

EE-224:

Digital Design

Course Introduction

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WHAT IS THE DIFFERENCE BETWEEN THE COMPUTING INDUSTRY AND THE PAPER TOWEL INDUSTRY?



Industry of Replacement



1971

2015



Industry of new possibilities



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CAN WE CONTINUE BEING AN INDUSTRY OF NEW POSSIBILITIES ???

Personalized
healthcare

Virtual
reality

Real-time
translators



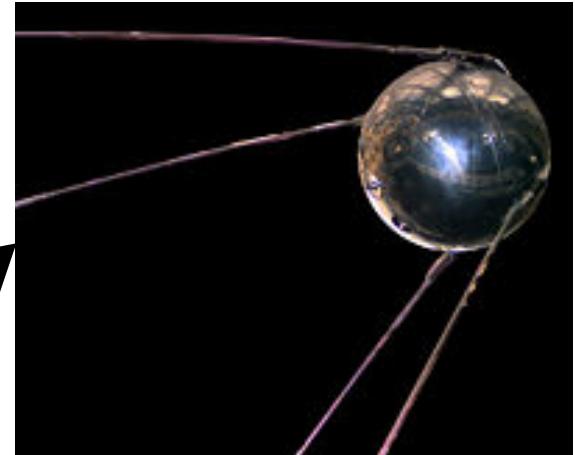
- There were many inventions in the 20th century: Airplane, Nuclear Power generation, Computer, Space aircraft, etc.
- However, everything has to be controlled by electronics
- Electronics
 - **Most important invention in the 20th century**
- What is Electronics: To use electrons, Electronic Circuits, IC (Integrated Circuits)?
- Without IC, Mobile phone not possible, for example.



World of 1958:

70 Years is a long time!

Artificial Satellite
Sputnik, Oct.4, 1957



Radio → TV (made of Vacuum Tube)



Sony Transistor
Radio Started 1955



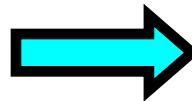
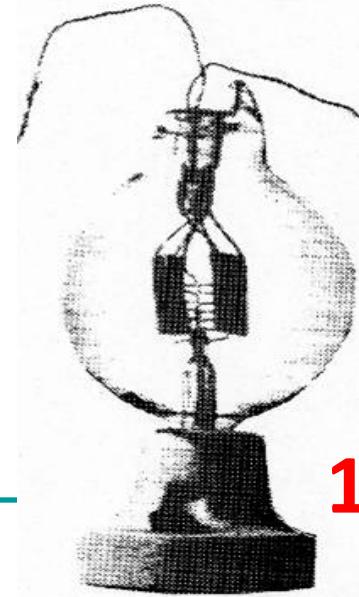
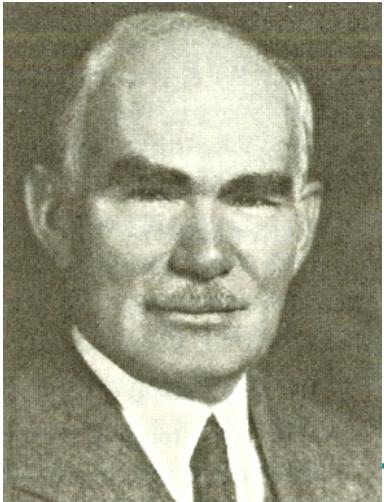
History of Electronics

- Electronics is the most important invention of the 20th century
- Electronic Circuits in 100 years

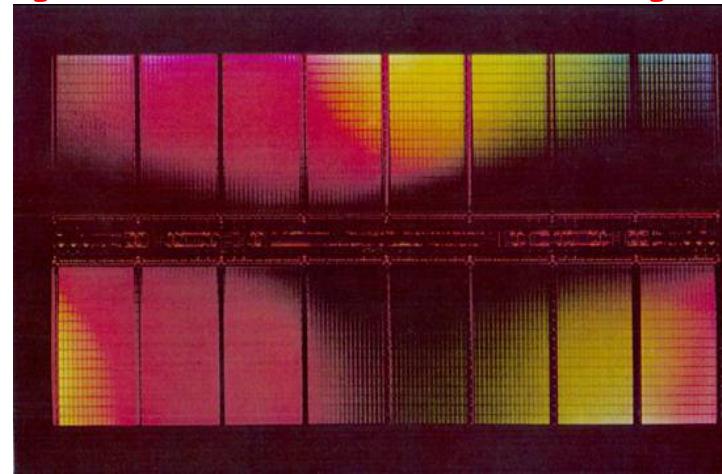
Vacuum tube → VLSI

(Very Large Scale Integrated circuits)

12 years ago, it was the 100 year anniversary



1906

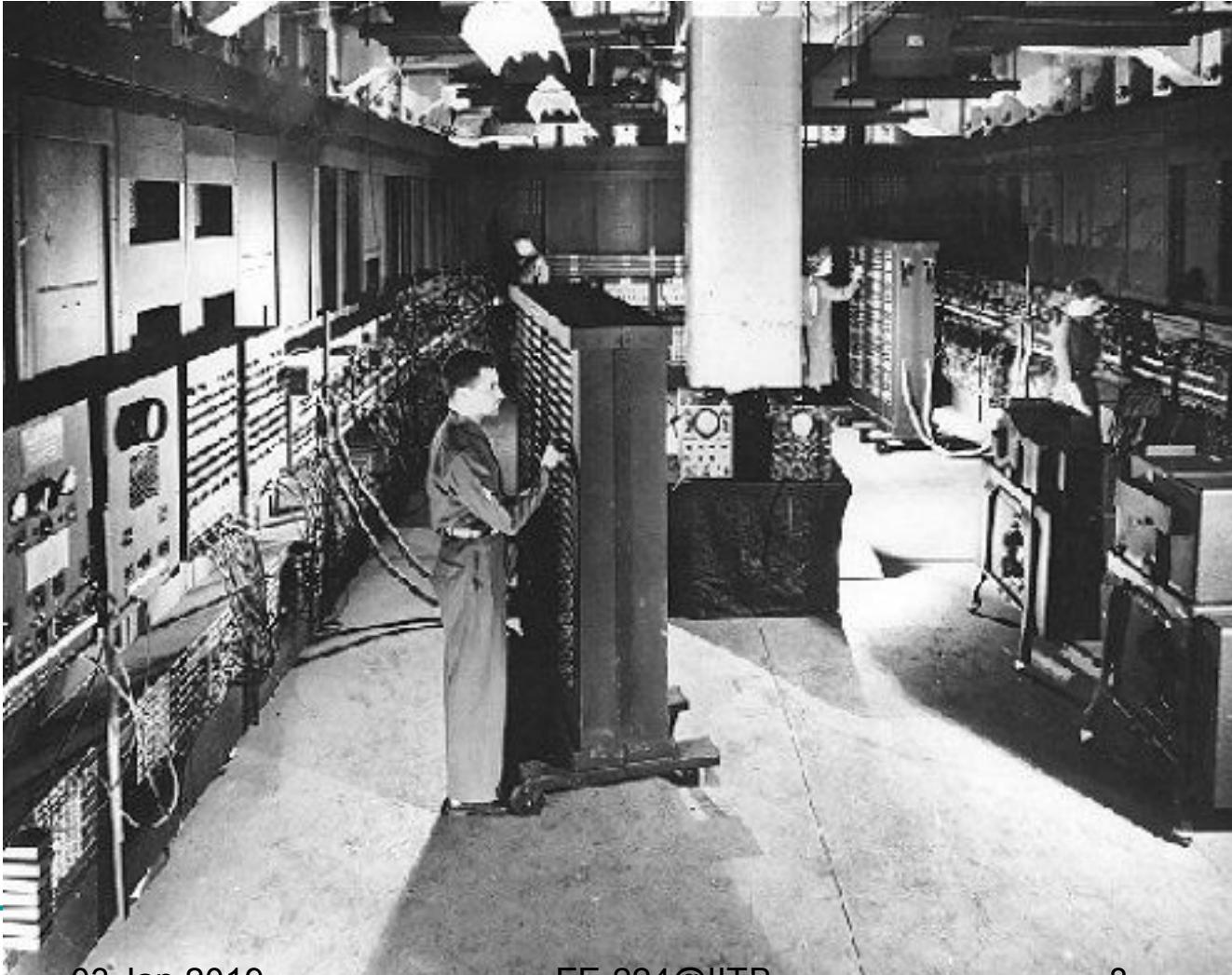


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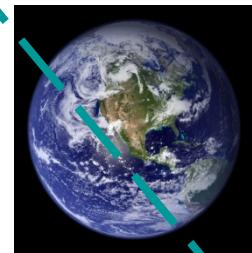
Electronic Computer

First Computer ENIAC: made of huge number of vacuum tubes 1946

Big size, huge power, short life time filament



Wanted: CUSTOMERS, who breathe, eat, and live in.....



Global & Regional Political & Macro-Economic Environments



Customer Demand

~\$ 50,000B

Electronic End Equipment

~\$ 1050B

Semiconductors

~\$ 400B

**Semiconductor
Equipment &
Materials**

~\$ 100B



International Technolog

03 Jan 2019



Sources: NASA Govt., SEMI

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Interesting Applications



Why Study Digital Design?

- **It's exciting!**; It has never been more exciting!
- It impacts every other aspect of electrical engineering and computer science



Bionics:

Sensors in latex fingers instantly register hot and cold, and an electronic interface in his artificial limb stimulates the nerve endings in his upper arm, which then pass the information to his brain. The \$3,000 system allows his hand to feel pressure and weight, so for the first time since losing his arms in a 1986 accident, he can pick up a can of soda without crushing it or having it slip through his fingers. *One Digital Day*

Next Generation Vehicles



28 Mar 2018

virendra@NIT Sikkim

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Next Generation Vehicles

WILL IT FIT IN MY GARAGE?

- Price: £36,025 - £49,945
- Length: 16ft 1in
- Width: 6ft 1in
- Fuel consumption: 40.9 mpg
- 0 to 62 mph: 4.8 seconds

■ The new 5-series BMW allows driver to take hands off steering wheel for up to 30 seconds - at speeds of up to 130mph where legal.

P ■ A remote control parking app allows the driver standing outside the vehicle to park the car into or out of a tight parking spot or garage where access is restricted.

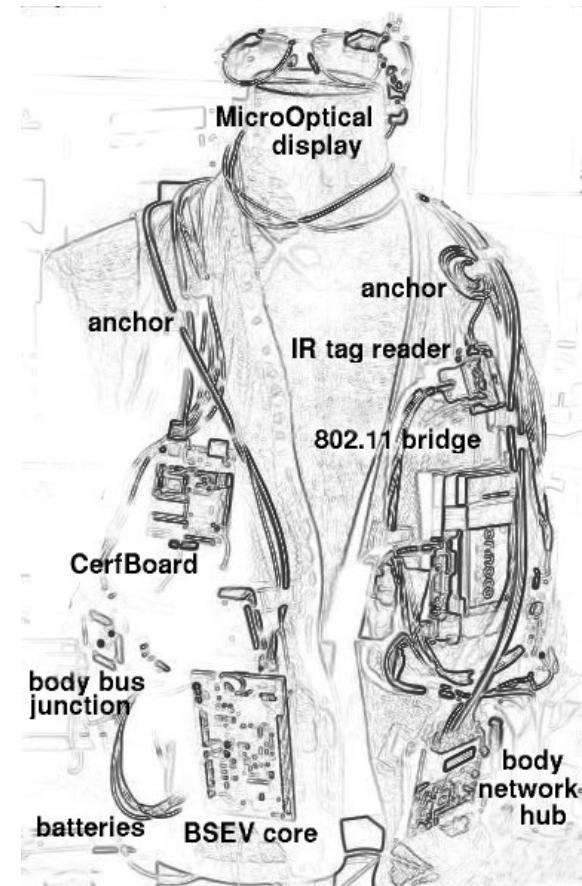
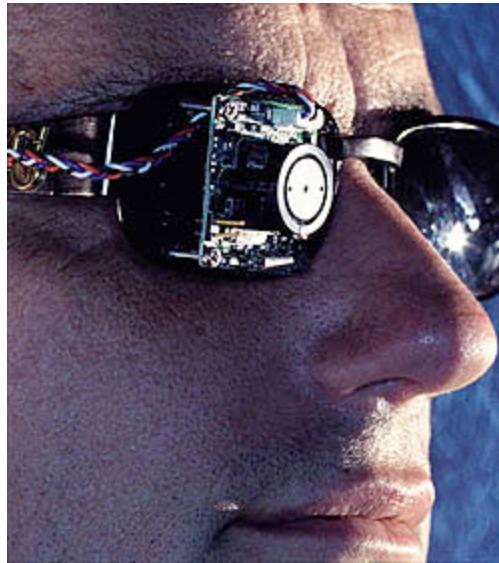
■ Radar sensors check for traffic at junctions

■ Overtakes cars on motorways and dual carriageways by itself from 44mph to 112mph if driver holds down indicator.

■ Gesture control allows drivers to swipe, point or make circular motions to choose music, or with a 'wave of a hand' get rid of an unwanted phone

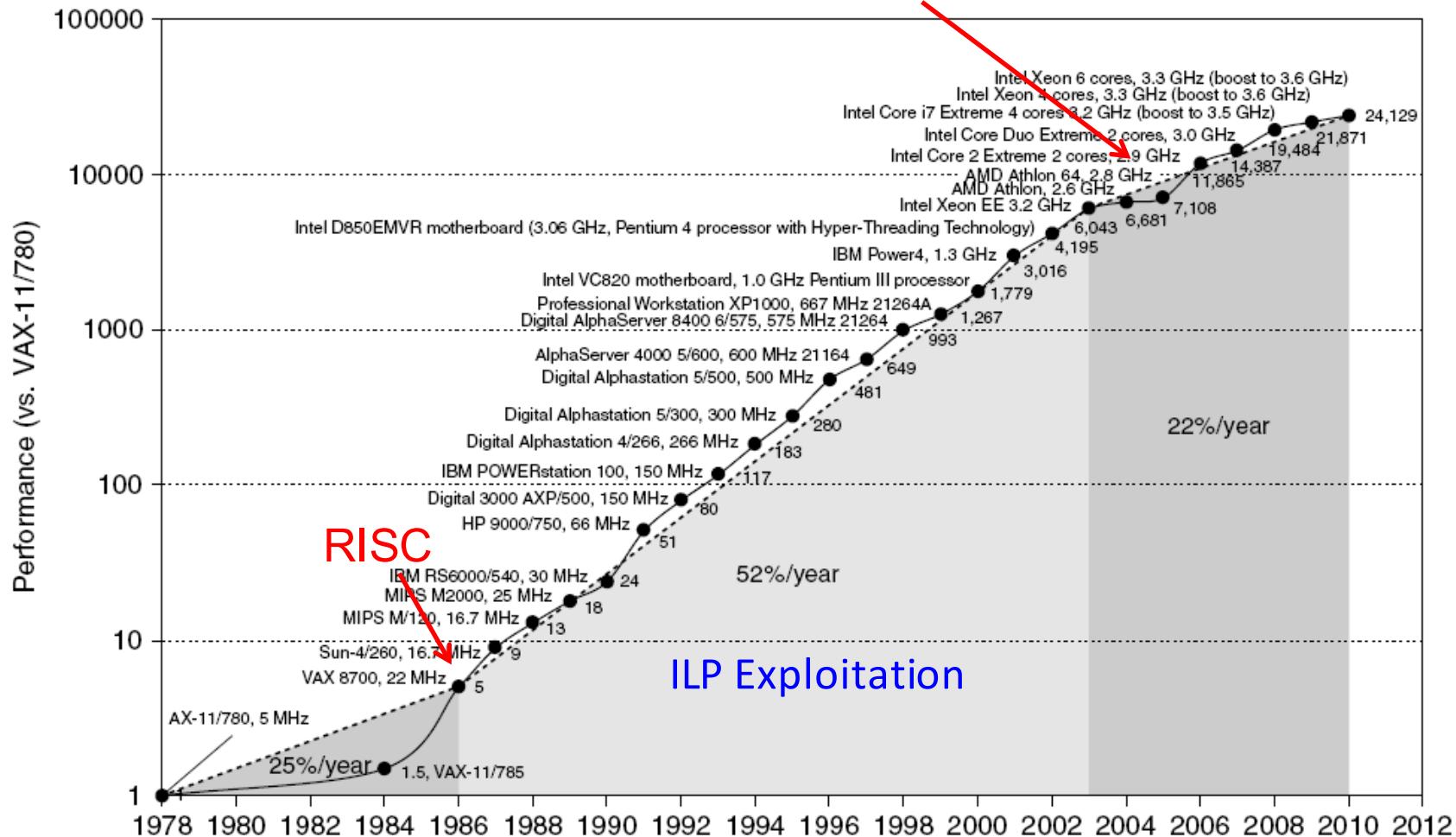
■ The car will send a live visual alert to your mobile phone if it detects someone trying to break into it or if it has been hit by another vehicle. Four cameras will record the face of the villain trying to steal it or the car that hit it.

Why to Study Digital Design?



Single Processor Performance

Move to multi-processor



Chip Realization Process

Customer's need

Determine requirements

Write specifications

Design synthesis and Verification

Test development

Fabrication

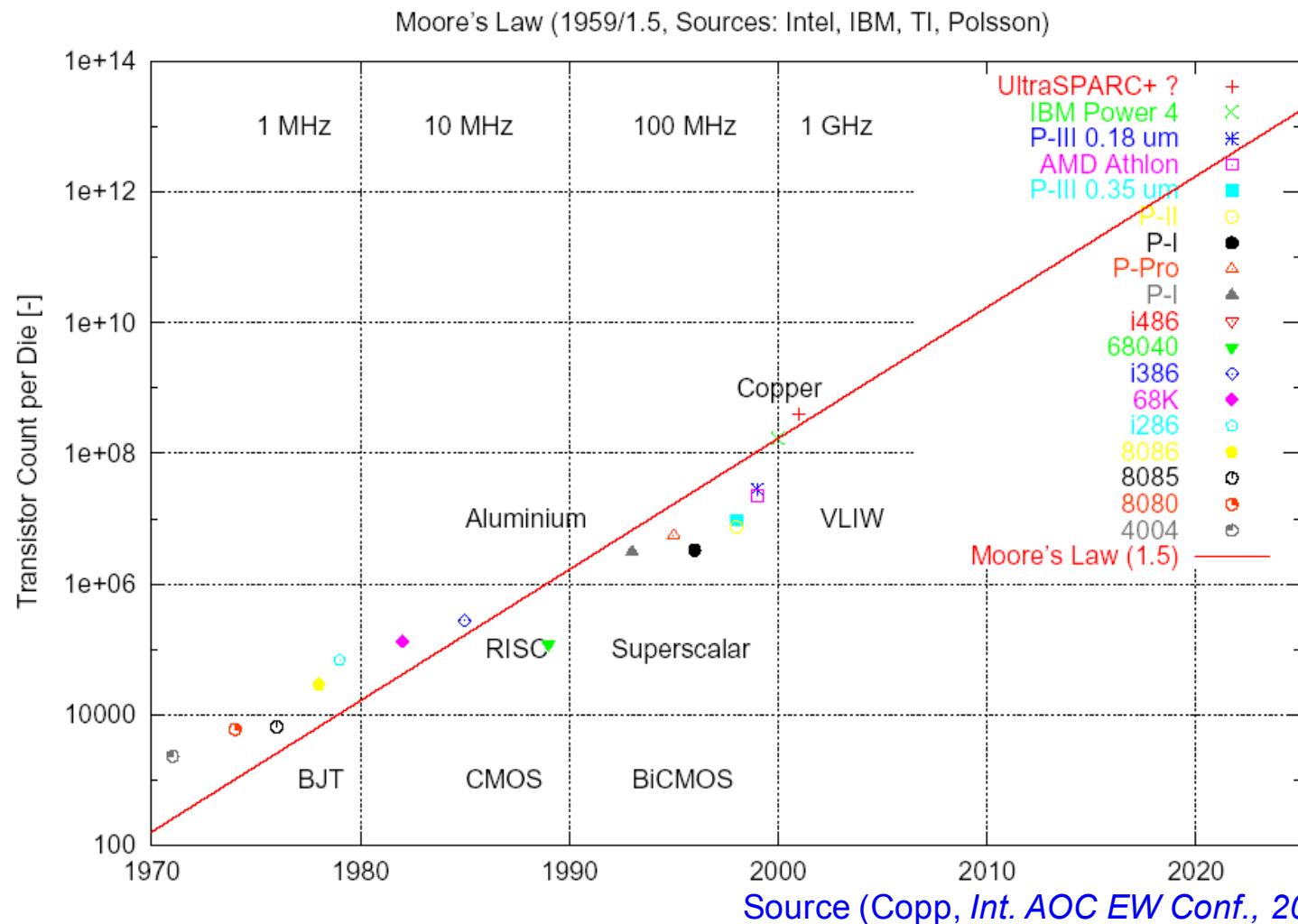
Manufacturing test

Chips to customer



Motivation: Moore's Law

Complexity Growth of VLSI circuits



What is logic?

- Logic is the study of valid reasoning.
- That is, logic tries to establish criteria to decide whether some piece of reasoning is valid or invalid.



Valid Reasoning

- While in every piece of reasoning certain statements are *claimed to* follow from others, this may in fact not be the case.
- Example: “If I win the lottery, then I’m happy. However, I did not win the lottery. Therefore, I am not happy.”
- A piece of reasoning is *valid* if the statements that are claimed to follow from previous ones do *indeed* follow from those. Otherwise, the reasoning is said to be *invalid*.



Logic

- Crucial for mathematical reasoning
- Used for designing electronic circuitry
- Logic is a system based on **propositions**.
- A proposition is a statement that is either **true** or **false** (not both).
- We say that the **truth value** of a proposition is either true (T) or false (F).
- Corresponds to **1** and **0** in digital circuits



The Statement/Proposition Game

- “Elephants are bigger than mice.”

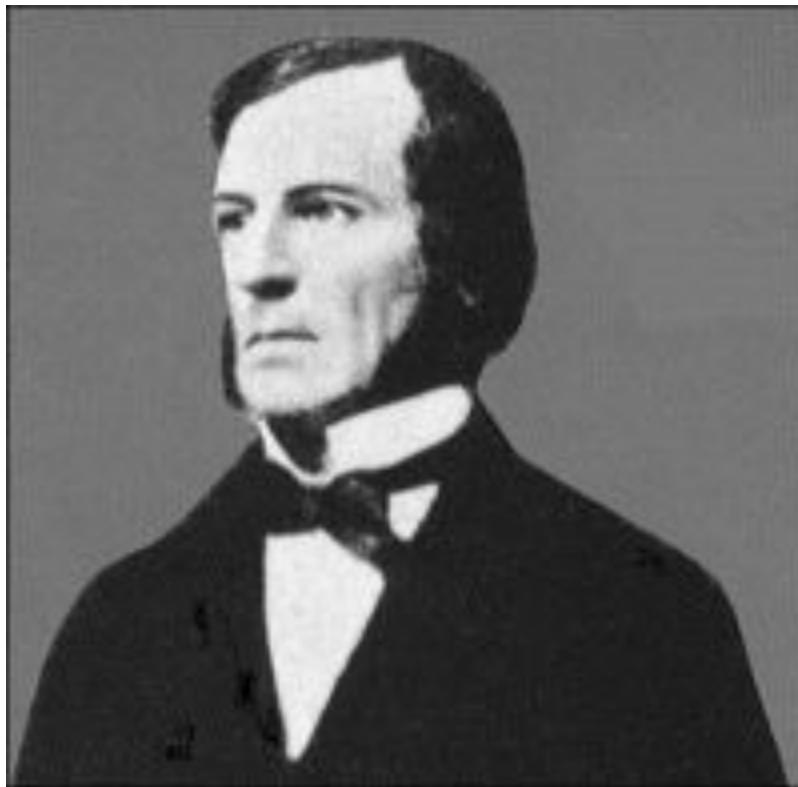
Is this a statement? yes

Is this a proposition? yes

**What is the truth value
of the proposition?** true



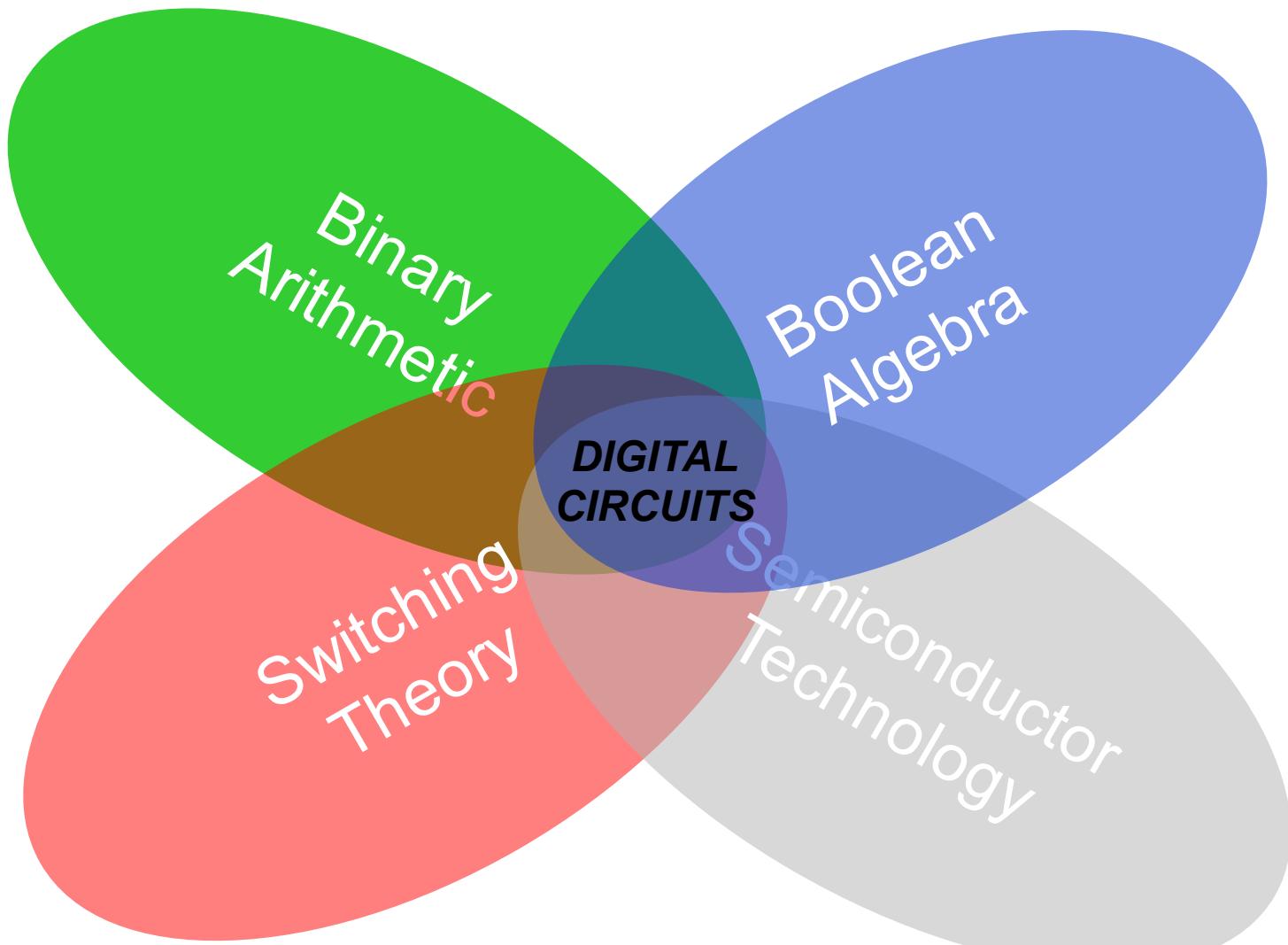
George Boole, 1815-1864



- Born, Lincoln, England
- Professor of Math., Queen's College, Cork, Ireland
- Book, *The Laws of Thought*, 1853



Digital Systems



Course Schedule

Class Hours: Slot 3

- ❖ Monday: 10:30 am to 11:30 am
- ❖ Tuesday: 11:30 am to 12:30 pm
- ❖ Thursday: 8:30 am to 19:30 am

Tutorial: Wednesday (7:00 pm to 8:30 pm)

Office Hours: TBD



Course Evaluation

- ❖ Mid Term Exam (15%)
 - Open Book/Notes Exam
- ❖ Final Exam (30%)
 - Open Book/Notes Exam
- ❖ Assignments (15%)
 - Set of assignments will be given periodically
- ❖ Course Project-I (15%)
 - ❖ Group (Max size 3/4)
- ❖ Continuous Evaluations (25%) – weekly quiz
 - Weekly Quiz – Open Book (90% best will be counted)
- [BONUS] Project - II (10%)
- [BONUS] Class notes (5%)



Grades

Absolute Grade

- > 90: AA
- 81 – 90: AB
- 71 – 80: BB
- 61 – 70: BC
- 51 – 60: CC
- 45 – 50: CD
- 40 – 44: DD
- < 40 : FR



Books

- Switching and Finite Automata Theory
 - Kohavi and Jha
- Digital Design
 - John F Wakerley
- Digital Design
 - Morris Mano



Thank You

