Lecture 1
Course Objectives

CPS310

Computer Organization II

WINTER 2022

This Lecture

1.1 Overview

1.2 A Brief History

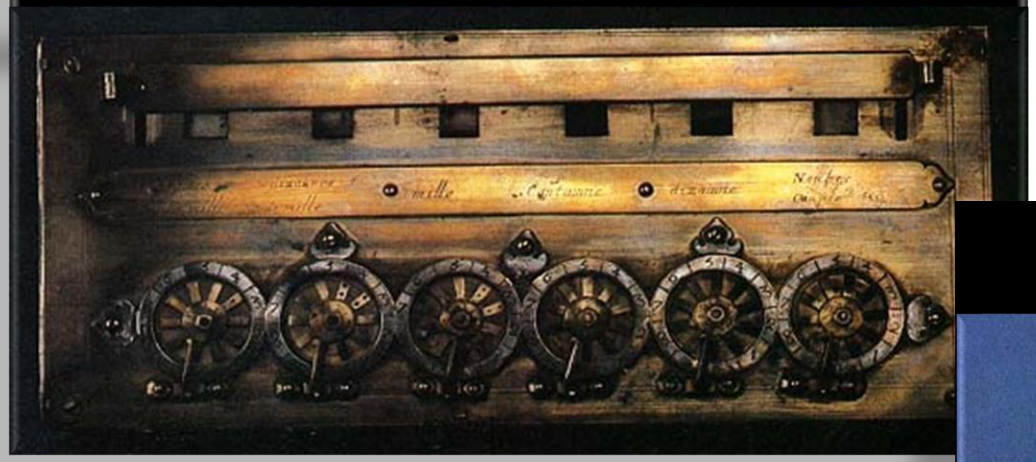
1.3 The Von Neumann Model

1.4 The System Bus Model

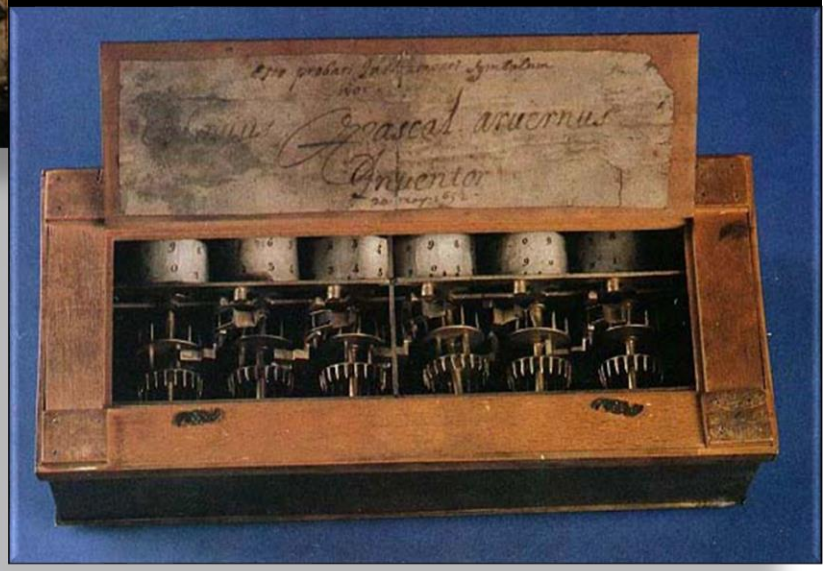
1.5 Levels of Machines

Pascal's Calculating Machine (1600's)

Performs basic arithmetic operations



(Source: IEEE)



Babbage's Analytical Engine (1800's)

1800's –

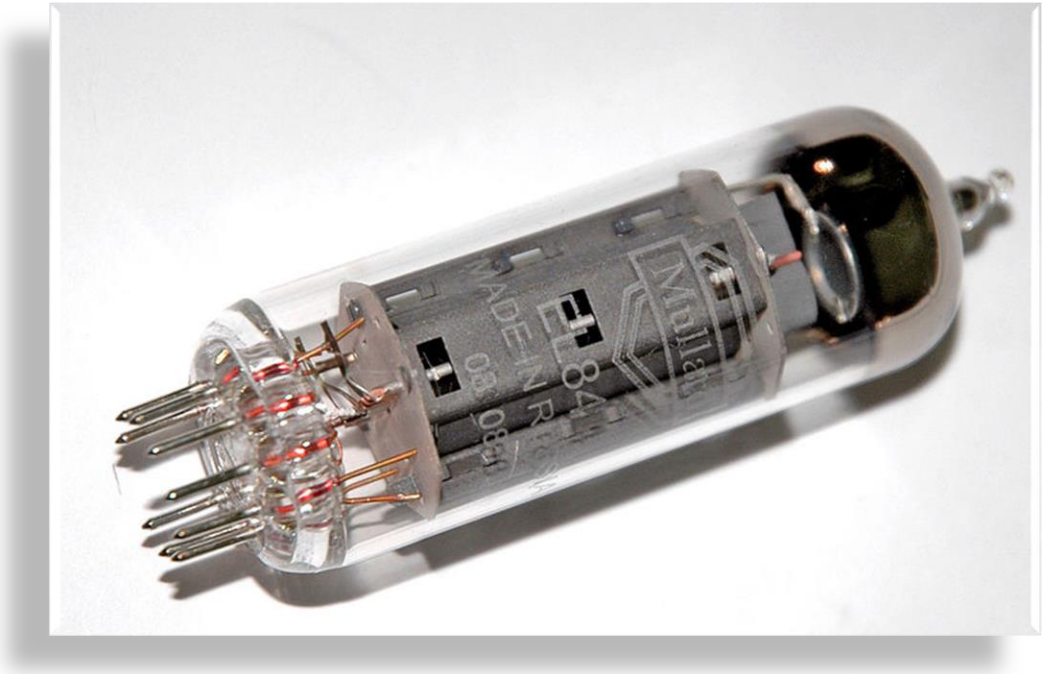
Babbage put the concepts of mechanical control and mechanical calculation together into a machine that has the basic parts of a digital computer.

Source: Smithsonian Museum

First Generation - Vacuum Tubes

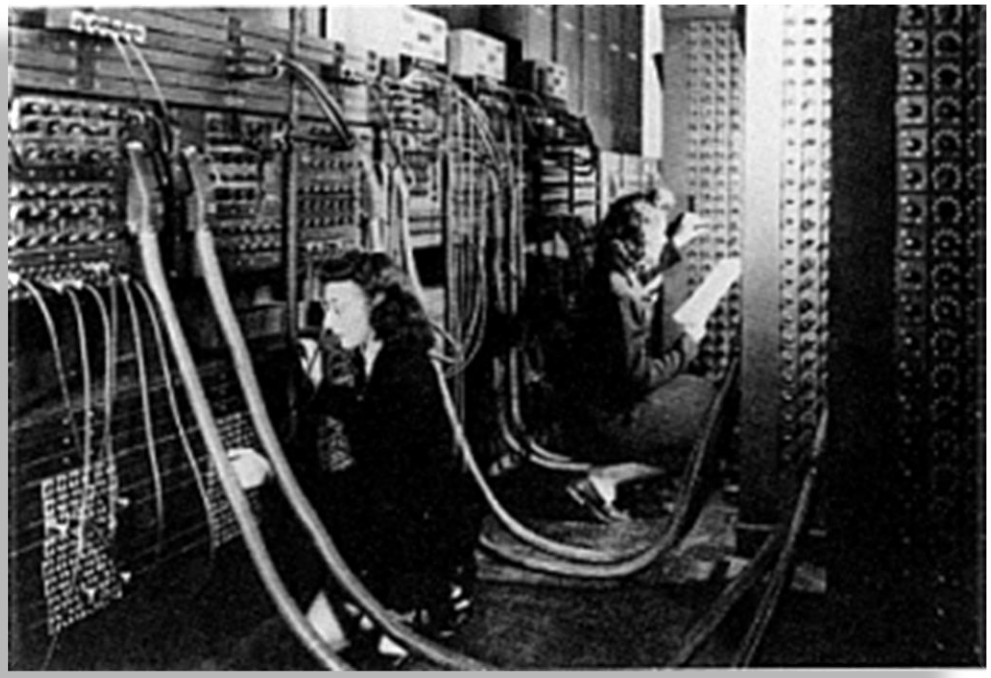
Electronic devices to controls the flow of electrons in an vacuum environment.

Main Applications: switches, amplifiers



ENIAC

- Early electronic general purpose computer
- University of Pennsylvania



UNIVAC 1

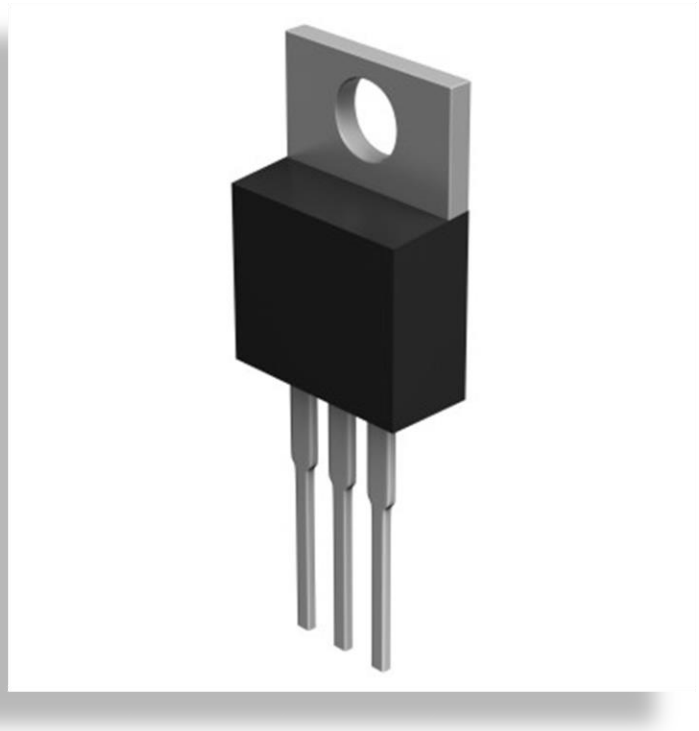
First commercially produced computer in the world

Second Generation - Transistors

A semiconductor device

Main Applications: amplifiers, switches

- smaller
- faster
- cheaper
- more energy-efficient
- more reliable



UNIVAC 1108

- Low price
- General purpose
- Multiprogramming
- Multiprocessing
- Efficient

Third Generation - Integrated Circuits (ICs)

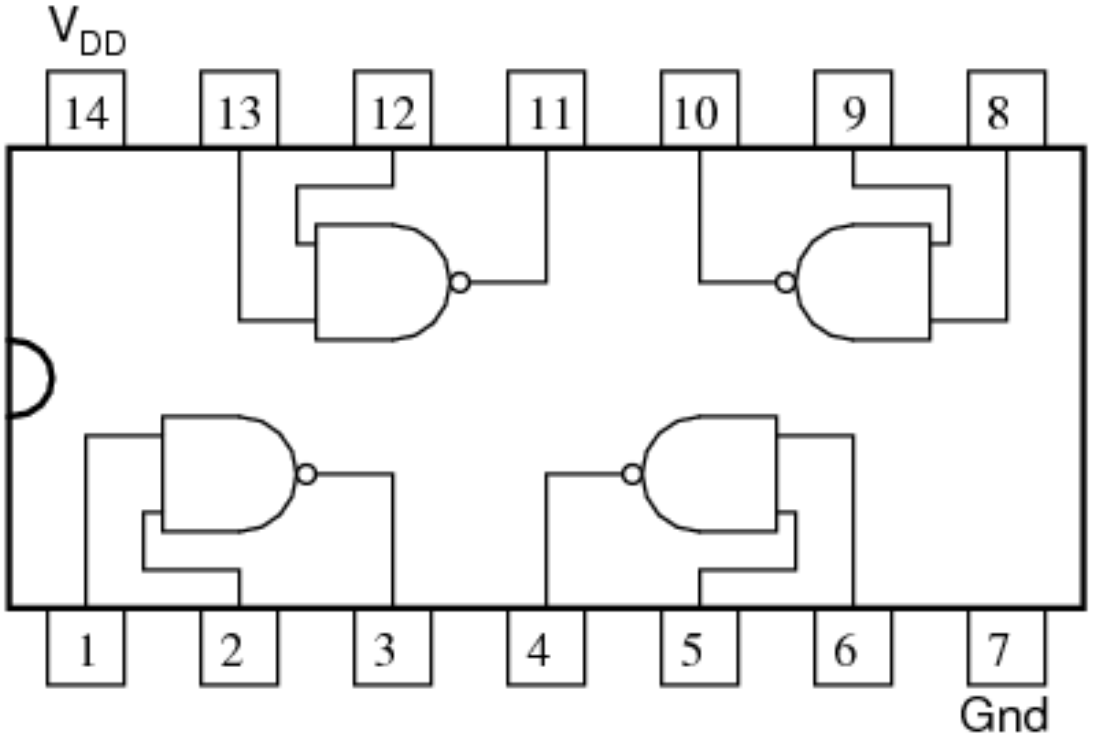
Miniaturized transistors inside silicon chips/semiconductors increased

- Speed
- Efficiency
- Reliability

Few examples of ICs (1)

A NAND Chip

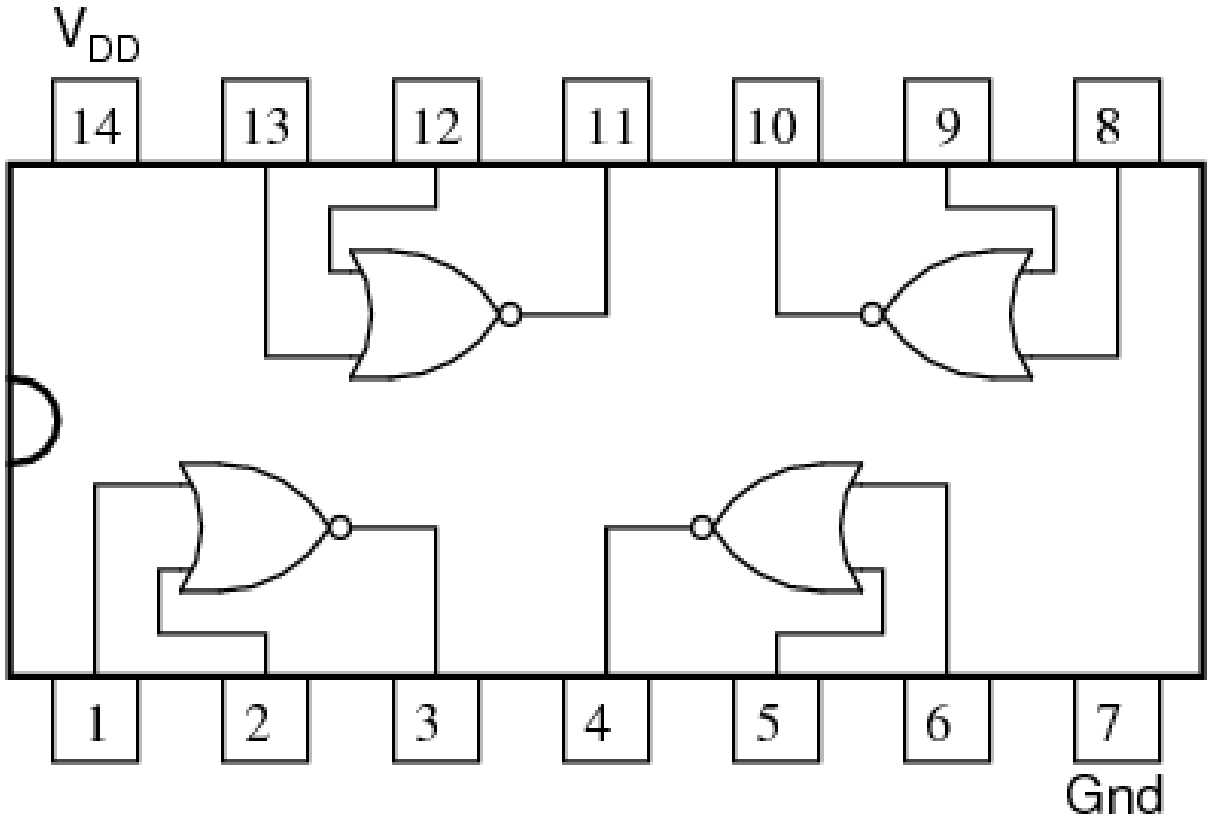
"Pinout," or "connection" diagram for the 4011 quad NAND gate



Few Examples of ICs (2)

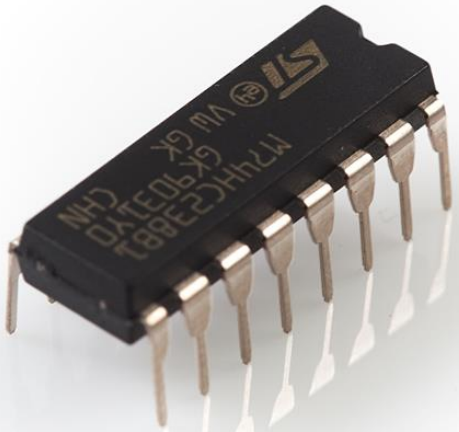
A NOR Chip

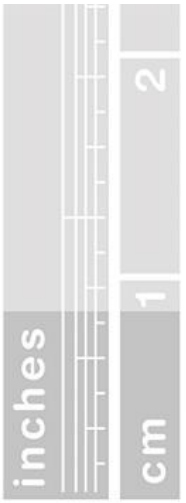
"Pinout," or "connection" diagram for the 4001 quad NOR gate

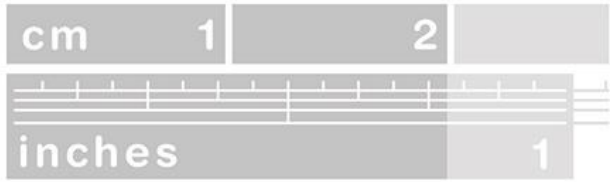


Few Examples of ICs (3)

A 3-to-8 Decoder

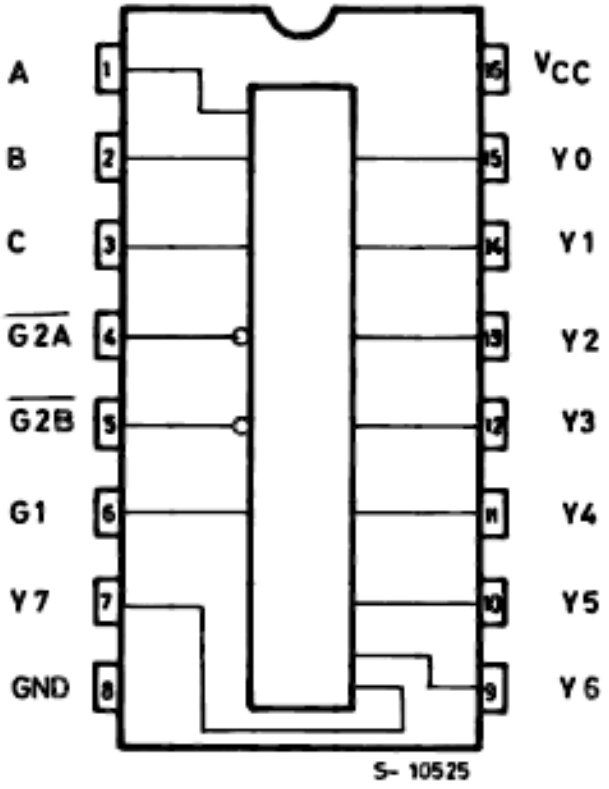


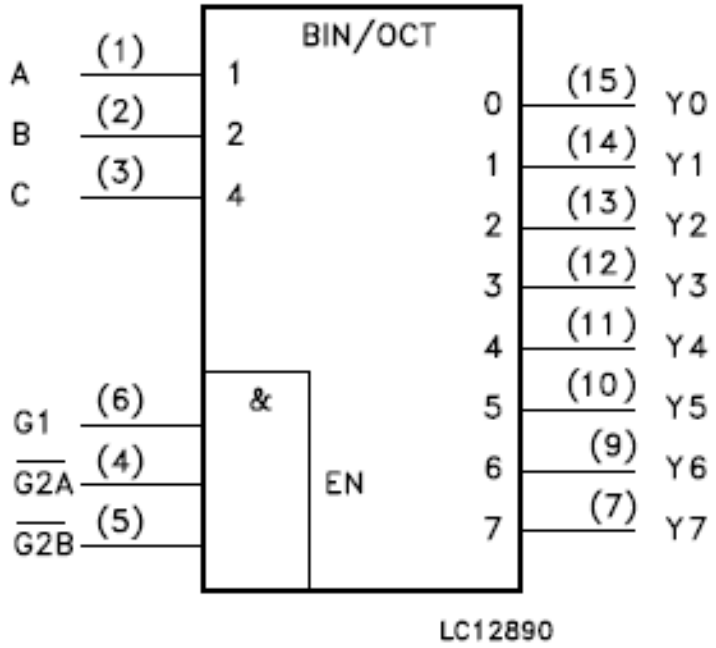




Decoder PIN-OUT

Pin configurations





Decoder Pin Description

Description of the information as previous slide

PIN DESCRIPTION

PIN No	SYMBOL	NAME AND FUNCTION
1, 2, 3	A, B, C	Data Inputs
4, 5	$\overline{G2A}$ $\overline{G2B}$	Enable Input (Active LOW)
6	G1	Data Enable Input (Active HIGH)
15, 14, 13, 12, 11, 10, 9, 7	Y0 to Y7	Outputs
8	GND	Ground (0V)
16	V_{CC}	Positive Supply Voltage

Decoder Truth-Table

TRUTH TABLE

INPUTS						OUTPUTS								SELECTED OUTPUT
ENABLE			SELECT											
$\overline{G2B}$	$\overline{G2A}$	G1	C	B	A	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7	
X	X	L	X	X	X	L	L	L	L	L	L	L	L	NONE
X	H	X	X	X	X	L	L	L	L	L	L	L	L	NONE
H	X	X	X	X	X	L	L	L	L	L	L	L	L	NONE
L	L	H	L	L	L	H	L	L	L	L	L	L	L	Y0
L	L	H	L	L	H	L	H	L	L	L	L	L	L	Y1
L	L	H	L	H	L	L	L	H	L	L	L	L	L	Y2
L	L	H	L	H	H	L	L	L	H	L	L	L	L	Y3
L	L	H	H	L	L	L	L	L	L	H	L	L	L	Y4
L	L	H	H	L	H	L	L	L	L	L	H	L	L	Y5
L	L	H	H	H	L	L	L	L	L	L	L	H	L	Y6
L	L	H	H	H	H	L	L	L	L	L	L	L	H	Y7

X : Don't Care

PDP-11

Programmed Data Processor Computer

16-bit machine

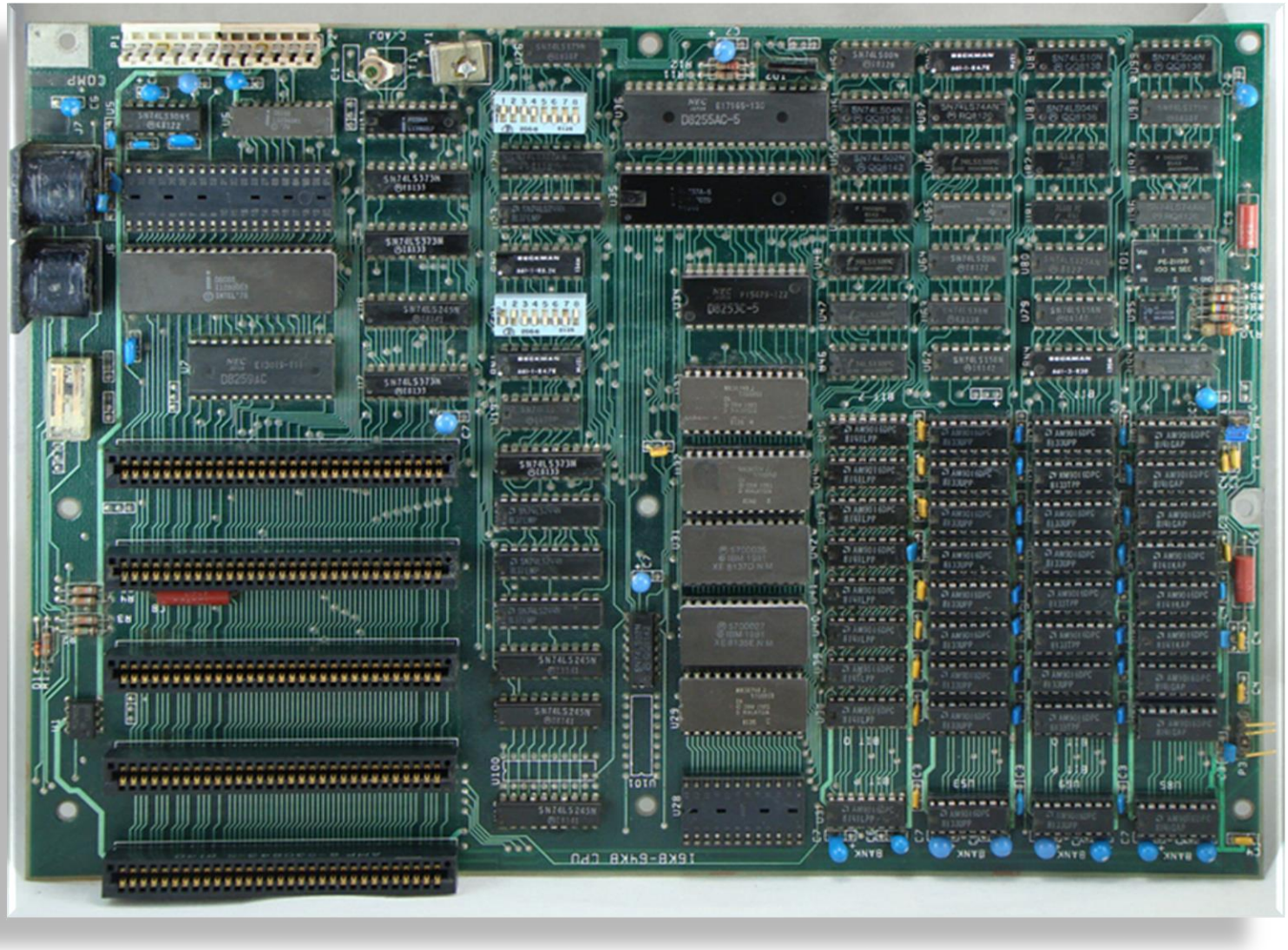
PDP-11 - Digital Equipment Corporation - DEC

Fourth Generation – VLSI, Microprocessor

IBM PC

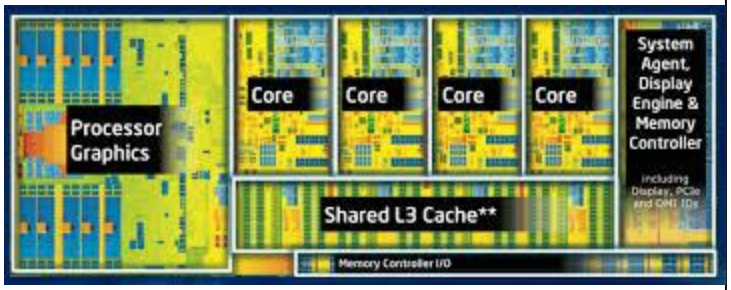
- Less expensive
- Reliable
- Powerful
- Smaller
- Energy Efficient

IBM PC Motherboard



Fifth Generation

- ULSI (Ultra Large Scale Integration)
- Parallel Processing
- Superconductors
- Quantum Computing
- AI



The von Neumann Model

The von Neumann model consists of five major components:

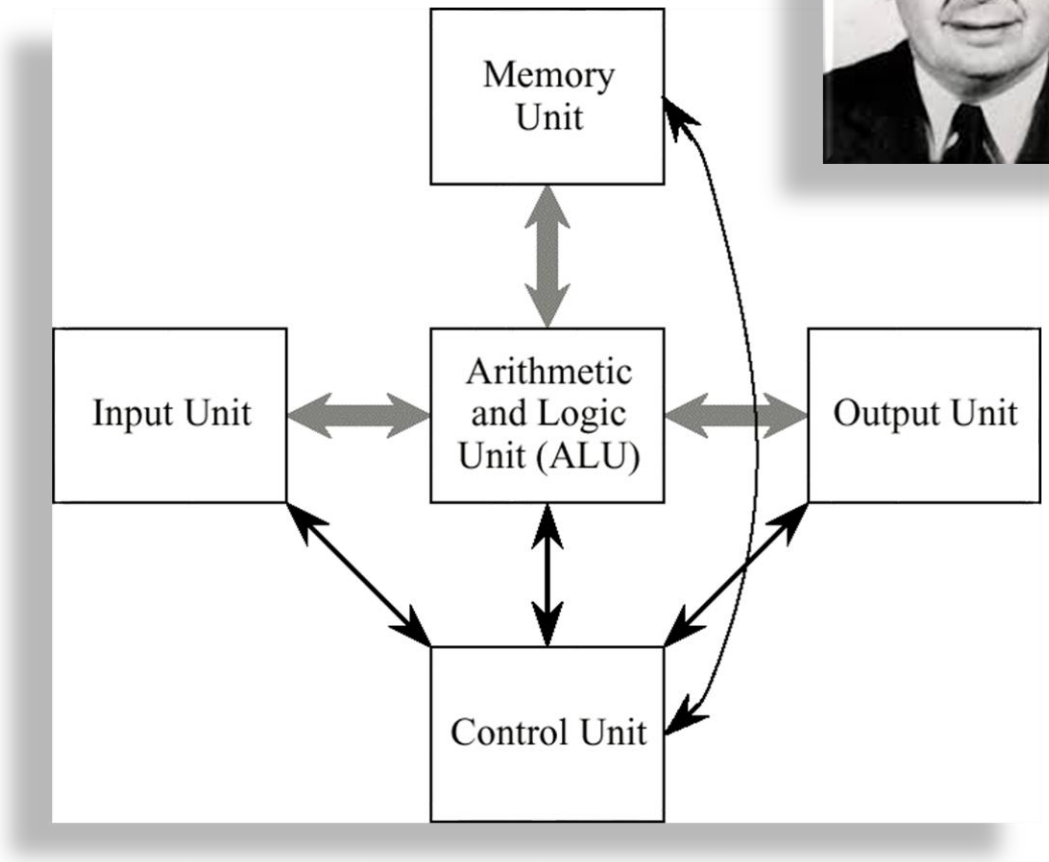
(1) input unit;

(2) output unit;

(3) arithmetic logic unit;

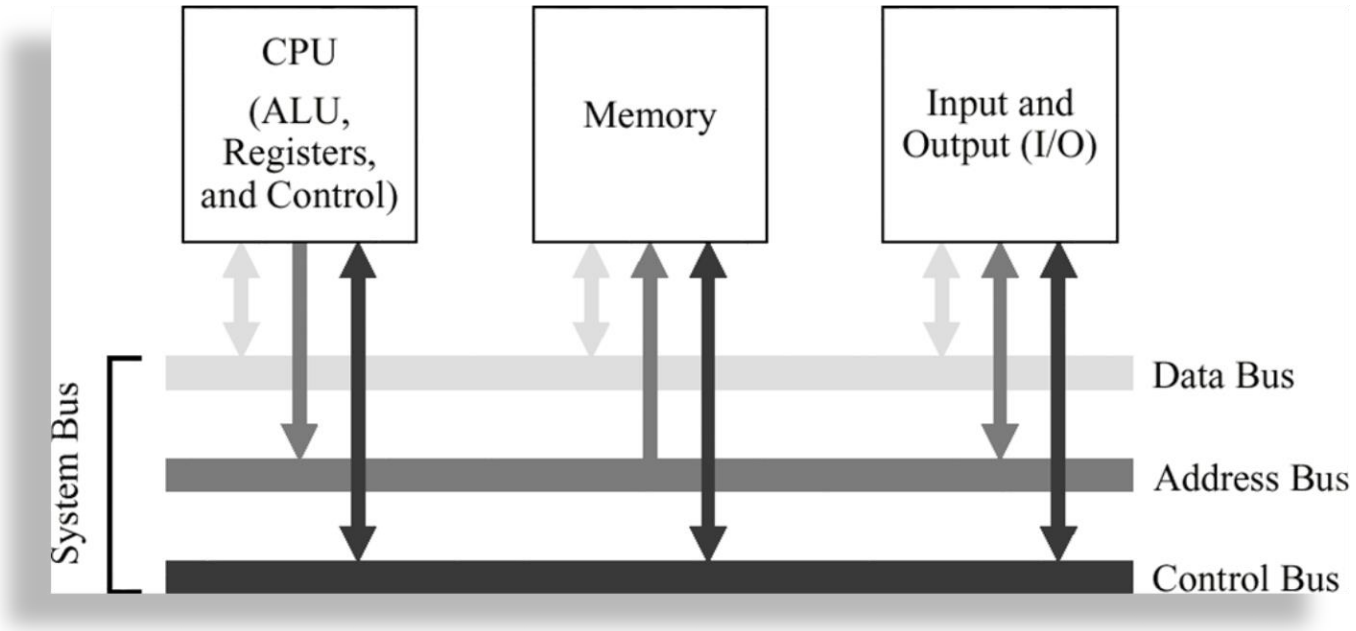
(4) memory unit;

(5) control unit.



The System Bus Model

- A refinement of the von Neumann model, the system bus model has a CPU (ALU and control), memory, and an input/output unit
- Communication among components is handled by a shared pathway called the ***system bus***, which is made up of the data bus, the address bus, and the control bus. There is also a power bus, and some architectures may also have a separate I/O bus



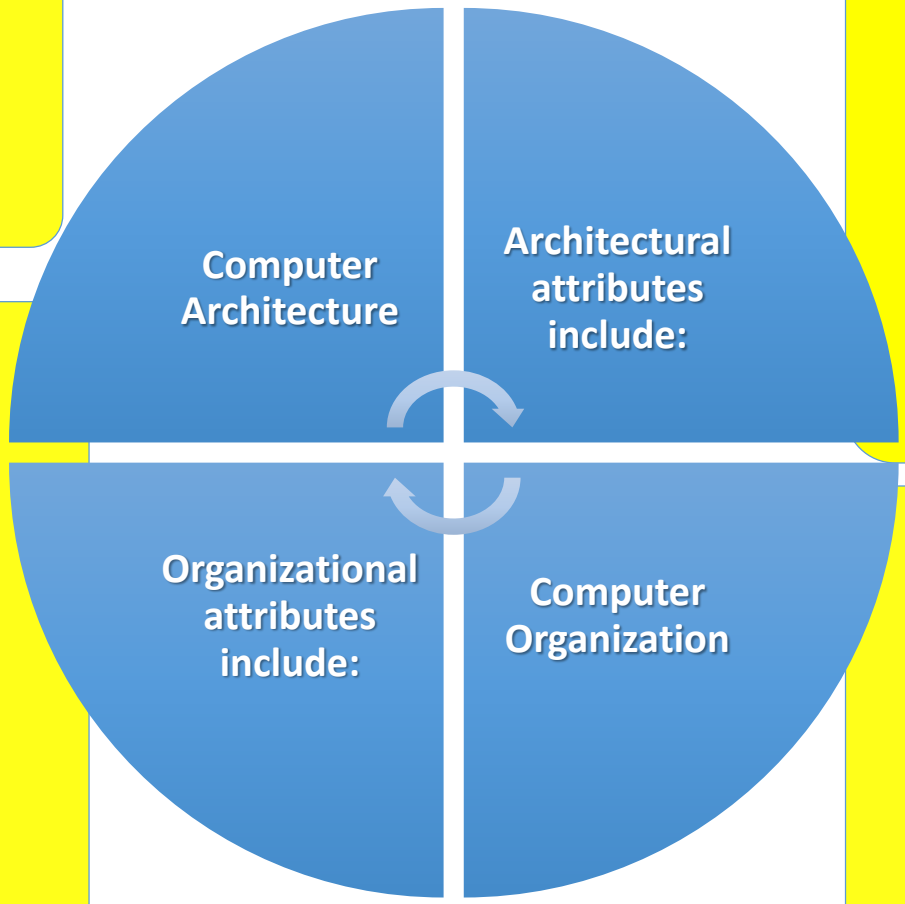
Basic Definitions

- ***Computer architecture*** **deals with the** ***functional behavior*** **of a computer system as viewed by a programmer (e.g., the size of a data type – 32 bits to an integer).**
- ***Computer organization*** **deals with** ***structural relationships*** **that are not visible to the programmer (e.g., clock frequency or the size of the physical memory).**
- **There is a concept of** ***levels*** **in computer architecture.**
- **The basic idea is that there are many levels at which a computer can be considered, from the highest level, where the user is running programs, to the lowest level, consisting of transistors and wires.**

Computer Architecture

Computer Organization

- Attributes of a system visible to the programmer
- Have a direct impact on the logical execution of a program



- Instruction set, number of bits used to represent various data types, I/O mechanisms, techniques for addressing memory

- Hardware details transparent to the programmer, control signals, interfaces between the computer and peripherals, memory technology used

- The operational units and their interconnections that realize the architectural specifications

Levels of Machines

There are a number of levels in a computer from the user level down to the transistor level.

Progressing from the top level downward, the levels become less abstract as more of the internal structure of the computer becomes visible.