INTRODUCING COMPUTERS

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Introduction to Computer Science

What is computer science?

"Everything that happens after you ask a question from Google until you get a result."

Lance Fortnow

- **It is a discipline that seeks to build a scientific foundation for computer design and information processing using computers**
- **Computer science is the study of**
  - **What can be accomplished using computers, and**
  - **How to construct software to do these things**

Ref:http://blogs.msdn.com/b/alfredth/archive/2011/03/10/what-is-computer-science-all-about.aspx

Why study computers?

- A computer is a profoundly important technological device
- Broadly impactful, Occasionally disruptive
- Computers have had impacts on the way we live, the way we think, and the way we do business
- But we are perhaps only 1/3 to 1/2 of the way through the process of absorbing the impact of computing in our lives
- Computers will have a substantial influence on any area of study you choose at CUI
- So, understanding computers is important

- Computers have become an integral part of our lives
- Pervasive computing, also known as ubiquitous computing is a concept where computing is made to appear anytime and everywhere
- It is a growing trend of embedding computational capability (generally in the form of microprocessors) into everyday objects to make them effectively communicate and perform useful tasks
- Internet of Things, or IoT, is a system of interrelated computing devices (objects, people or mechanical machines) with unique identifiers (UIDs)
- These devices have the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction

What is a computer?

- A computer can be defined as a programmable electronic machine that accepts input (data), processes it and gives out results (information)

- It allows the user to store all sorts of data and then 'process' that data, or carry out actions with the data, such as calculating numbers or organizing words

- "A computer is a machine for manipulating data according to a list of instructions known as a program"

Wikipedia

The Computer Defined

- **Modern computers are digital**
  - **Two digits combine to make data**
- **Older computers were analog**
  - **A range of values made data**
- **Computers have had more impact on our society than any other invention**
  - **Changed work and leisure activities**
  - **Used by all demographic groups**
- **Computers are important because**
  - **Provide information to users**
  - **Information is critical to our society**
  - **Managing information is difficult**

Types of Computers

- Computers for individuals
- Computers for organizations
- Computers in society

Computers for individuals

Desktop computers
- The most common type of computer
- Sits on the desk or floor
- Performs a variety of tasks
- Best for individual use

Laptop computers
- Small portable computers also called notebook computers
- Weighs between 3 and 8 pounds
- About 8 ½ by 13 inches
- Typically as powerful as a desktop

Computers for individuals

Tablet computers

- ❑ **Newest development in portable computers**
- ❑ **Input is through a pen (or hand), touch screen**
- ❑ **Run specialized versions of office products**

Smart phones

- ❑ **Hybrid of cell phone and PDA**
- ❑ **A cell phone that offers more advanced computing ability**
- ❑ **Web surfing, e-mail access, GPS and many other Apps**
- ❑ **Allow users to store information, take pictures, install programs**

Computers for individuals

Wearable computers

- **Also known as body-borne computers are the latest trend in computing**

- **Essentially, common computer applications (e-mail, multimedia, calendar, scheduler) are integrated into**

- **watches, cell phones, visors and even clothing**

Computers for Organizations

Network servers

- ❑ **Centralized computer, all other devices connect to it**
- ❑ **Provides access to network resources**
- ❑ **Multiple servers are called server farms**
- ❑ **Often simply a powerful desktop**

Workstations

- ❑ **Specialized computers**
- ❑ **Optimized for science or graphics**
- ❑ **More powerful than a desktop**
- ❑ **Mostly seen in offices or attached to a network**

Computers for Organizations

Supercomputers
- The most powerful computers made
- Handle large and complex calculations
- Process trillions of operations per second
- Found in research organizations

Mainframes
- Used in large organizations
- They are of size of a large cabinet
- Handle thousands of users simultaneously
- Users access through a terminal

Computers in Society

- **Examples of some of the computers available in society**
- **Education**
- **Finance**
- **Government**
- **Healthcare**
- **Science**
- **Publishing**
- **Travel**
- **Industry**

Advantages of Computers

- **Automatic**
- **Speed**
- **Reliability**
- **Diligence**
- **Consistency**
- **Versatility**
- **Storage**
- **Communication**
- **No feelings**

Disadvantages of Computers

- **No I.Q**
- **Violation of privacy**
- **Impact on labor force**
- **Health Risks**
- **Impact on environment**

The Origin of Computers

- Where did the computers come from?
- Why did computers emerge in the 1940s?
- How did computers differ from the previous technologies for computation?
- Threads in the story
  - Charles Babbage / Ada Lovelace: Difference Engine, Analytical Engine
  - Tabulating machines, card-based calculators
  - ENIAC to EDVAC to UNIVAC and the birth of the commercial computing industry
    - Ref: https://www.livescience.com/20718-computer-history.html
    - Ref: https://thumbnails-visually.netdna-ssl.com/the-evolution-of-computers

The Origin of Computers

- **Computers are nothing more but Calculating Machines**
- **It took over generations for early man to build mechanical devices for counting large numbers**
- **The first calculating device called ABACUS was developed by the Egyptian and Chinese people**
- **The word ABACUS means calculating board**
- **It consisted of sticks in horizontal positions on which were inserted sets of pebbles**
- **It has a number of horizontal bars each having ten beads**
- **Horizontal bars represent units, tens, hundreds, etc.**

The Origin of Computers

Charles Babbage (1791-1871), British

- Motivated by the desire to reduce drudgery of calculation, and to improve its accuracy
- Was born in the steam age, when electronics was in its infancy
- As a consequence, thought to create a mechanical, steam-powered computing machine
- First machine was the Difference Engine, a mechanical calculator
- Second machine was the Analytical Engine, a programmable calculation device

  Read more here: https://en.wikipedia.org/wiki/Charles_Babbage

The Origin of Computers

Ada Lovelace (1815 – 1852)

- **A mathematical genius, worked with Babbage on Analytical Engine**
- **Documented the Analytical Engine, but more importantly programmed Analytical Engine**
- **Though never realized, Ada developed a strong mental model of how it works, and then developed programs, also in her head, that ran on the machine**
- **Generally credited as being the world's first computer programmer**

  Read more here: https://en.wikipedia.org/wiki/Ada_Lovelace

Generations of Computers

- The evolution of computer started from the 16th century and resulted in the form that we see today
- The present day computer, however, has also undergone rapid change during the last fifty-sixty years
- This period, during which the evolution of computer took place, can be divided into five distinct phases known as Generations of Computers
- Each phase is distinguished from others on the basis of the type of switching circuits used
- Each generation is characterized by major technological development that fundamentally changed the way computers operate, resulting in increasingly smaller, cheaper and more powerful, efficient and reliable devices

    Read more here: https://www.webopedia.com/DidYouKnow/Hardware_Software/Five

Generations of Computers

FIRST GENERATION (1940-1956)

- The first computers used vacuum tubes for circuitry and magnetic drums for memory and were often enormous, taking up entire rooms

- They were too expensive to operate

- They required a great deal of electricity and generated a lot of heat

- They relied on machine language to perform operations and could solve one problem at a time

- Input was based on punched cards and paper tape and output was displayed printouts

- Some of the computers of the first generation were ENIAC (Electronic Numerical Integrator and Calculator) and EDVAC (Electronic Discrete Variable Automatic Computer)

Generations of Computers

SECOND GENERATION (1956-1963)

☐ **Around 1955, vacuum tubes were replaced with transistors in the second generation computers**

☐ **Transistor was far superior to the vacuum tube, allowing computers to become smaller, faster, cheaper, more energy efficient and more reliable**

☐ **It is in the second generation that the concept of Central Processing Unit (CPU), memory, programming language and input and output units were developed**

☐ **They used assembly languages and early versions of high-level languages like COBOL and FORTAN**

☐ **Some of the computers of the second generation were IBM 1620, IBM 1401 and CDC 3600**

Generations of Computers

THIRD GENERATION (1964-1971)

- The development of the integrated circuit was the hallmark of the third generation of computers

- Transistors were miniaturized and placed on silicon chips called Integrated Circuits (ICs) which drastically increased the speed and efficiency of computers

- A single IC has many transistors, registers and capacitors built on a single thin slice of silicon

- Instead of punched cards and printouts, user interacted with computers through keyboards and monitors, and run different applications at one time on them

- They became accessible to mass audience because they were smaller and cheaper than their predecessors

- Some of the computers developed during this period were IBM-360, ICL-1900, IBM-370, and VAX-750

- Higher level language such as BASIC was developed during this period

Generations of Computers

FORTH GENERATION (1971-Present)

- The present day computers that you see today are the fourth generation computers that started around 1970s

- It uses Large Scale Integrated Circuits (LSIC) built on a single silicon chip called microprocessors

- The microprocessor brought the forth generation of computers, as thousands of integrated circuits were built onto a single silicon chip

- The Intel 4004 chip, developed 1971, located all the components of the computer, from CPU and memory to input/output controls, on a single chip

- In 1981 IBM introduced its first computer for home users, 1984 Apple introduced the Macintosh

- Microprocessors moved from desktop computers and into many areas of life as more and more everyday products began to use microprocessor

- This generation also brought the concept of GUIs, the mouse and handheld devices

Generations of Computers

FIFTH GENERATION (Present and Beyond)

- **Fifth generation computing devices, based on artificial intelligence, are still in development, though there are some applications, such as voice recognition, that are being used today**

- **The use of parallel processing, quantum computation and molecular and nanotechnology will radically change the face of computers in years to come**

- **The goal of modern computers is to develop devices that respond to natural language input and are capable of learning and self-organization**

Evolution of Computers

ENIAC – Electronic Numerical Integrator and Calculator

- Development began during WWII, but was completed in 1946
- ENIAC could be programmed, Not a stored program computer
- Complex sequences of instructions, could include loops, branches, and subroutines
- Taking a problem and mapping it onto the machine was complex, often took weeks
- Once a potential mapping was put onto paper, the process of getting the program into the ENIAC took days of manipulating cables and switches

Read more here: https://en.wikipedia.org/wiki/ENIAC

Youtube video: https://www.youtube.com/watch?v=k4oGI_dNaPc

Evolution of Computers

EDVAC - Electronic Discrete Variable Automatic Computer

☐ **A follow-on to ENIAC - Key idea was to create a stored program computer**

☐ **An important feature of this device was that operating instructions and function tables would be stored in exactly the same sort of memory device as that used for numbers**

☐ **This notion of stored-program computing has been central to every computer that has come since**

UNIVAC 1 - Universal Automatic Computer

☐ **First commercial computer, launched the commercial computer industry**

☐ **It used about 5,000 vacuum tubes, weighed 16,686 pounds and consumed 125 kW**

☐ **It could perform about 1,905 operations per second running on a 2.25 MHz clock and occupied more than 35.5 m² (382 ft²) of floor space**

> **Read more here: https://en.wikipedia.org/wiki/EDVAC and https://en.wikipedia.org/wiki/UNIVAC_1**

> **Youtube video: https://www.youtube.com/watch?v=ZU-IVshCAss**

Evolution of Computers

Microprocessors

- **First microprocessor is Intel 4004 (1971, 4-bit)**
- **First computer based on microprocessor is Intel SIM4-01**
- **First microprocessor used in a "PC" is 8008 (1972, 8-bit)**
- **First PC based on 8008 is Micral (1973)**
- **First IBM PC was available in 1981 (8088, 4.77MHz, 16-bit, x86 architecture)**
- **First Pentium processor introduced by Intel in 1993 (200 MHz), Pentium-II (1997, 500 MHz), Pentium-III (1999, 900 MHz), Pentium 4 (2000, 2.26 GHz), all are based on x86 architecture and 32-bit**
- **First 64-bit processor is Intel Itanium (2001, 800 MHz)**
- **Then came the Core i3, i5, i7, i9, and high-end Xeon series processors (2010 onwards, microarchitecture)**

Read more here: https://www.tomshardware.com/picturestory/710-history-of-intel-cpus.html and https://en.wikipedia.org/wiki/List_of_Intel_microprocessors

Evolution of Computers

Microprocessor VS Microcontroller VS Microcomputer

- **Microprocessor: is a single integrated circuit that has ability to perform all the functions of central processing unit in a single microchip**

- **Microcontroller: is a highly integrated chip that has all the necessary components present in a single microchip**

- **Microcomputer: is simply a personal computer with all the circuitry at one place, but not in single chip**

Evolution of Computers

Computer History Museum

☐ **Located in Mountain View, perhaps the best computer history museum in the world**

☐ **Exhibit first 2000 years of computing**

Ref: https://www.computerhistory.org