Organization vs. Architecture

Architecture	The attributes of a system visible to a programmer
Organization	The oerational units and their interconnections that realize the architectural specifications

Main Components of the CPU

Control Unit	Controls the operation of the CPU and hence the computer
Arithmetic and Logic Unit	Performs the computers data processing function
Registers	provides storage central to the CPU
CPU Interconnection	some mechanism that provides for communication among the control unit, ALU, and registers

Integer Representation

Sign Magnitude:
+18 = 00010010
-18 = 10010010
Benefits: Simple

Integer Representation (cont)

Drawbacks: addition and subtraction need to take sign and number into consideration for calculations and there are two ways to represent 0.
To extend range: Move sign bit to new leftmost bit and fill rest with 0s
Two's Complement:
Similar to sign magnitude, except for how the other digits except the signed one are considered.
to extend range: move sign bit to new leftmost bit and fill rest with same sign as sign bit
Biased Representation
A fixed value is subtracted from the field

Structure vs. Function

Structure	The way in which the components are interrelated
Function	The operation of each individual component as part of the structure

HISTORY

First generation computers: ENIAC -> IAS Computer -> UNIVAC
"von Neumann Machines"
Why important? - Stored-Program Concept
How does it work? - 1000 memory locations called words, which are 40 bits each. Each word is divided into a left and right instruction. Each instruction is divided into an 8 bit opcode saying the operation to be performed and a 12 bit address pointing to one of the words in memory. Repeatedly performs instruction cycles, divided between the fetch and execute cycles. In the fetch cycle, the opcode of the next instruction is loaded into the IR and the address portion is loaded into the MAR.

HISTORY (cont)

This instruction may be taken from the IBR, or it can be obtained from memory by loading a word into the MBR and then down to the IBR, IR, and MAR. Once opcode is in IR, execute cycle is performed - opcode is interpreted and sends out the appropriate signals to cause data to be moved or an operation to be performed by the ALU. Second Generation: Transistors
Transistors are smaller and cheaper than vacuum tubes. This created a huge boom in availability of computers.
Third Generation: Integrated Circuits
All of these components can now be produced in silicon chips instead of discrete components, further reducing the cost and size of computers.

Main Functions that a computer can perform

- Data Processing
- Data Storage
- Date Movement
- Control

Moore's Law

The number of transistors that can be placed onto a chip doubles every year. **revised to every 18 months since the 1970s**

Importance:

1) Cost remains relatively the same while computing power doubles

2) Operating Speed is increased due to shorter electrical pathways because everything is so close together

3) Smaller size means computers can be placed in more environments

4) Reduction in power and cooling requirements

5) With more circuitry on each chip, there are fewer interchip connections

Main Components of a Computer

Central Processing Unit (CPU)	Controls the operation of the computer and performs its data processing functions
Main Memory	Stores Data
I/O	Moves data between the computer and its external environment
System Interconnections	Some mechanism that provides for communication among CPU, main memory, and I/O.

EQUATIONS

CPI = (SUM_i=1^n (CPI_i x I_i)) / I_C

T = I_C x CPI x Tau

Tau = 1/f

MIPS rate = I_C / (T x 10^6) or f / (CPI x 10^6)

MFLOPS rate = (number of executed floating-point operations in a program) / (execution time x 10^6)

speedup (Amdahl's Law) = 1 / ((1 - f) + (f/N))