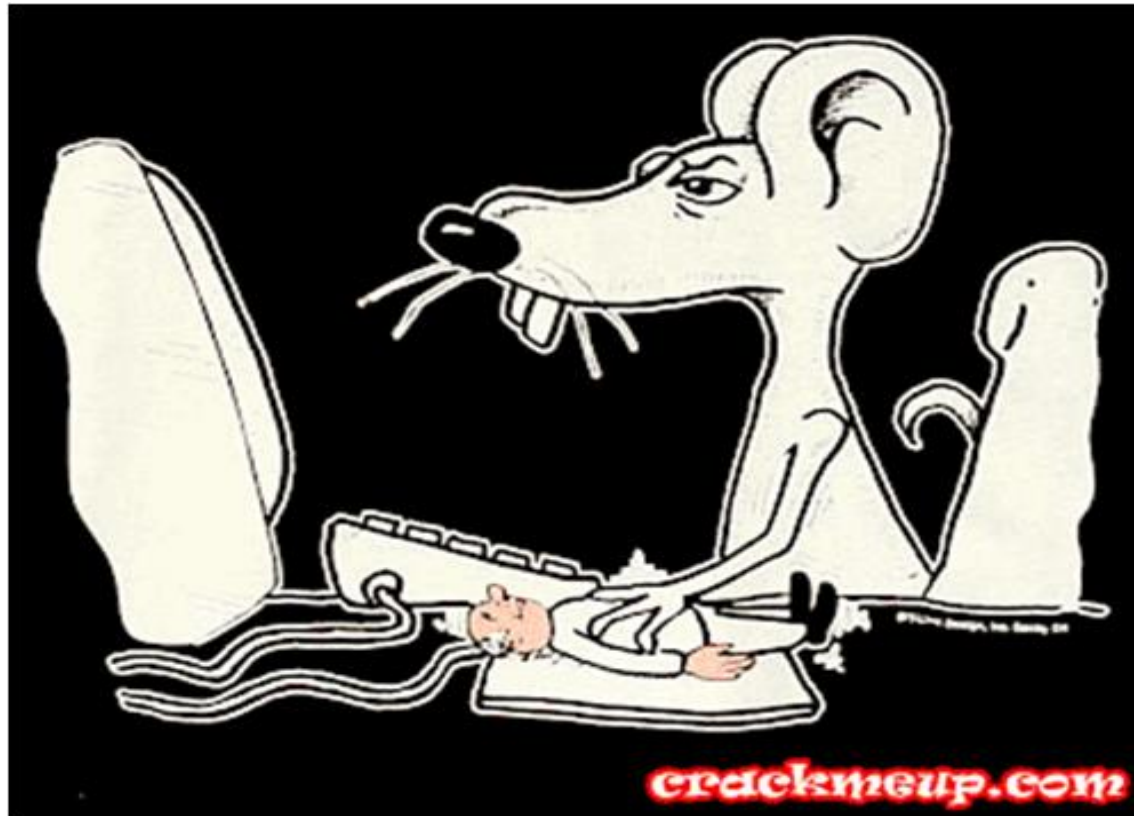# History of computers

ENIAC (Electronic Numerical Integrator And Computer)

First Generation: Vacuum Tubes

Under the supervision of Mauchly (EE professor) and Eckert (grad student) at University of Pennsylvania's Moore School of Electrical Engineering , proposed to build a general-purpose computer using vacuum tubes.

The first general purpose electronic digital computer was designed to respond to US war time needs during world war II.

A vacuum tube is an electronic device consisting of a system of electrodes arranged in an evacuated glass envelope. This helps in establishing electronic circuits.

ENIAC Diagram

It was 10 feet tall, occupied 1,000 square feet of floor- space, weighed in at approximately 30 tons
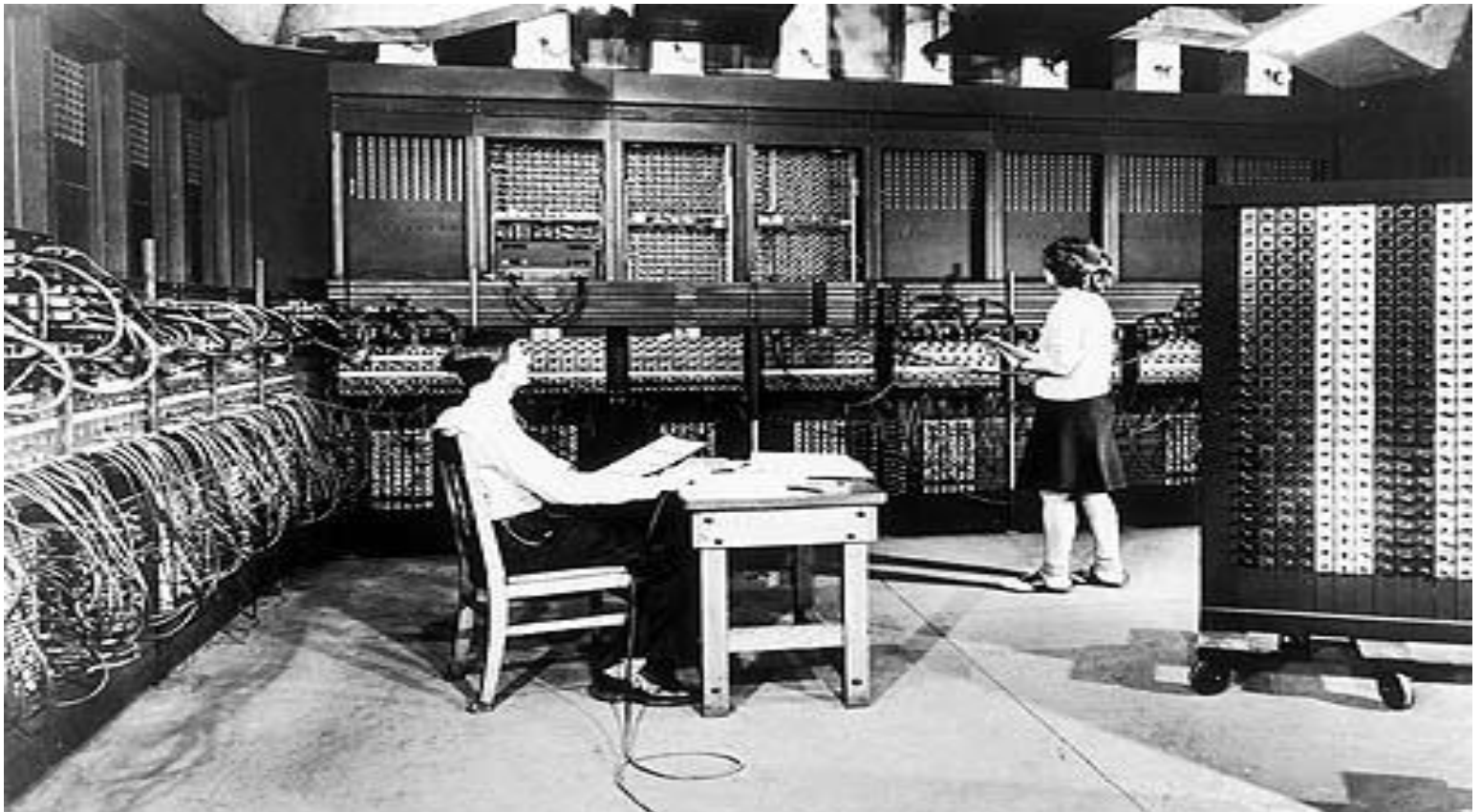
ENIAC (continued)

- In 1943, this proposal was accepted by the Army, and work began on the ENIAC.

- Finished work in 1946.

- It used more than 70,000 resistors, 10,000 capacitors, 6,000 switches, and 18,000 vacuum tubes.

- It consumed 160 kilowatts of electrical power

ENIAC

- The ENIAC was decimal rather than a binary machine. That is, numbers were represented in decimal form and arithmetic was performed in the decimal system.

- The major drawback of the ENIAC was that it had to be programmed manually by setting switches and plugging and unplugging cables.

- ENIAC had no memory so every instruction had to be hard-wired by using switches.

The Von Neumann machine

- Neumann proposed for a new computer called EDVAC (Electronic Discrete Variable Automatic) Computer.

- Design for a new stored program computer started in 1946.

- In 1946, Von Neumann and his colleagues began the design of a new stored-program computer, at the Princeton Institute of Advanced Studies (IAS).
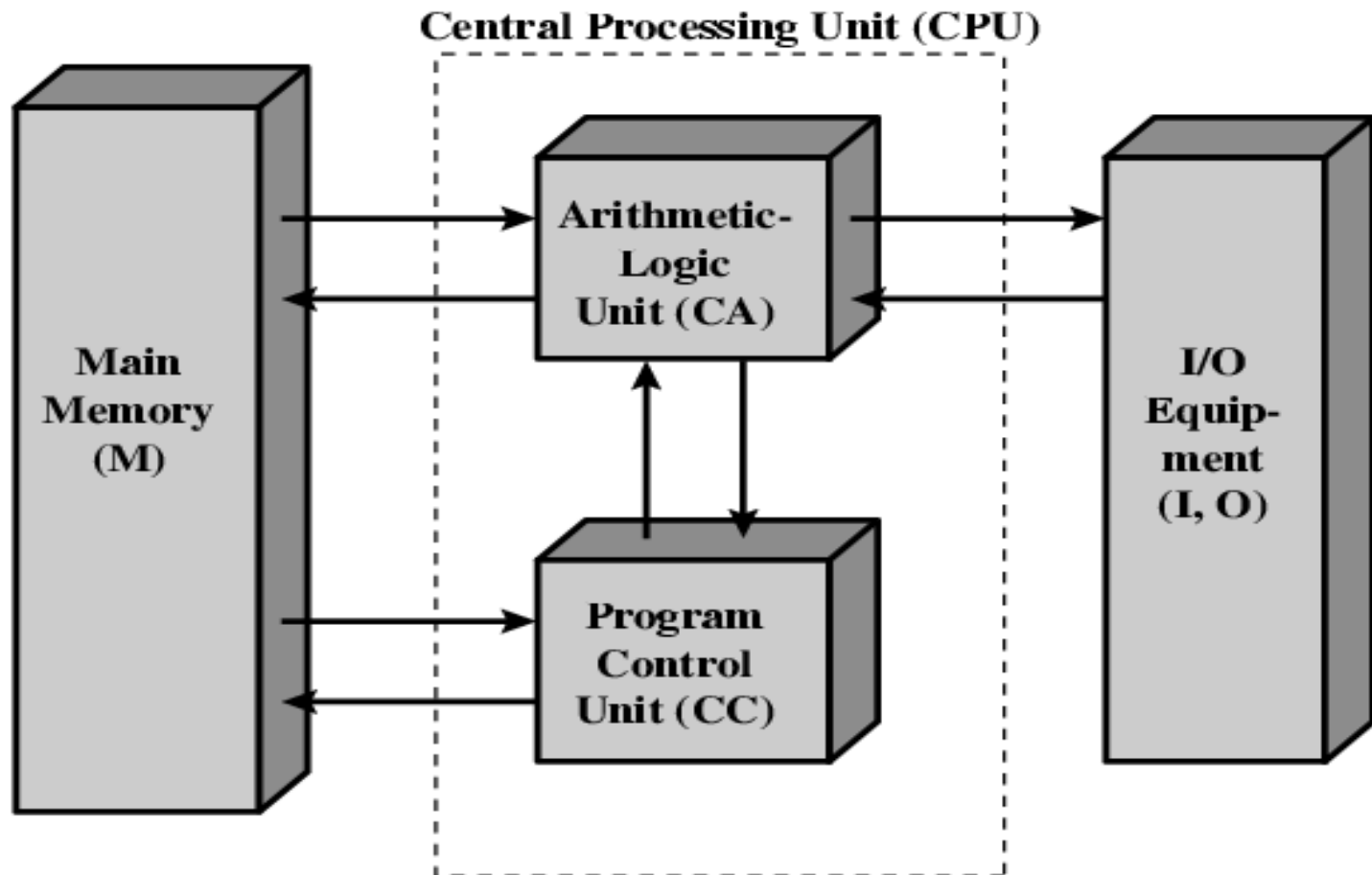
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The Von Neumann machine

- The IAS computer, although not completed until 1952, is the prototype of all subsequent general-purpose computers.

- Figure 1 shows the general structure of the IAS computer. It consists of:

Structure of IAS machine. Fig 1

PC : Keeps track of the next instruction to be executed.
CPU: executes program instructions stored in main memory.

Central Processing Unit (CPU)

Main Memory (M)

Arithmetic-Logic Unit (CA)

Program Control Unit (CC)

I/O Equip-ment (I, O)

Explanation: The Von Neumann machine

○ It consists of the following :

A main memory, . Since the CPU works in a fetch execute cycle. Main memory stores both data and instructions that will be executed by the CPU.

An arithmetic-logical unit (ALU).

CPU uses the ALU to perform mathematical calculations like addition, subtraction & multiplication .

- **A control unit,** Interprets computer program instructions stored in memory and causes them to execute. It further transmits directions to the other components of the computer system. Input and output (I/O) equipment operated by the control unit.

- **The Input device:** reads required data into computer memory

- **Output Device:** Eg CRT monitor, printer receives final results for display / storage

Structure of IAS machine
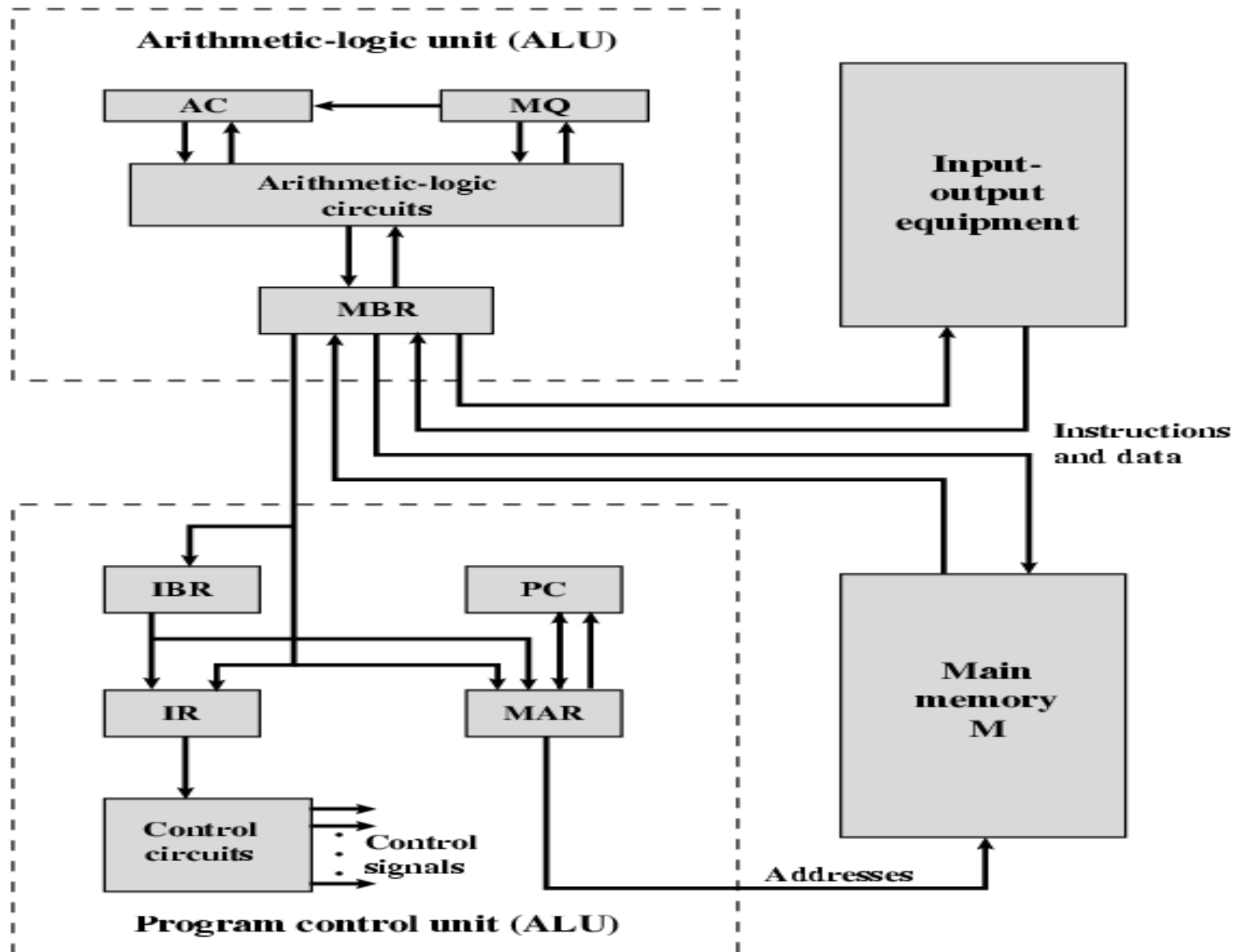
IAS Registers

Registers : Temporary storage areas and are basically for the CPU. Registers do store data temporarily as it is fetched from main memory (RAM)

- Set of registers (storage in CPU)
  - Memory Buffer Register (MBR)
  - Memory Address Register (MAR)
  - Instruction Register (IR)
  - Program Counter (PC)

- The first four registers above, are the major CPU registers. Others include;
  - Instruction Buffer Register (IBR)
  - Accumulator (AC)
  - Multiplier Quotient (MQ)

Second Generation : Transistors

The first major change in the electronic computer came with the replacement of the vacuum tube by the transistor.

The second generation of computers relied on **transistor technology.**

- Transistors are smaller, cheaper and dissipate less heat than a vacuum tube

- Unlike the vacuum tube, which requires wires, metal plates, a glass capsule, and a vacuum, the transistor is a solid-state device, made from silicon.

It was invented at Bell Labs by William Shockley et al.

- It has become widely accepted to classify computers into generations based on the fundamental hardware technology employed.

- Each new generation is characterized by greater processing performance, larger memory capacity, and smaller size than the previous one.

- The transistor is a three terminal, solid state electronic device. Used in Radios.

Growth in CPU Transistor Count
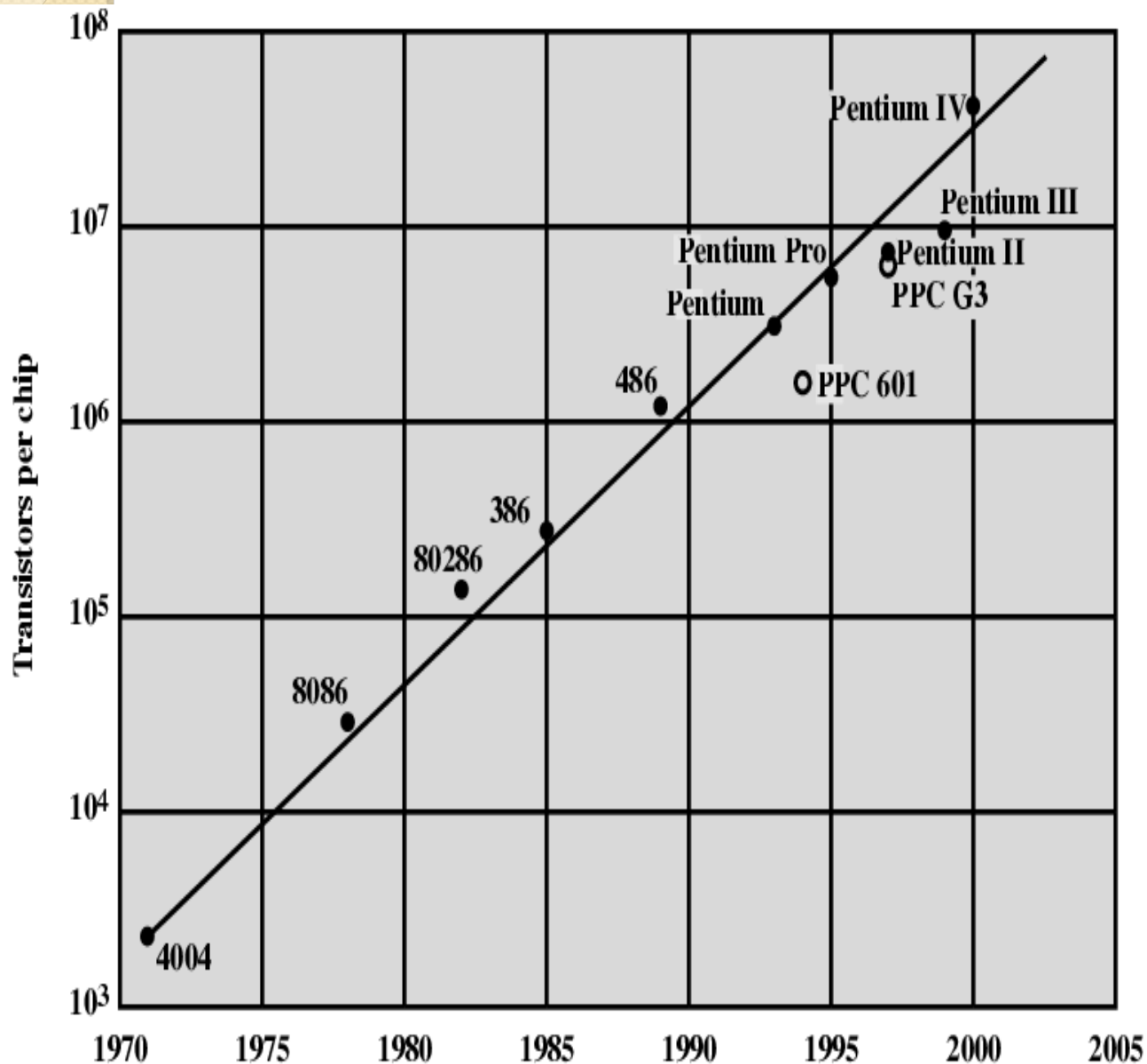
Pentium is a series of instruction set architecture-compatible microprocessors produced by Intel. The original Pentium was first released on March 22, 1993

Third Generation: Intergration circuits

- The third generation computers used **integration circuits** (IC's) which were made by combining several transistors together. Integrated circuits or IC semiconductor devices with several transistors built in one physical.

- 3G was developed due to weaknesses of 2G generating a lot of heat which damaged the sensitive parts of the computer.

- Each device is packaged and wired on the circuit board.

- IC's started and this defined the third generation.

- An integrated circuit is an array of electronic circuits and components that has been diffused or implanted onto the surface of a single crystal, or chip, of semiconducting material such as silicon.

Later Generations: Fourth, Fifth -to date – Advanced integrated circuits

- Computers in the fourth and fifth generations based on advances in the integrated circuits technology. They used (LSI) and (VLSI).

- Started with large-scale integration (LSI), that is over 1000 components placed on a single Integrated Circuit chip.

- Then to Very large-scale integration (VLSI) with more than 10,000 components

Computer Generations

- X-tics of generations
  - Each *generation* of *computer* is characterized by a major technological development that fundamentally changed the way computers operate
  - **Miniaturization-** the process of making things smaller using modern technology. E.g mechanical, optical and electronic products/devices.
    - Portability, increase in speed.
  - Reduction in processor heating.
- The history provides an overview of computer structure and the function

Summary of Computer Generations

- Vacuum Tubes.
- Transistors that were developed in bell balls.
- 3rd Generation. Integrated Circuit.
- 4th & 5th Generation based on advance in integrated circuit technology.
  LSI (Large Scale Integration)
  VLSI (Very Large Scale Integration)

Research Exercise

i) *To be attempted by all students before the next lecture.*

   ◦ Research about computer generations and fill the table on slide 22.

ii) Explain the term Miniaturization as used in computer generation.

iii) When tracing the evolution of a computer, what advantages come with the fourth generation?

iv) Explain the concept of stored program as suggested by Von Neumann.

v) The computer has evolved through different stages over time. What key characteristics differentiate the different computer generations?

SUMMARY OF COMPUTER GENERATIONS

Generation	Year Range	Example Machine	Hardware	Performance
1	1943-1946	ENAIC	Vacuum Tubes	2Kb Memory, 10 KIPS
2				
3				
4				
5				