VLSI Design - Final Project

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For the project, we were expected to build a 4x4 bit multiplier in ngspice from scratch. We had to find the propagation delay and estimate the power of our design. We then had to test our design using two common VLSI design tools - MAGIC and Verilog.

1. NgSpice

- To make the multiplier circuit, I first made sub-circuits of the common gates we would use like AND, NAND, XOR, Half-adder, Full-adder etc.
- To calculate propagation delay, I gave the inputs to the multiplier as pulses of different frequencies.
- To calculate power, we give all the inputs as 0 and then try to see the static power in the circuit using the formula :
  $p = V * I$

2. MAGIC

- MAGIC is a common tool used to make layouts of various circuits.
- For the multiplier, I made the basic layout for the AND and XOR gate and then created the half-adder and full-adder sub-circuits from then. Finally, I built the multiplier by connecting all the components together.
- We then use MAGIC to extract a netlist and verify if our ngspice code matches with that of the extracted spice file.

2. Verilog

- Just like done previously, we build sub-circuits for the smaller components and then put them together to build the multiplier circuit.
- We then plot the gtkwave of the circuit and see how the output changes with the input.
- We notice that the multiplier circuit is correct because the outputs are consistent with the binary multiplication of the inputs.