Information System

An information system refers to a group of interconnected components, e.g., hardware, software, data, etc., that work together to collate, store, process, and disseminate information, typically in service of a business or organization.

Components of Information Systems

Five major components

- Hardware
- Software
- Data
- People
- Processes

Technology   The application of scientific knowledge for practical purposes

Hardware   The tangible, physical portion of an information system.

Software   The set of instructions that tell the hardware what to do.

- Application - Allows users to perform productive tasks
- Operating - Provides the interface between the hardware and application software

Data   A collection of facts.

Networking Communication

People   Front-line user support staff, system analysts, developers, and chief information officer (CIO).

Processes   A series of steps undertaken to achieve a desired outcome or goal.

Role of Information Systems

Mainframe Era Late 1950s - 1970s

- Room-sized business computers with several machines linked together
- Primarily used to organize and store large volumes of information, e.g., scientific calculations and accounting.
- Expensive to buy and maintain, so were used by large firms, universities, and government agencies.
- Manufacturing Resources Planning (MRP) systems running on mainframes allowed firms also to manage the manufacturing process. Tasks like creating bills of materials and scheduling production.

Pc Revolution

- 1975 with the creation of microcomputers
- Improvements in usability and availability of practical software led to relatively widespread adoption
- Apple II and IBM PC
- The proliferation of computer companies and their products drove computer prices down and encouraged innovation
- These PCs were standalone machines, i.e. not connected to a network
- IBM PC
- MS-DOS
- WordPerfect, Lotus 1-2-3

Client-Server

- mid 1980s
- Connecting computers as a way to collaborate and share resources, i.e., client-server
- Clients were PCs connected to central computers, known as Servers, via Local Area Network (LAN). Servers would determine permissions for each user as a way of managing access to resources.
- This networking stayed mainly within the confines of each business.
- The rise of Enterprise Resource Planning (ERP) systems (An application with a centralized database that could be used to run a company's entire business)
- Windows
- Microsoft Word, Excel

The Internet, World Wide Web, and E-Commerce

- Advanced Research Projects Administration (ARPA) Net.
- 1989 with the development of the World Wide Web by Tim Berners-Lee. This became a catalyst for the growth of the Internet as a way for businesses to share information about themselves.
- Dot-Com bubble burst.
- The increased speed of data sharing via the Internet led to a rise in malicious software creation and infection.

Web 2.0

- 2000s
- Websites became more interactive as customers wanted more customizability.
- Website creation became more accessible as the users now did not need to do any programming to make an interactive website
- Key developments in this stage include Blogging, Social Networking, and Interactive Comments.
- Disintermediation was rampant, key examples being the decline of physical bookstores, Video rental chains, and the newspaper industry.

Disintermediation

The process of technology replacing a middleman in a transaction

The Post-PC World

- With the introduction of the more mobile and easy-to-operate smartphone, PC sales have dropped slightly. Although with this decline in sales, the PC still has a vital role in the business environment.
- Cloud computing provides users with mobile access to data and applications relegating the PC to more of a part of the communications flow rather than a repository of programs and information.

Hardware

> Digital devices you can physically touch

Digital Devices

> A device that processes electronic signals into discrete values or which there can be two or more. In comparison Analog signals are continuous and can be represented by a smooth wave pattern

These two discrete values are known as binary .i.e. 1s and 0s, with one representing "on" and a zero representing "off", where the value represents the presence of an electronic signal (high voltage and low voltage). Each value is referred to as a bit (binary digit) and a group of 8 bits is a byte. Early computers could only process 8 bits of data (1 byte) at a time. Current PCs can process 64 bits (8 bytes) at a time.

Word-Size

> The number of bits that can be processed by a computer.

128	64	32	16	8	4	2	1
0	0	0	0	0	0	0	0

Tour of a PC

Basic components of a PC:

- Central Processing Unit (CPU)
- Memory
- Circuit Board
- Storage
- Input / Output devices

Processing Data: The CPU

> Carries out the commands sent to it by the software and returns results to be acted upon

The speed ("clock time") of a CPU is measured in hertz (one cycle per second). CPU chips contain multiple processors, which increase the processing power of a computer by providing the capability of multiple CPUs all sharing the processing load.

Moore's Law

> An empirical observation that the density of integrated circuits on a chip doubles every two years. Largely debunked

Huang's Law

> An observation that the performance of a graphics processing unit (GPU) will more than double every two years. Up for debate.

Motherboard

> The main circuit board on the computer, the CPU, memory, storage components, etc. all connect into the motherboard

Most modern motherboards have many integrated components such as network interface card (NIC), video and sound processing. The motherboard provides much of the bus of the computer. The bus is a important factor in determining the computer's speed, i.e. how fast the bus can transfer data and the number of data bits what can be moved at one time. The motherboard serves as a bus through traces which provide connections between the motherboard components.

Bus

> The electrical connections between different computer components

Random-Access Memory (RAM)

> The working memory of a computer

RAM transfers data faster than the Hard Disk so programs are loaded onto it for speed. For a computer to work effectively some minimal amount of RAM is required. RAM is volatile, meaning it can only store data when receiving power, i.e. when the computer turns off any data stored in RAM is lost. RAM is usually installed in a PC using a Double Data Rate (DDR) memory module, the type of which depends on the motherboard. Generations of DDR:

- DDR1
- DDR2
- DDR3
- DDR4
- DDR5

Which each generation running faster than the previous.

Hard Disk (HD)

> A computer's long term storage medium

Considered non-volatile as data is kept even after power is lost. Drives with a capacity less than 1 Terabyte usually have a single platter.

Solid State Drives (SSD)

> A storage medium that uses flash memory incorporating Electrically Erasable Programmable Read Only Memory (EEPROM) chips, instead of spinning disks

The use of flash memory makes SSDs lighter, faster and less affected by fall damage than hard disks.

Removable Media

- Floppy disks
- CD-ROM drives
- Universal Serial Bus drives (USB) - Also use EEPROM technology

Network Connection

> The ability of a computer to connect to other computers to share resources, using a Network Interface Card (NIC)

Ethernet Network ports come built into most modern PC motherboards.

Input and Output

> Channels for receiving and delivering input and output to the user respectively.

Input and output devices are connected to the computer via various connection ports,which are generally apart of the motherboard.

Bluetooth

> A wireless technology that allows devices to exchange under short distances (10 to 100 meters) using radio waves.

The devices communicating must both have a Bluetooth communication chip installed.

Input Devices

> Devices that allow users to input data into the computer.

Today the primary input devices of a PC are the mouse and keyboard.

Output Devices

> Devices that deliver data output to the user.

Primary output devices include monitors.

Which Hardware Components Contribute to the Speed of Your Computer.

In hardware speed is improved by giving electrons shorter distances to travel in completing a circuit.

Hardware that contribute to the speed of a computer:

- CPU - Clock Speed (GHz)
- Motherboard - Bus Speed (MHz)
- RAM - Data Transfer Rate (Mb/s)
- Hard Disk - Access Time (ms) and Data Transfer Rate (MBit/s)

Other Computing Devices

Software

> The Set of Instructions that tell the hardware what to do.

Developed by developers through the process of programming.

Types of Software

Software can be divided onto two categories:

- Operating Systems
- Application Software

Operating Systems

An Operating System (OS) is first loaded into the computer by the boot program.

- Provides a platform for software developers to develop applications
- Manages all the programs in the computer
- Manages the hardware resources of the computer
- Provides the user-interface components

Microsoft

- First operating system for the IBM-PC (MS-DOS) - 1981
- Windows - 1985

Apple

- Macintosh (Mac OS) - 1984
- OS versions named after mountains (El Capitan, Sierra, High Sierra)

Linux

- Open Source
- UNIX offshoot with UNIX utilities provided by the GNU project

Application Software

Software utilized to accomplish a specific goal, such as word processing, calculations, surfing the net.

The "Killer" App

A software that becomes so essential that large number of people will buy a device just to run that application.

Productivity Software

Standard tools for the workplace. They allow employees to complete their daily work efficiently.

Utility Software

Programs that allow you to fix or modify your computer in some way. .e.g anti viruses. Created to fill shortcomings in an OS.

Programming Software

Programs that allow you to produce software. Provide developers with an environment in which can write, test, and compile code, typically called an Integrated Development Environment (IDE).

Mobile Applications

Software designed to run specifically on a mobile device

Cloud Computing

> Allows users to access software and data storage services on the Internet

The cloud refers to applications, services and data storage located on the Internet. Cloud Service Providers rely on giant server farms and massive storage devices that are connected via the Internet.

Advantages

- No installation of maintenance
- Available from any computer with internet access
- Can scale easily
- New applications can be up and running quickly
- Services can be leased on an as-needed basis
- Not limited by availability of memory or disk space
- No loss of information if a disk crashes or laptop is lost or stolen

Disadvantages

- Your info is stored on someone else's computer
- Internet access is required
- Third-Party service providers

Private Cloud

> A section of web server space is given to a specific or

Virtualisation

> The process of using software to simulate a computer or some other device.

Virtual computers are referred to as Virtual Machines (VMs). Ergs implement virtual machines to reduce the number of physical servers needed to provide necessary services to users.

Software Creation

Modern software applications are written using a programming language.

Programming Language

> A set of commands and syntax that can be organized logically to execute specific functions.

Open-Source Software

> Software where the source code is available for any one to copy, alter to their needs and use.

Data, Information and Knowledge

Data

> Raw facts, devoid of context or intent. Data can be quantitative or qualitative:

- Quantitative - Numeric data, the result of a measurement, count or some other mathematical calculation.
- Qualitative - Descriptive data.

Information

> Processed data that possesses context, relevance, and purpose.

Knowledge

> Human beliefs/perceptions about relationships among facts or concepts relevant to a particular area of study. Knowledge can be viewed as information that facilitates action.

- Explicit knowledge - Knowledge that can be expressed in to words or numbers
- Tacit knowledge - Insights and intuition that are difficult to transfer to another person by means of simple communication.

Wisdom

> The ability to combine knowledge and experience to produce a deeper understanding of a topic.

Big Data

> Massively large datasets that conventional data processing technologies do not have sufficient power to analyse them.

Databases

> A tool that allows for the aggregation and analysis of data

Reasons databases are needed

1. Build up of redundant data
2. Potential violation of data integrity
3. Otherwise relying on human memory to store and search for needed data

Data Models and Relational Databases

Data Model

> The Logical structure of data items and their relationships

Relational Database

> A Database model where data is organized into tables (relations).

Field

> A criterion which defines the structure of data stored in each table

Record

> An instance of a set of fields in a table

Primary Key

> A unique field that denotes each separate record

Foreign Key

> A primary key that has been referenced in another table

Normalization

> To design a database in a way that reduces data redundancy and ensures data integrity

1st Normal Form

2nd Normal Form

3rd Normal Form

Data Types

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.