EP241 Computer Programming

Topic 1

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Department of Electric and Electronics Engineering

Sep 2016

Content of Topic 1

- **Introduction to course**
- **Introduction to Computers**
- **Introduction to Programming**

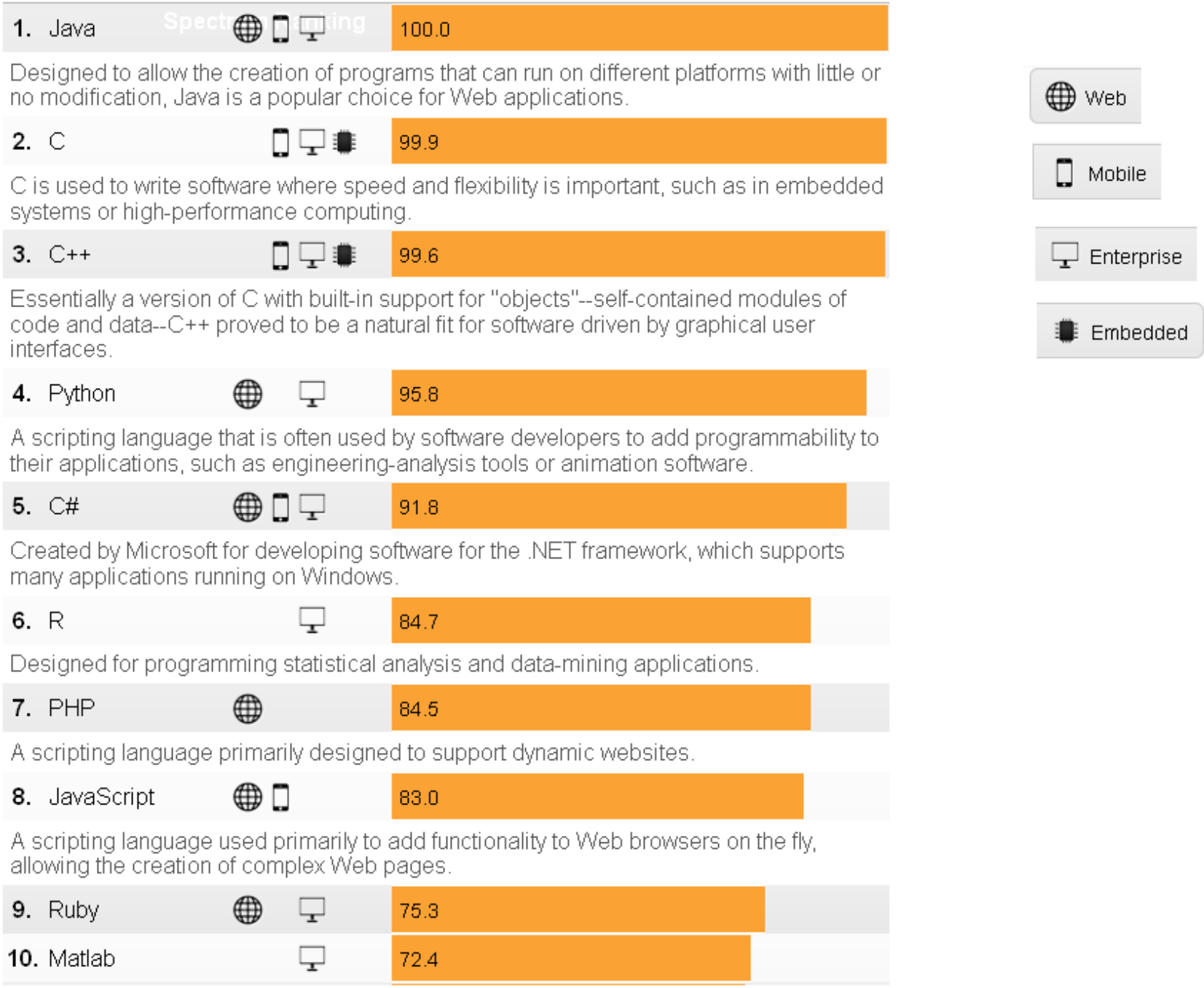

Ruby
Python
C++
JavaScript
Programming
Languages
R
C#
C
Matlab
PHP
Java

Introduction

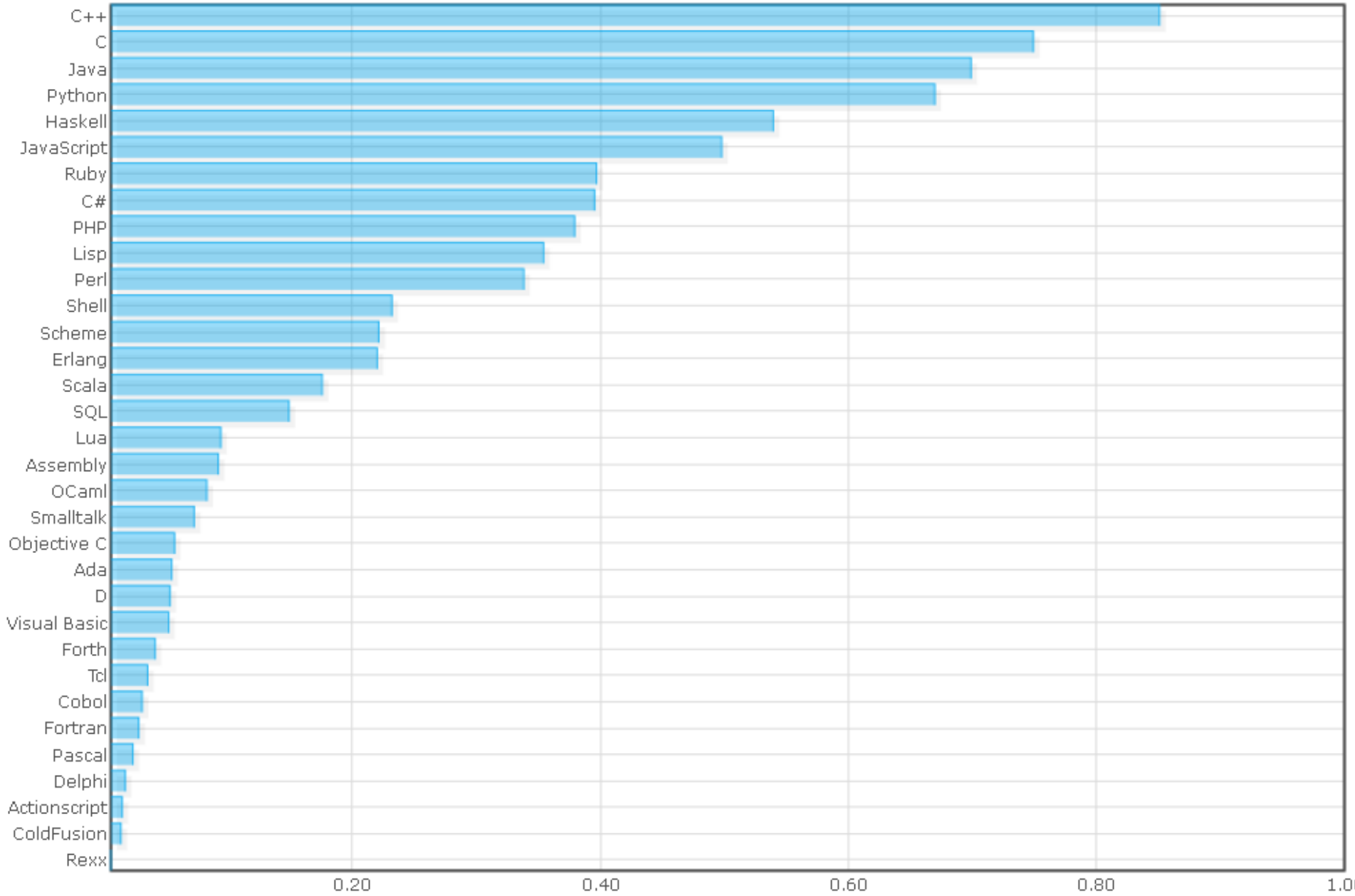
- *Computer programming* is an essential part of the work of many scientists and engineers.

- **This semester we will teach C++ Programming Language**
  - C++ is used to write software where speed and flexibility is important
  - C++ is good at embedded systems or high-performance computing
  - C++ has has a lot of technical programming details
  - C++ is mostly prefered by engineers and young programmers!

http://spectrum.ieee.org/static/interactive-the-top-programming-languages-2015



http://langpop.com

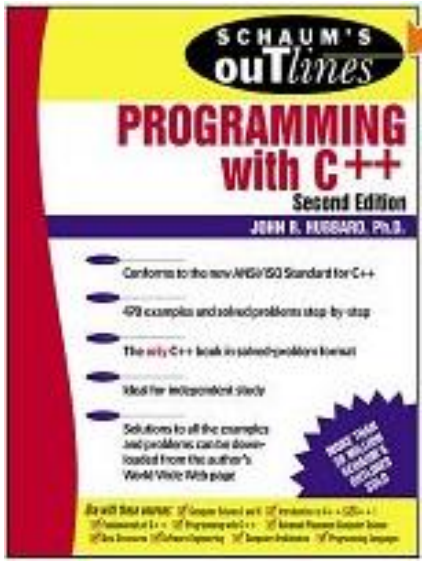


THE COURSE

Web Resources for the Course

- **Course web page (for Exam questions and results)**
  http://www.gantep.edu.tr/~bingul/ep241
- **University of Gaziantep C++ resource page**
  cpp.gantep.edu.tr
  - Tutorials, Sample Programs, Howtos
- **C++ Resources Network:**
  www.cplusplus.com
- **C++ Reference:**
  www.cppreference.com
- **Türkçe 'C Programlama Dili'ne Giriş':**
  www.gantep.edu.tr/~bingul/c
- **Also search *Google* and *Wikipedia* for any of the expressions used in this course.**

The Course Books

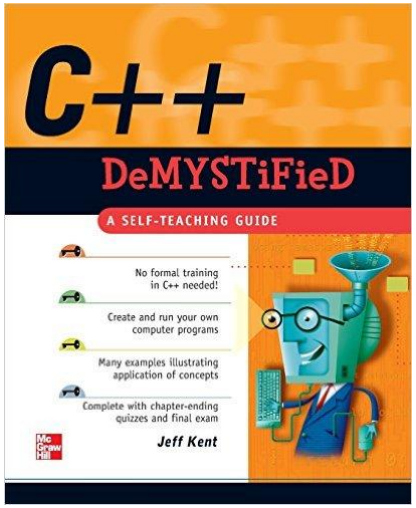


Programming with C++

John R. Hubbard

Schaum Outline Series (2000)

~ 15 $



C++ Demistified

Jeff Kent

McGrawHill (2004)

~ 15 $

The Course Content

- Introduction to Programming and C++
- Structure and Basics of C++
- Control Structures: Selection & Loops
- Functions
- Arrays
- References & Pointers
- Dynamic Arrays and Vectors
- File Processing
- Basic Classes (and intoduction to OOP)
- Processing

Lectures, Labs, Attendance, Exams

- **Mondays**

  three-hour lecture

  13:30-16:30

- **Fridays**

  two-hour programming session in BIM labs

  08:30-10:30

- **Attendance**

  You must attend <u>at least 50%</u> of the course

- **Exams**

  All *written exams*

  - **Attendance** **10%** **Weakly**
  - **Quiz** **20%** **Weakly**
  - **Mid-term** **30%**
  - **Final** **40%**

Grading

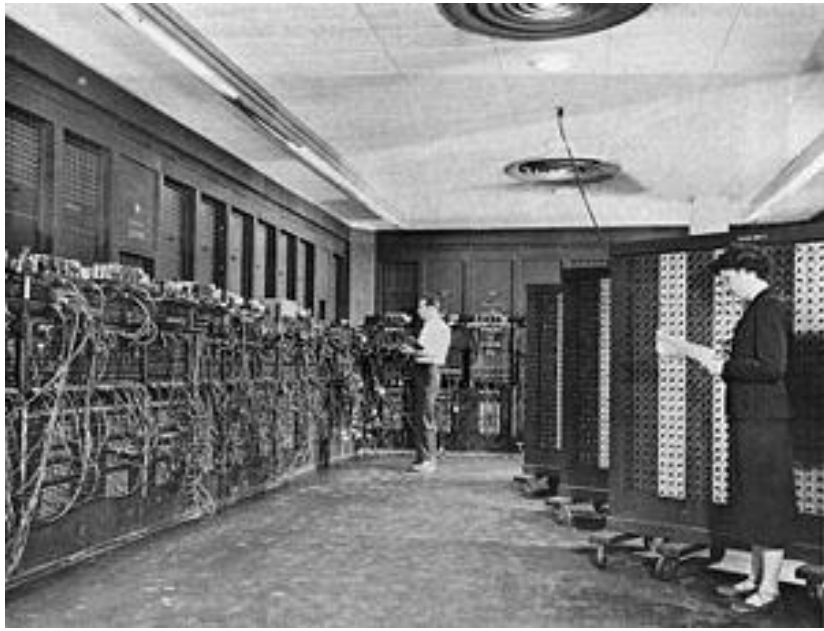
Independent from the arithmetic mean of the class, the following rules will be applied:

- **00 – 19 >> FF**
- **20 – 29 >> FD**
- **30 – 39 >> DD**
- **40 – 49 >> DC**
- **50 – 59 >> CC**
- **60 – 66 >> CB**
- **67 – 74 >> BB**
- **75 – 84 >> BA**
- **85 – 99 >> AA**

THE COMPUTER

The Computer

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



- A computer is a machine that manipulates data according to a set of instructions.
- 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.

The 5 MB Hard Disk of by IBM (1956)

the 10-Megabyte Computer System

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- 28-Amp Power Supply
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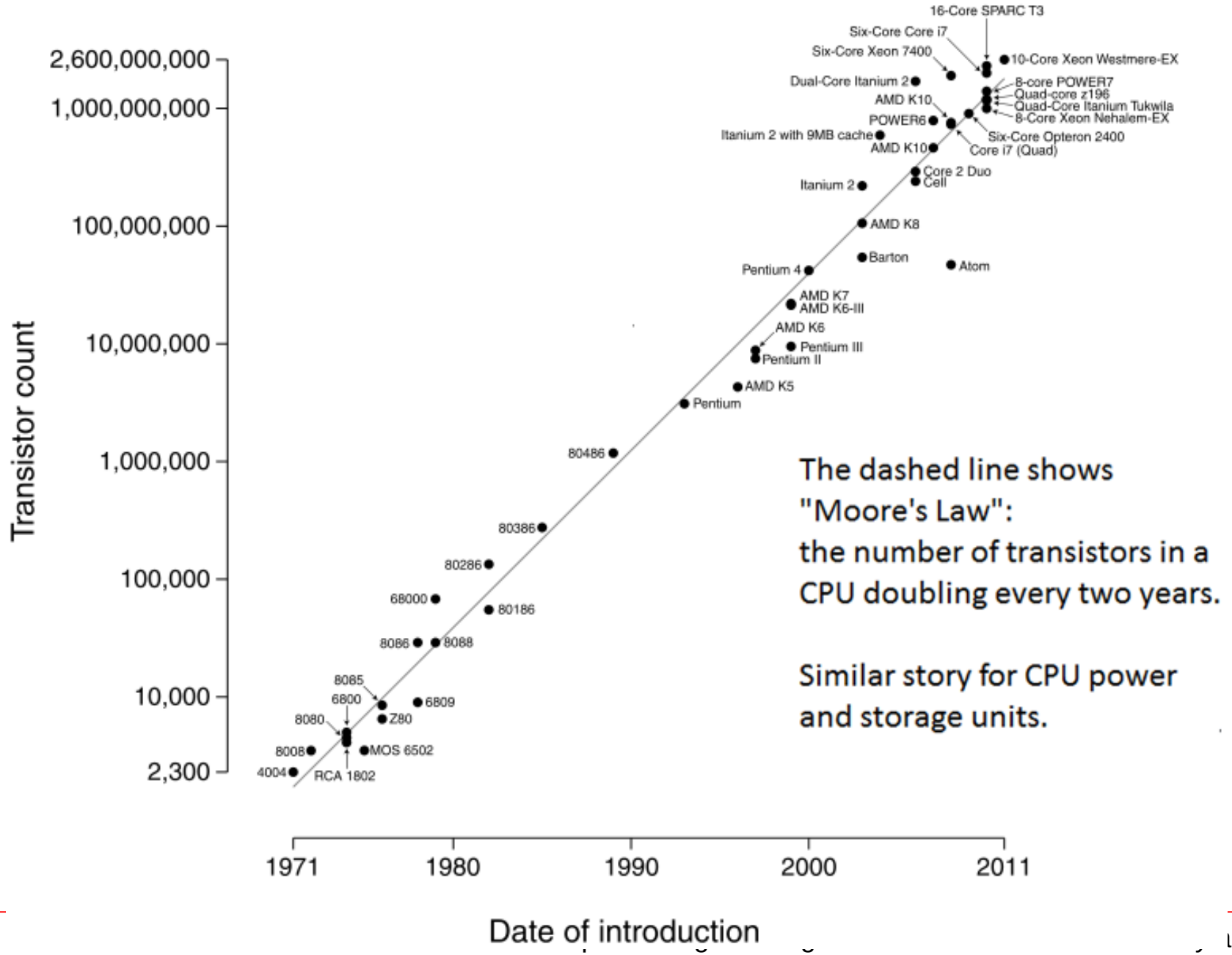
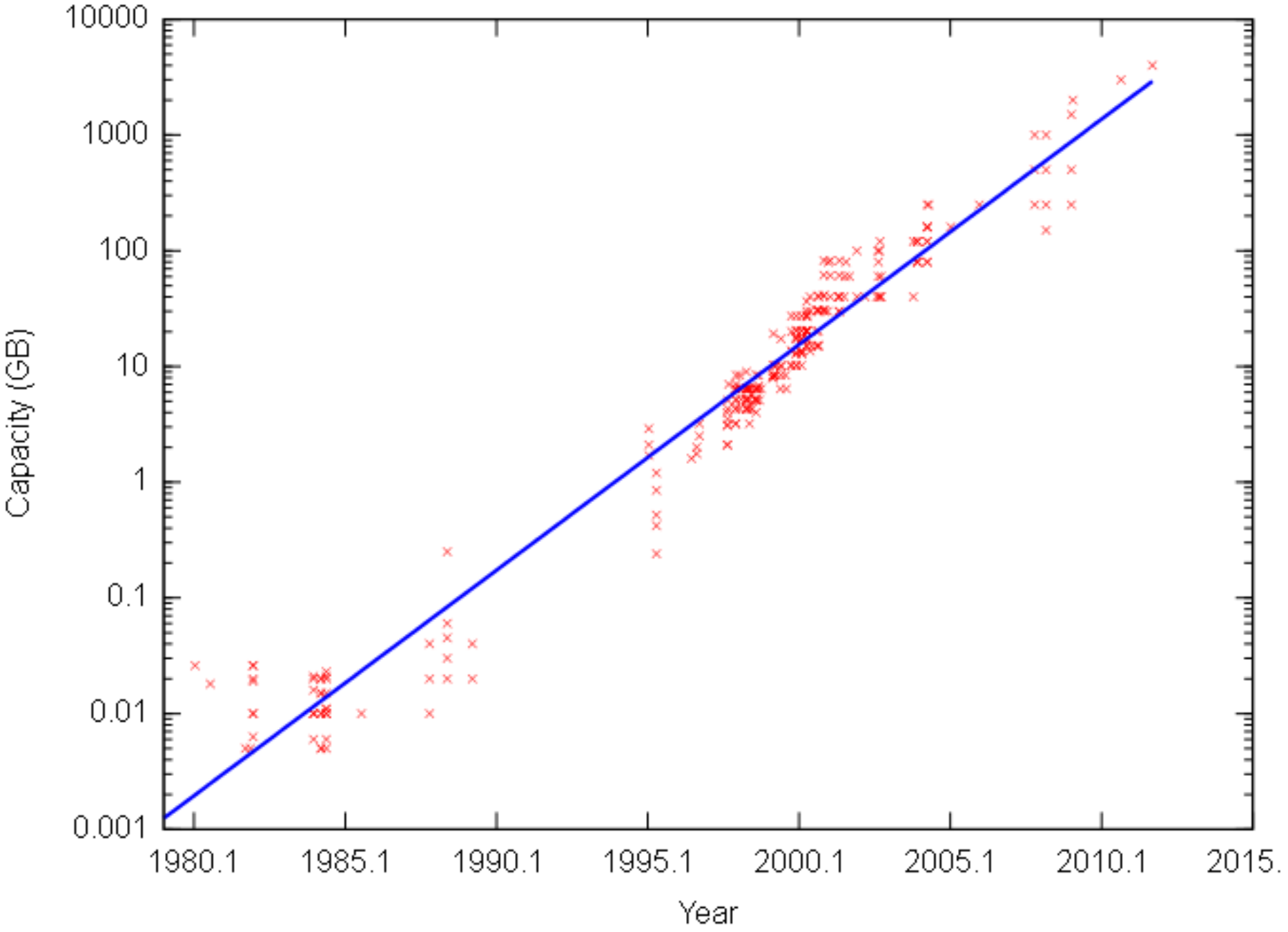
Microprocessor Transistor Counts 1971-2011 & Moore's Law




10000
1000
100
10
1
0.1
0.01
0.001
Capacity (GB)
1980.1
1985.1
1990.1
1995.1
2000.1
2005.1
2010.1
2015.
Year

Parts of a Digital Computer

A computer can be divided into two main parts:

Hardware and *Software*.

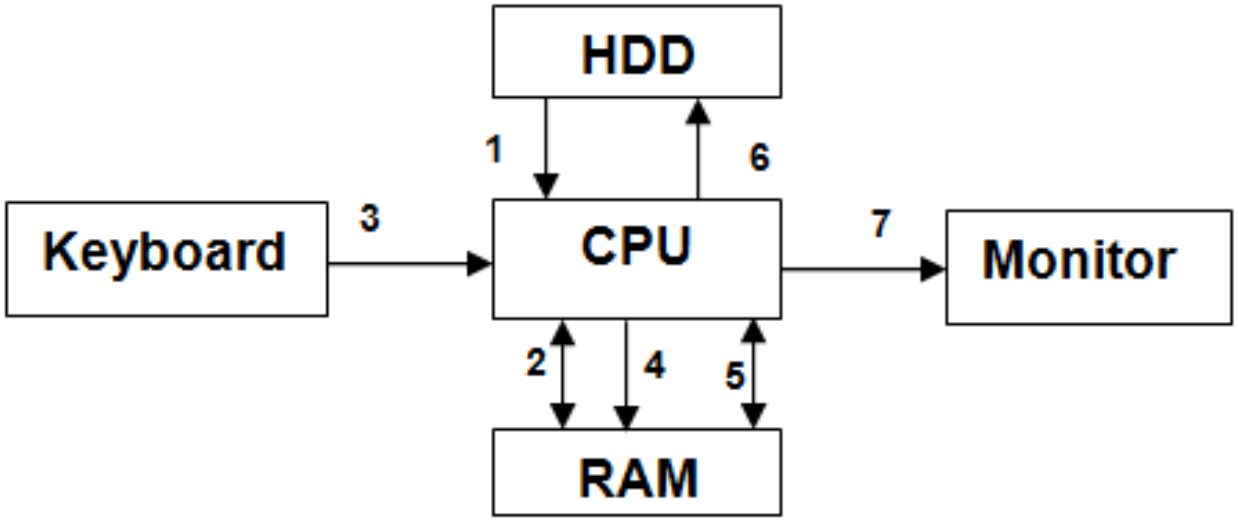
Hardware (=Donanım)

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



A program is input from an HDD(1) and executed in RAM(2).

Data is input 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*
- *…*

Parts of a Digital Computer

Compilers

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

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

Examples are:

Fortran

C

C++

Java

Pascal

Basic….

INTRODUCTION TO PROGRAMMING

Computer Programming

See **http://en.wikipedia.org/wiki/Computer_programming**

Computer programming (coding) is the process of

- writing,
- testing / debugging
- maintaining

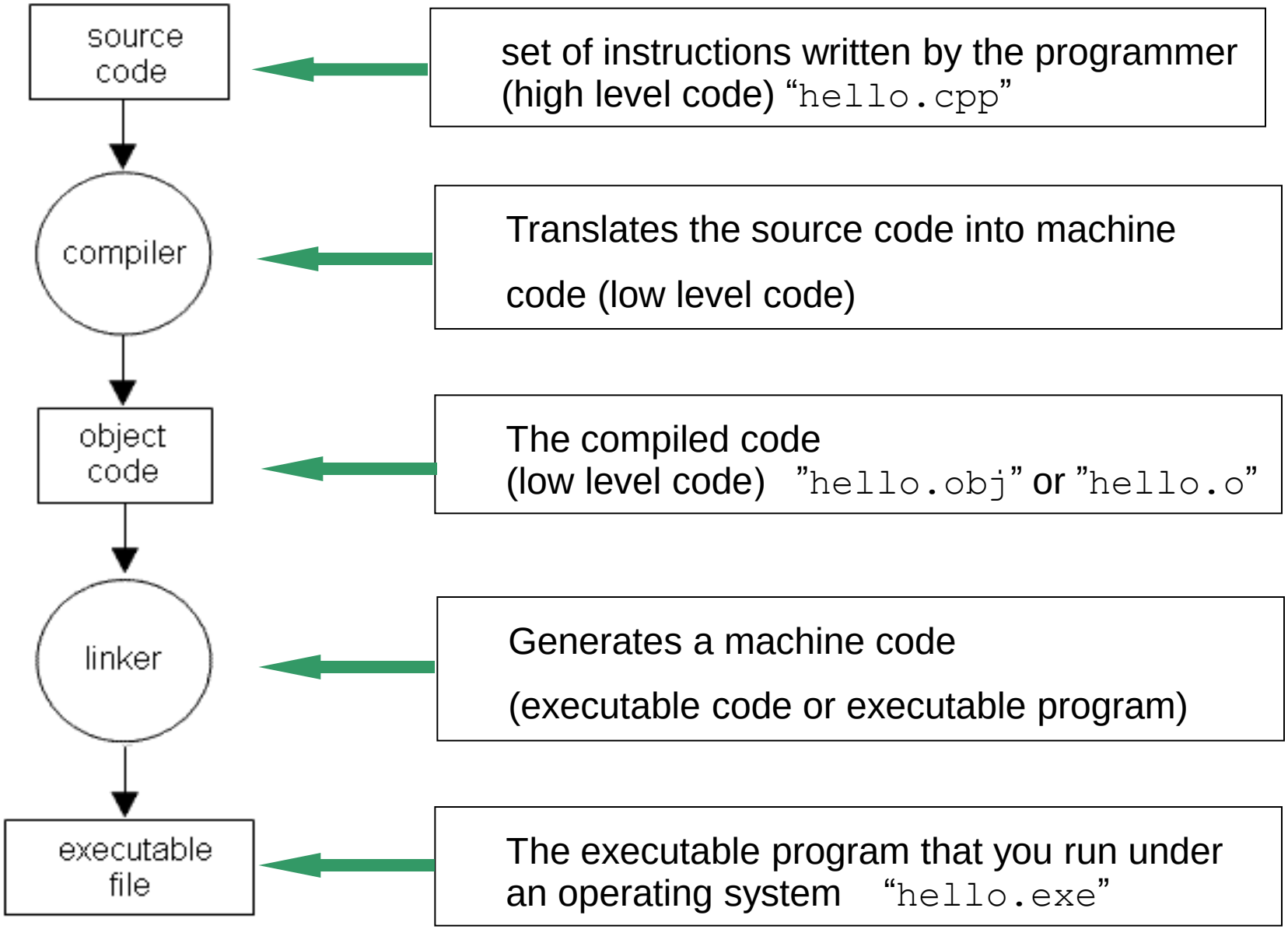
the source code of computer programs.

The source code is written in a programming language, e.g.

```
// A simple C++ program
#include <iostream>

int main(){
  cout << "Hello World!\n";
  return 0;
}
```

Generating an Executable File



Problem Solving with Computers

Problem solving with computers involves several steps:

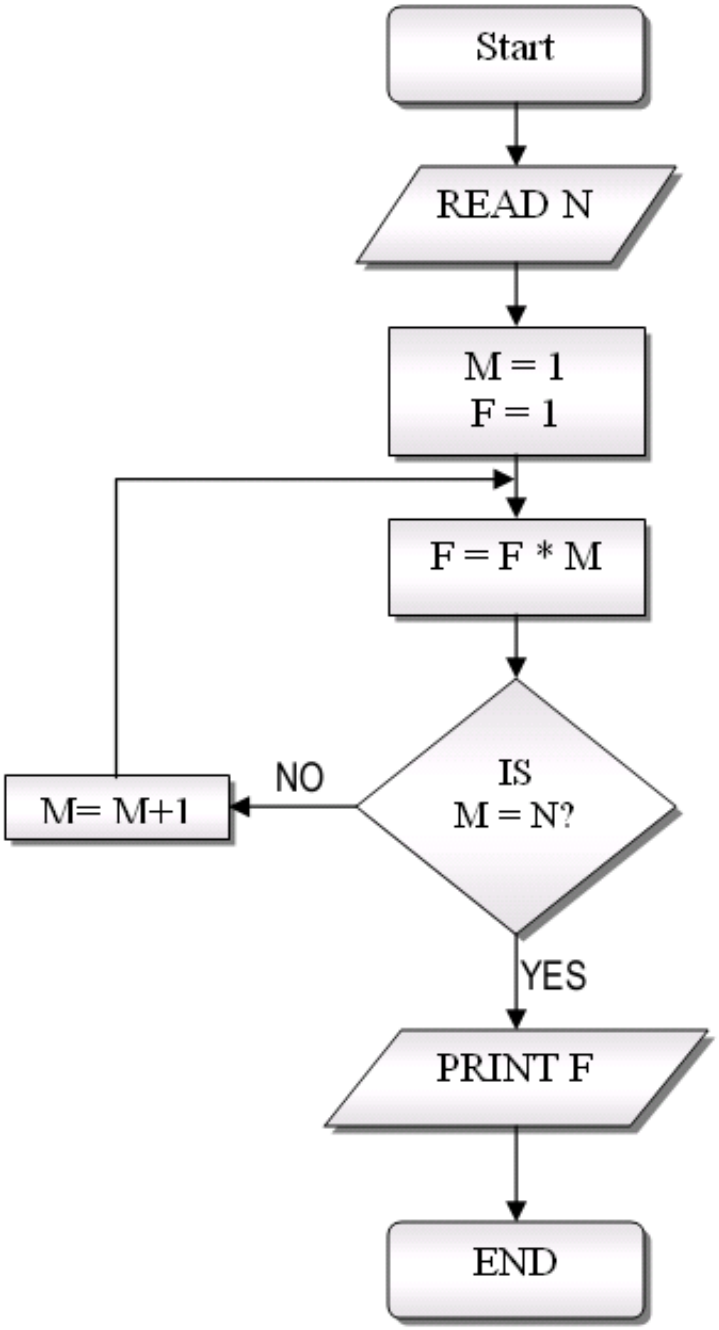
1. Clearly define the problem
2. Analyse the problem and formulate a method to solve it
3. Describe the solution in the form of an algorithm.
4. Draw a flowchart of the algorithm
5. Write the computer program
6. Compile and run the program (debugging)
7. Test the program (debugging)
8. Interpretation of results

Algorithms & Flow Charts

- **Algorithm**
  gives a step-by-step description of the solution

```
S1: Start
S2: Input N
S3: Set M = 1 and F = 1
S4: Set F = F*M
S5: If M = N GOTO S7
S6: Set M = M + 1 and GOTO S4
S7: Output F
S8: End
```

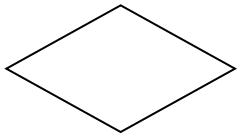
- **Flow chart**
  gives the logical flow of the solution in a diagrammatic form.



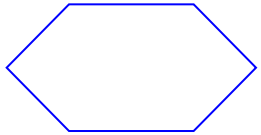
Beginning or end of an algorithm

Input or output of information

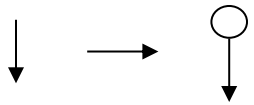
A computation



Decision making



The beginning of the repetition structure.



The direction of flow of the algorithm.

Circles with arrows connect the flowchart between pages.

Pro.gram.mer (noun)

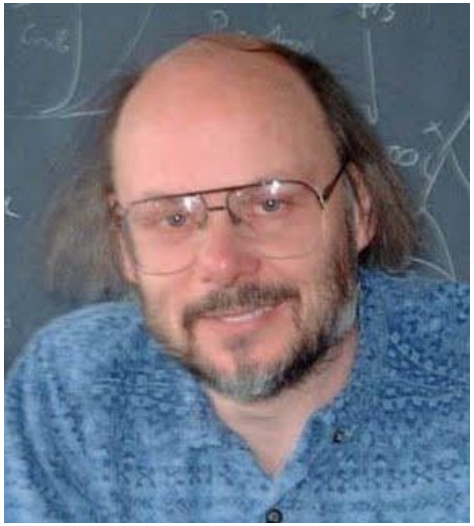
An organism that converts caffeine into code.

FIRST C++ PROGRAM

What is C++?

See **`http://en.wikipedia.org/wiki/C++`**

- **C++** (pronounced "C plus plus")
  - is a general-purpose and middle-level programming language
  - is an enhancement to C
  - was developed by Danish computer scientist **Bjarne Stroustrup** in 1979 (called C with Classes) at Bell Labs (named C++ in 1983)



C++ Standards

- C++ is standardized by an ISO working group known as JTC1 / SC22/WG21.

- First ratified in 1998 ISO/IEC 14882:1998

Year	C++ Standard	Informal name
1998	ISO/IEC 14882:1998[16]	C++98
2003	ISO/IEC 14882:2003[17]	C++03
2011	ISO/IEC 14882:2011[7]	C++11
2014	ISO/IEC 14882:2014[18]	C++14
2017	to be determined	C++17
2020	to be determined	C++20[13]

A First C++ Program

```
// First C++ program
#include <iostream>
using namespace std;

int main()
{
    cout << "Hello World!";
    return 0;
}
```

Program source file name: `hello.cpp`

In general, C++ files have extentions:

`.cpp`, `.c++`, `.cxx`, `.cc`

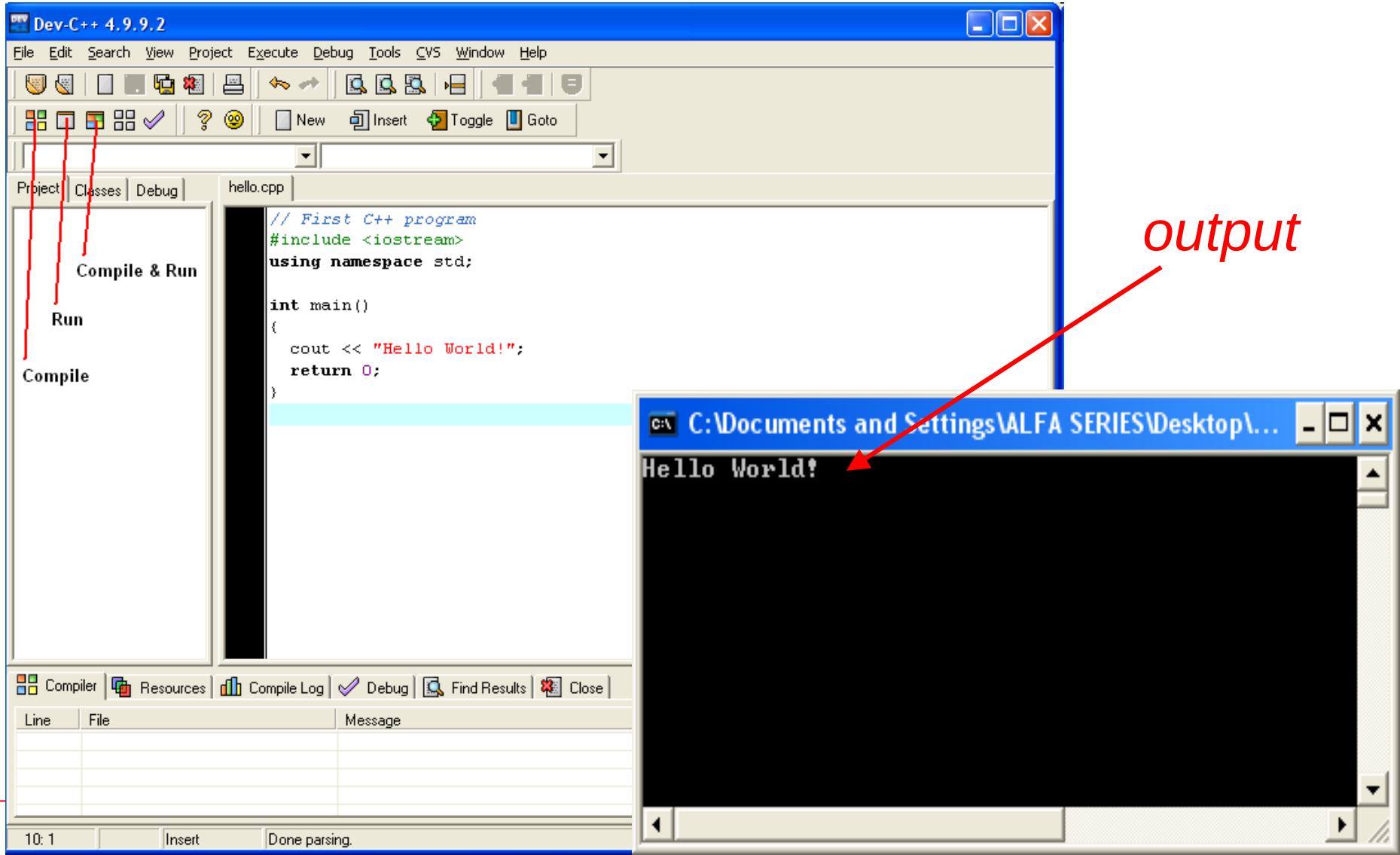
```
1: // First C++ program
2: #include <iostream>
3: using namespace std;
4:
5: int main()
6: {
7:     cout << "Hello World!";
8:     return 0;
9: }
```

- **Line 1:** Lines starting with **//** are considered as comment.
- **Line 2:** Lines starting with **#** are directives for preprocessor **#include <iostream>** tells the compiler to include the **iostream** file containing declarations of basic input output.
- **Line 3:** All elements (variables, objects, ...) of C++ library declared in **std namespace**. **cout** is the part of **std** namespace.
- **Line 4:** An empty line does nothing but helps readability.
- **Line 5:** Actual program, program starts with **main()** function.
  Each C++ program must have only one **main()** function.
  The beginning and end of the **main()** block is indicated by braces **{ }**.
- **Line 7:** Outputs "**Hello World**" to the user screen.
- **Line 9:** return statement terminates the function (here main program).
  return 0 sends a message to OS: "program ends without an error"

Compile and Run

We will use Dev-C++ compiler

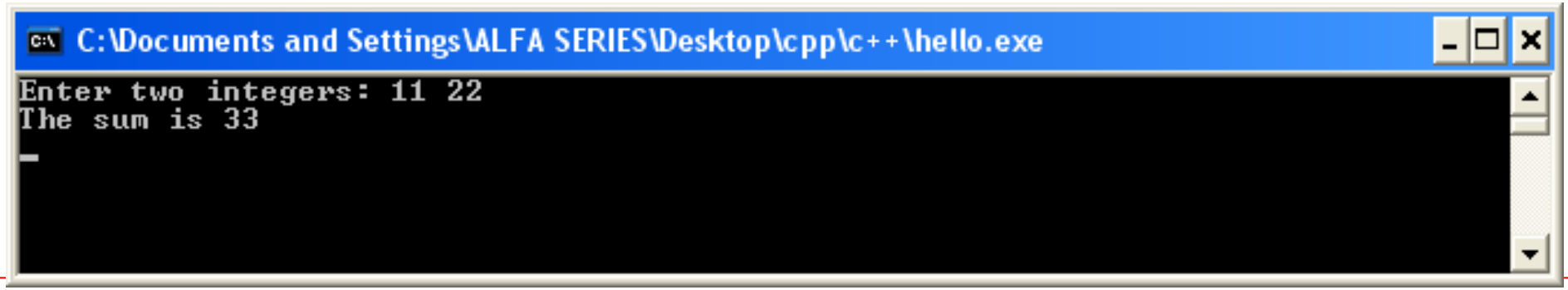
http://www1.gantep.edu.tr/~cpp/howto-compileDev-C++.php



Our Second C++ Program

```
// Calculates the sum of two integers
#include <iostream>
using namespace std;


int main() {
   int a, b, total;
   cout << "Enter two integers: ";
   cin  >> a >> b;
   total = a + b;
   cout << "The sum is " << total << endl;
   return 0;
}
```



Standard Input and Output (I/O)

- The standard C++ library includes the header file **`iostream`**, where the input and output stream objects are declared.
  - **`cout`** to output data to the *screen*
  - **`cin`** to input data from the *keyboard*.

*This specific file (**`iostream`**) can be found usually under the folder:*

for Linux (GCC) ***`/usr/include/`***

for Windows (Dev-C++) ***`C:\Dev-Cpp\include\`***

Standard Input and Output (I/O)

- **Basic Output**

```
cout << "Hello World!";          Outputs: Hello World!
cout << "Hello " << "World!";    Outputs: Hello World!
cout << 1453;                    Outputs the number: 1453
cout << x;                       Outputs the content of: x
```

- **Line break on output**

```
cout << "University of ";          outputs:
cout << "Gaziantep";                University of Gaziantep

cout << "University of\n ";         University of
cout << "Gaziantep";                Gaziantep

cout << "University of " << endl;   University of
cout << "Gaziantep";                Gaziantep
```

Standard Input and Output (I/O)

- **Basic Input**

`cin >> a;` reads a variable from keyboard to a variable `a`

`cin >> a >> b;` reads variables from keyboard to `a` and `b`

```
// Calculates the product of two integers
#include <iostream>
using namespace std;

int main()
{
  int a, b, p;
  cout << "Enter two integers: ";
  cin >> a >> b;
  cout << "The product is " << a*b << endl;
}
```

Standard Input and Output (I/O)

If you remove the line "`using namespace std;`" then the source code on the previous pages needs modifying as follows:

```
// Calculates the product of two integers
#include <iostream>


int main()
{
  int a, b, p;
  std::cout << "Enter two integers: ";
  std::cin >> a >> b;
  std::cout << "The product is " << a*b << std::endl;
}
```

Exercises

1. What is a compiler?
2. What is the difference between the compiler and the preprocessor?
3. Why is the function main() special?
4. What are the two types of comments, and how do they differ?
5. Write the smallest program that can be compiled, linked, and run.

6. Why does the following program fail?

```
#include <iostream>
using namespace std;
int main() {
   cout << Is there a bug here?";
}
```

7. Explain why we use std:: in the following program. What is the the output of program?

```
#include <iostream>
int main() {
   std::cout << " ##  #   # " << std::endl;
   std::cout << "#   ### ###" << std::endl;
   std::cout << " ##  #   # " << std::endl;
   return 0;
}
```

8. Write a program to input radius (an integer) of a sphere from keyboard and output its surface area and volume to the screen.