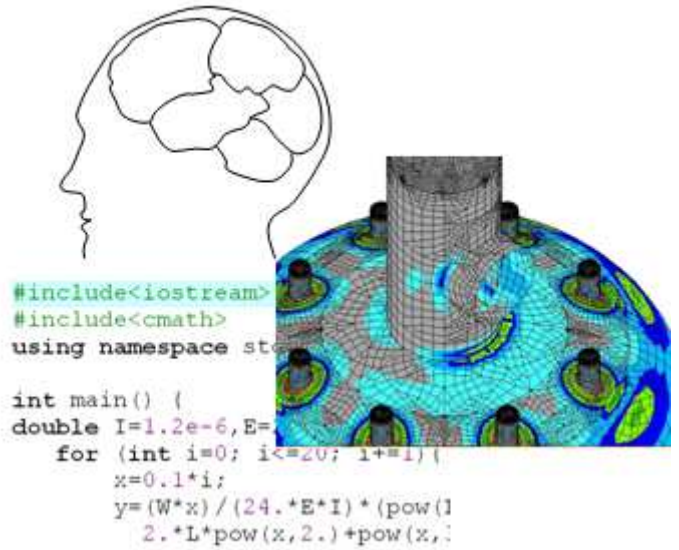
ME 240
Computation for
Mechanical
Engineering



Lecture 3

C++ Structure, and programming

Computer Programming

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

Computer programming (coding) is the process of

- writing,
- testing / debugging / troubleshooting
- maintaining

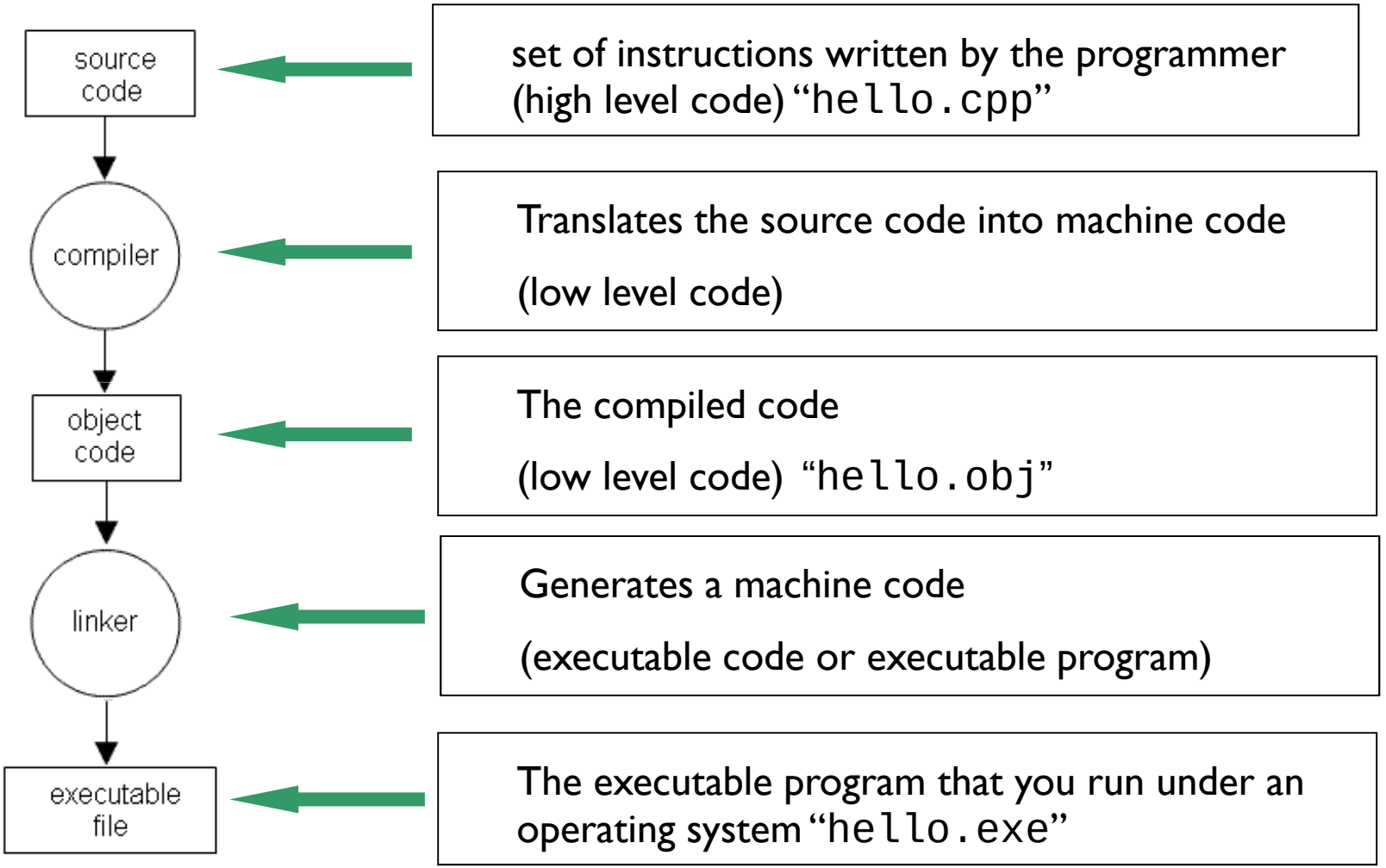
the source code of computer programs.

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;
}
```

Generating an Executable File



Problem Solving with Computers

Problem solving with computers involves several steps:

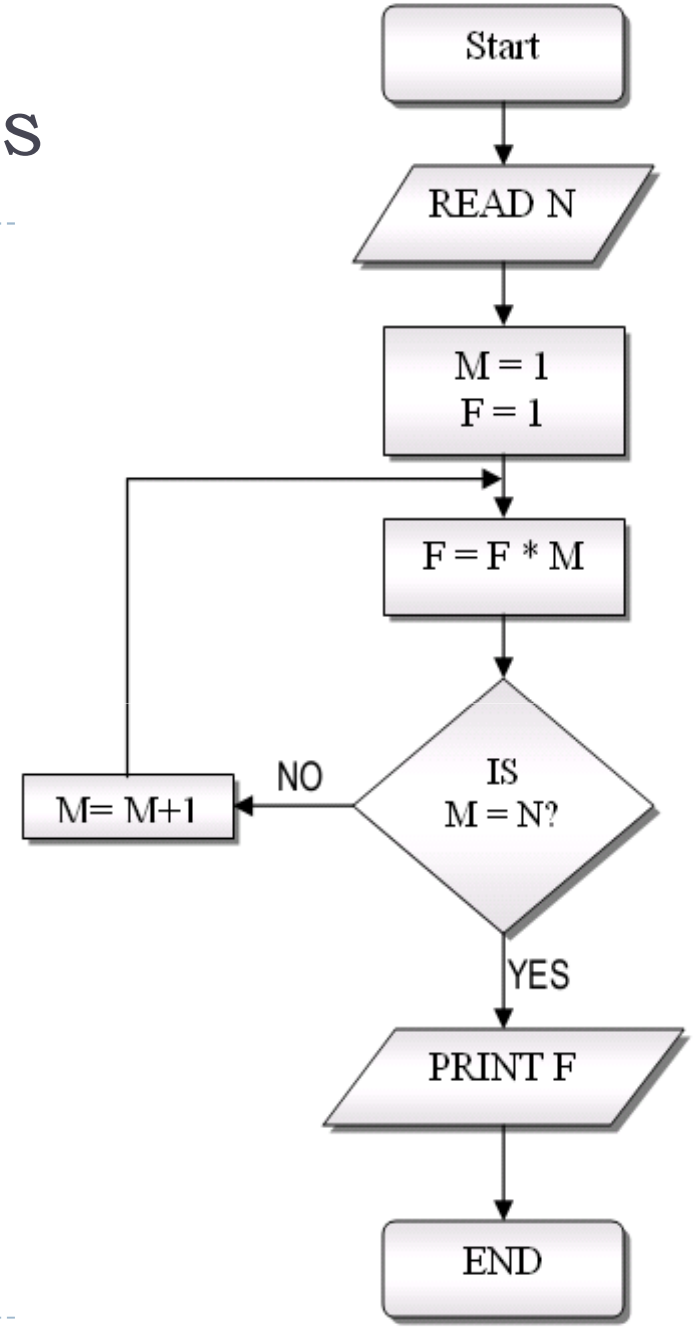
1. Clearly define the problem.
2. Analyse the problem and formulate a method to solve it.
3. Describe the solution in the form of an algorithm.
4. Draw a flowchart of the algorithm.
5. Write the computer program.
6. Compile and run the program (debugging).
7. Test the program (debugging).
8. Interpretation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

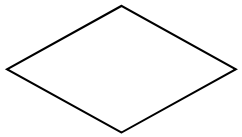
- **Flow chart**
  gives the logical flow of the solution in a diagrammatic form.



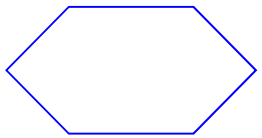
Beginning or end of an algorithm

Input or output of information

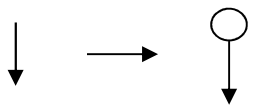
A computation



Decision making



The beginning of the repetition structure.



The direction of flow of the algorithm.

Circles with arrows connect the flowchart between pages.

What is C++?

C++ (pronounced "C plus plus")

- is a general-purpose and middle-level programming language
- supports procedural programming, object-based programming, object-oriented programming, generic programming and functional programming
- 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.

Our First C++ Program

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

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

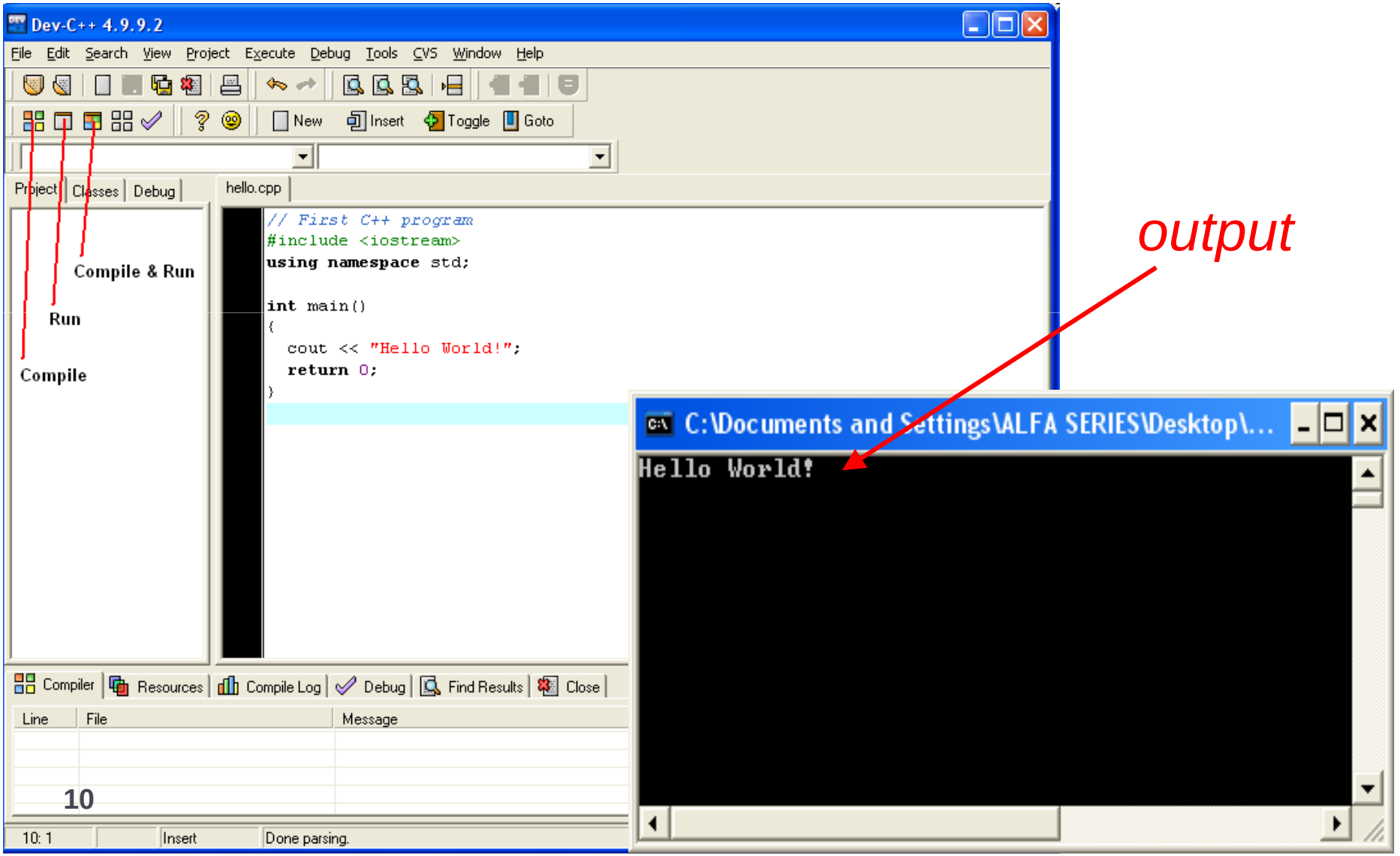
Program source file name: `hello.cpp`

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 variables, objects etc of the `std` C++ library may be referenced;
  for example `cout` is the part of `std` namespace.
- **Line 4:** An empty line does nothing except help readability.
- **Line 5:** The main function of the program is declared here.
  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 screen.
- **Line 8:** [optionally] the `return` statement terminates the function;
  `return 0` sends a message to OS: "program ends without an error"

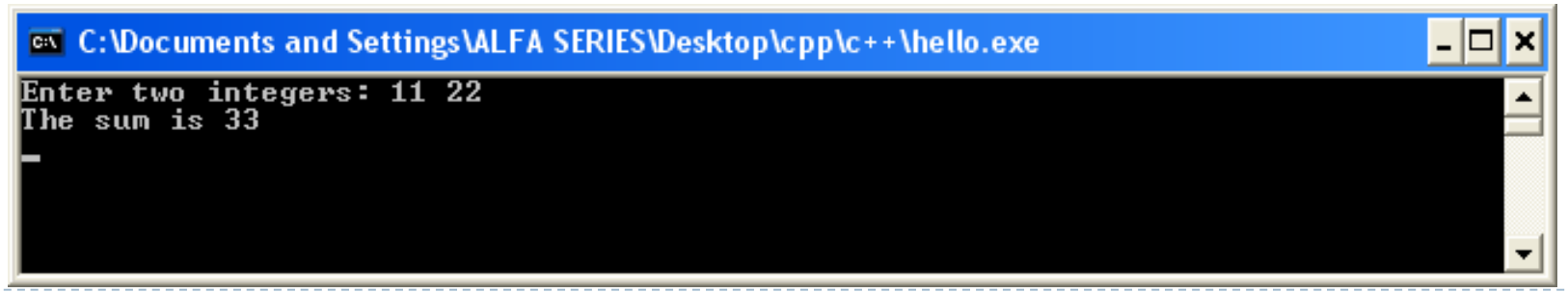
Compile and Run



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

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

Outputs:

Standard Input and Output (I/O)

- **Basic Input**

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

```
cin >> a >> b;
```
reads values from the keyboard to 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;
}
```

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;
}
```