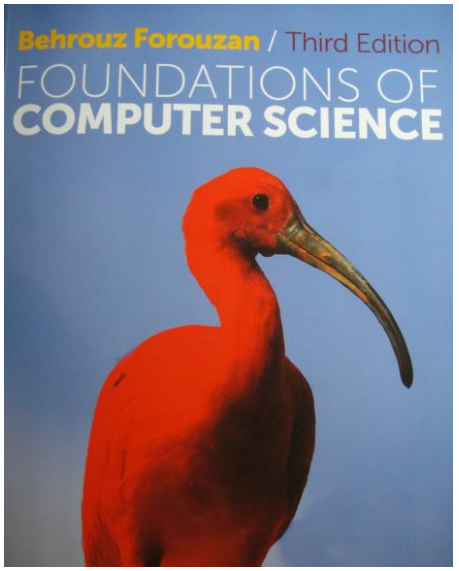


Chapter 1

Introduction

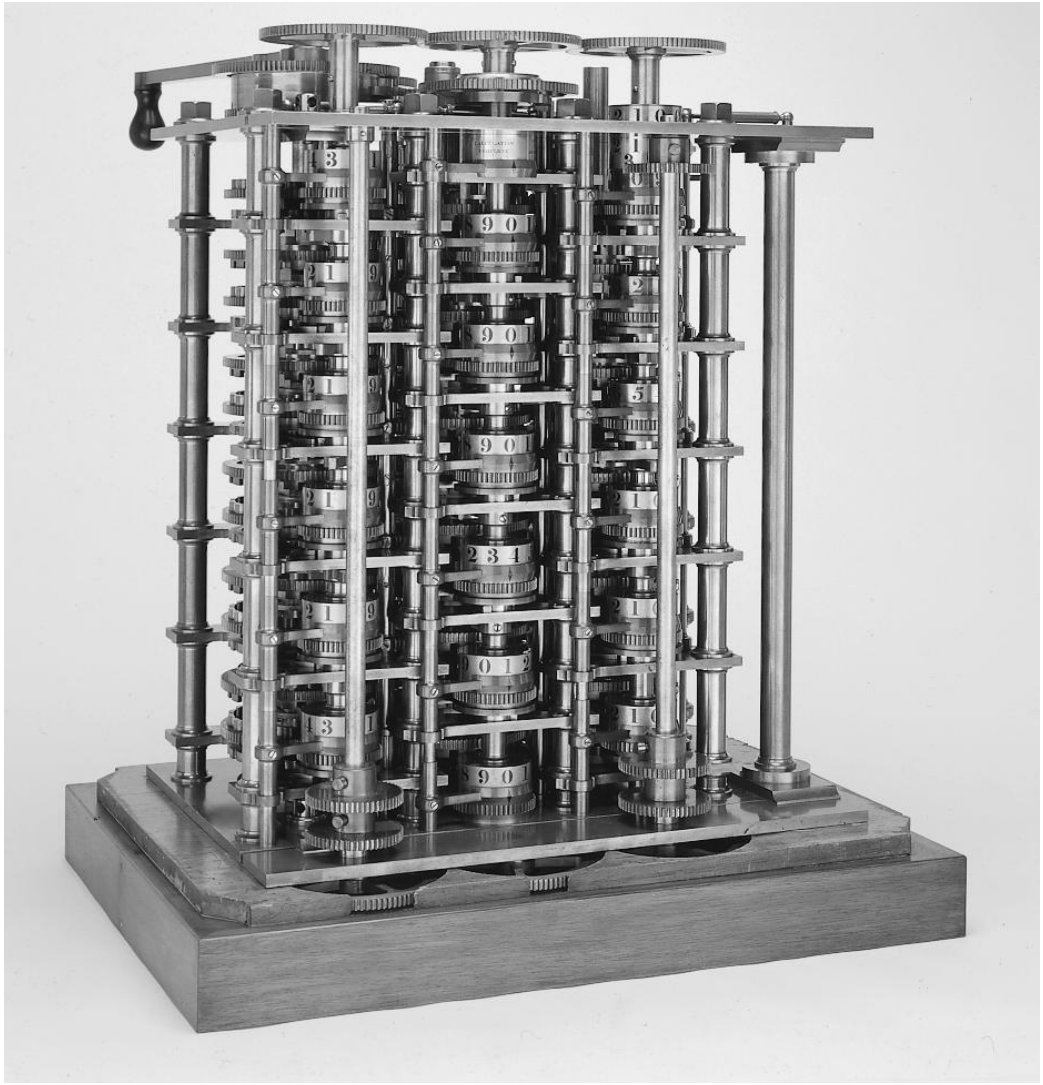
Objectives

After studying this chapter, students should be able to:

- Define the Turing model of a computer.
- Define the von Neumann model of a computer.
- Describe the three components of a computer: hardware, data, and software.
- List topics related to computer hardware.
- List topics related to data.
- List topics related to software.
- Give a short history of computers.
- Discuss some social and ethical issues related to the use of computers.

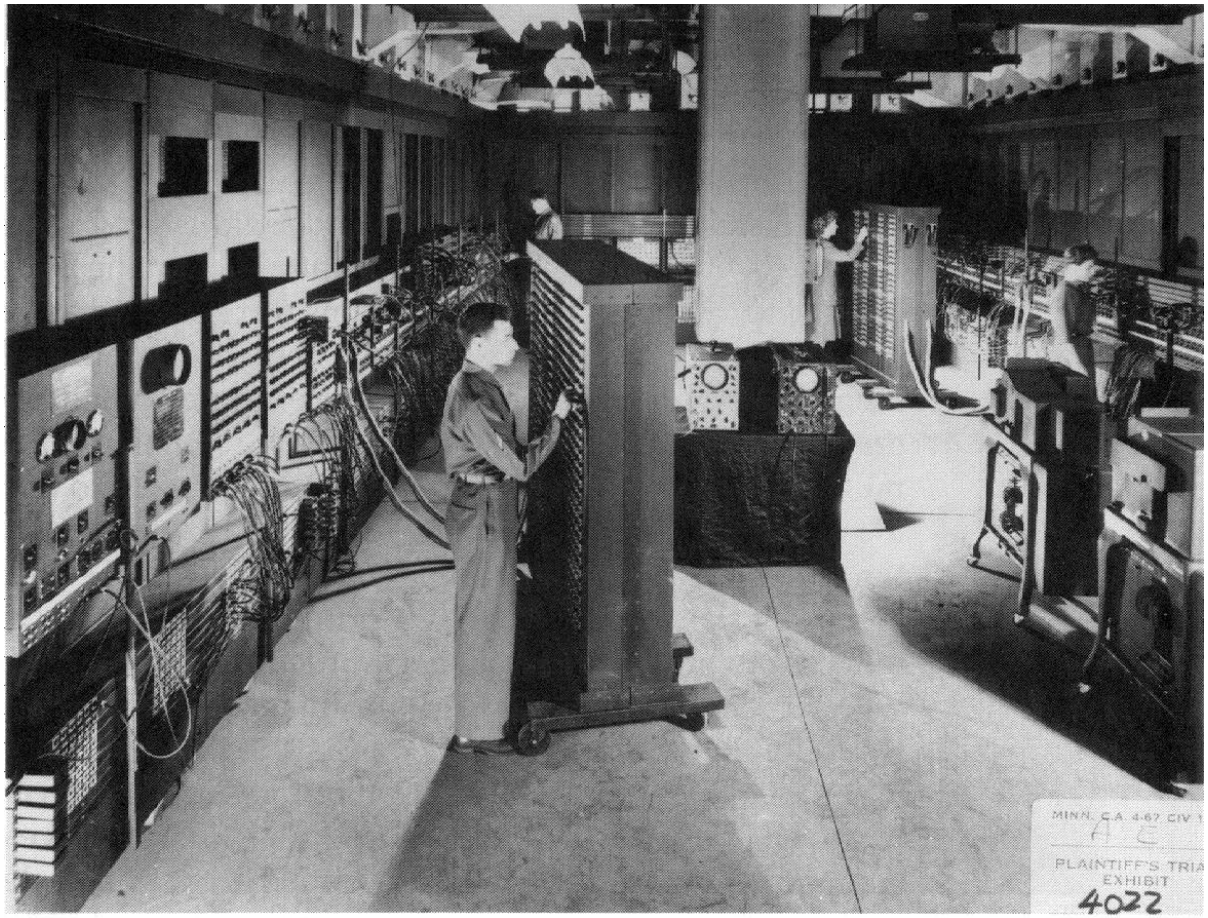
The First Mechanical Computer

The baggage difference engine created in **1832** and it used **25000parts**.



The First Electronic Computer

The first general-purpose electronic computer called **ENIAC** (Electronic Numerical Integrator and Calculator) was made by **John Mauchly** and **J. Presoer Eckert in 1946**. It used **18000 vacuum tubes** and was 100x10feet^2 and **30 tons**.



Computer Generations (1950–present)

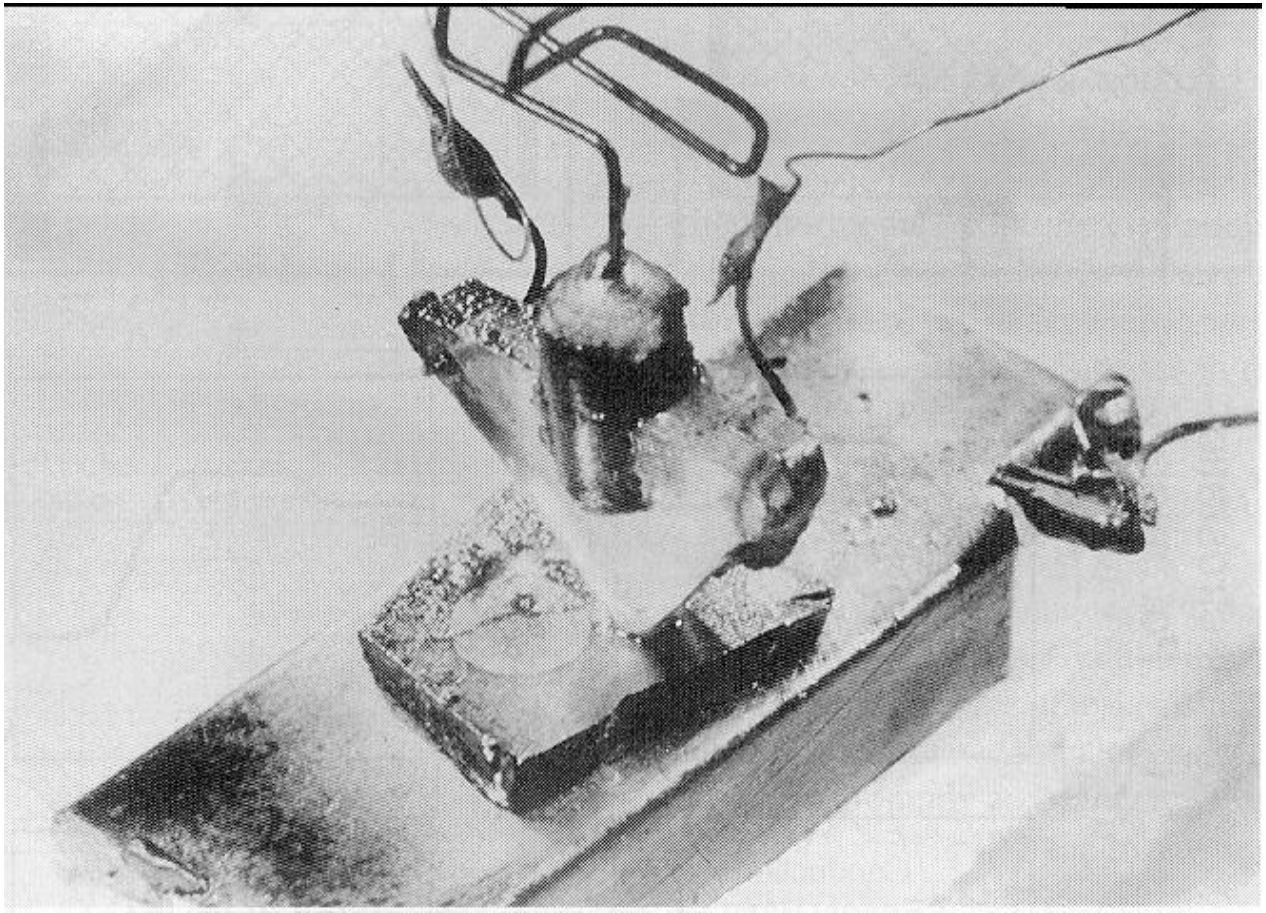
Computers built after 1950 more or less follow the von Neumann model. They have become faster, smaller, and cheaper, but the principle is almost the same. Historians divide this period into generations, with each generation witnessing some major change in hardware or software (but not in the model).

First Generation

The first generation (roughly **1950–1959**) is characterized by the emergence of commercial computers.

Second Generation

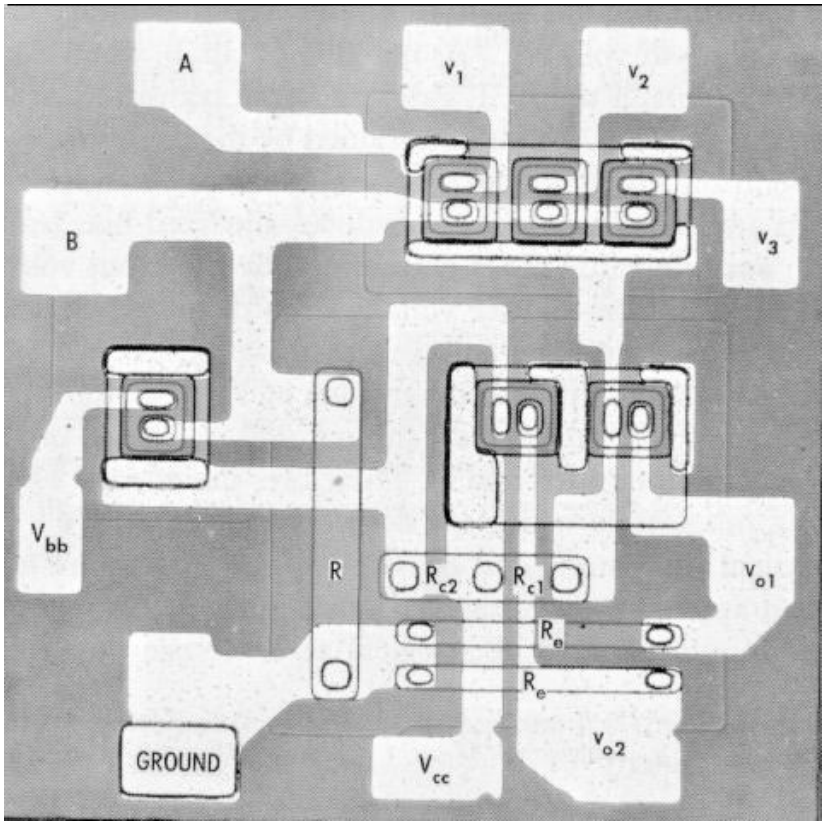
Second-generation computers (roughly **1959–1965**) used **transistors** instead of vacuum tubes. Two high-level programming languages, FORTRAN and COBOL invented and made programming easier.



First transistor
Bell Labs, 1948

Third Generation

The invention of the **integrated circuit (IC)** reduced the cost and size of computers even further. Minicomputers appeared on the market. Canned programs, popularly known as **software packages**, became available. This generation lasted roughly from **1965 to 1975**.



The first bipolar logic in1960's
ECL 3-input Gate, Motorola 1966

Fourth Generation

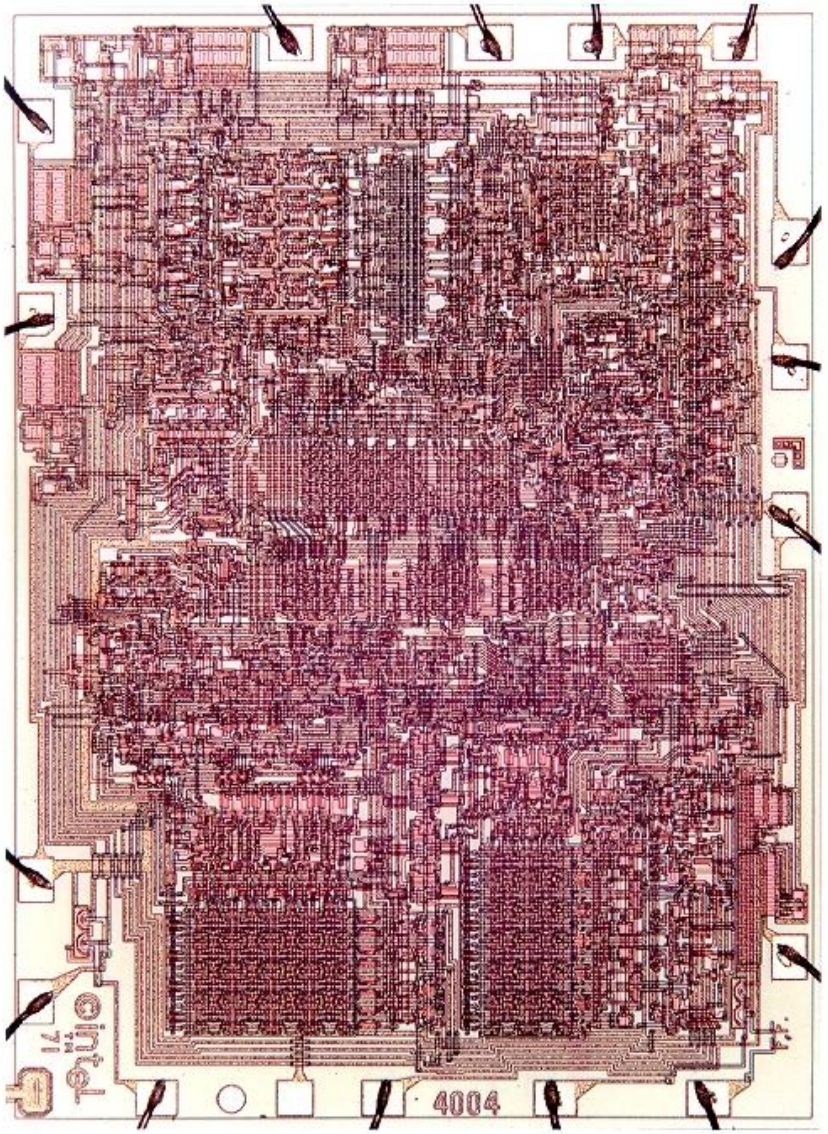
The fourth generation (approximately **1975–1985**) saw the appearance of **microcomputers**. The first **desktop calculator**, the Altair 8800, became available in 1975. This generation also saw the emergence of **computer networks.**

Fifth Generation

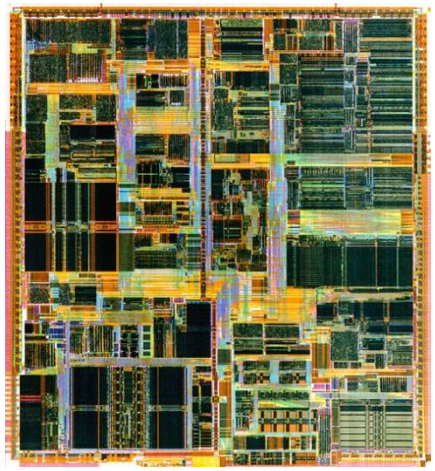
This open-ended generation started in **1985**. It has witnessed the appearance of **laptop** and **palmtop** computers, improvements in **secondary storage** media (**CD-ROM**, **DVD** and so on), the use of **multimedia**, and the phenomenon of virtual reality.

The First Microprocessor, Intel 4004

1000 transistors, 1 MHz operation, 1971



Intel Pentium IV Microprocessor, 2001



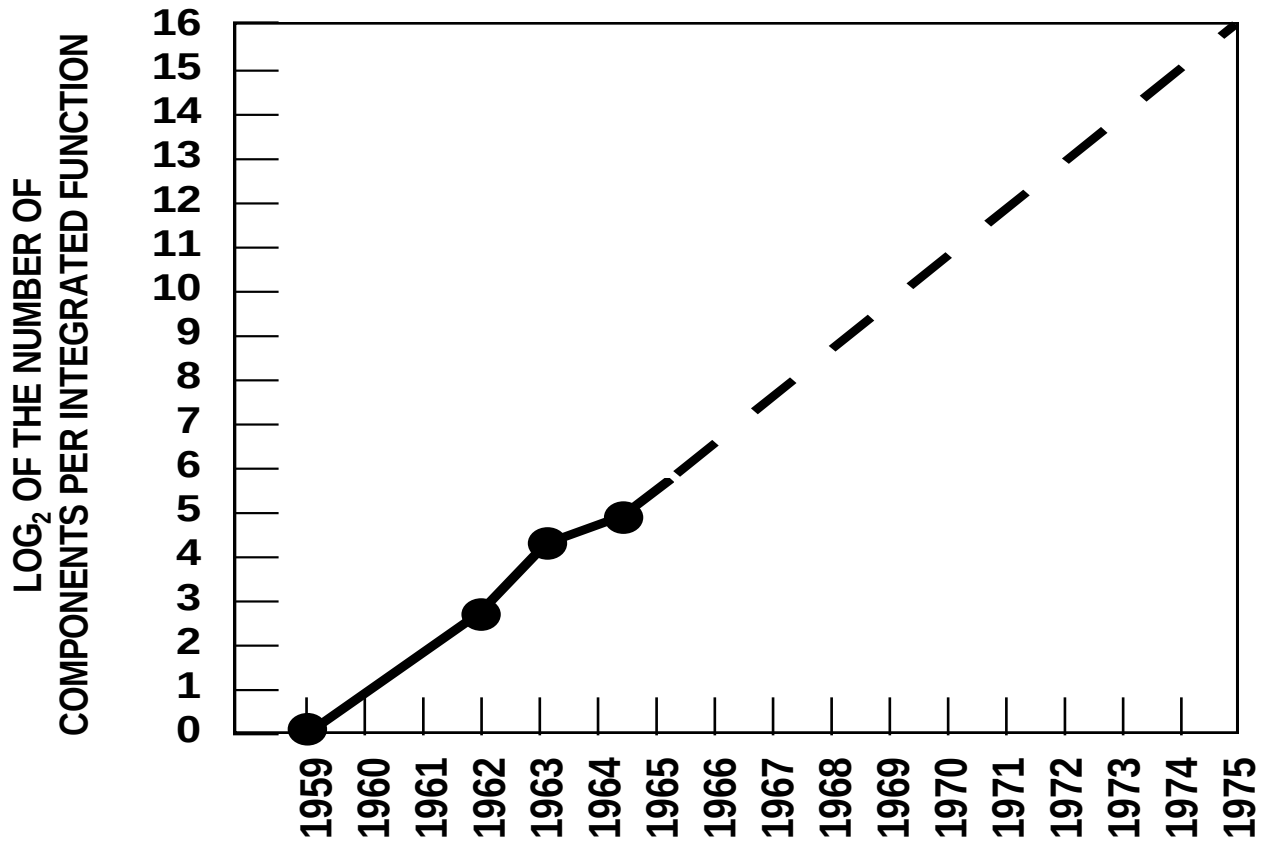
512GB SanDisk Extreme PRO SDXC UHS-I (Source：SanDisk) NT$28,000 / 2014

Intel core i11, 2013

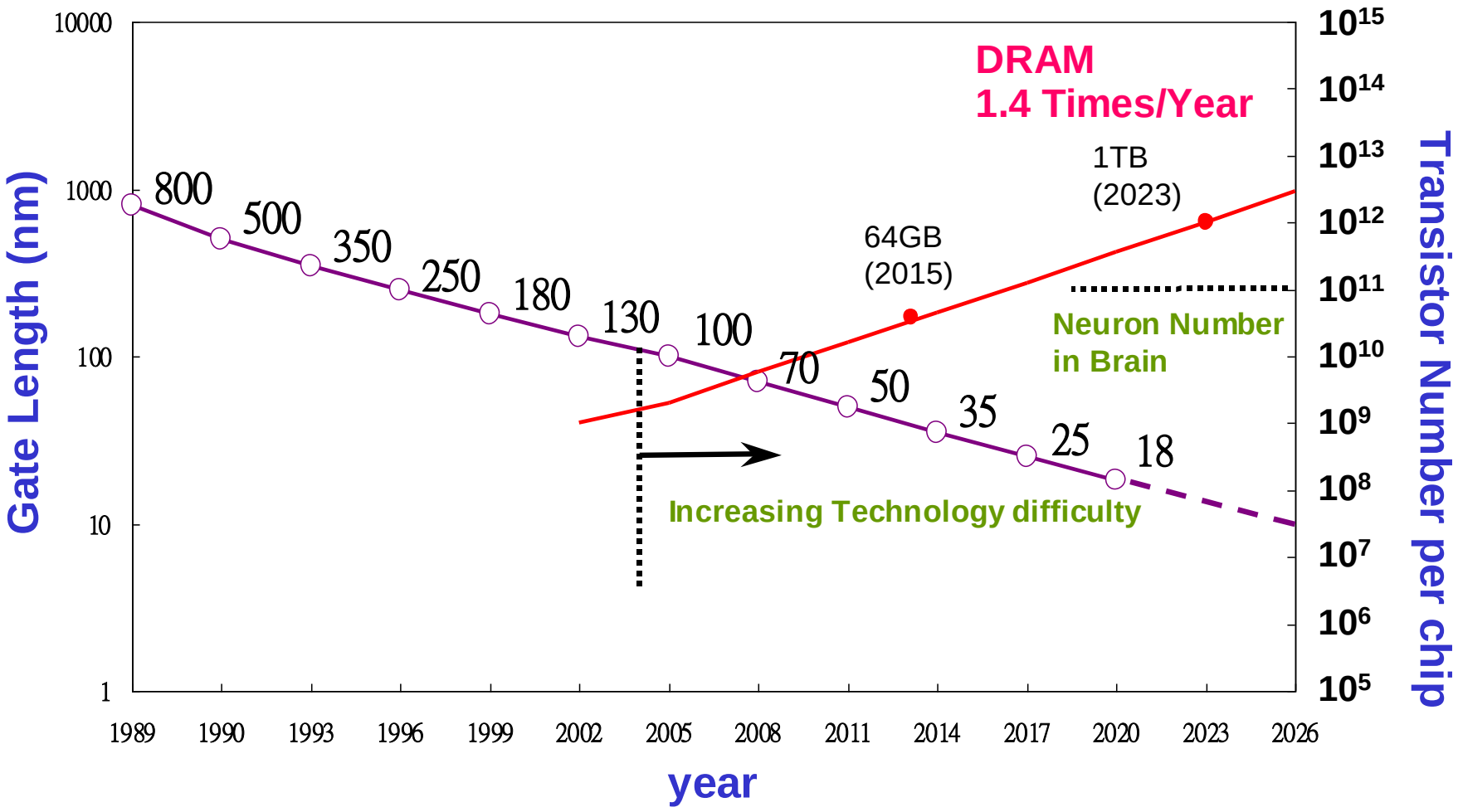
Pictures source: google's web

Moore's Law (*Electronics*, April 19, 1965)

In **1965, Gordon Moore** noted that **the number of transistors on a chip doubled every 18 to 24 months**. He made a prediction that **semiconductor technology will double its effectiveness every 18 months.**



Technology Evolution



Courtesy, Intel

Nano-Meter Scaling

Human hair's diameter：70~100μm

Human felling cell：50~100 μm

Human ovum cell：100 μm

Plant cell：100 μm

Human red hemocyte：5 μm

Germ：1~8 μm

Virus：hundreds nm

Protein：number tens nm

DNA：2nm

Atom：0.1nm

$T = 10^{12}$

$G = 10^{9}$

$M = 10^{6}$

$k = 10^{3}$

$m = 10^{-3}$

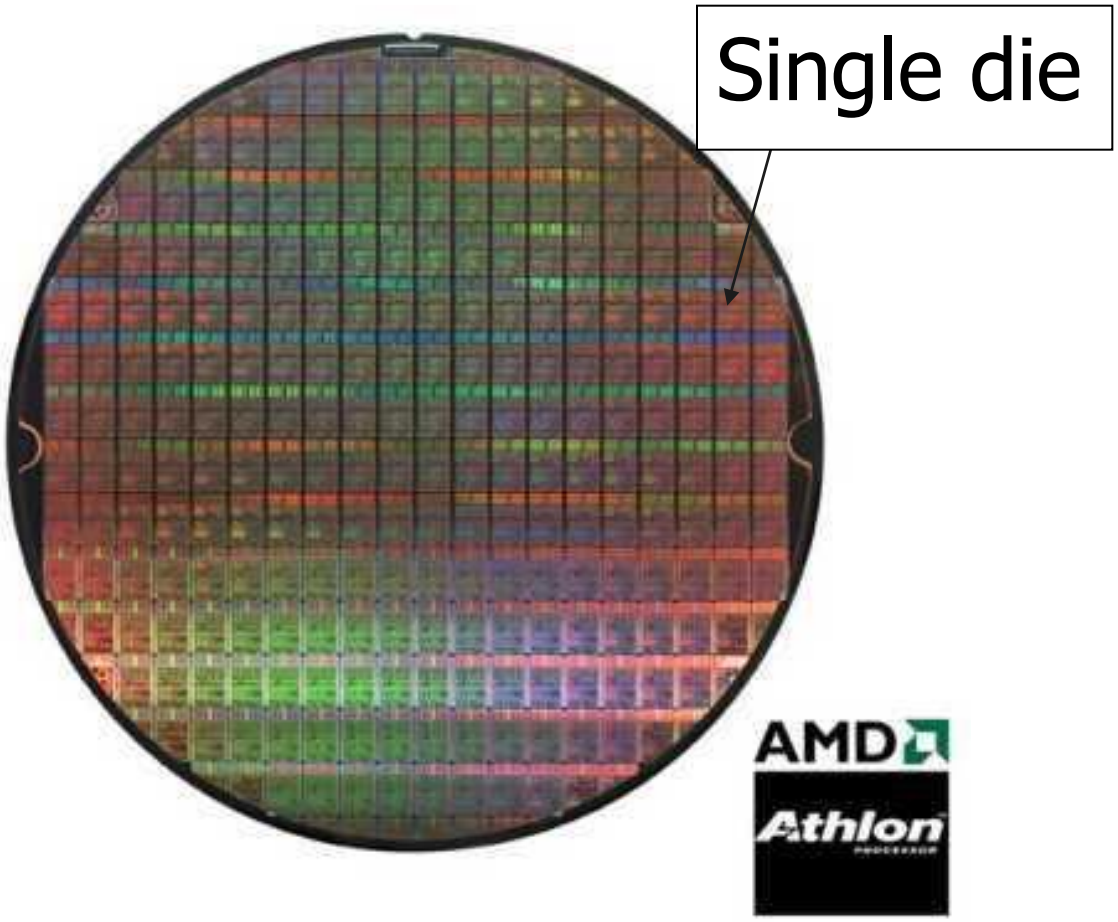
$\mu = 10^{-6}$

$n = 10^{-9}$

$p = 10^{-12}$

$f = 10^{-15}$

Wafer Size



2”, 3”, and 5”

1987, 6” (150mm)

1991, 8” (200mm)

1999, 12” (300mm)

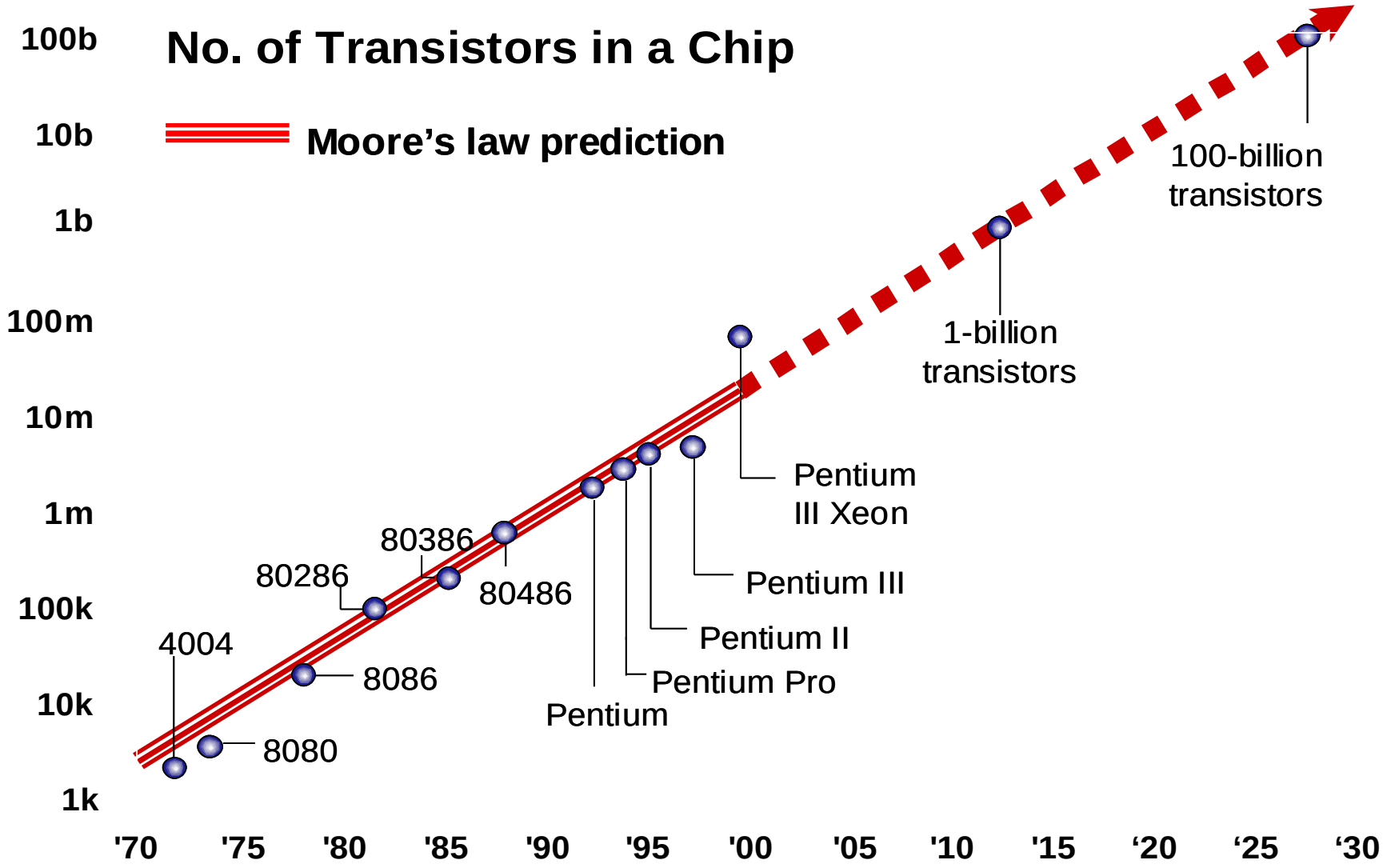
2007, 18” (450mm)

More dies per wafer, low cost

From http://www.amd.com

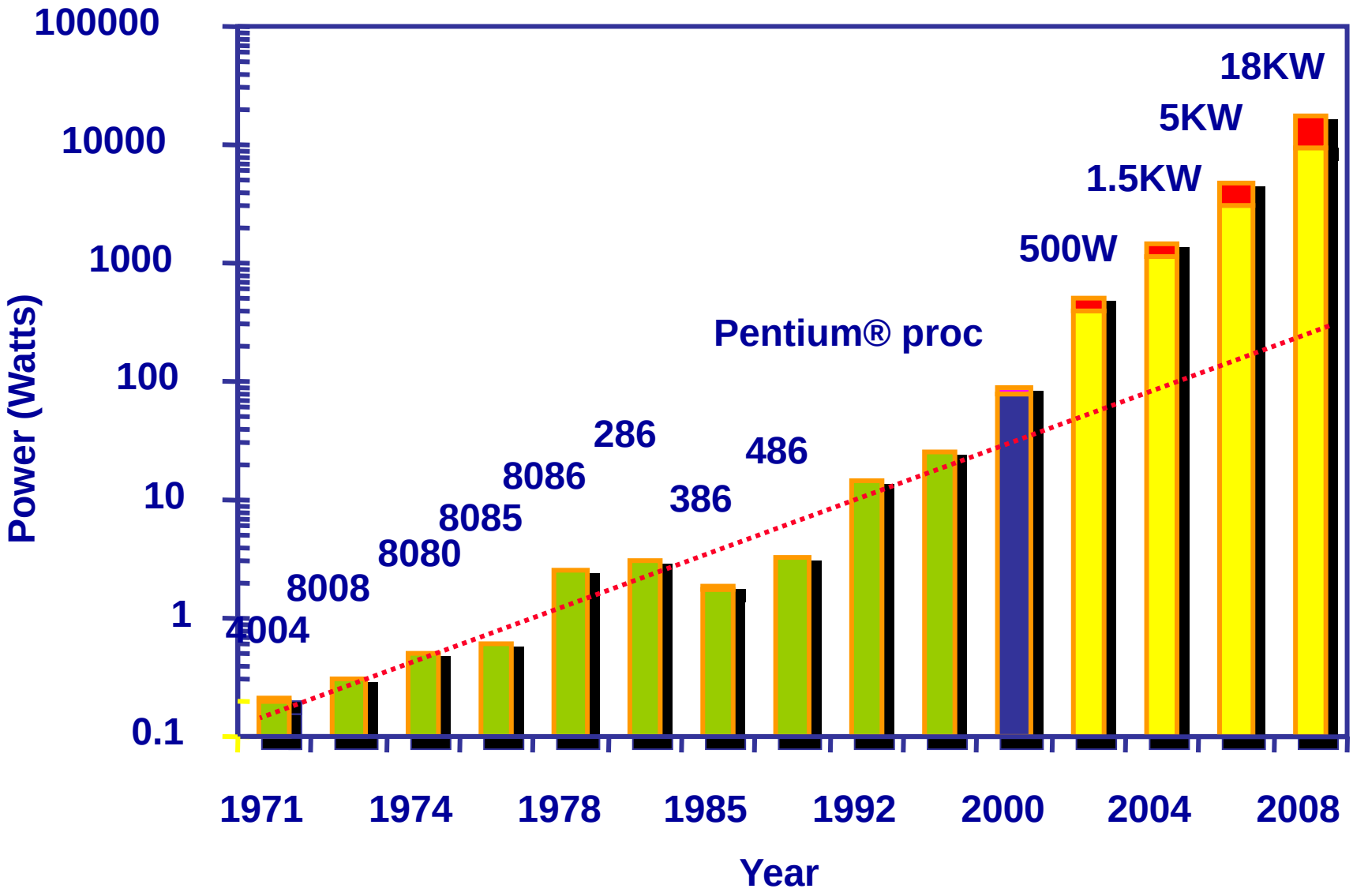
CPU Evolution

Die size grows by 14% to satisfy Moore's Law



Courtesy, Intel

Power will be a major problem



Courtesy, Intel

Five Parts in This Course

Part I: Data Representation and Operation

This part includes Chapters 2, 3, and 4. Chapter 2 discusses number systems; how a quantity can be represented using symbols. Chapter 3 discusses how different data is stored inside the computer. Chapter 4 discusses some primitive operations on bits.

Part II: Computer Hardware

This part includes Chapters 5 and 6. Chapter 5 gives a general idea of computer hardware, discussing different computer organizations. Chapter 6 shows how individual computers are connected to make computer networks and internetworks (internets).

Part III: Computer Software

This part includes Chapters 7, 8, 9 and 10. Chapter 7 discusses operating systems. Chapter 8 shows how problem solving is reduced to writing an algorithm for the problem. Chapter 9 takes a journey through the list of contemporary programming languages. Chapter 10 is a review of software engineering.

Part IV: Data Organization and Abstraction

Part IV includes Chapters 11, 12, 13 and 14. Chapter 11 discuss data structure, collecting data of the same or different type under one category. Chapter 12 discusses abstract data types. Chapter 13 shows how different file structure can be used for different purposes. Chapter 14 discusses databases.

Part V: Advanced Topics

This part covers Chapters 15, 16, 17 and 18. Chapter 15 discusses data compression. Chapter 16 explores some issues to do with security. Chapter 17 discusses the theory of computation. Chapter 18 is an introduction to artificial intelligence, a topic with day-to-day challenges in computer science.

Review Questions

- Please show the diagram of Turing model in a computer.
- Please show the diagram of Von Neumann model in a computer.
- What are the differences between Turing model and Von Neumann model?
- What are the differences among desktop, laptop, and palmtop computers?
- What the sequential operations are for executing an instruction?
- What is Moore's law?
- What is the mean of 22nm-processing technology.
- Please briefly describe the history of computers.
- What is digital divider?