

EE-309: Microprocessors

Course Introduction

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Lecture 0 (03 January 2022)

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Happy New Year 2022



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



Industry of Replacement



1971

2022



Industry of new possibilities



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

Personalized
healthcare

Virtual
reality

Real-time
translators



History of Electronics

- 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

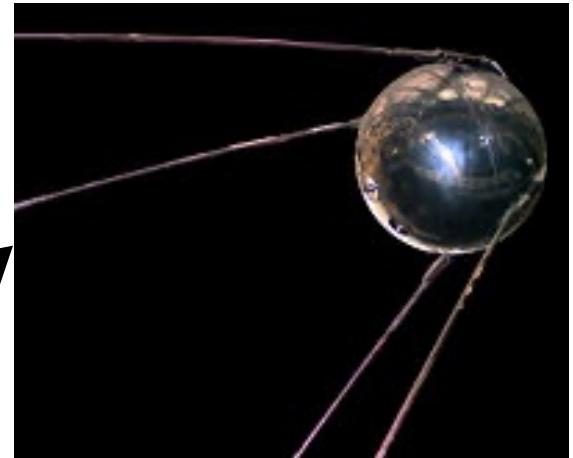


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World of 1958:

60 Years is a long time!

Artificial Satellite
Sputnik, Oct.4, 1957



Radio → TV (made of Vacuum Tube)



Sony Transistor
Radio Started 1955

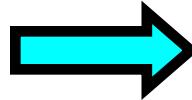
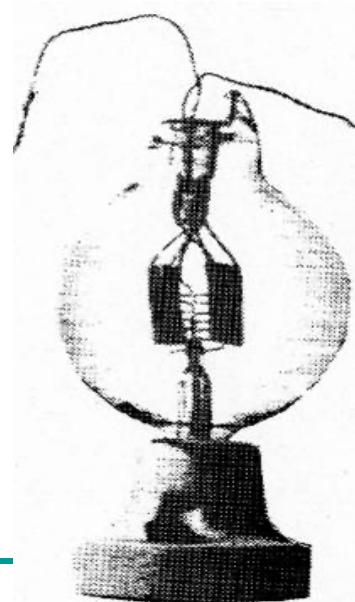
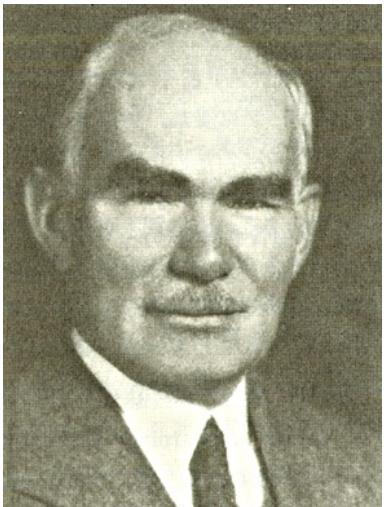


History of Electronics

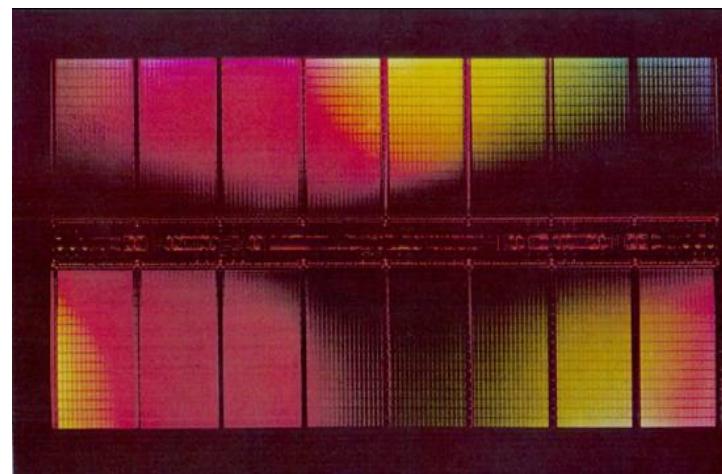
- Electronics is the most important invention of the 20th century
- Electronic Circuits in 100 years

Vacuum tube → VLSI (Very Large Scale Integrated circuits)

15 years ago, it was the 100 year anniversary

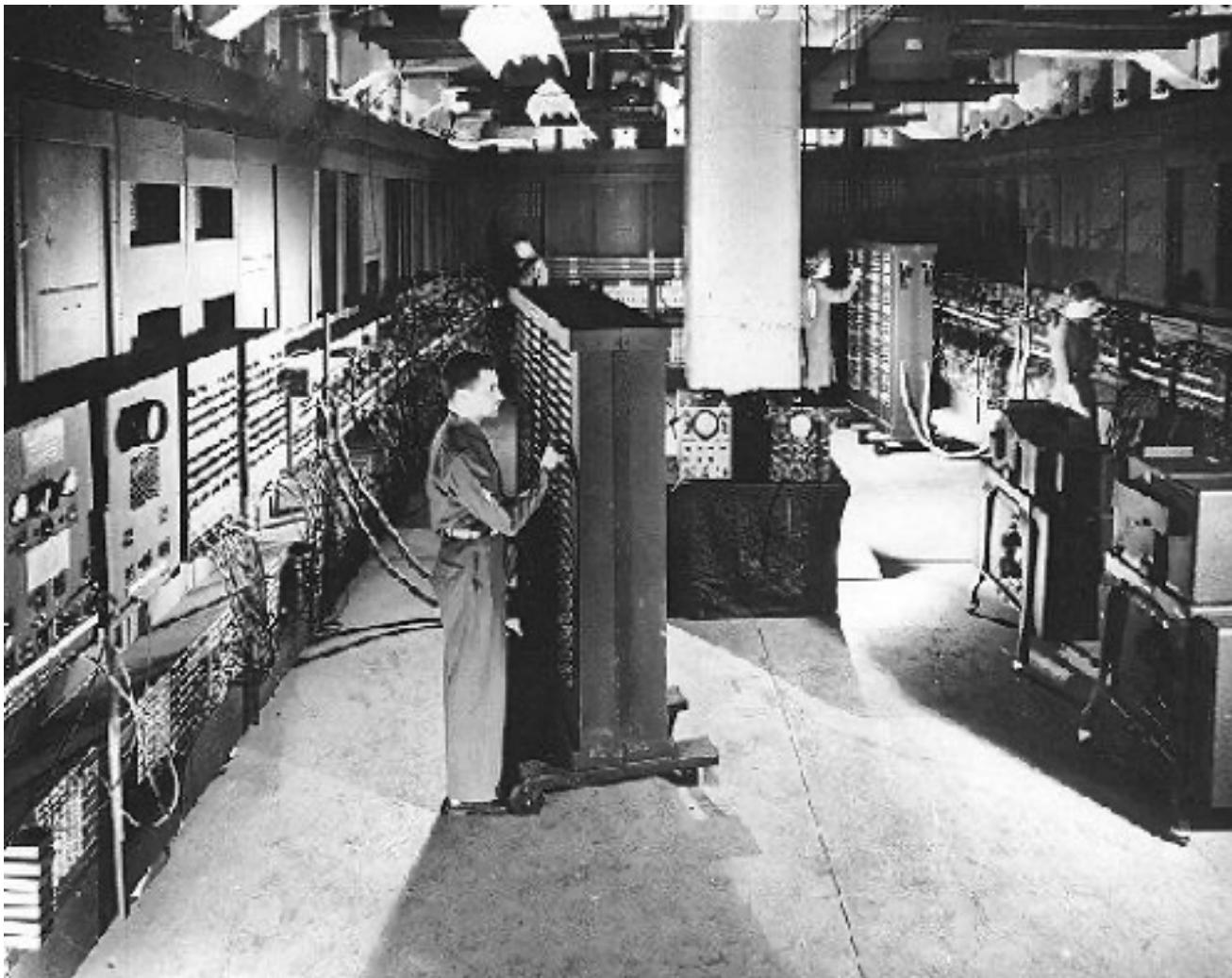


1906

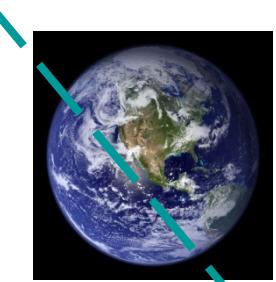


Electronic Computer

First Computer ENIAC: made of huge number of vacuum tubes, Big size, huge power, short life time filament



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



Global & Regional Political & Macro-Economic Environments



Customer Demand

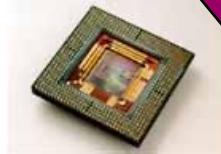
~\$ 50,000B

Electronic End Equipment

~\$ 1050B

Semiconductors

~\$ 400B



Semiconductor
Equipment &
Materials

~\$ 100B



International Techno

03 Jan 2022



Sources: NASA Gov., SEMI

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Interesting Applications



Why to Study Microprocessors?

- **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



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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.

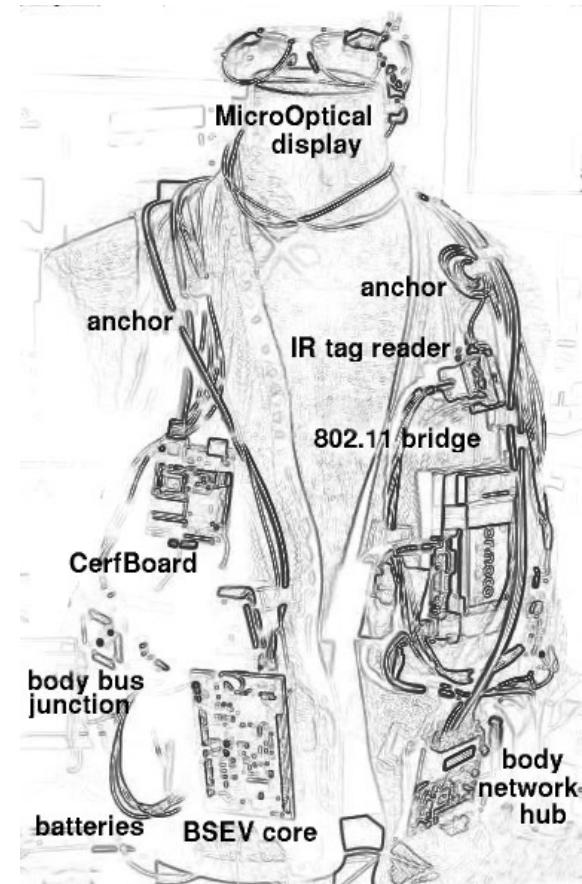
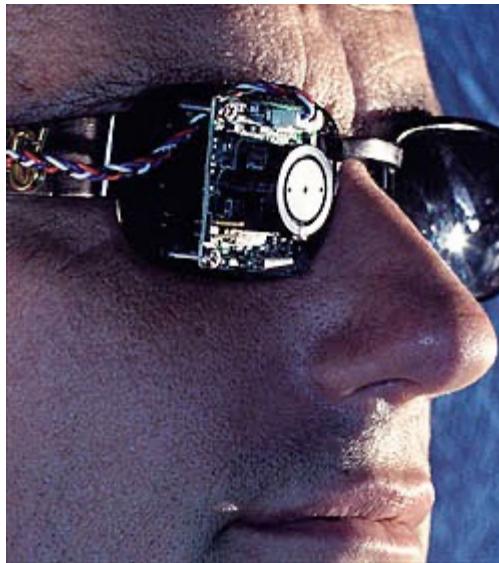
■ Radar sensors check for traffic at junctions

■ 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.

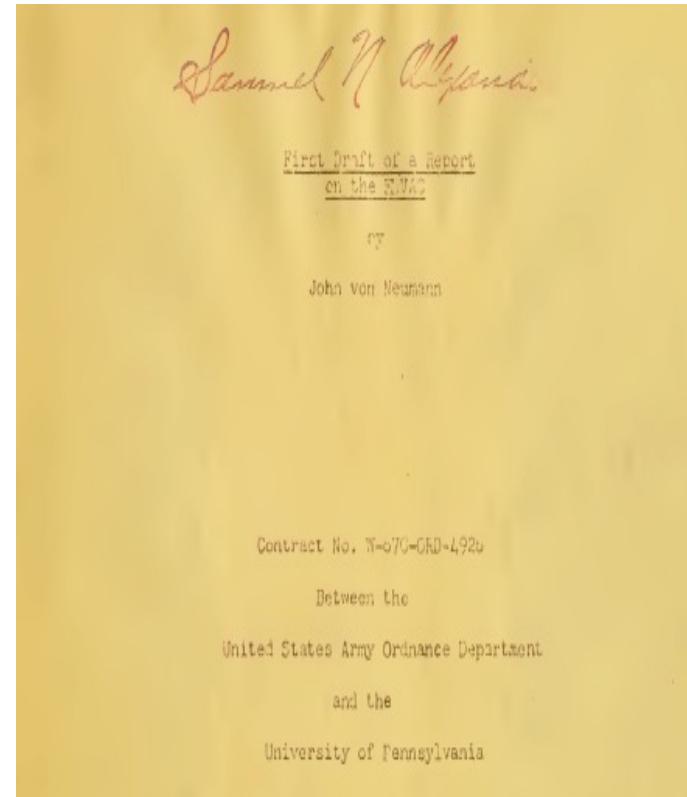
Why to Study Microprocessor Design?



First Draft of EDVAC



1945-52: John von Neumann proposed a “*stored program computer*” EDVAC (Electronic Discrete Variable Automatic Computer) – *Von Neumann Architecture* – use the same memory for program and data.



First Draft of a Report on the EDVAC

JOHN VON NEUMANN

Introduction

Normally first drafts are neither intended nor suitable for publication. This report is an exception. It is a first draft in the usual sense, but it contains a wealth of information, and it had a pervasive influence when it was first written. Most prominently, Alan Turing cites it, in his proposal for the Pilot ACE,* as the definitive source for understanding the nature and design of a general-purpose digital computer.

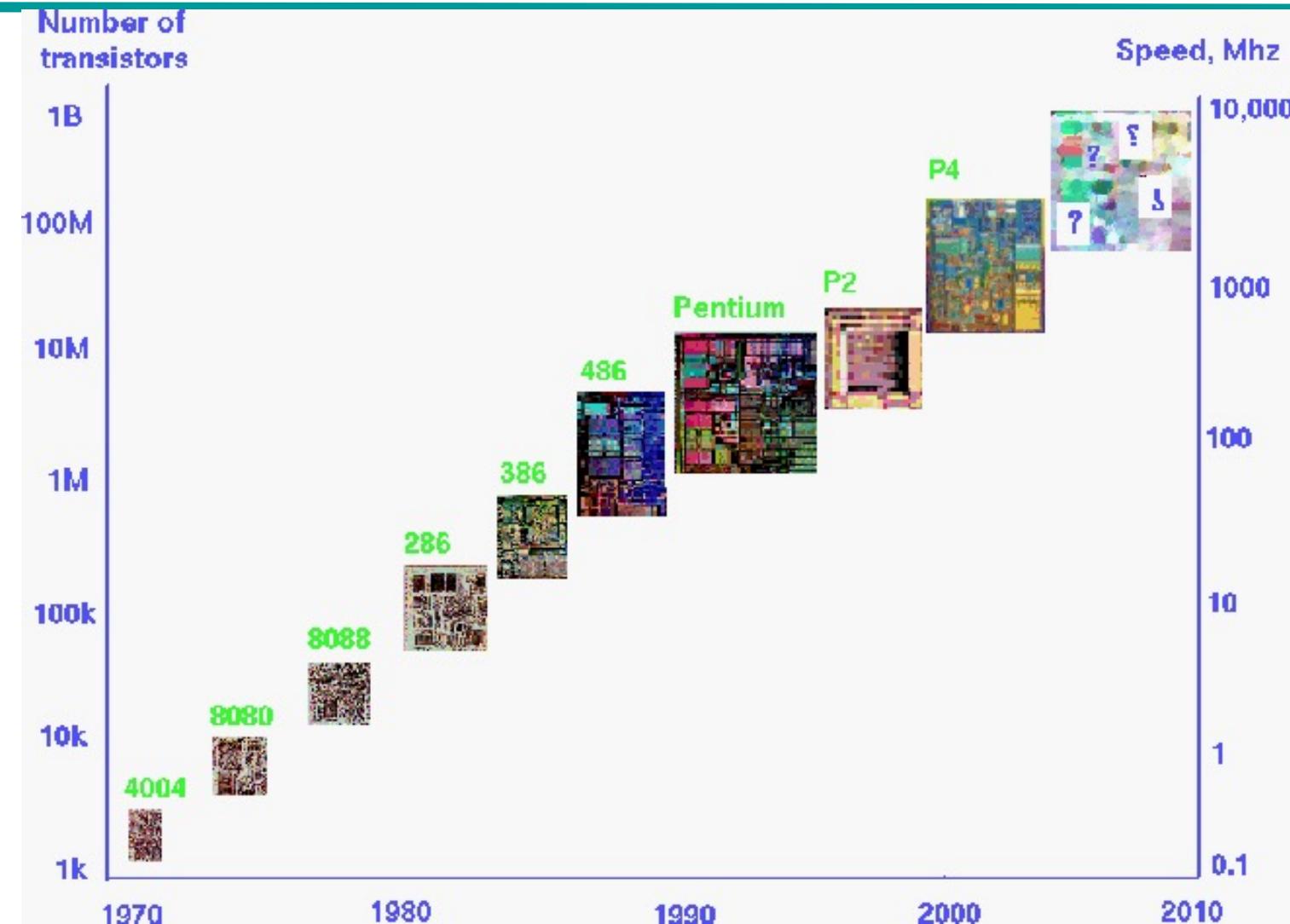
After having influenced the first generation of digital

taken great pains *not* to modify the intended expression, nor to editorialize on the original work. The report is still not easy reading, but to the best of my ability this version is a correct rendering of what von Neumann wrote and intended.

A careful reading of the report will be instructive to anyone with an interest in the past, present, or future of computing.

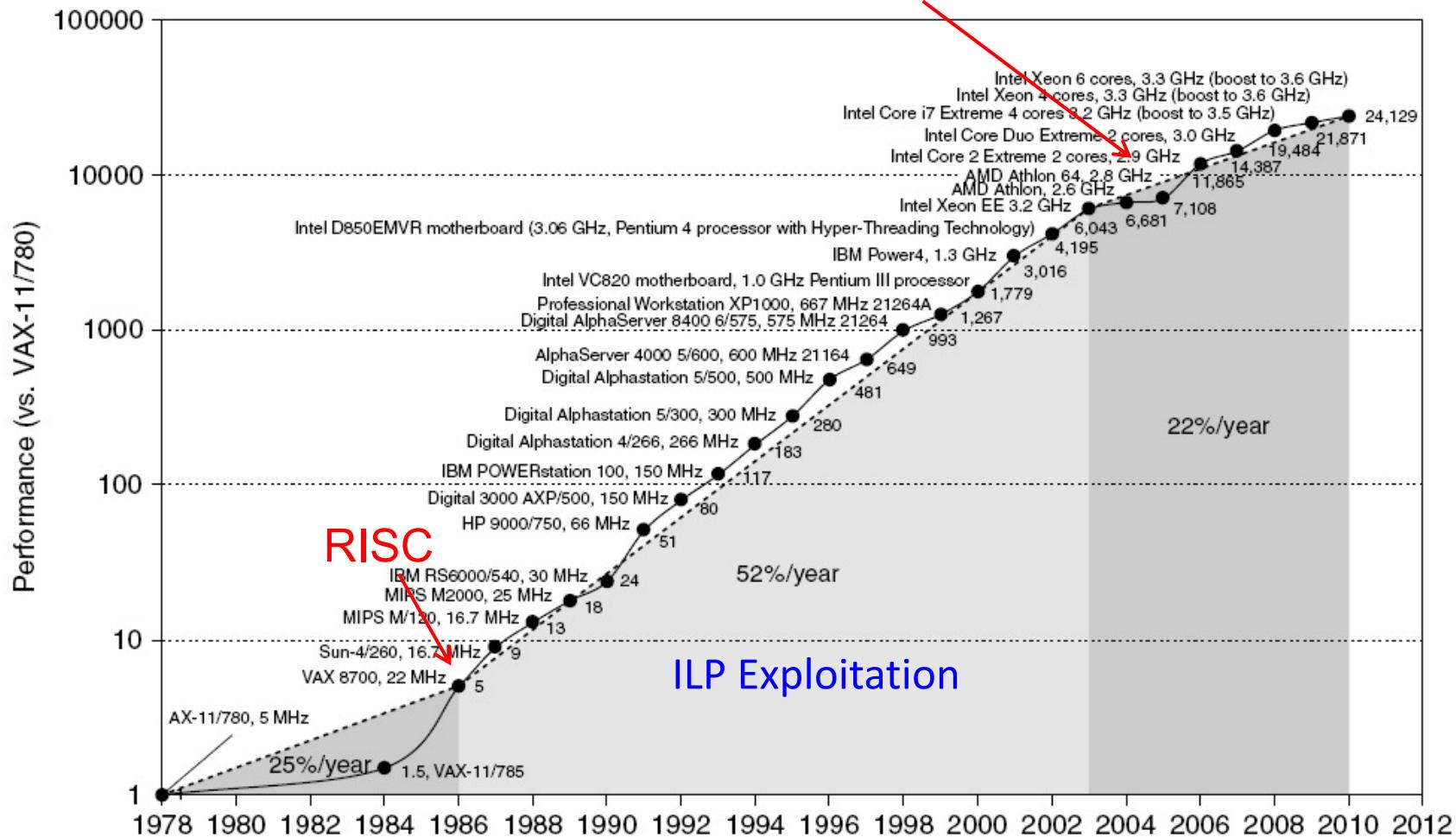


Microprocessor Designs

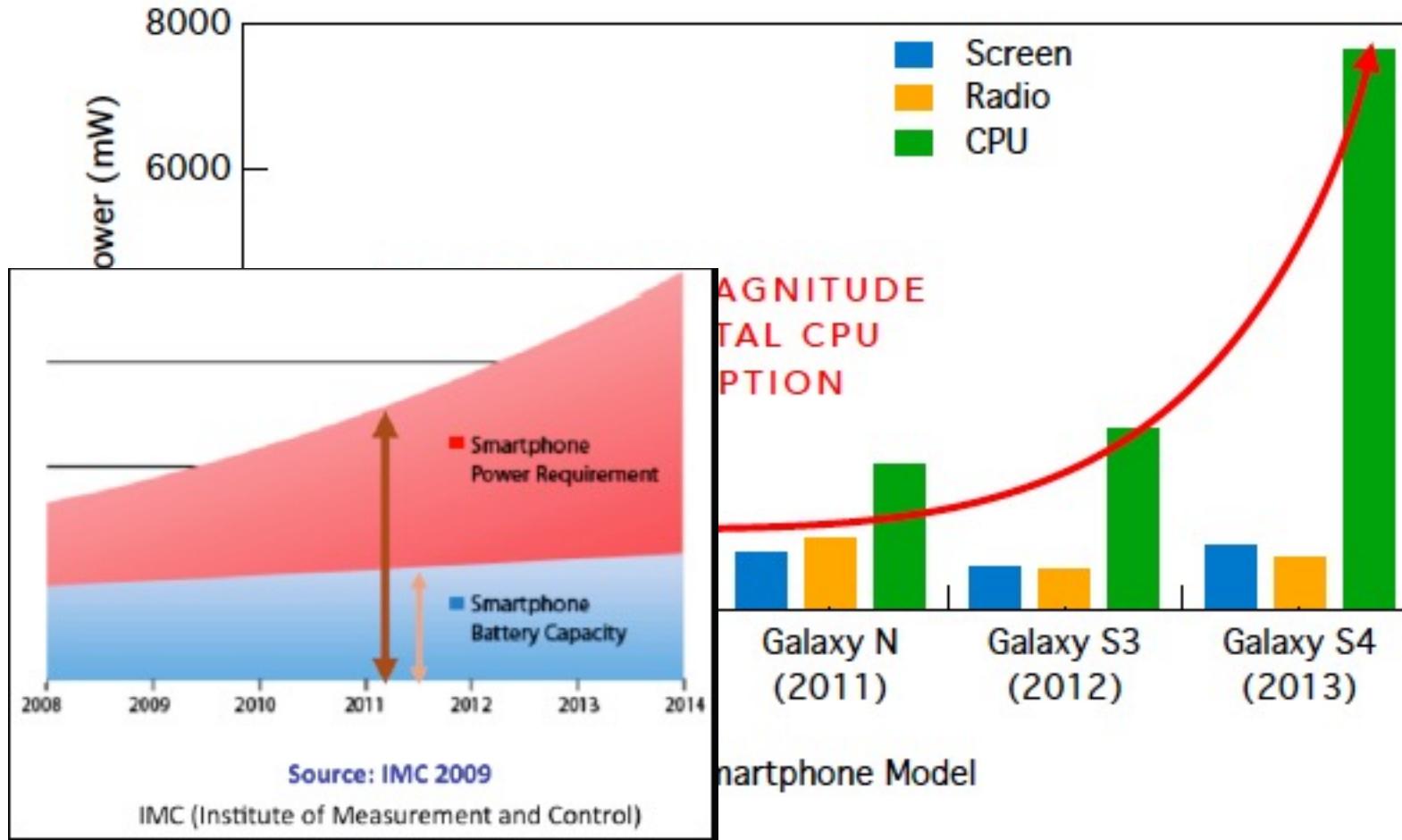


Single Processor Performance

Move to multi-processor



Mobile Devices Power Consumption



Computer Technology → Dramatic Change (1995-2005)

- Processor
 - 2X in speed every 1.5 years;
100X performance in last decade
- Memory
 - DRAM capacity: 2X / 2 years; **64X size in last decade**
 - Cost per bit: improves about 25% per year
- Disk
 - capacity: > 2X in size every 1.0 years
 - Cost per bit: improves about 100% per year
 - **250X size in last decade**



Putting it all in Perspective...

“If the automobile had followed the same development cycle as the computer, a **Rolls-Royce would today cost \$100**, get a million miles per gallon, and **explode once a year, killing everyone inside.**”

– *Robert X. Cringely*

Technical Writer, Broadcaster

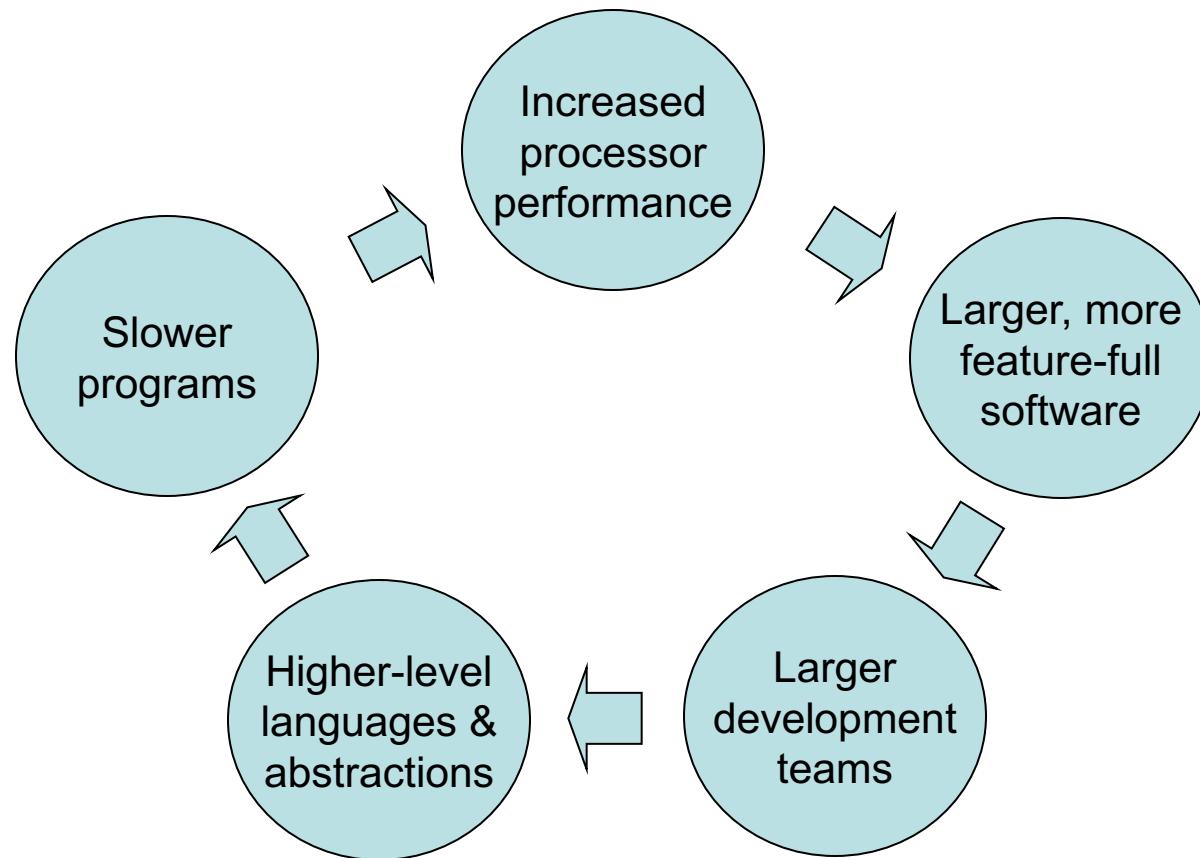
<http://www.pbs.org/cringely/about/>

Triumph of the Nerds

A history of the PC industry,
An ABC program a few years ago



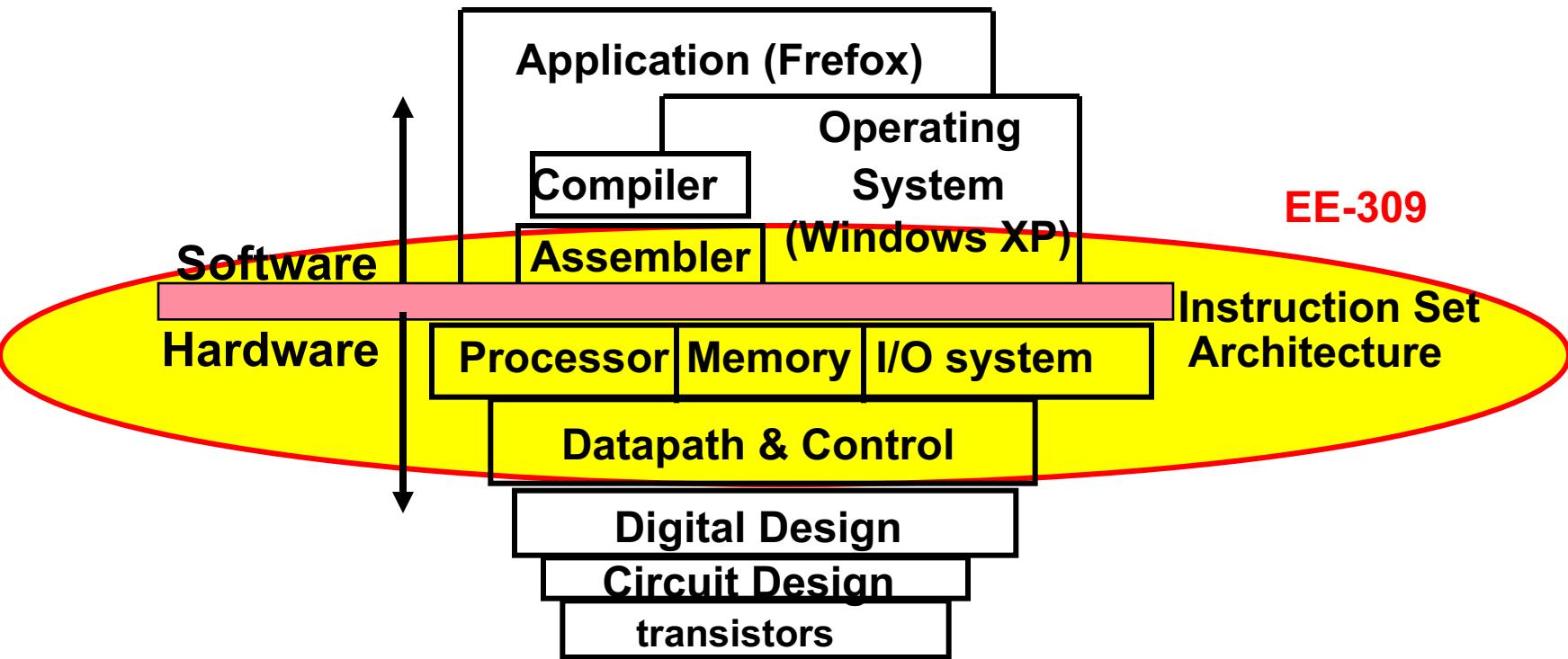
Virtuous Cycle, (1950 – 2005)



World-Wide Software Market (per IDC):
\$212b (2005)



What is this course about?



- Coordination of many *levels of abstraction*



Course Outline

- ❖ Introduction & 8085 Architectures [1 week]
- ❖ 8051 Architecture & Programming [2 Weeks]
- ❖ Device Interfacing [2 weeks]
- ❖ ISA and CISC Processor Design [3 Weeks]
- ❖ RISC Processor Design [3 Weeks]
- ❖ Pipelined Design [2 Weeks]
- ❖ Memory System Design [1 Week]
- ❖ GPU Architecture [if time permits]



Course Schedule

Class Hours: Slot 4

- ❖ Monday: 11:30 am to 12:30 pm
- ❖ Tuesday: 8:30 am to 9:30 am
- ❖ Thursday: 9:30 am to 10:30 am

Office Hours: TBD



Course Evaluation

- ❖ Mid Term Exam (10%)
 - Open Book/Notes Exam
 - ❖ Final Exam (30%)
 - Open Book/Notes Exam
 - ❖ Assignments (15%)
 - Set of assignments will be given periodically
 - ❖ Course Project (20%) – FPGA Implement. of pipelined IITB-RISC
 - Group (Max size 4)
 - ❖ Continuous Evaluations (25%) – weekly quiz
 - Weekly Quiz – Open Book (90% best will be counted)
-
- [BONUS] Project: Multiple issue IITB RISC implementation (15%)
 - [BONUS] Random Quizzes (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

- Microprocessor architecture, programming, and applications with 8085
 - Ramesh Gaonkar
- The 8051 microcontroller
 - Kenneth Ayala
- Computer Organization and Design
 - Patterson and Hennessy
- Microprocessor Design
 - Nick Tradenick



Thank You

