Computer Architecture & Network

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What we will Cover

- Introduction to computers and computer science:
  - Basic ideas and terms
  - Basic elements of a computer
  - Programs
  - High-level Languages
  - Low level Languages
  - Scripting languages
  - Key Developments in Software
  - Different types of operating systems
  - Different types of operating systems
  - Different types of hardware platforms
  - Compilers
  - Virtual Machines
  - Integrated development environments
  - Open-source overview
  - Computer Architecture - (15 %)

What is a Computer System?

- A **system** is a collection of elements or components that are organized for a common purpose
- A computer system is sized for the number of users it handles simultaneously, the type of work performed (office, engineering, etc.) and the volume of data that must be stored.
- Ericsson - networked society
- Dublin City Council pilot SMART CITY sensors

What is a Computer System?

- Regardless of the type of operation to be performed, the work of a computer can be characterized as an

input -> process -> output model

  - the program retrieves ***input*** from a disk file, mouse, keyboard or other type of input,
  - ***processes*** the input
  - produces the ***output*** to a disk, terminal, printer or some other type of output device

- All of the above operations are repetitive in nature

What is a Computer?

- A **computer** is an electronic device that manipulates data.
- It has the ability to:
  - **Store Data**
  - **Retrieve Data**
  - **Process Data**
- You can use a computer to type documents, send email, and browse the internet. You can also use it to handle spreadsheets, accounting, database management, presentations, games, and more.

What is a Computer System?

- ***Data being manipulated*** – can be alphanumeric, graphic or any other form. In all cases it is represented in a form that the computer will understand and manipulate.
- Eircom Broadband
- Vodafone mobile broadband
- File format standards, examples:
  - **Text:** ASCII, PDF
  - **Image:** jpeg, png, gif
  - **Video:** mpg, flv
  - **Audio:** mp3, wav

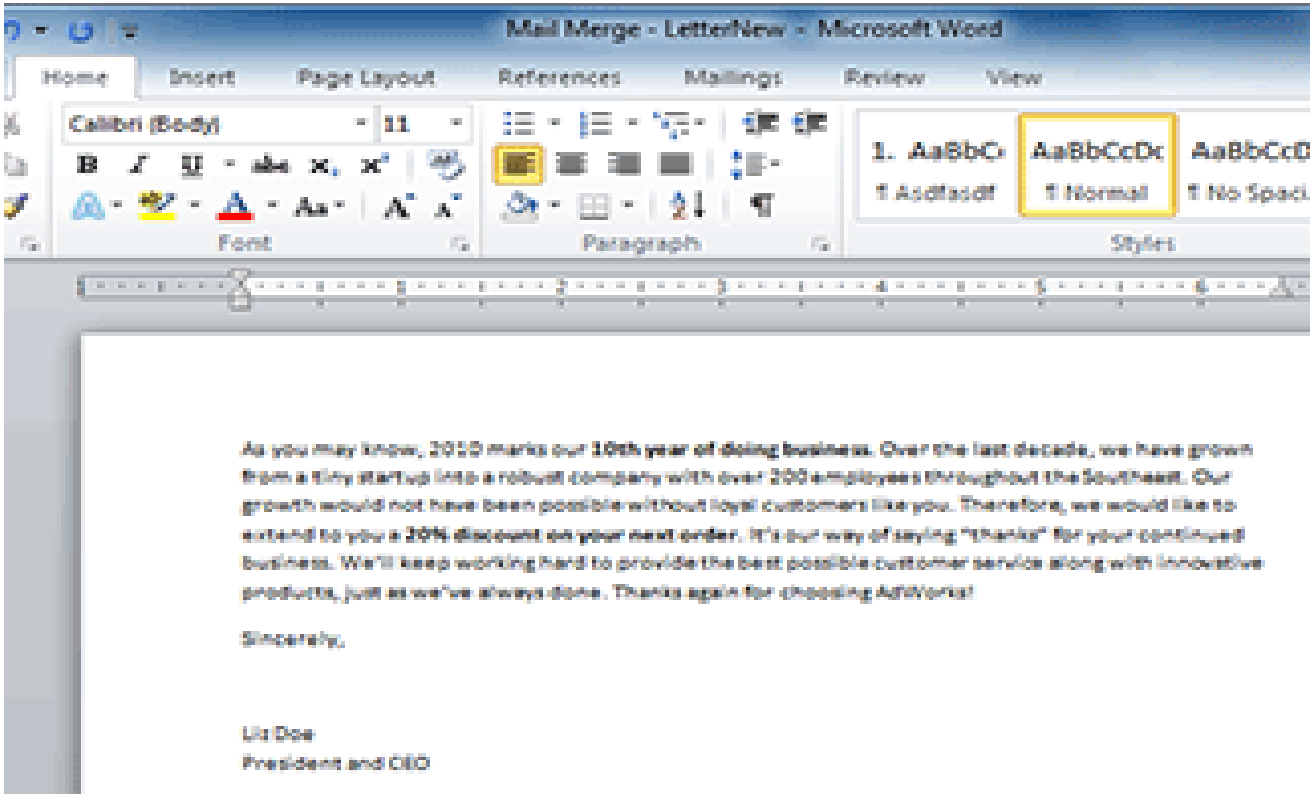
Key computer components

- ***Hardware*** – Provides the physical mechanisms to input and output data, manipulating data and controlling the various input, output, storage and communication components.
  - Monitors
  - Keyboards/Mouse
  - Case

Key computer components

- ***Software*** – is a set of instructions that tell the hardware exactly what tasks are to be performed and in what order. Some examples of software are web browsers, games, and word processors (MS Word)

Key computer components



Or this .ppt application!

Different types of computer

- Suggest an example of a computer?

Different types of computer

- Yes Desktop or laptop!
- Desktop:

- What else?

Different types of computer

- A **tablet** – touch screen as input interface
- A **mobile phone** – smart phones – can do many things computers can do – primary use case – internet access?
- A **smart TV** - content from the internet!

Different types of computer

- A **server** is a computer that runs “services“ which serve the needs of other computers (**clients**) on a network.
- Many businesses have **file servers** that employees can use to store and share files, **email servers,** print servers. A server can look like a regular desktop computer, or it can be much larger.
- Internet: **web pages** are stored on servers. When you use your browser to click a link, a **web server** delivers the page you requested.

Parts of a PC Computer

External:

- **Case** – Houses main components of a computer such as power supply, CPU etc.
- **Monitor** – interface for computer to present data to us – (unless touch screen)
- **Keyboard** – interface for us to communicate with the computer
- **Mouse** – interface for us to communicate with the computer

Computer: Architecture Vs Organization

- **Architecture**
  - Refers to those attributes of a system known to a programmer
    - The architecture of a CPU is actually its instruction set, number of bits used for data representation, addressing techniques, etc.
- **Organization**
  - Refers to the operational units and their interconnections that realize the architectural specifications
    - Hardware details not transparent to the programmer, such as control signals between different functional units, memory type (i.e. dynamic RAM or static RAM, etc…), registers type (static or dynamic), etc.

Computer: Architecture Vs Organization

- It is an architectural issue whether a computer will have or not a specific instruction (i.e. multiply), but it is an organization issue whether that instruction will be implemented by a special arithmetic unit or it will be implemented using the adder of the system by repetitive add operations

Inside the case

- **Motherboard:** computers main circuit board. It holds and connects all parts of the computer

Inside the case

- **CPU/Processor:** located on the motherboard. Its job is to carry out commands from the “interfaces” of keyboard or mouse or whenever an application is run.
  - Control unit (CU) & Arithmetic logic unit (ALU)
  - Speed of a processor is the number of instructions per second it can process – megahertz processor can execute millions of instructions per second, gigahertz – billions of instructions per second
  - Executes instructions that are fetched from main memory
  - Made up of millions of transistors
  - The transistors are the building blocks of logic gates

Inside the case

- **RAM** – short term memory of your computer.

Holds programs and data while in use

  - Static RAM – cache memory
  - Dynamic RAM
  - More RAM => more processing you can do at the same time!
  - RAM memory is volatile i.e. cleared when power is turned off.

- **Hard Drive** – Used for longer term storage. Documents, software and any other files stored here. If power removed, data is still safe!
  - A USB drive is a small portable hard drive!

Inside the case

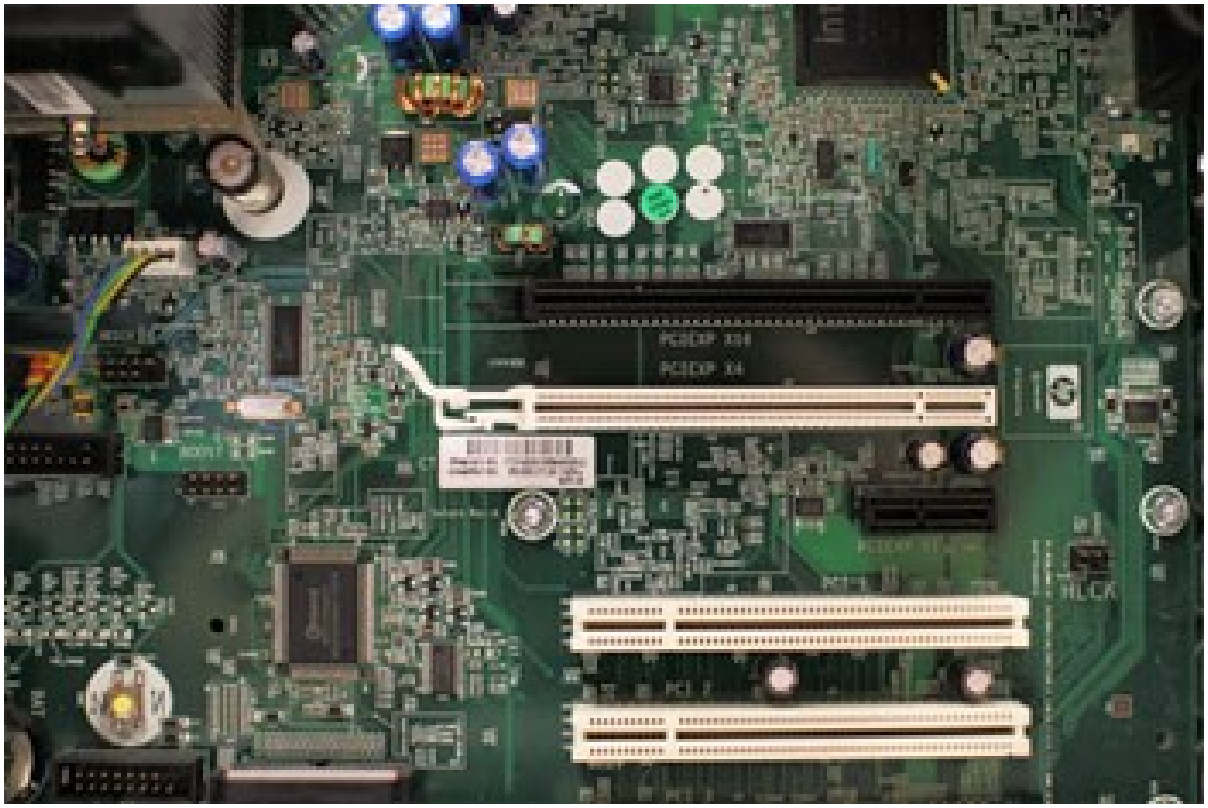
- Processor, main memory and IO are connected by the system bus.
- A bus is an electrical connection, A set of parallel wires.
- The system bus carries data, or an address, or control signals, and is split into three busses:
  - **Data** – bi-directional, transports data.
  - **Address** – uni-directional, used to address memory and I/O locations.
  - **Control** – bi-directional, used to transport control signals.

Inside the case

- **Video Card:** used to display data to the screen. Different types more efficiently present the images with varying resolutions.
- **Sound Card:** is responsible for what you hear in the speakers or headphones.
- **Network Card:** allows your computer to communicate over a network and access the internet. It can either connect with an Ethernet cable or through a wireless connection (often called Wi-Fi).
- **Powers Supply Unit:** converts power from plug into what's needed by computer.

Inside the computer

Key computer components



Operating Systems

- An operating system is a **software program**
- Facilitates communication between user and computer and within the computer. Provide user interface
- Abstraction: simplifies the usage of hardware resources. Provides a level of abstraction from the hardware :files, processes, thread etc.
- It allows multiples users and programs to access to same set of hardware resources.
- It generally has the following operations:
  - Manages memory
  - Manage processes
  - Manage software
  - Manage hardware

Operating Systems

- Most of the time, there are many different programs running at the same time, and they all need to access your computer's **Central Processing Unit (CPU)**, **memory**, and **storage**. The operating system coordinates all of this to make sure that each program gets what it needs.

- Most common OS's are Microsoft Windows, Apple Mach OS X, Linux – now numerous versions of each!

Operating Systems

- **Linux** – Open source software OS.
  - Name after Linus Torvalds who created the “kernel” in 1991 – kernel is central part of any OS – its the brain.

- Anyone name some other operating systems?
  - It is probably in your pocket or in your bag.

Computer Applications

- An application is a piece of software that runs inside your operating system and allows you to perform specific tasks.

- Mobile apps & Desktop apps

Programming Languages

- A programming language is an artificial language that sends instructions to a computer.
- They can be used to control behaviour or to express algorithms precisely.
- Thousands of languages exist
- Each language has its own syntax and semantics

Programming Languages

- A high level programming language has a strong level of abstraction from the details of the computer.
- High level languages like Java – deal with objects, variables, arrays, loops, threads etc.

- Low level languages on the other hand provide little or no abstraction from the computers instruction set architecture. Low level languages deal with memory addresses, registry etc. E.g. Assembly language – some consider the C programming language now to be low level – Others disagree ;)

Programming Languages

- Native Vs Web
- Web: application that is coded in a browser-supported language (JavaScript, HTML, CSS etc) – high level of abstraction.
- Native: language developed for a particular processor to use that processors instruction set.

Programming Languages

- Levels of abstraction
  - High level languages
    - system.out.print()
  - Assembly MOV R1, 40000
    - opcode/register, address
  - Machine code
    - Binary: 1000100001000010000