

# Defining Information Technology

## Computation's Greatest Hits

- Digitizing information
- Stored-program computers
- Transistors
- Integrated Circuits
- Personal Computers
- The Internet
- World Wide Web
- Layered Software Development

## Digitizing Information

Inputting data represented using numbers into a computer

- Herman Hollerith's digitization of census records in 1890 using punch cards
- Rudimentary digitization, i.e., no computer was actually used. Instead, the presence and absence of holes in the punch cards represented data.

## Stored-Program Computers

- The use of punch cards required mechanical tabulating machines, i.e., no software, just hardware.
- To change the operations the machines performed required it to be rewired. These machines evolved to have plugboards to allow programmers to rewire them. These machines only supported elementary operations as a result.
- The advent of the electronic computer removed the need for rewiring by introducing a Central Processing Unit (CPU). The CPU performed instructions stored in the computer's memory.

## Advantages

- The CPU allowed programs to be easily and quickly changed by simply loading new instructions into the memory.
- The CPU also allowed for programs to grow in complexity.
- The CPU made computations autonomous, i.e., needing no human supervision.

## Disadvantages

- Due to the technical requirements of the CPU, they were very complex, i.e., requiring many un-miniaturized parts making the computers they inhabited quite large and expensive.
- Early computers' electronic circuits were built from vacuum tubes, which were reasonably reliable at a small scale, but due to the amount required to support a CPU made them unreliable.

## Transistors

A solid-state semiconductor device with three terminals, which can be used for amplification, switching, voltage stabilization, signal modulation, etc.

- 1947 invented by John Bardeen, Walter Brattain, and William Shockley
- Transistors essentially replaced vacuum tubes because they consume less power, are incredibly reliable, and are smaller in size and weight.
- The use of transistors reduced the size of CPUs but also increased how complex they could get.
- Although the introduction of transistors made constructing computers relatively easier, it still took a lot of work to put together a computer due to the tens of thousands of separate parts that had to be assembled, i.e. (each transistor, capacitor, and resistor).

## Integrated Circuits

Monolithic blocks (chips) made of silicon and closely related elements in which both active parts, i.e. transistors, and connective parts i.e. wires, are fabricated together in a multi-step process

- The problem of efficiently assembling computers out of the various components was solved by integration.
- This method of creating computer components drastically improved efficiency as it took less time connecting the individual components before they were fully formed than manufacturing each component first and then connecting them after, and also as a result of photolithography
- A process where chip makers print all the components needed (wires, transistors, etc.) onto the chip
- To perform photolithography, a mask specifying the shapes of a layer is required. Because the printing uses light passing through the mask, it doesn't matter how complex or simple the mask is.

## Personal Computers

- Moore's Law - An empirical observation that the density of transistors on a chip doubles every two years.
- The advent of ICs made computer production so inexpensive that proliferation to the masses was inevitable.

## The Internet

- ARPANet sent its first packet in 1969
- A common communication protocol (TCP/IP) allowed separate LANs to connect, leading to the creation of the internet, a network of networks.

## **World Wide Web**

- Created by Tim Berners-Lee
- The idea was to create an online center (homepage) where everyone could access the documents, images, and other resources could be easily disseminated in Tim's workplace.
- Hyper Text Transfer Protocol (HTTP)

## **Layered Software Development**

- Until the 1980s programs tended to be monolithic and lightly structured resulting in them being difficult to write and maintain.
- Software development applies a layered approach in which programs at one level apply code for the more primitive operations from lower levels and provide more advanced facilities for higher levels.
- As a result of this layering, programmers can rely on the primitive levels without understanding exactly how they work beyond knowing the proper way to use them. They are building on the work of thousands of other programmers who contributed to these layers, i.e., Standing on the shoulders of giants.

The reduction of the impact of complexity has often been a key result of these discoveries.

## **Terms of Endearment**

### **Processors**

A processor includes the CPU, a small amount of memory called a cache, and is connected to some input and/or output devices.

### **Advanced RISC (Reduced Instruction-Set Computer) Machine (ARM)**

A processor specialized to be part of other systems.

Allows code to be easily written to manage operations of a particular device rather than designing specific electronics to manage operations.

### **Software**

The instructions computers perform to implement applications.

Software instructs computer hardware by providing the steps needed to perform a task.

### **Programming**

Instructing an agent to perform some function or action by giving a step-by-step process

Agent

Anything that can follow instructions

### **Algorithms**

A precise and systematic method for producing a specified result

For a process to be an algorithm, it must have these properties:

- Input specified - What it is given as data.
- Output specified - What it will produce as a result.
- Definitive - The whole process is spelled out unambiguously
- Effective - Within the abilities of the agent, following the instructions.
- Finite - The agent will eventually finish the computation, either giving the right answer or stopping and reporting that one is possible.