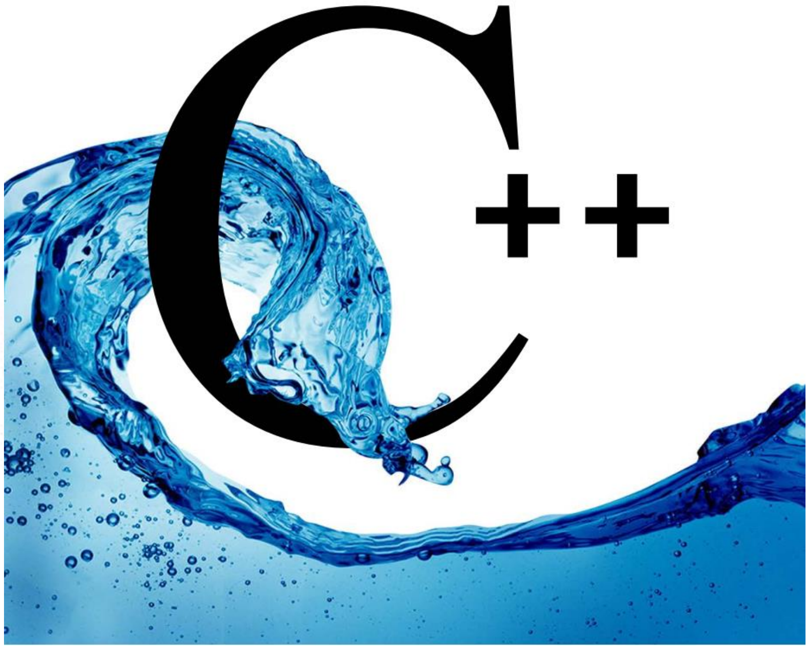
ME 110
Computation for
Mechanical
Engineering



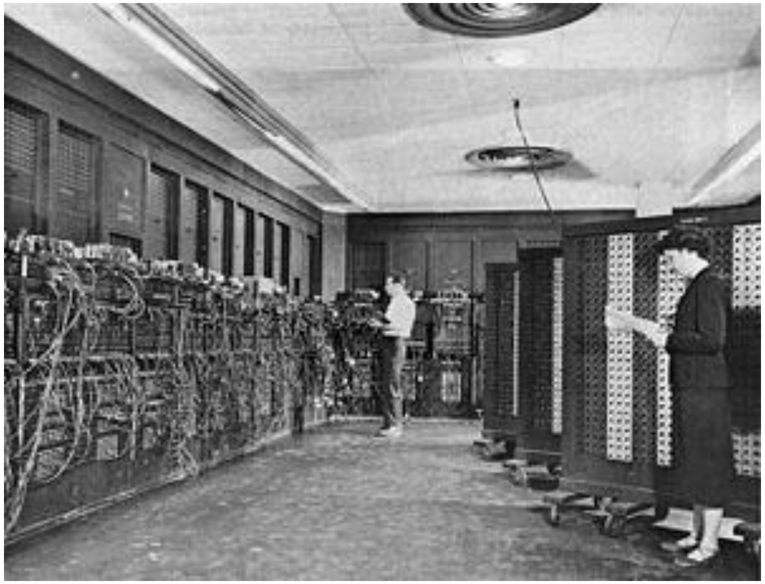
Lecture 2

Introduction to the Computer

The Computer

See **`http://en.wikipedia.org/wiki/Computer`**

- A computer is a machine that can be programmed to carry out sequences of arithmetic or logical operations (computation) automatically.
- The first computers were developed in 1940–1945, they were very large in size!



- Modern computers are based on integrated circuits making them very fast and small in size.

Parts of a Digital Computer

A computer can be divided into two main parts: *Hardware* and *Software*.

Hardware (=Donanım)

See **`http://en.wikipedia.org/wiki/Hardware`**

Hardware is the electronic and mechanical parts of the computer.

- *Storage Units*
- *Input Units*
- *Output Units*
- *Process Units*

Parts of a Digital Computer

Storage Units

These are used in both input and output of data:

- HDD ("Hard Disk Drive")
  – high capacity, relatively cheap, slow.
- SSD ("Solid State Drive")
  – high capacity, relatively expensive, fast.
- RAM ("Random Access Memory")
  – low capacity, expensive, but very fast.

- Others:
  Flash memory (memory cards, USB flash drives), CD, DVD...

Parts of a Digital Computer

Input Units

Used for input of data:

- Keyboard,
- Mouse
- Touch screen/pad
- RAM,
- HDD
- Flash memory…

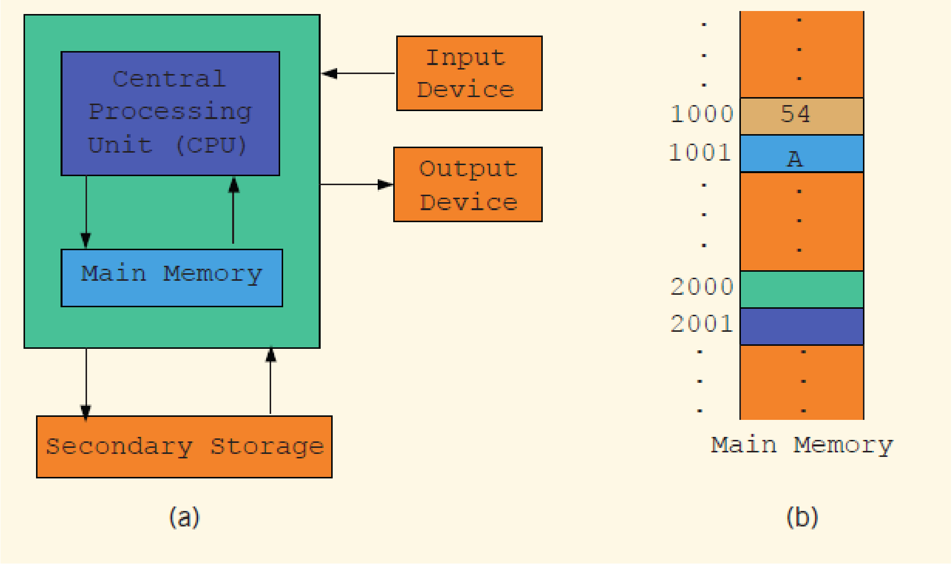
Parts of a Digital Computer

Output Units

Used for output of data:

- Monitor
- Printer
- Speaker
- RAM
- HDD
- Flash Memory

Parts of a Digital Computer



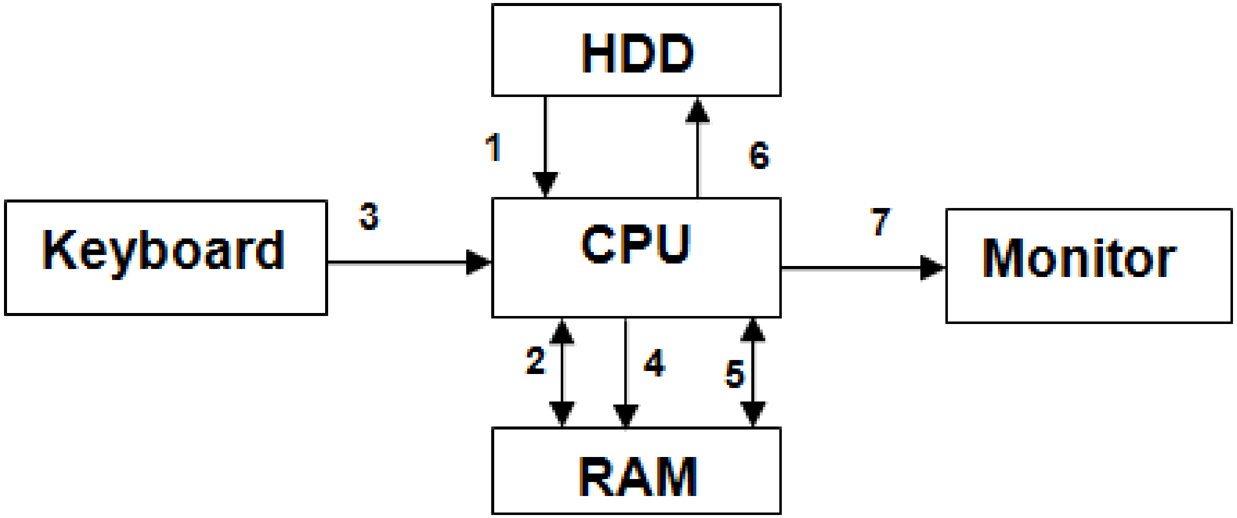
Process Units

CPU: Central Processing Unit

This coordinates the operation of computer system and performs arithmetic logic operations.

- Main memory is an ordered sequence of <u>memory cells</u>
  - Each cell has a unique location in main memory, called the <u>address</u> of the cell
- Each cell can contain either a programming instruction or data

Parts of a Digital Computer



Data inputs from a keyboard(3) which is again stored in RAM(4).

The CPU operates on the program and data in RAM(5) and outputs results to the HDD(6) as well as the monitor(7).

This is all controlled by the CPU requiring only basic data flow instructions from the programmer.

Parts of a Digital Computer

Software (=Yazılım)

See **`http://en.wikipedia.org/wiki/Software`**

Software consists of programs loaded from storage units. The programs execute on the computer hardware forming, for example,

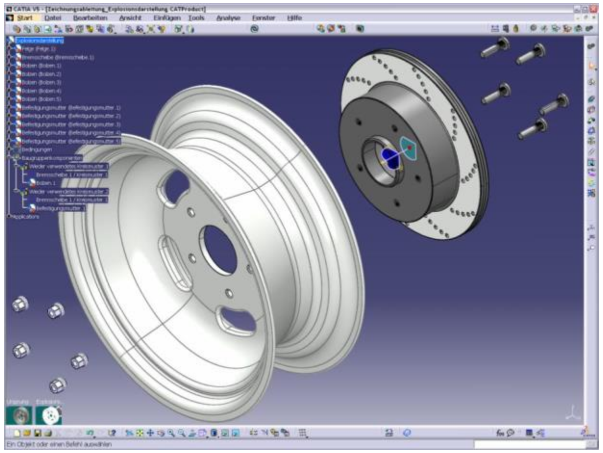
- *Operating System (OS)*
- *Compilers*
- *Application Programs*
- …

An Engineer and Computers

Engineers use computers extensively

- to produce and analyze designs;
- to simulate and test how a machine, structure, or system operates;
- to generate specifications for parts;
- to monitor the quality of products; and
- to control the efficiency of processes

Courtesy of BMW


CATIA V5 - [Zeichnungsableitung_Explosionsdarstellung.CATProduct]
Start
Datei
Bearbeiten
Ansicht
Einfügen
Tools
Analyse
Fenster
Hilfe
Explosionsdarstellung
Ein Objekt oder einen Befehl auswählen

The Language of a Computer

- Analog signals: continuous wave forms
- Digital signals: sequences of 0s and 1s
- Machine language: language of a computer; a sequence of 0s and 1s
- Binary digit (bit): the digit 0 or 1
- Binary code (binary number): a sequence of 0s and 1s

The Language of a Computer (cont'd.)

- Byte:
  - A sequence of eight bits
- Kilobyte (KB): 2^{10} bytes = 1024 bytes
- ASCII (American Standard Code for Information Interchange)
  - 128 characters
  - A is encoded as 1000001 (66th character)
  - 3 is encoded as 0110011

The Evolution of Programming Languages

- Early computers were programmed in machine language
- To calculate `wages = rate * hours` in machine language:

```
100100 010001     //Load

100110 010010     //Multiply

100010 010011     //Store
```

Computer Languages

Language	Application Area	Origin of Name
Fortran	Scientific programming	**For**mula **tran**slation
COBOL	Business data processing	**Co**mmon **B**usiness-**O**riented **L**anguage
Lisp	Artificial intelligence (AI)	**Lis**t **p**rocessing
C	Systems programming	Predecessor language was named B
Prolog	Artificial intelligence	Logic programming
Ada	Real-time distributed systems	*Ada Augusta Byron collaborated with* nineteenth-century computer pioneer Charles Babbage
Smalltalk	Graphical user interfaces; object-oriented programming	Objects "talk" to one another via messages
C++	Supports objects and object-oriented programming	Incremental modification of C (++ is the C increment operator)
Java	Supports Web programming	Originally named "Oak"

Operating System (OS)

The OS is a program written to interface between the computer and it's user. All other software runs under the OS.

Examples are:

Miscrosoft Windows (XP, Vista, 7)

Linux (e.g. Redhat, Ubuntu, Pardus)

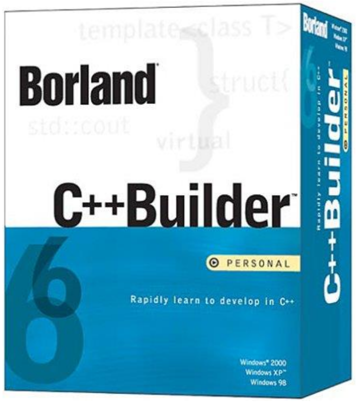
Mac OS X.

Compilers

Many programming languages require a compiler to translate the statements of program written in a high level language into a low level language (machine code).

In this course we will use Dev C++ compiler to obtain the executable forms of our programs.

Ms. Visual Studio and Borland C++ can also be used for compiling our C++ programs



Application Programs

These are (usually compiled) programs written to perform a specific task.

Examples are:

Microsoft Word

AutoCAD,

SolidWorks

Catia

ANSYS

DS
CATIA
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Why Use a Language Like C++?

At its core, a computer is just a processor with some memory, capable of running tiny instructions like "store 5 in memory location 23459."

Why would we express a program as a text file in a programming language, instead of writing processor instructions?

The advantages:

1. Conciseness: programming languages allow us to express common sequences of commands more concisely. C++ provides some especially powerful shorthands.

2. Maintainability: modifying code is easier when it entails just a few text edits, instead of rearranging hundreds of processor instructions. C++ is object oriented, which further improves maintainability.

3. Portability: different processors make different instructions available. Programs written as text can be translated into instructions for many different processors; one of C++'s strengths is that it can be used to write programs for nearly any processor.

C++ is a high-level language: when you write a program in it, the shorthands are sufficiently expressive that you don't need to worry about the details of processor instructions. C++ does give access to some lower-level functionality than other languages (e.g. memory addresses).

General Notes on C++

C++ is immensely popular, particularly for applications that require speed and/or Access to some low-level features. It was created in 1979 by Bjarne Stroustrup, at first as a set of extensions to the C programming language. C++ extends C; our first few lectures will basically be on the C parts of the language.

Everything in C++ is case sensitive: **someName** is not the same as **SomeName**