VLSI SYSTEM DESIGN

Noor Mahammad Sk

Course

- Monday – 1000 Hrs @H13
- Tuesday – 0900 Hrs @H13
- Friday – 1200 Hrs @H13

- Practice @L209
  - COE - Wednesday 0900 to 1200 Hrs
  - CED - Friday 0900 to 1200 Hrs

Course Evaluation Policy

- Internal Exam – 40% Weightage
  - Quiz1 – 20 Marks
  - Quiz2 – 20 Marks
- External Exam – 60% Weightage
  - Assignments – 20 Marks
  - End-Semester Exam – 40 Marks

Pre-requisites

- Semiconductor Physics
- Digital Logic Design concepts

Course Content

- MOS Transistors and CMOS logic
- CMOS Fabrication and Layout
- Design Partitioning
- Design Abstraction
- Technology Related CAD Issues
- Delay and Power
- Robustness
- Datapath Subsystem
- Design Methodology and Tools
- Testing, Debugging and Verification
- CMOs Chip Design Options
- Static Timing Analysis

Reference Text Books

- Weste and Eshraghian, Principles of CMOS VLSI Design, Addison Wesley, 4Th Edison 2011.
- Geiger R L, Allen and Strader, VLSI Design Techniques for Analog and Digital Circuits, McGraw-Hill, 1990.
- Wolf W, Modern VLSI Design, Pearson Education Publishers, 1997.

Introduction to VLSI Design

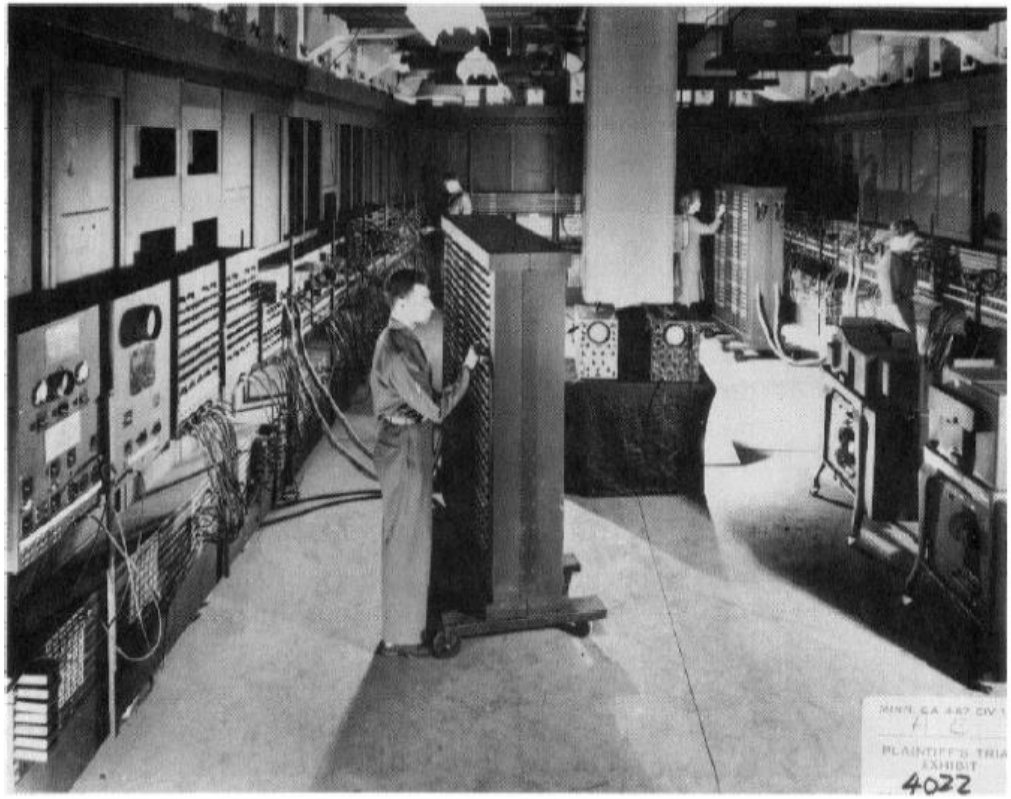
Dr Noor Mahammad Sk

The Babbage Difference Machine

- In 1832

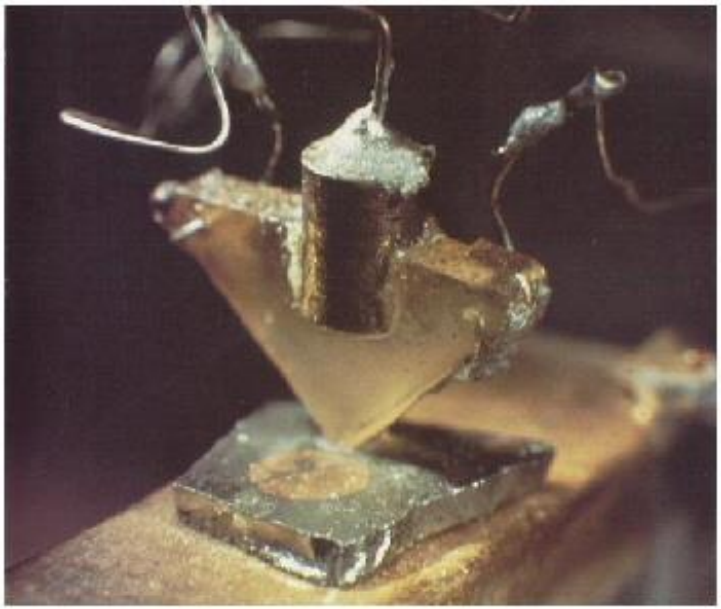
The First Electronic Computer

- In 1946 (ENIAC - *Electronic Numerical Integrator And Computer*)
- They were programmed by setting switches or plugboards similar to early telephone switchboards for each run



Invention of the Transistor

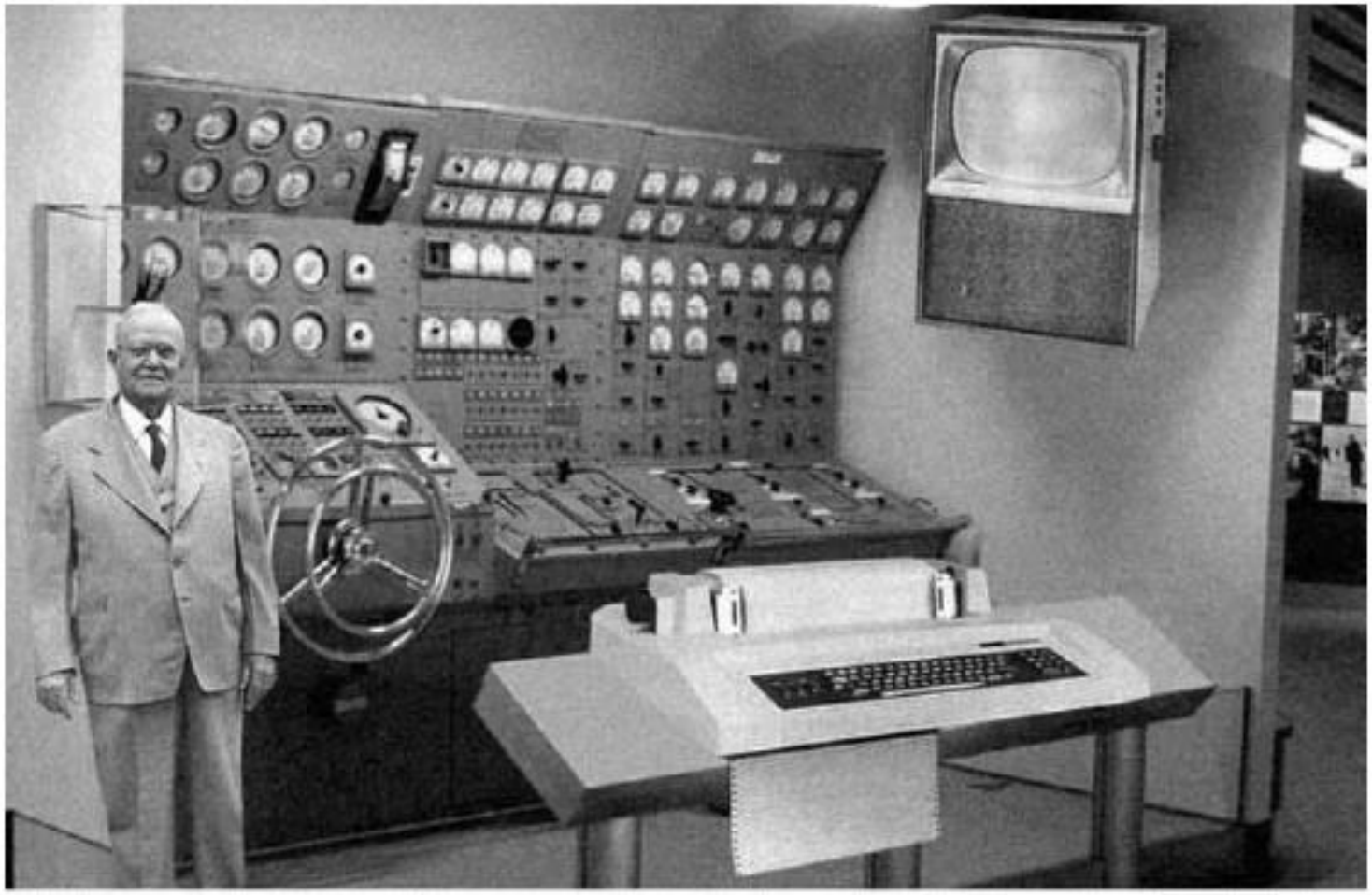
- Vacuum tubes ruled in first half of 20th century Large, expensive, power-hungry, unreliable
- 1947: first point contact transistor
  - John Bardeen and Walter Brattain at Bell Labs



http://101science.com/transistor.htm

Prediction about Home PC in 1954

- Scientist from the RAND Corporation have created this model to illustrates how a “home computer” could look like in the year 2004.



Super Computer

Modern day Computers

Bread Board Design

- What are the difficulties that you find in the circuit design using the bread boards??
- What you are looking for?

Integrated Circuit

- Why IC?
- What are the Advantages?
- How it can be designed?
- What factors motivated to one to go for ICs?

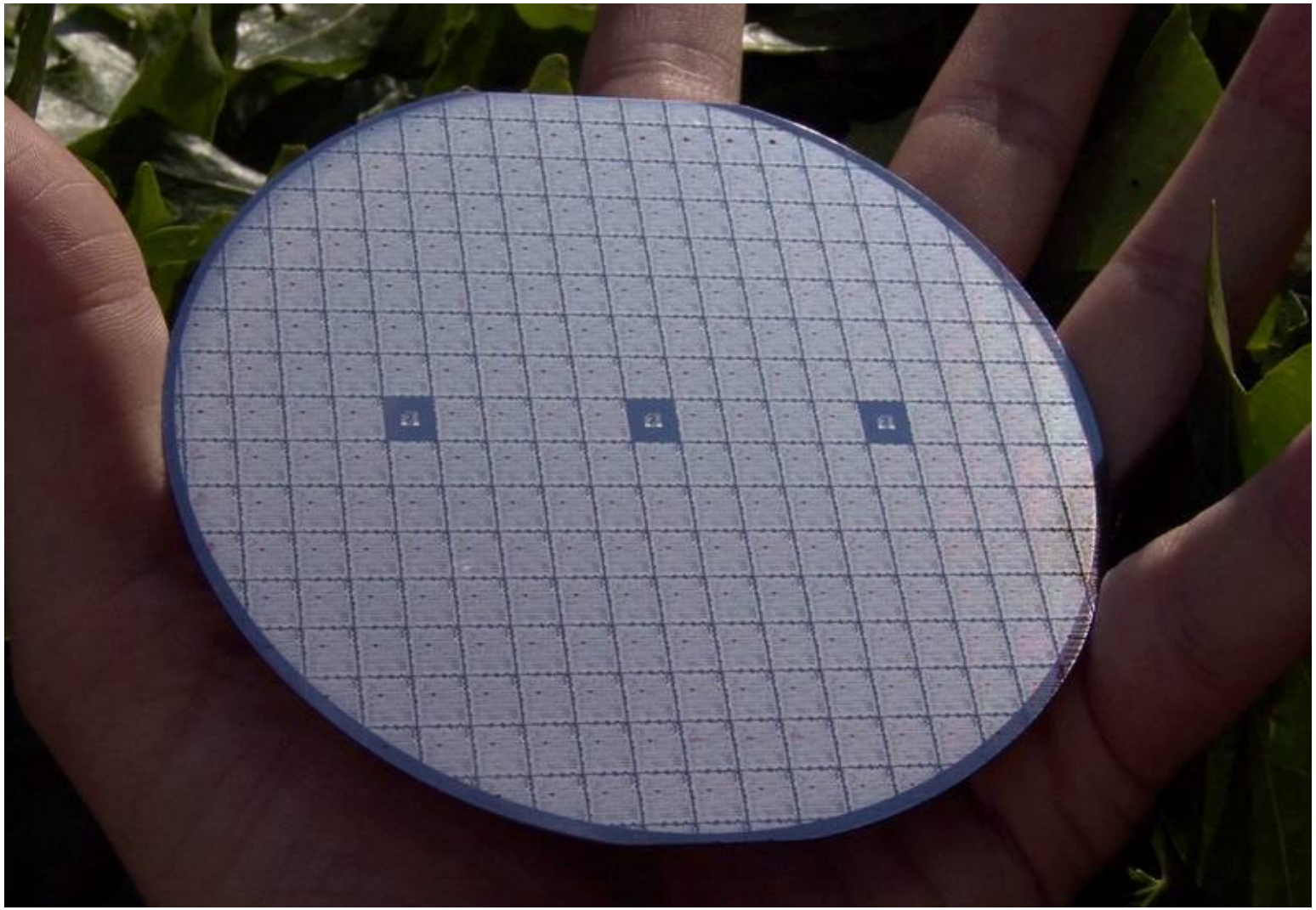
Key Parameter of any circuit Design

- Frequency (Delay)
- Complexity of inter connections of components
- Power Consumption
- Heat Dissipation
- Efficient Design (Optimized)
- Verification of Design
- Testing the circuit after implementation

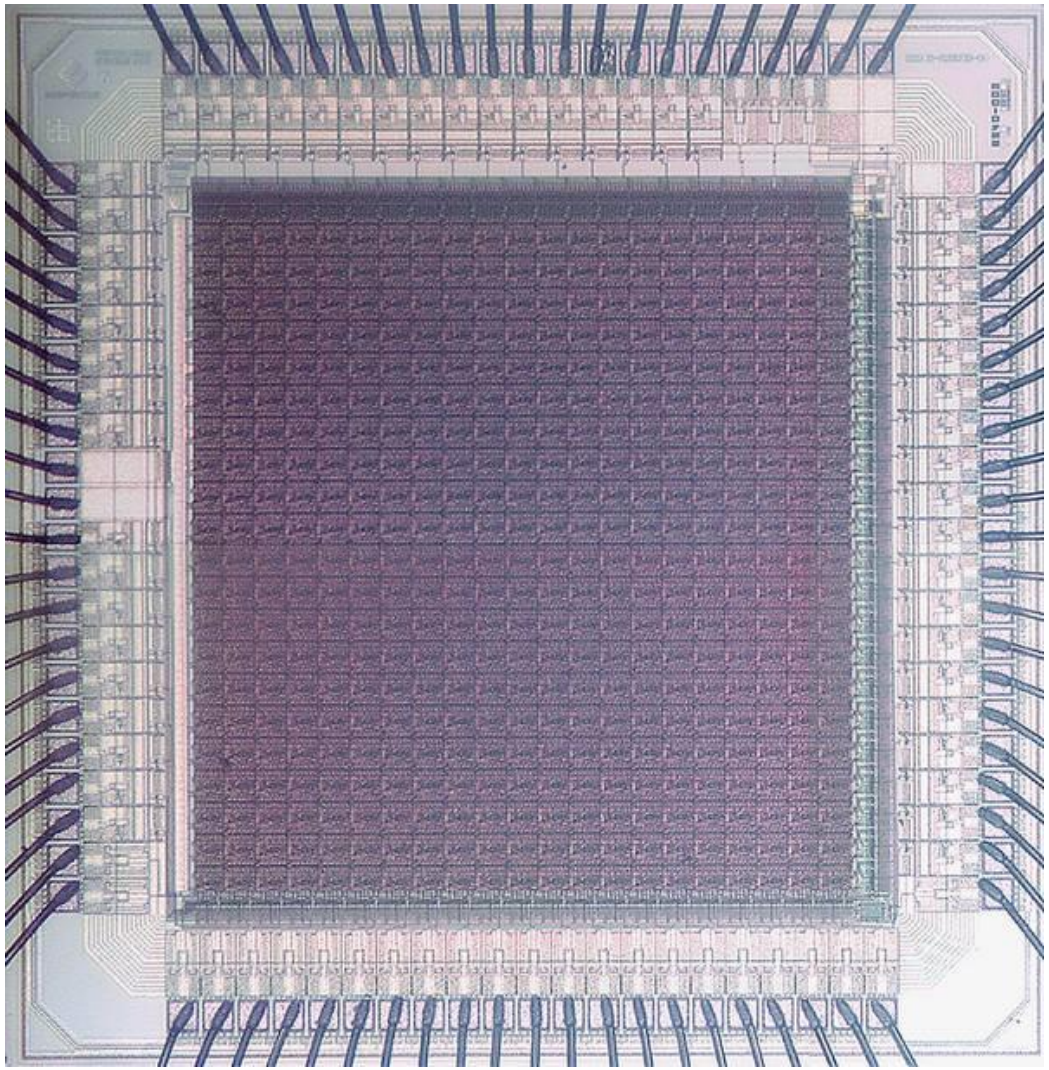
Integrated Circuits

- Collection of components on a single die or on single wafer
- Components may be logic gates or transistors or macro-blocks

Die



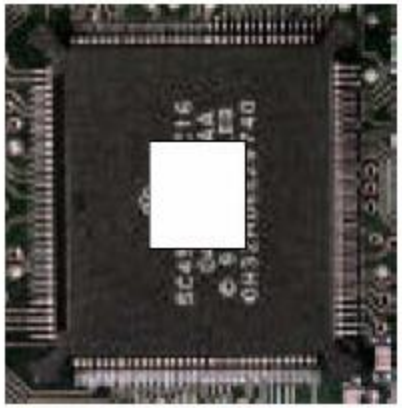
Integrated Circuit



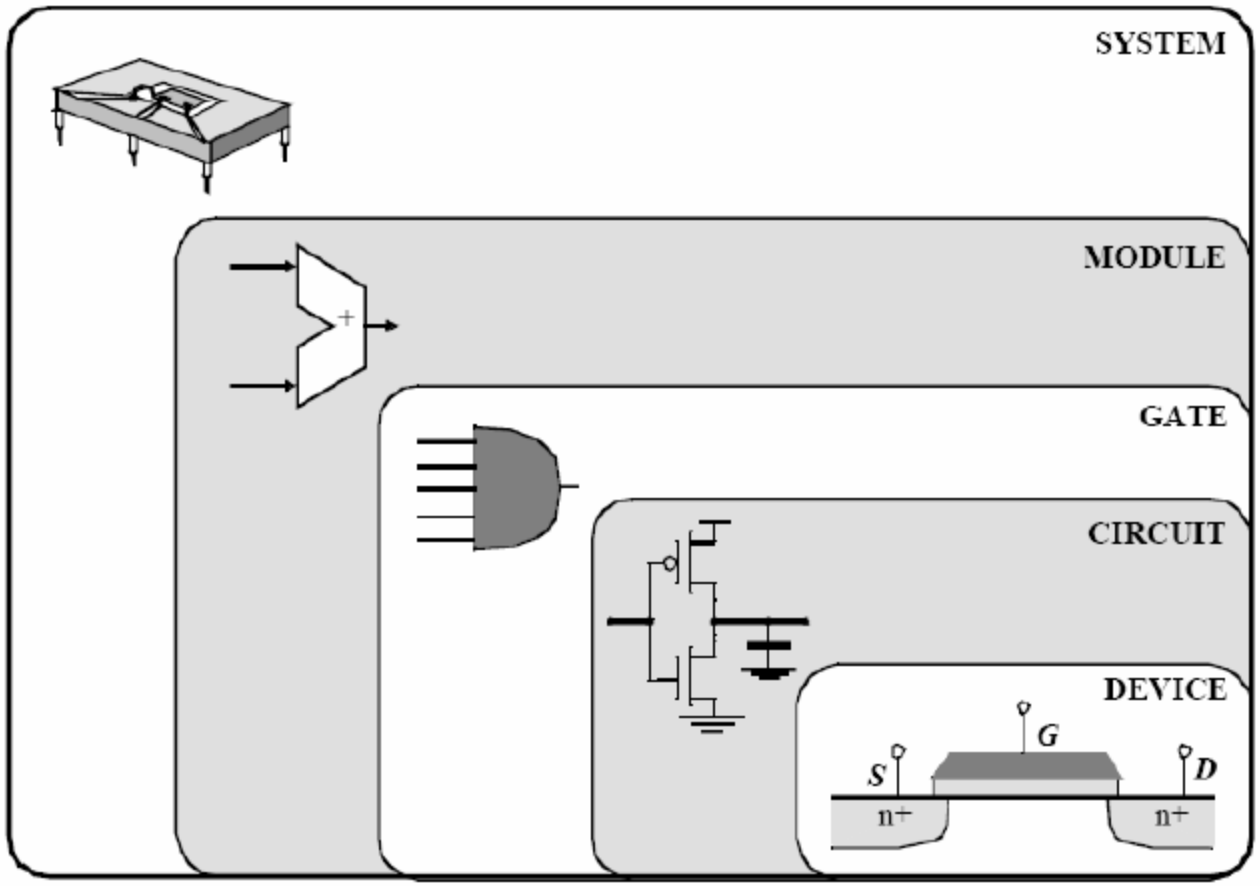
History of Integration

- **Small-Scale Integration** (**SSI**, ~10 gates per chip, 60's),
- **Medium Scale Integration** (**MSI**, ~100–1000 gates per chip, 70's),
- **Large-Scale Integration** (**LSI**, ~1000–10,000 gates per chip, 80's),
- **Very Large-Scale Integration** (**VLSI**, ~10,000–1,00,000 gates per chip, 90's),
- **Ultra Large Scale Integration** (**ULSI**, ~1M–10M gates per chip)

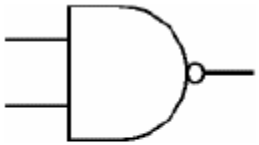
How does a microprocessor look?



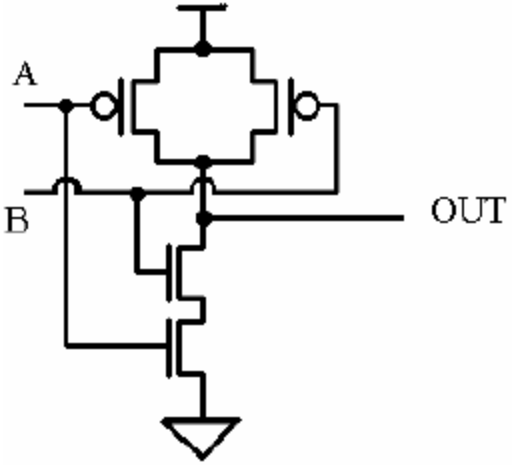
Circuits Design: Abstraction Levels

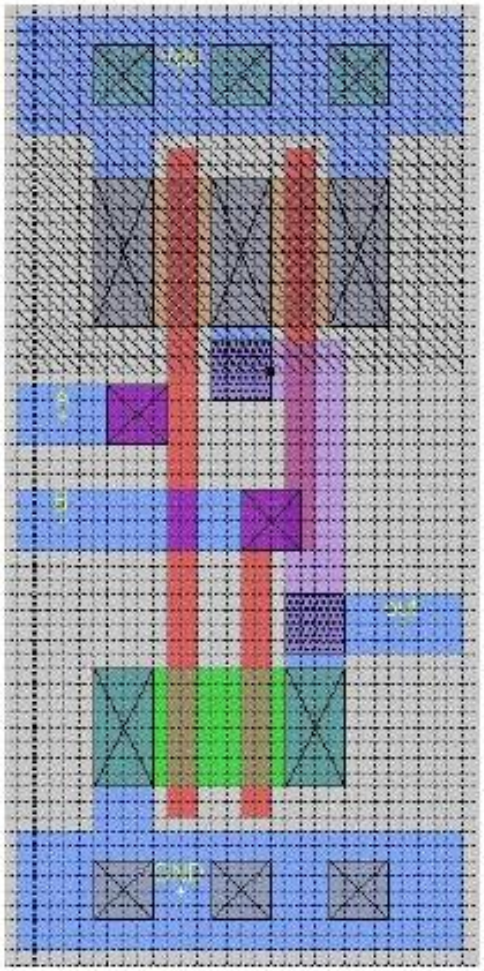


Digital Circuits: Logic to Device



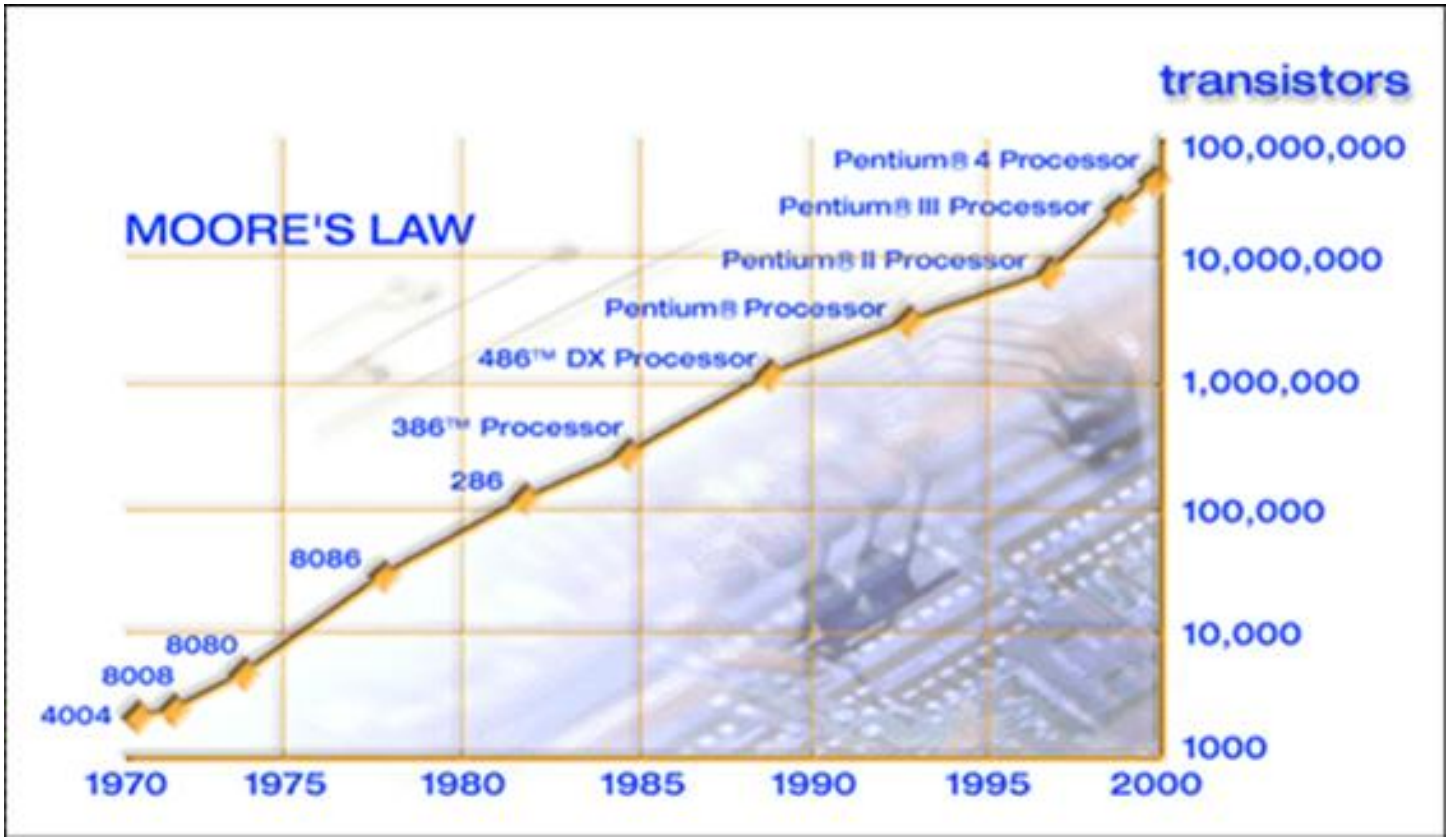
(NAND Gate)





Moore's Law

- #Transistors on a given area doubles every 18 Months

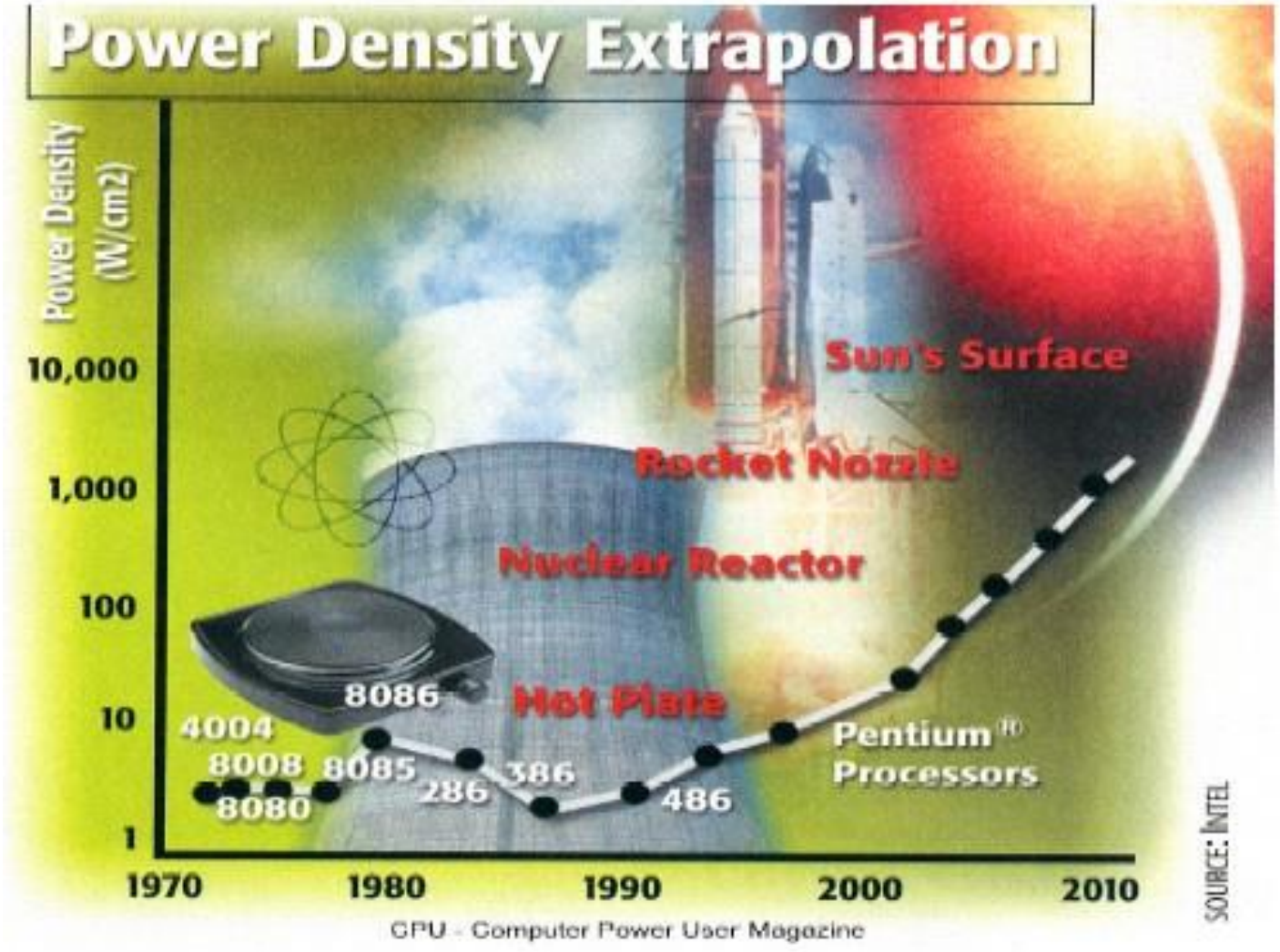


Gordon E. Moore

Source: Intel

Hprcse

Power Density in Processors



Source: Intel

History of Technology

- Bipolar Technology
- Transistor-Transistor Logic (TTL)
- Metal Oxide Silicon (MOS)
  - Difficult to make metal gate n-channel MOS (nMOS or NMOS)
- Complementary MOS (CMOS)
  - Greatly reduced power

Semiconductor Applications

- 3C: Computer/ Communication/ Consumables
- Computer: Desktop Computer/ Notebook
- Communication: ADSL/ Cable Modem/ Bluetooth/ VoIP
- Consumables: Game/ DVD/ Digital Camera

Types of Chips

- DRAMs: serves as a primary memory for computers
- Microprocessors
- ASICs
- DSP Processors
- Programmable Memory Chips

THANK YOU!!

Dr Noor Mahammad Sk