



EP578 Computing for Physicists

Topic 1

INTRODUCTION

*Department of
Engineering Physics
University of Gaziantep*

Course web page
www.gantep.edu.tr/~bingul/ep578



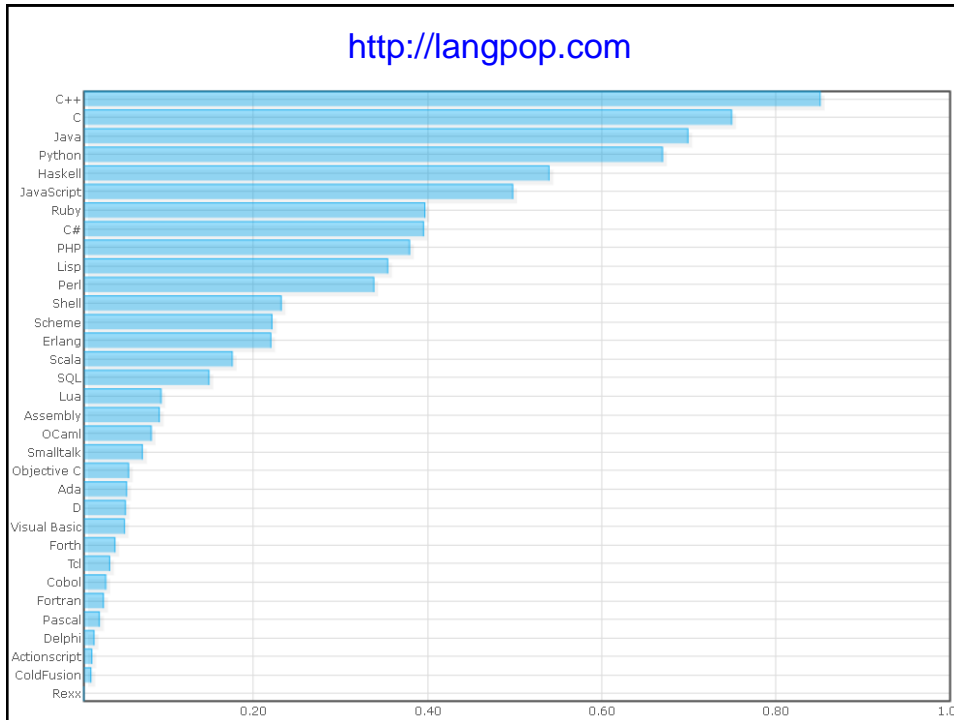
Sep 2011

Sayfa 1

1. Introduction

- The course is an introductory and intermediate level course in numerical and computational methods in Physics.
- You will learn some Physics Simulations and Analysis via C++ and ROOT programs.

Sayfa 2



- **Computer programming** is an essential part of the work of many scientists and engineers.
- **We will teach C++ Programming Language & ROOT which**
 - is not easy to learn (compared to Fortran)
 - has a lot of technical programming details
 - is good at system and hardware programming
 - is mostly preferred by engineers and young programmers!
 - is widely used in the software industry & HEP & NP
- **We will use Linux Operating System (Ubuntu Dist.)**

2. Web Resources for the Course

- Course web page
www.gantep.edu.tr/~bingul/ep578
- University of Gaziantep C++ resource page
cpp.gantep.edu.tr
- C++ Resources Network:
www.cplusplus.com
- C++ Reference:
www.cppreference.com
- Türkçe 'C Programlama Dili'ne Giriş':
www.gantep.edu.tr/~bingul/c
- ROOT – Object oriented Data Analysis Framework
root.cern.ch

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3. Course Content

- Introduction to Programming
- History of C++
- Structure and Basis of C++
- ROOT program
- Monte Carlo Methods
- Simulations of Physical Systems
e.g. Radiative and particle decays, Cross-sections,
Probability distributions, ...

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4. Marking / Grading

- Homeworks %70
- Final %30

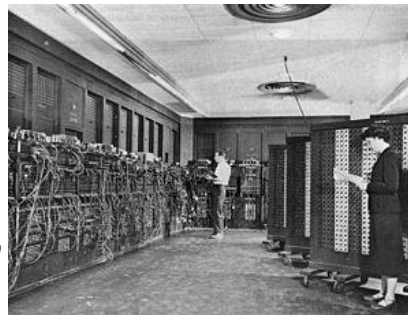
- 70 CC
- 75 CB
- 80 BB
- 85 BA
- 90+ AA

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5. 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.

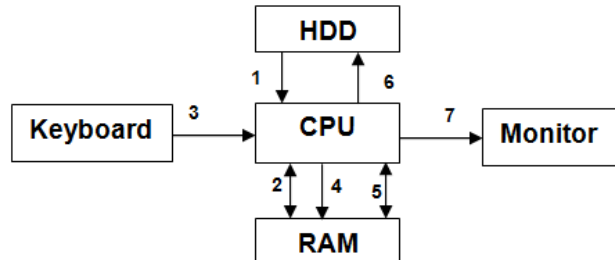


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6. Parts of a Digital Computer

A computer can be divided into two main parts:

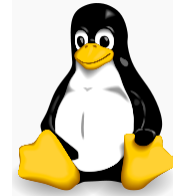
- **Hardware (=Donanim):** electronic and mechanical parts.
Storage Units, Input Units, Output Units, Process Units



- **Software (=Yazılım):** all programs running
 - Operating System (OS)
 - Compilers
 - Application Programs

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7. Linux Operating System



- Wikipedia says:
“Linux is a computer operating system which is based on free and open source software. Although many different varieties of Linux exist, all are Unix-like and based on the Linux kernel, an operating system kernel created in 1992 by Linus Torvalds.”
- Linux can be installed on a wide variety of computer hardware, ranging from
 - mobile phones, tablet computers, routers and video game consoles,
 - to
 - desktop/laptop computers, mainframes and supercomputers.

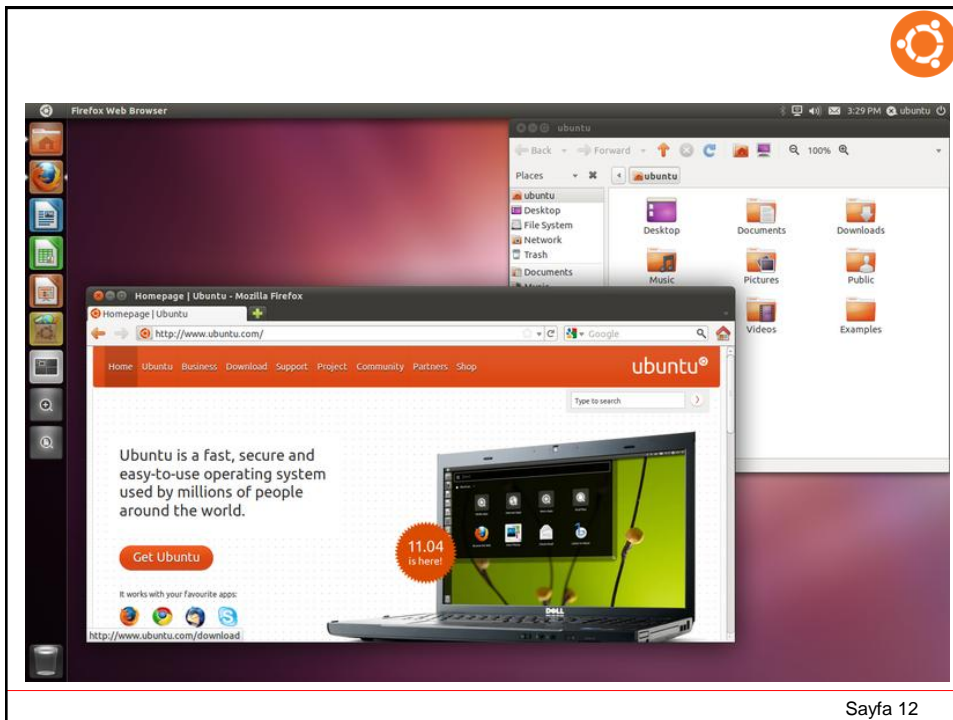
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8. Ubuntu



- Wikipedia says:
“Ubuntu is a computer operating system based on the Debian GNU/Linux distribution and distributed as free and open source software. It is named after the Southern African philosophy of Ubuntu (humanity towards others).”
- <http://www.ubuntu.com>

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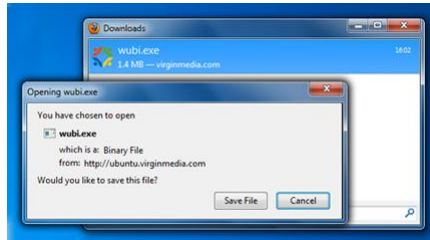
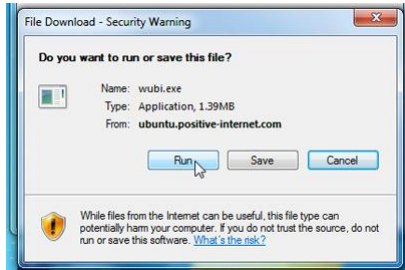


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Download

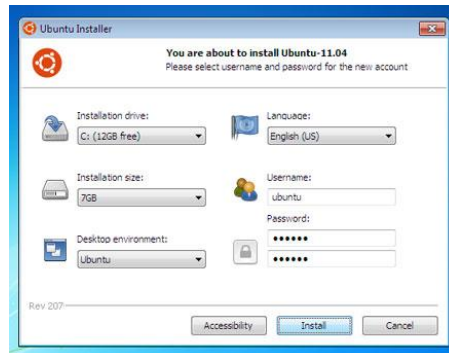


- Go to:
<http://www.ubuntu.com/download>
- Select Run it with Windows and run wubi.exe

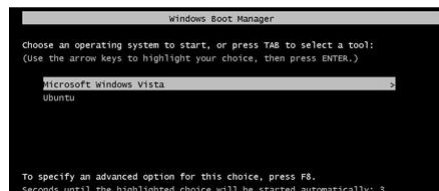


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Install



- After your computer restarts:



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Uninstall



1. Re-run **wubi.exe**
2. click on **Remove** button

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9. Computer Programming

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

Computer programming (coding) is the process of

- writing,
- Testing / debugging / troubleshooting
- maintaining

the source code of computer programs.

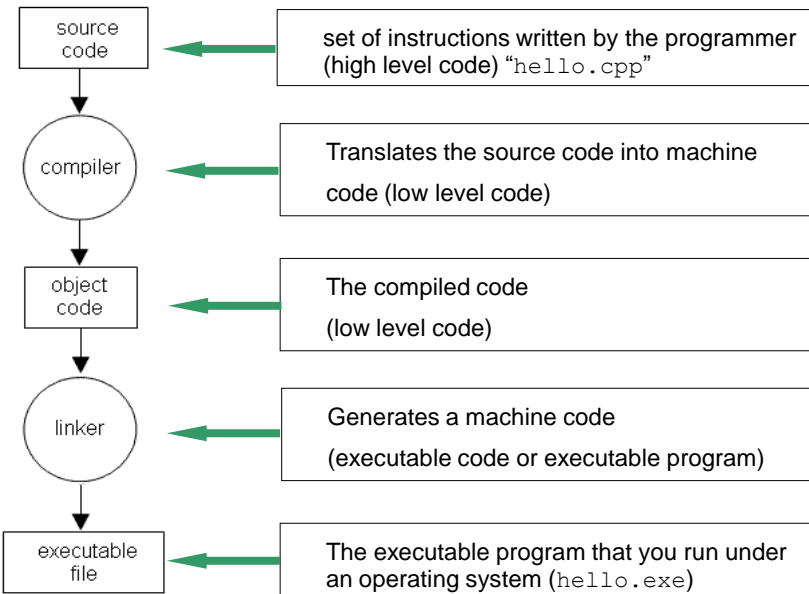
The **source code** is written in a programming language, e.g.

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

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

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Generating an Executable File



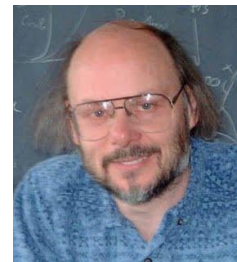
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10. What is C++?

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)
 - was ratified in 1998 ISO/IEC 14882:1998
 - and in 2003 ISO/IEC 14882:2003
- Recently, a revised ISO C++ standard, known informally as **C++0x** has been produced.



You can find a recent talk given by him at CERN:

<http://indico.cern.ch/conferenceDisplay.py?confId=67017>

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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`

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

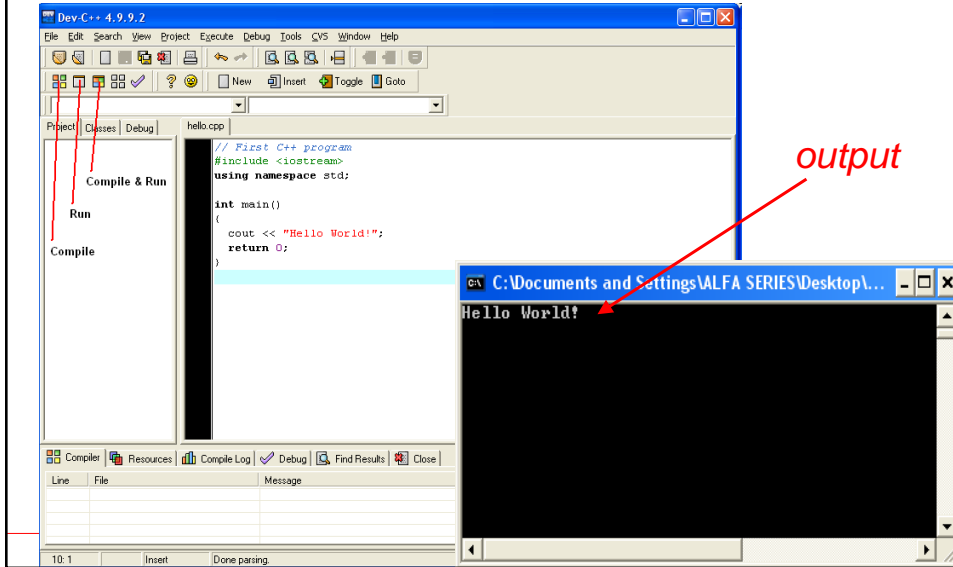
- **Line 1:** Lines starting with `//` are considered as comment.
- **Line 2:** Lines starting with `#` are directives for preprocessor `#include <iostream>` tells the compiler to include the `iostream` file containing declarations of basic input output.
- **Line 3:** All elements (variables, objects, ...) 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"

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Compile and Run

We will use Dev-C++ compiler

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



Compile and Run

We use g++ command in a Terminal



A Second 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;
}
```

```
Enter two integers: 11 22
The sum is 33
```

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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\`

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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
```

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Standard Input and Output (I/O)

Basic Input

```
cin >> a;           // reads variable a from keyboard
cin >> a >> b;      // reads variables a and b
```

```
// 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;
}
```

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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 sum of two integers
#include <iostream>

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

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11. Homeworks 1

Solve the following problems. You have to prepare a pdf document and sent it to me until next lecture.

E-mail: [bingul\[at\]gantep.edu.tr](mailto:bingul@gantep.edu.tr) (*replace [at] with @*)

1. Write a program named `triangle.cpp` to input the base b and height h of a right-angle triangle, and output its area.
2. Write a program named `circle.cpp` to input the radius r of a circle and output the circumference of the circle.
3. Write a program to input kinetic energy K in MeV of a free electron (with mass $m_e = 0.511 \text{ MeV}/c^2$) and outputs the momentum in MeV/c and de Broglie wavelength in nanometers of the electron. Use relativistic kinematics.

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