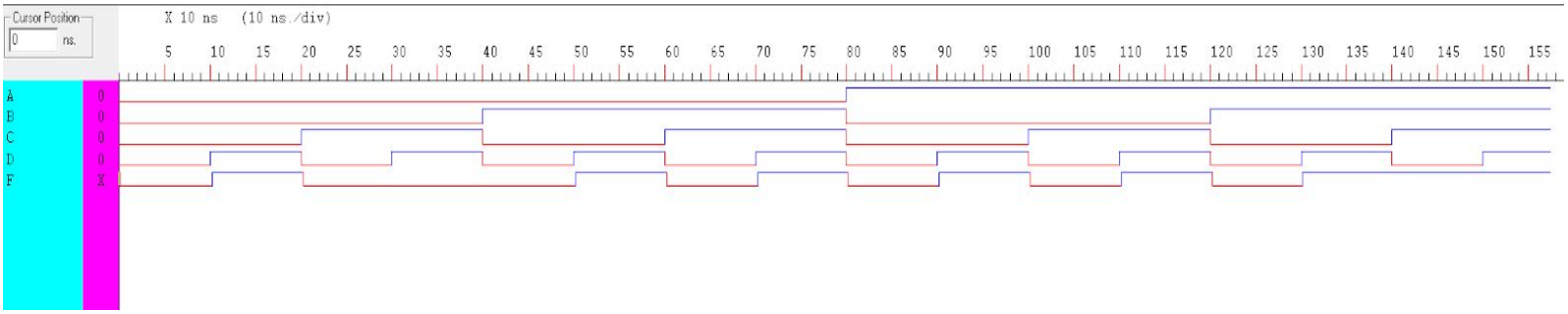
5. Truth Table



Circuit Schematic



Timing Diagram



6. Yes, the output matches the truth table.

Part 4: Physically Build your Circuit

Links:

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https://drive.google.com/file/d/1CqP3ZVnFnUgm9lgb2vd4YaaqGseaApeV/view?usp=sharing

Thomas Nguyen (UID 1870696)

https://drive.google.com/file/d/1BpkpbfQ9PfN9MdT8tWhn7ySkQ2VGkxxS/view?usp=sharing

Conclusion

In this lab we got practice and improved at manipulating logic functions algebraically and simulating them to verify our results. We also physically built a logic function for the first time and learned the importance of things like pull-down resistors and how to troubleshoot our circuits if they do not work correctly.