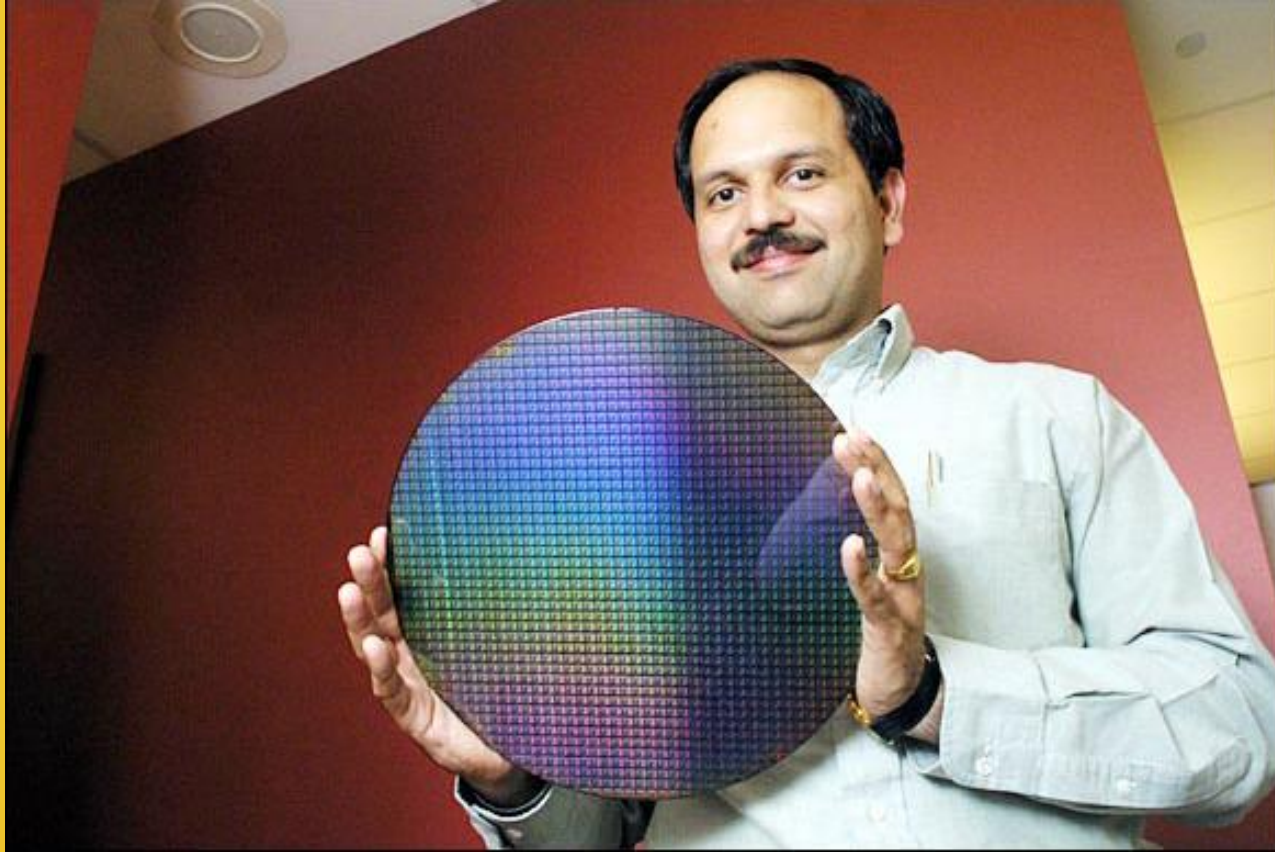


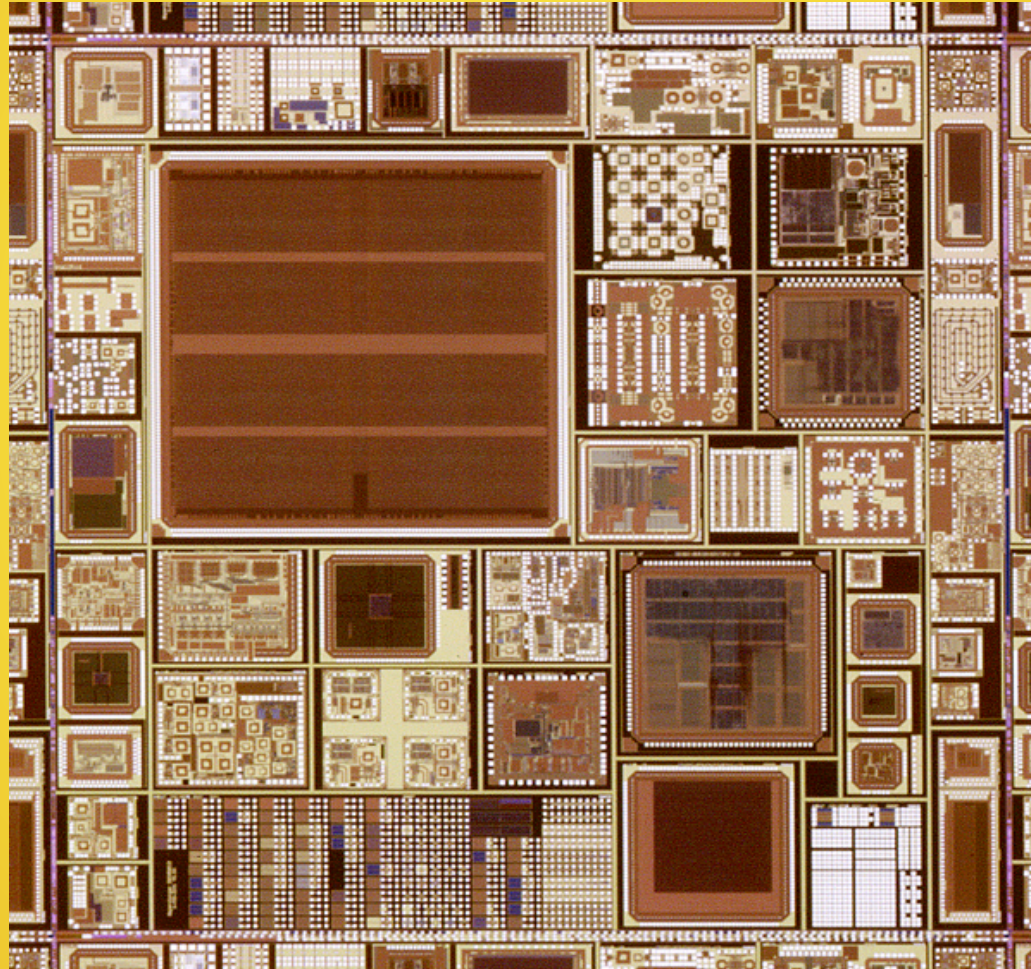
ELE 447/448 Digital Integrated Circuit Design I



IBM 300 mm Wafer



MPW Reticule

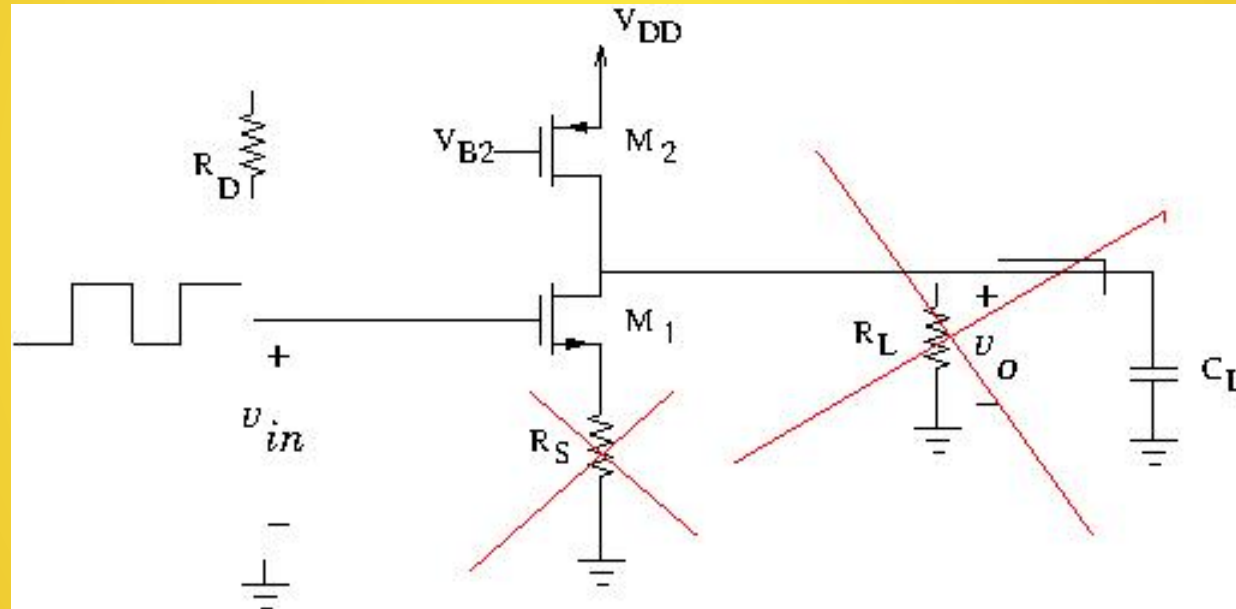


Course/Lab Description

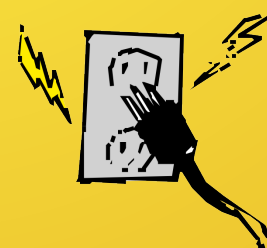
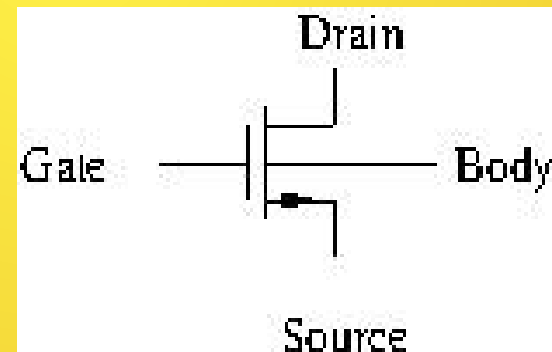
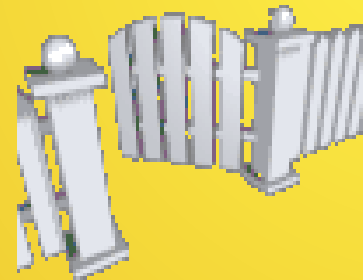
- Full Custom Analog Integrated Circuit Design
- Synthesis of Systems Based Upon Hand Crafted Transistors
- Students Learn to Use CAD Tools
- Project Based Course

- Course Sequence:
 - ELE 447/448 Digital IC Design I
 - ELE 537 Digital IC Design II
 - ELE 539 Analog IC Design

Use Pseudo nMOS & CMOS Inverters to Introduce Static Logic Families



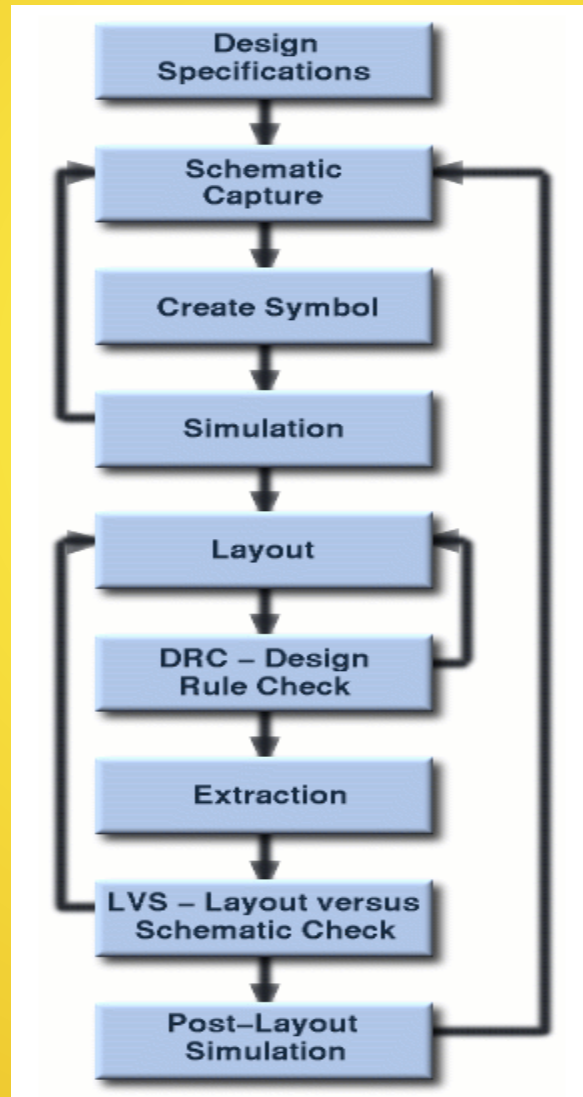
We Will Need to Think About Device Physics/Models



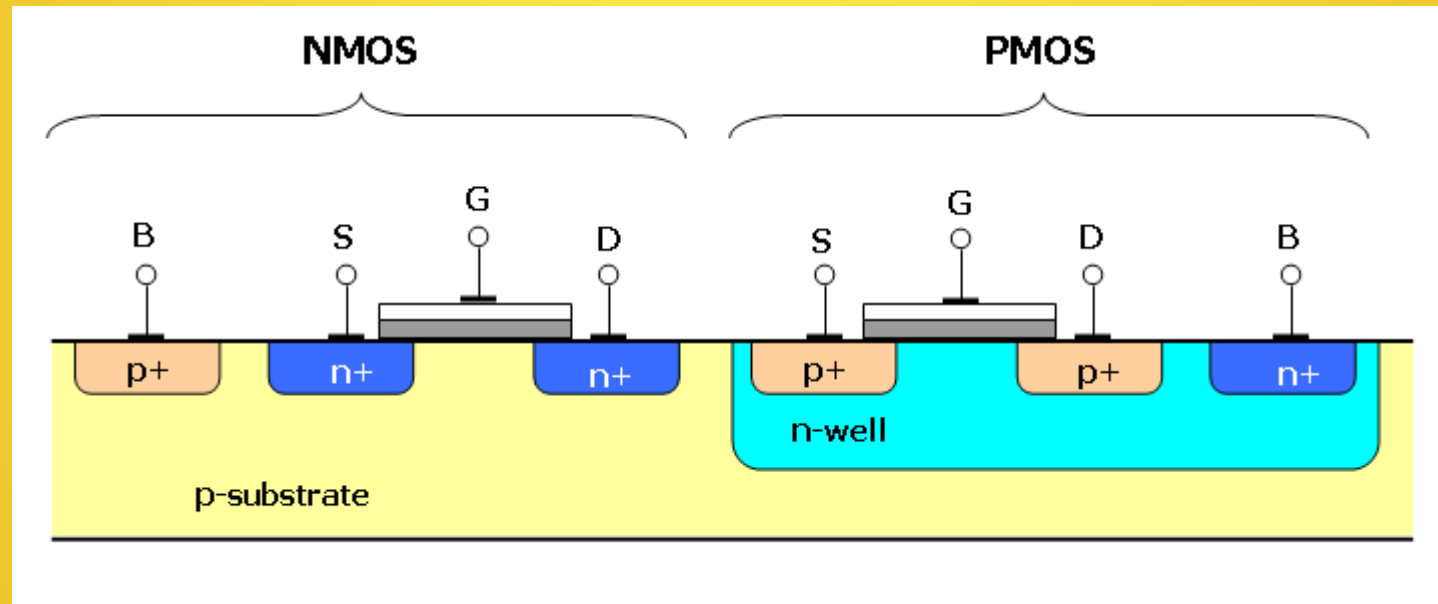
Topics

- Switch Models for MOS Transistor Analysis/Synthesis
- RC Models/Transient Response for Timing Analysis
- Understanding Device Physics → Designer's Point of View
- Device Technology Scaling and its Implications on a Designer
- Synthesis of Basic Gates to Building Blocks (e.g. Adders, Mux's, etc.) to Systems To an Entire IC
- Detailed Study/Analysis of High-Speed Cells (usually one type/family)
- Overview of Highlighted System/Project
- Logic Families: Static CMOS, Pseudo nMOS, Dynamic Logic
- Circuit Simulation Tools → HSPICE and Spectre
- Design Flow → Cadence/Mentor Graphics
- Layout
- Verification
- Manufacturability, Reliability, Yield

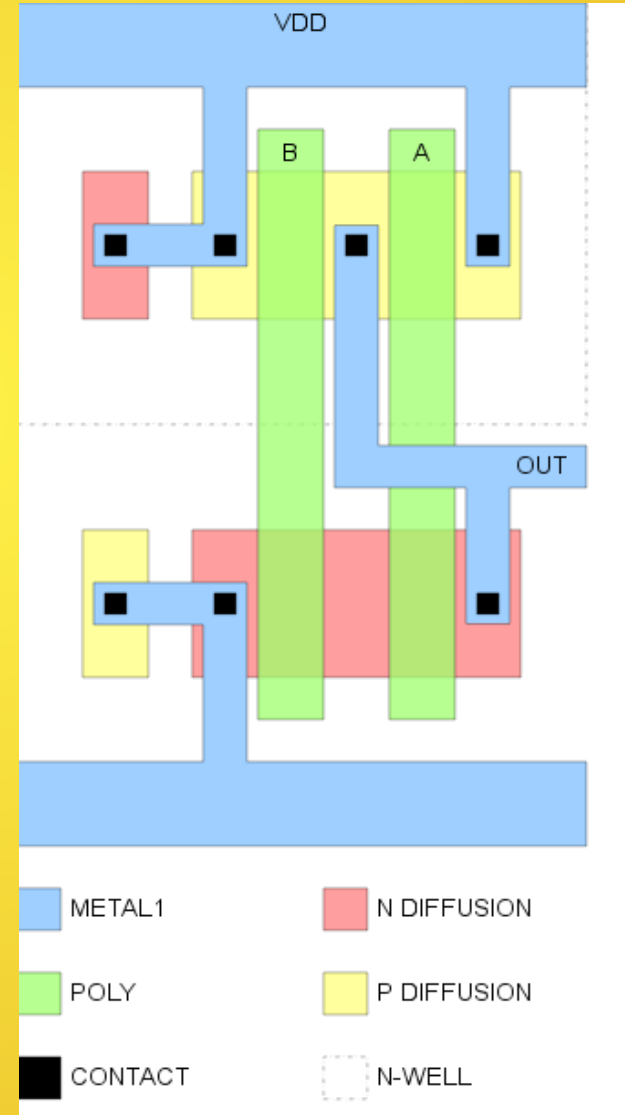
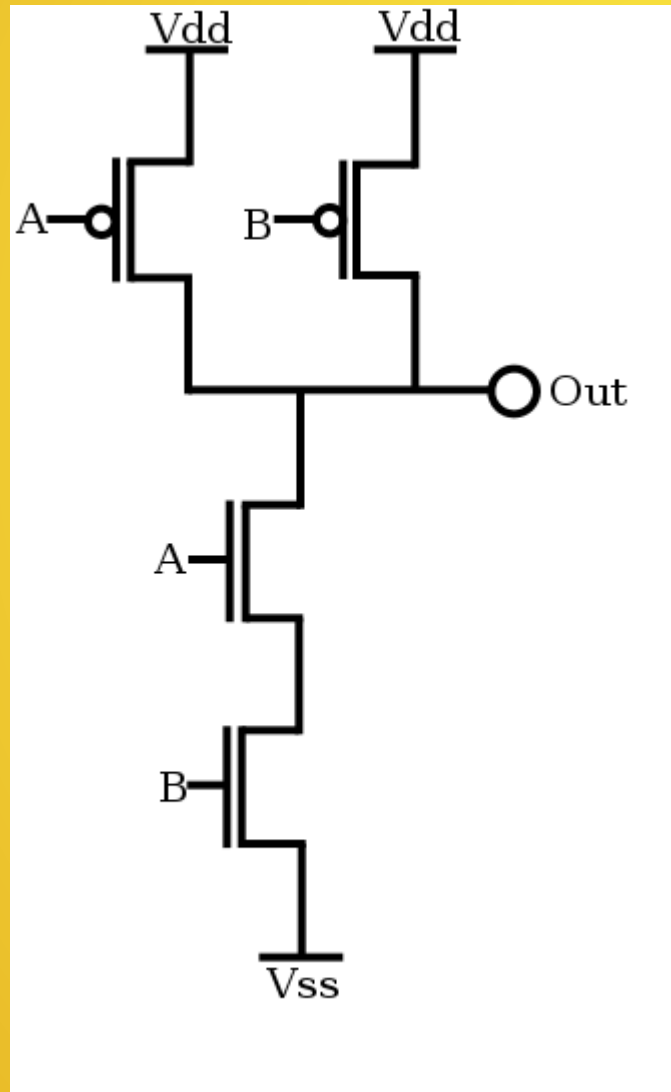
Design Flow



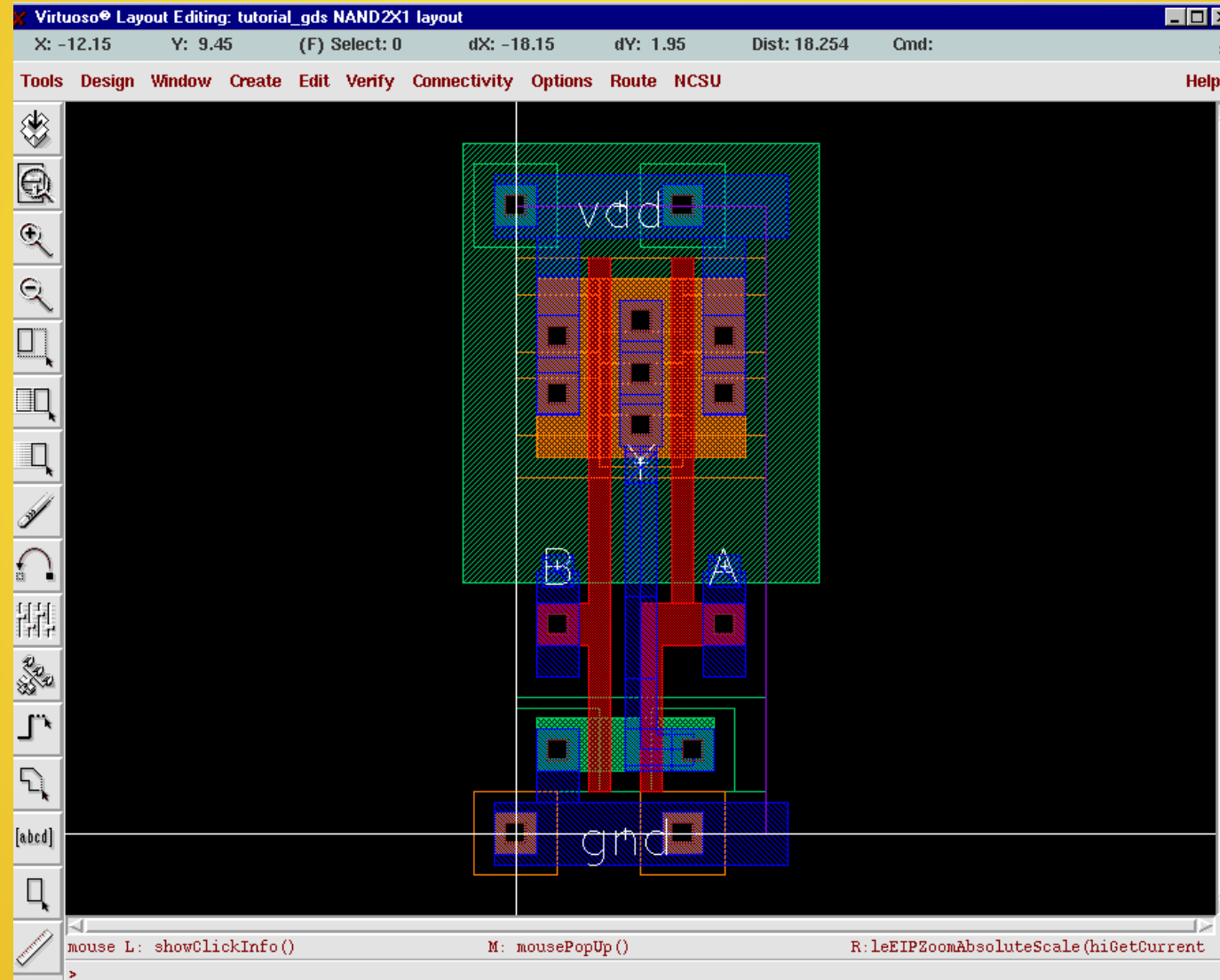
Simplified CMOS Cross Section



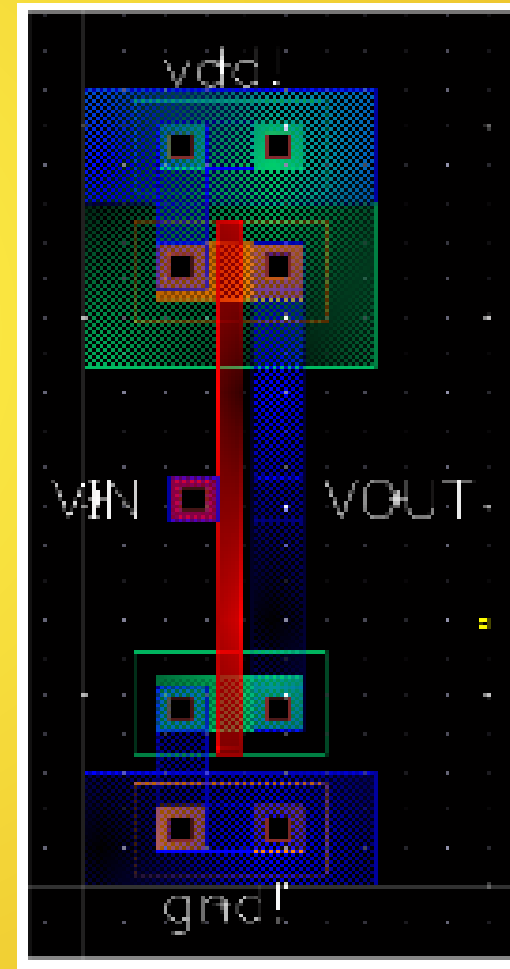
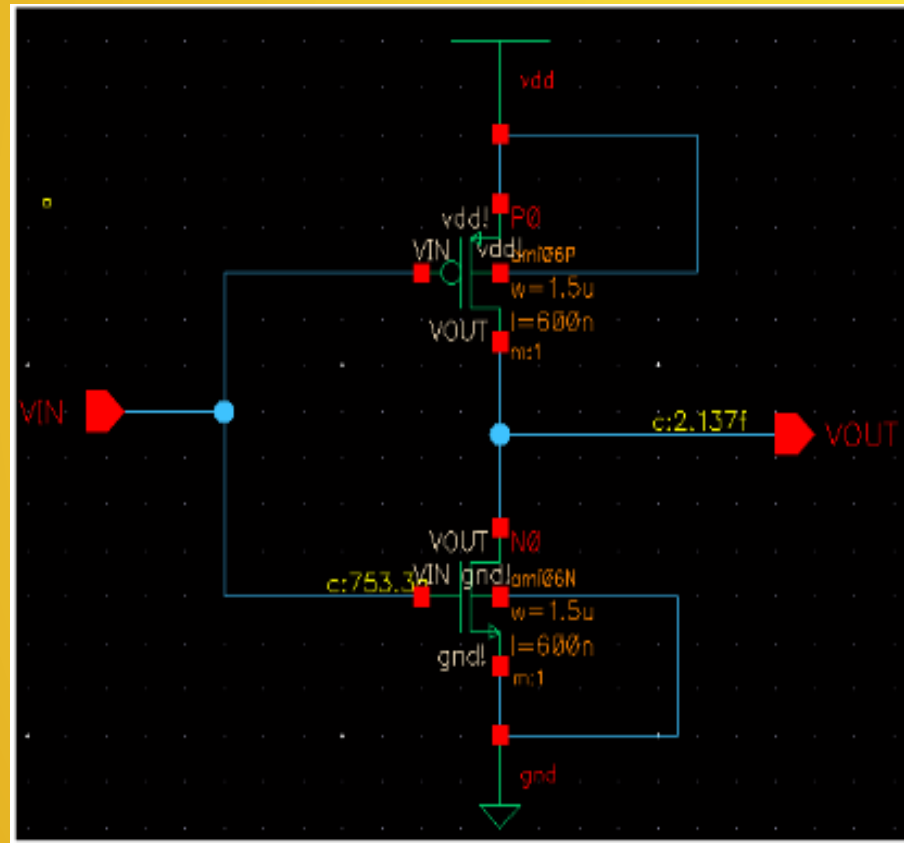
Example: Nand Gate



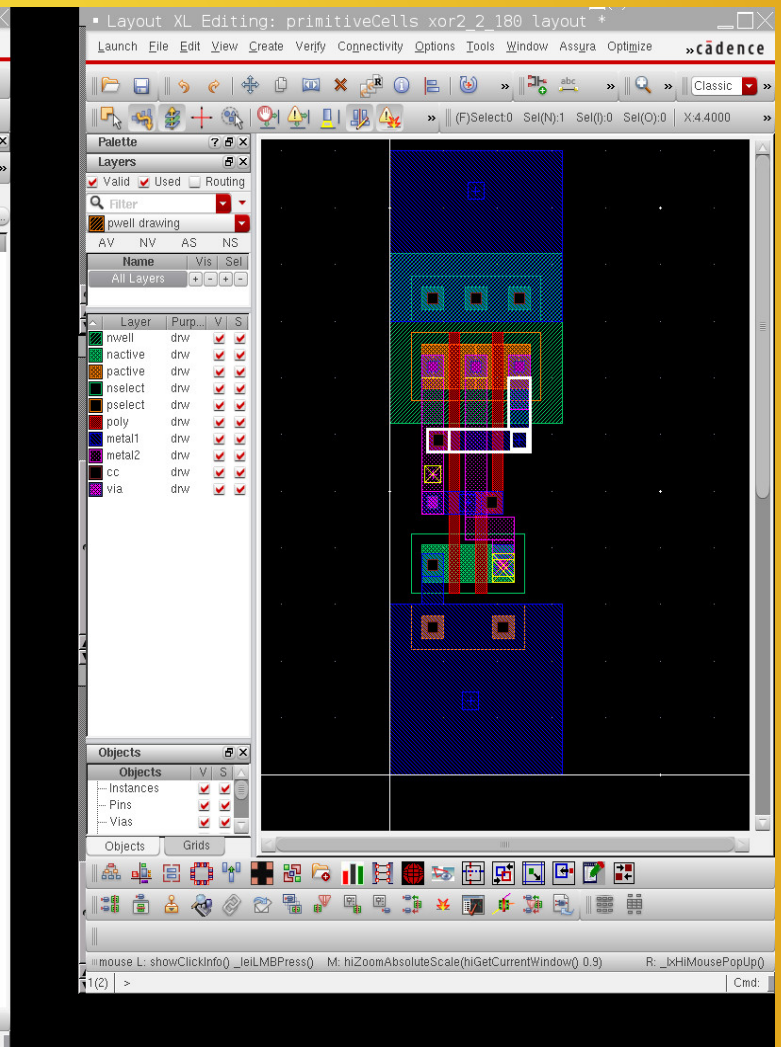
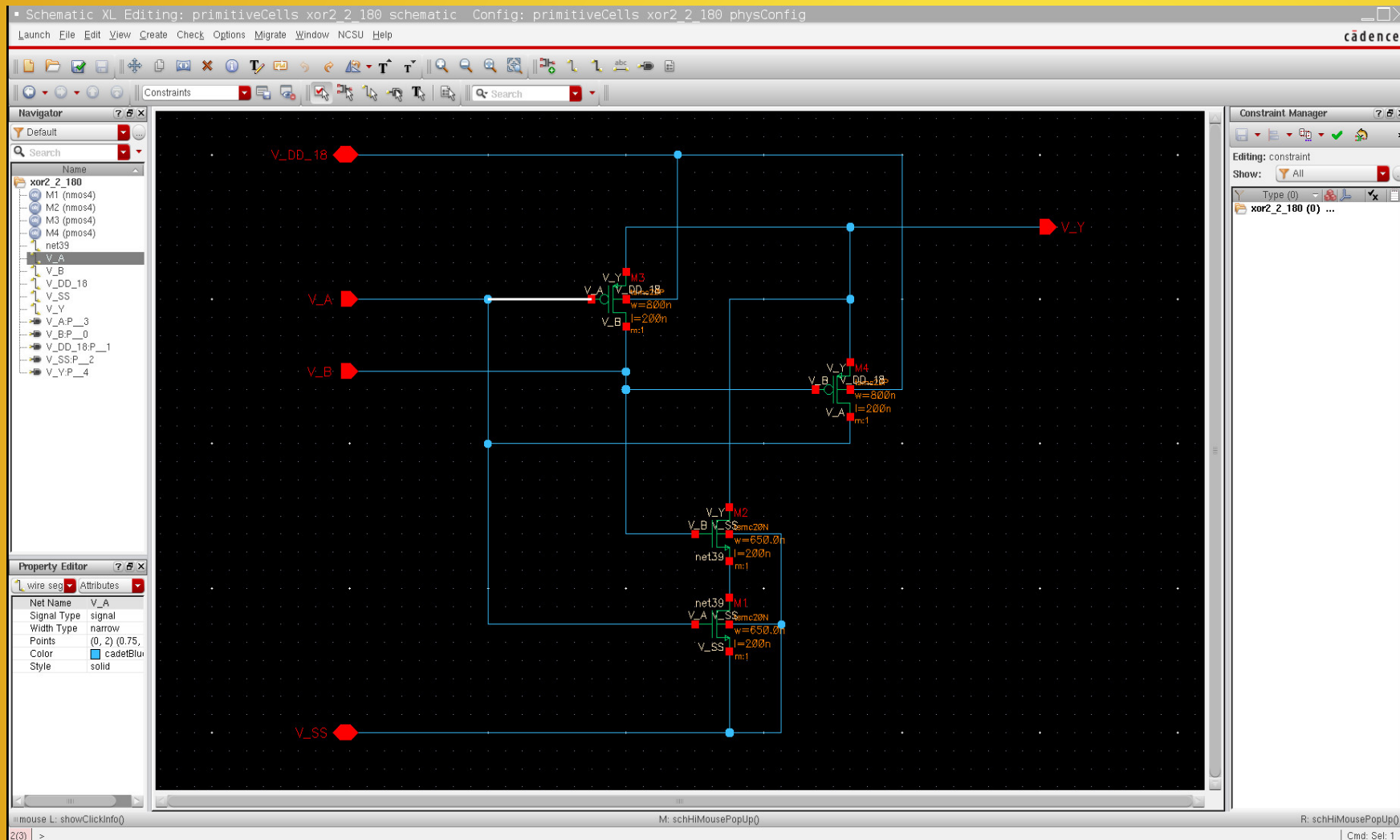
Virtuoso Layout of Nand2 Gate ...



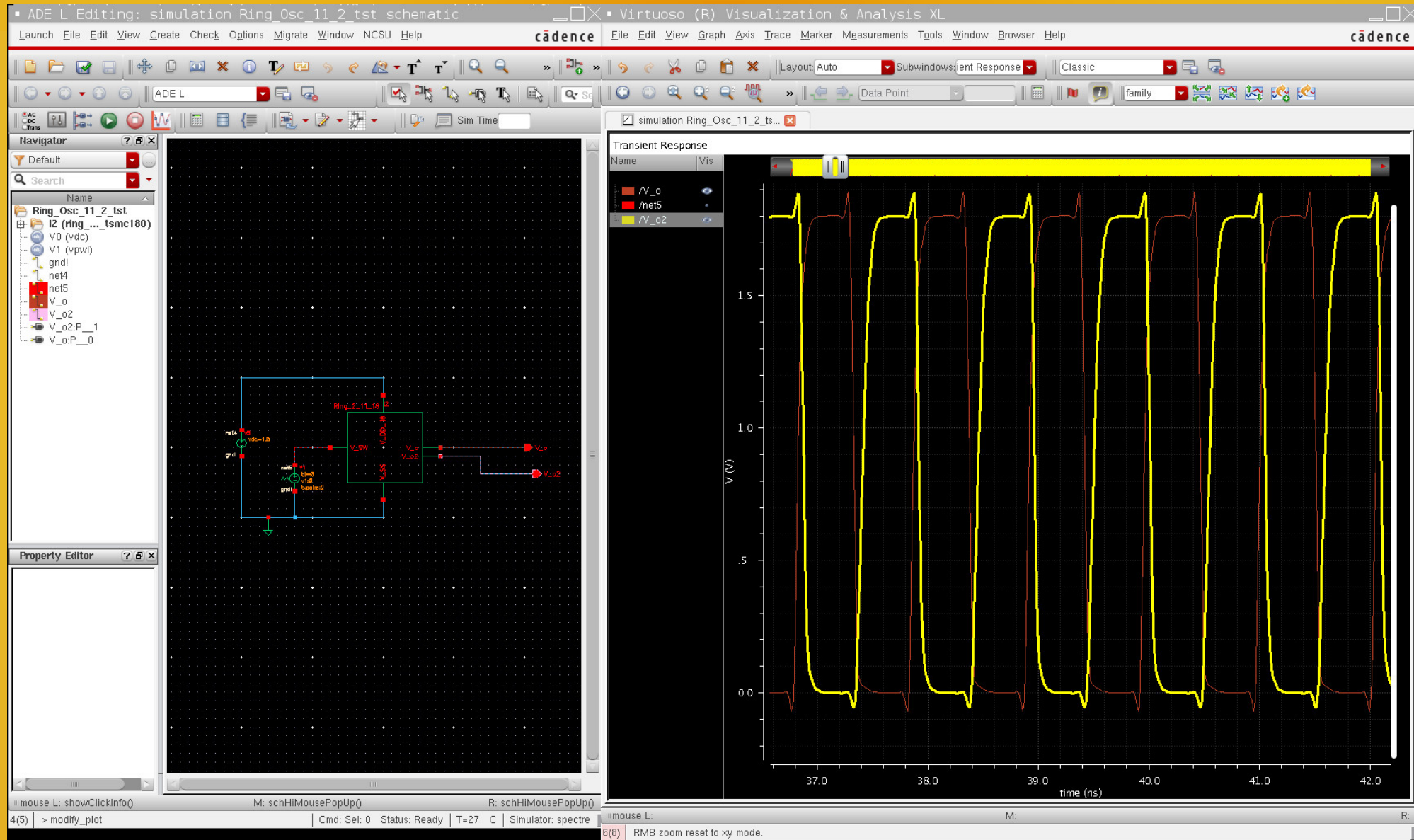
Virtuoso Schematic & Layout Example: Inverter



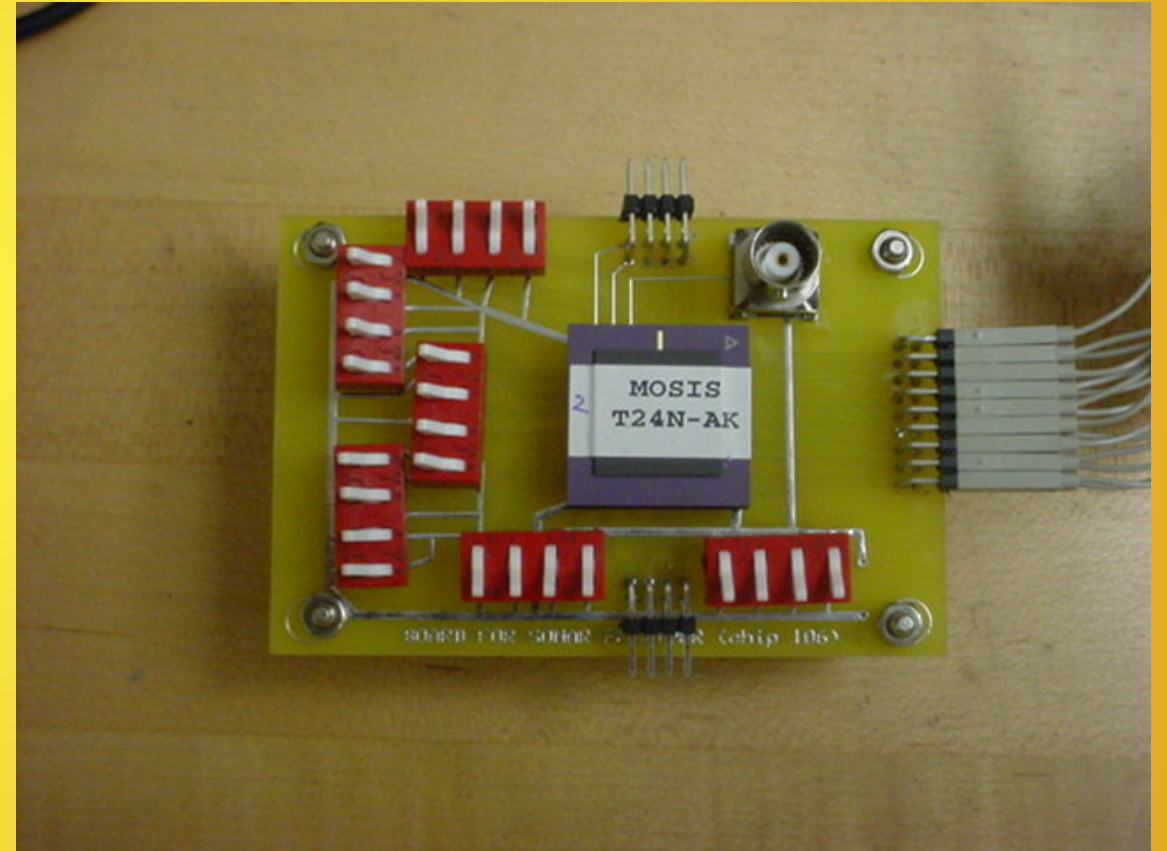
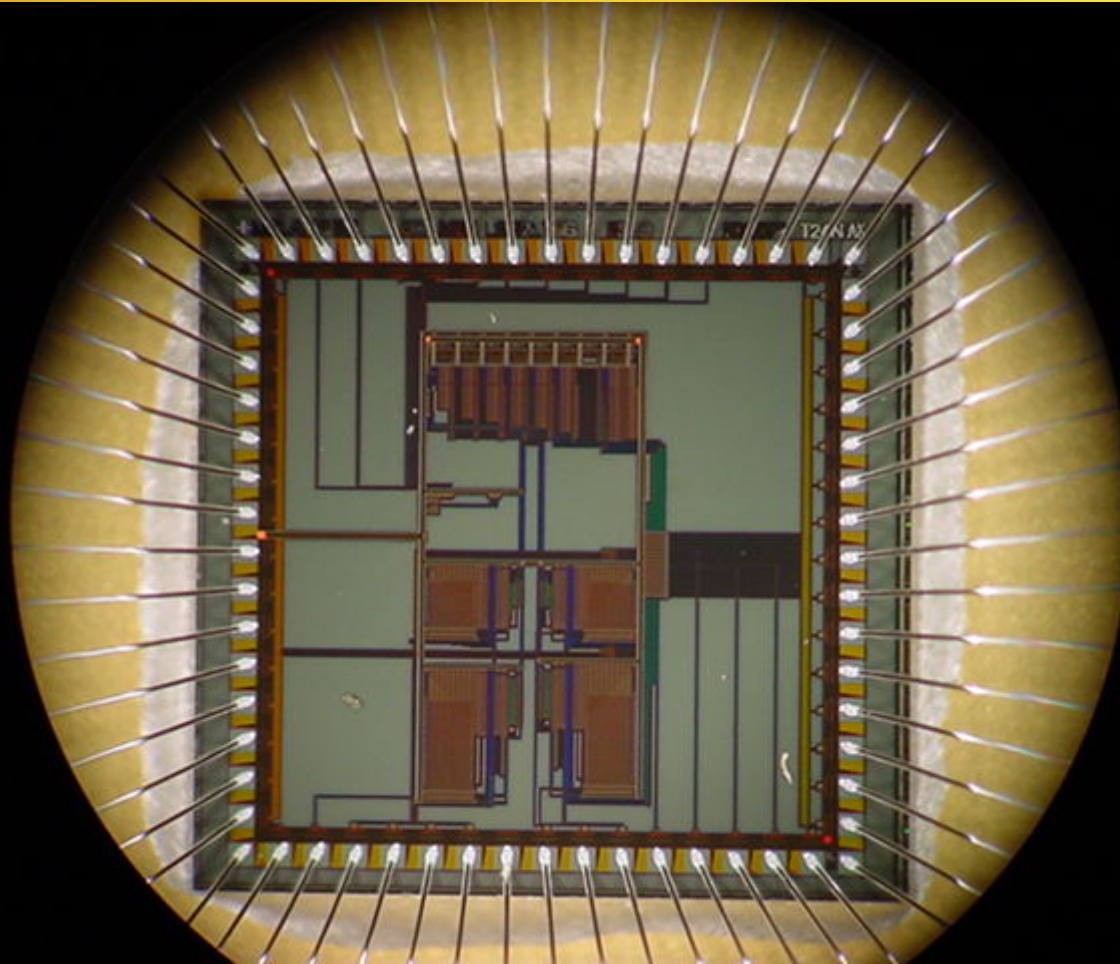
4 Transistor xnor Schematic & Layout



ADE Schematic Simulation



ICs Testing



Summary

- Project Based Course: Grading will be based upon a combination of Labs, Hwk, Exams and a Final Project
- Students are expected to understand basic circuit analysis, Emag and Electronics I
- A basic understanding of digital logic, e.g. gates, latches, flip-flops, counters, adders, etc. is also required