Introduction to Lab Sessions

PRO1

Josep Carmona, Lluís Padró

UNIVERSITAT POLITÈCNICA
DE CATALUNYA
BARCELONATECH

Introduction

Introduction

- In this course we will learn to write programs that run in *command-line mode* (i.e. with no GUI)
- Example:

```cpp
int main() {
     cout << "What is your name? ";
     string name;
     cin >> name;
     cout << "Hello " << name;
     cout << ", nice to meet you.";
     cout << endl;
}
```

```
$ ./hello
What is your name? Maria
Hello Maria, nice to meet you.
$
```

Introduction

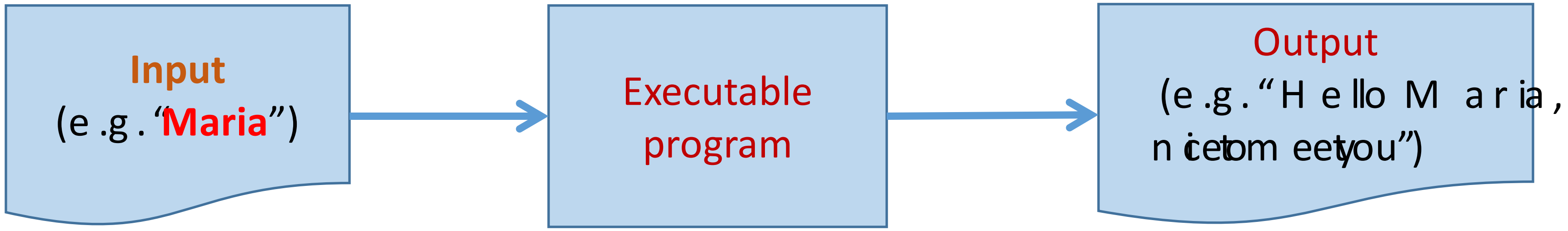
- Our programs will normally read some input (e.g. the user name in previous slide) and produce some output (e.g. the greeting)
- Example:

```
int main() {
  cout << "Enter a number: ";
  int n;
  cin >> n;
  cout << n << "x1 = " << n*1 << endl;
  cout << n << "x2 = " << n*2 << endl;
  cout << n << "x3 = " << n*3 << endl;
  cout << n << "x4 = " << n*4 << endl;
  cout << n << "x5 = " << n*5 << endl;
}
```

```
$ ./multiply
Enter a number: 121
121x1 = 121
121x2 = 242
121x3 = 363
121x4 = 484
121x5 = 605
$
```

Building programs

- To be run in a computer, programs need to be in *executable* (a.k.a. *binary*) form.
- The program will read the input, process it, and produce the appropriate output



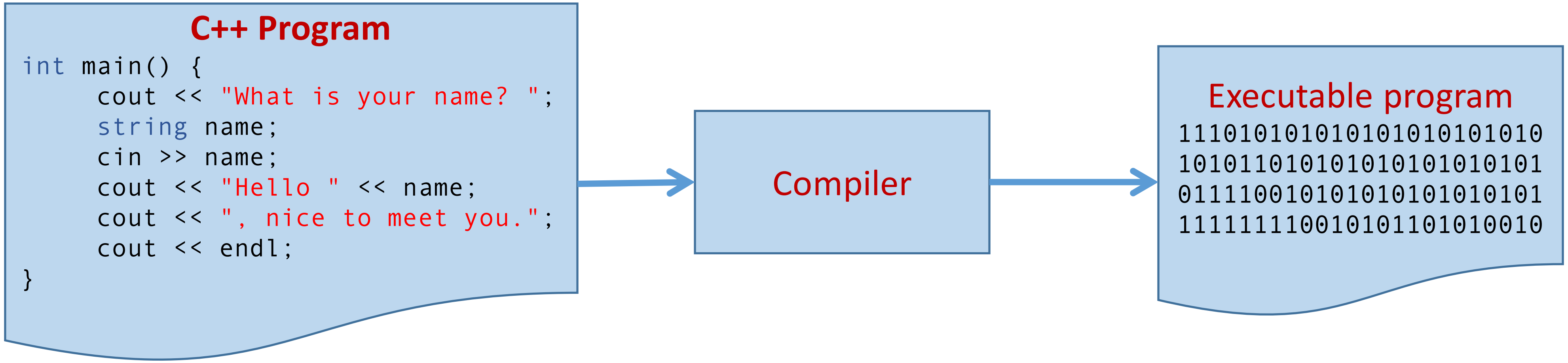
Input
(e.g. “Maria”)

Executable program

Output
(e.g. “Hello Maria, nice to meet you”)

Building programs

- We can not write programs directly in binary (too costly and error prone)
- Thus, we have *Programming Languages* (e.g. C++) that are closer to humans. Programs written in such languages must be converted to binary using a *compiler*.



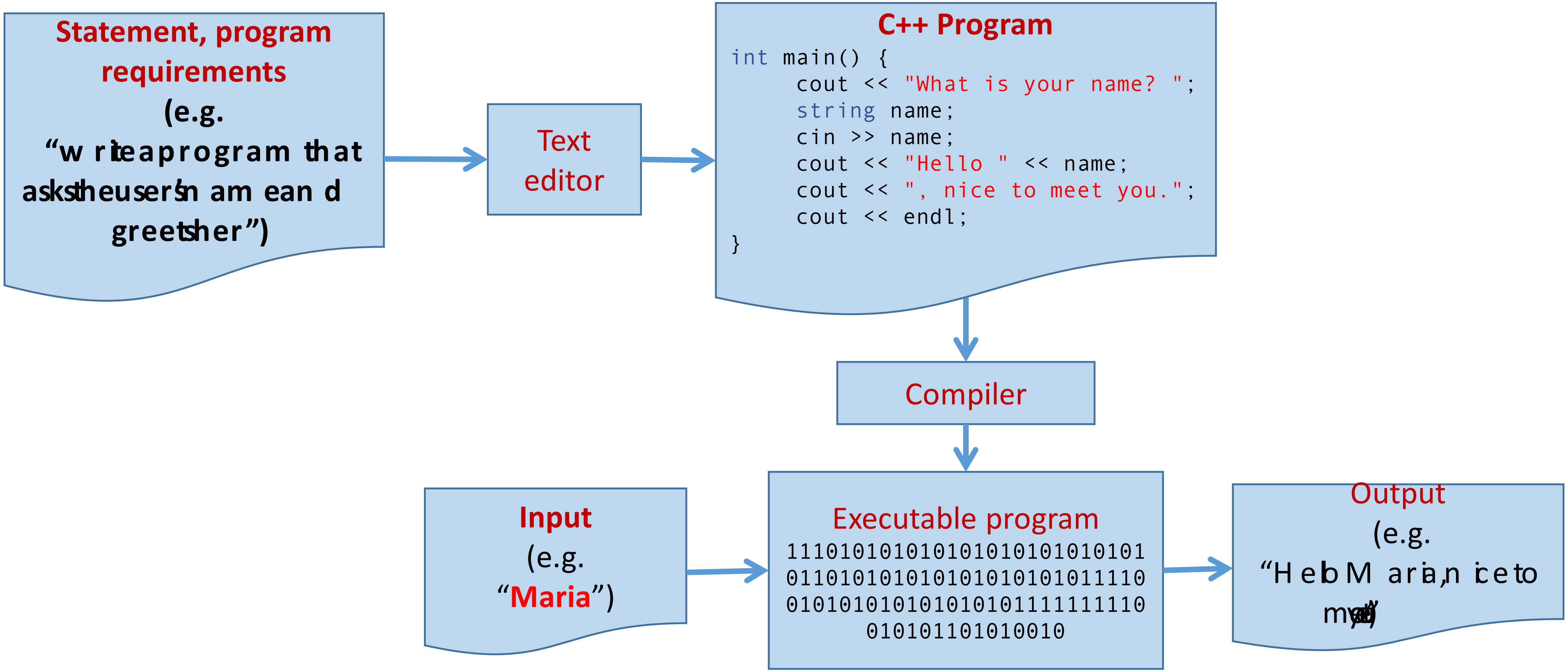
C++ Program

```
int main() {
     cout << "What is your name? ";
     string name;
     cin >> name;
     cout << "Hello " << name;
     cout << ", nice to meet you.";
     cout << endl;
}
```

Executable program

```
111010101010101010101010
101011010101010101010101
011110010101010101010101
111111110010101101010010
```

Putting it all toghether



Statement, program requirements

(e.g.

“write a program that asks the user's name and greets her”)

Text editor

C++ Program

```
int main() {
     cout << "What is your name? ";
     string name;
     cin >> name;
     cout << "Hello " << name;
     cout << ", nice to meet you.";
     cout << endl;
}
```

Compiler

Input

(e.g.

“**Maria**”)

Executable program

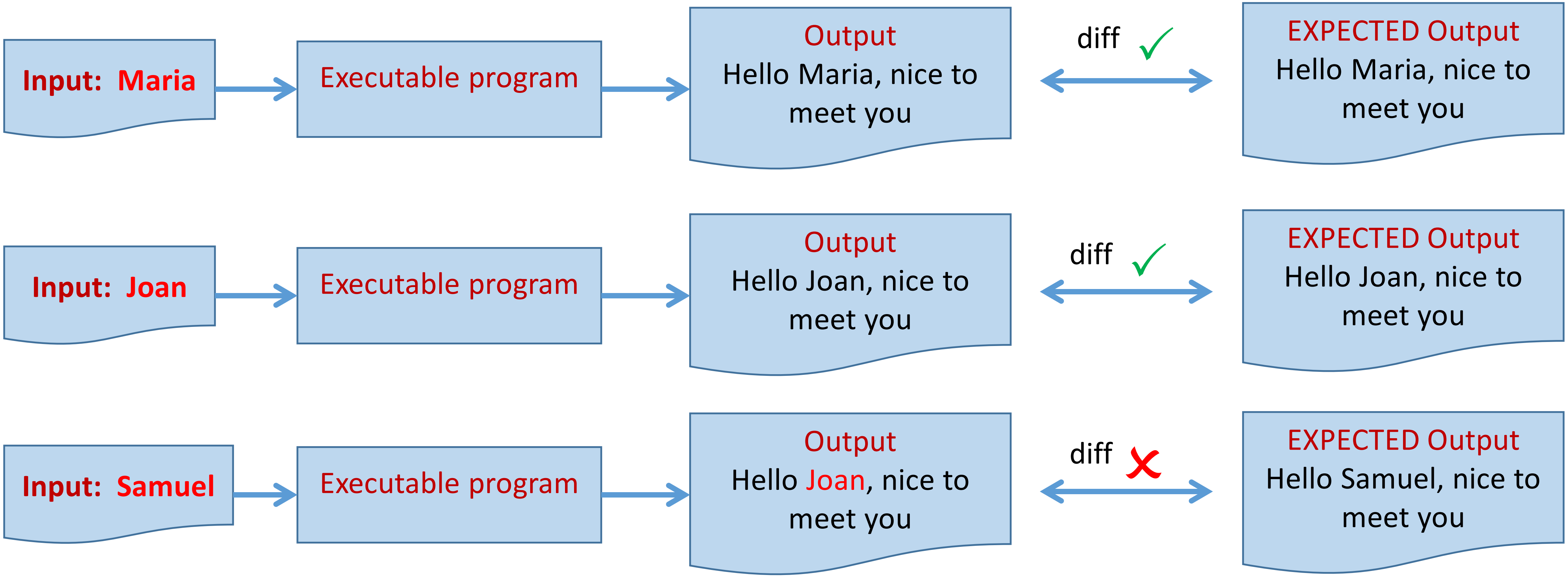
```
111010101010101010101010101
011010101010101010101011110
010101010101010101111111110
010101101010010
```

Output

(e.g.

“Hello Maria, nice to meet you”)

Checking that the program works



Input: Maria → Executable program → Output Hello Maria, nice to meet you ← diff ✓ → EXPECTED Output Hello Maria, nice to meet you

Input: Joan → Executable program → Output Hello Joan, nice to meet you ← diff ✓ → EXPECTED Output Hello Joan, nice to meet you

Input: Samuel → Executable program → Output Hello Joan, nice to meet you ← diff ✗ → EXPECTED Output Hello Samuel, nice to meet you

Linux

Linux desktop and command line

- In Linux, you have a desktop similar to that of any other O.S.
- Most tasks (copying or renaming a file, moving it to a different folder, create a new folder, etc) can be performed using the graphical desktop interface
- However, we are going to write *command-line* interface programs, which need to be run in a command line interpreter (also known as *console*, *terminal*, or *shell*)
- From the console, you can run commands to execute any program, or to handle files (copy, rename, move, etc).

Basic shell commands

A terminal has, in a given moment, one and only one *current working directory* (i.e. the *folder* we have currently open).

Shell commands are always referred to the current working directory

`cd` *`dirname`*	Open folder with given name
`cd ..`	Close current folder and go back to parent.
`pwd`	Print current working directory
`ls`	List contents of current directory
`mkdir` *`dirname`*	Create new directory with given name
`rmdir` *`dirname`*	Remove directory with given name

Basic shell commands (cont.)

`cp` *file1* *file2*	Copy file1 to file2
`mv` *file1* *file2*	Rename file1 to file2
`rm` *file*	Remove file
`more` *file*	Show content of file

Extensive and detailed step-by-step tutorial on shell commands for newbies:

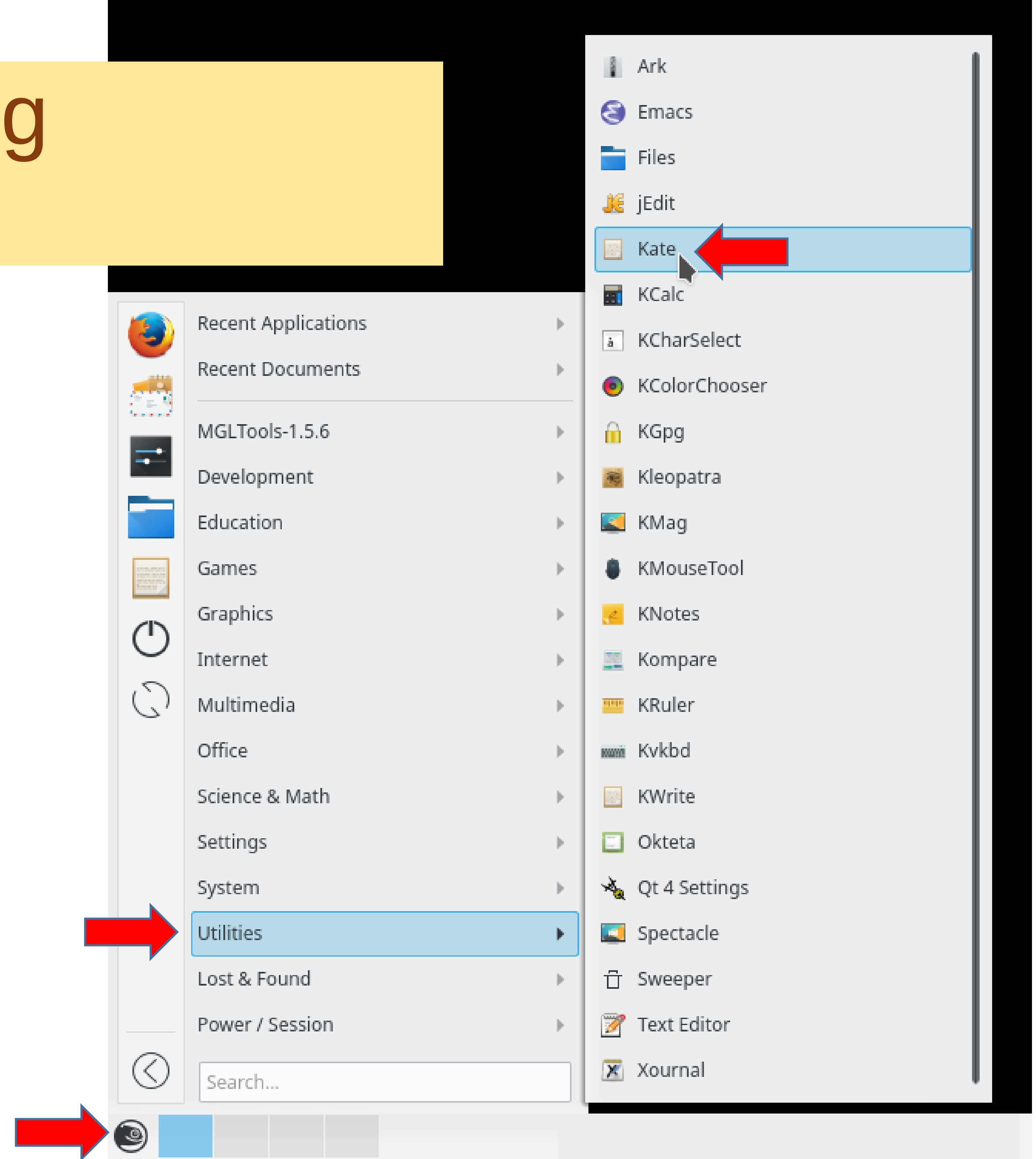
http://linuxcommand.org/

Writing programs

Set up programming environment

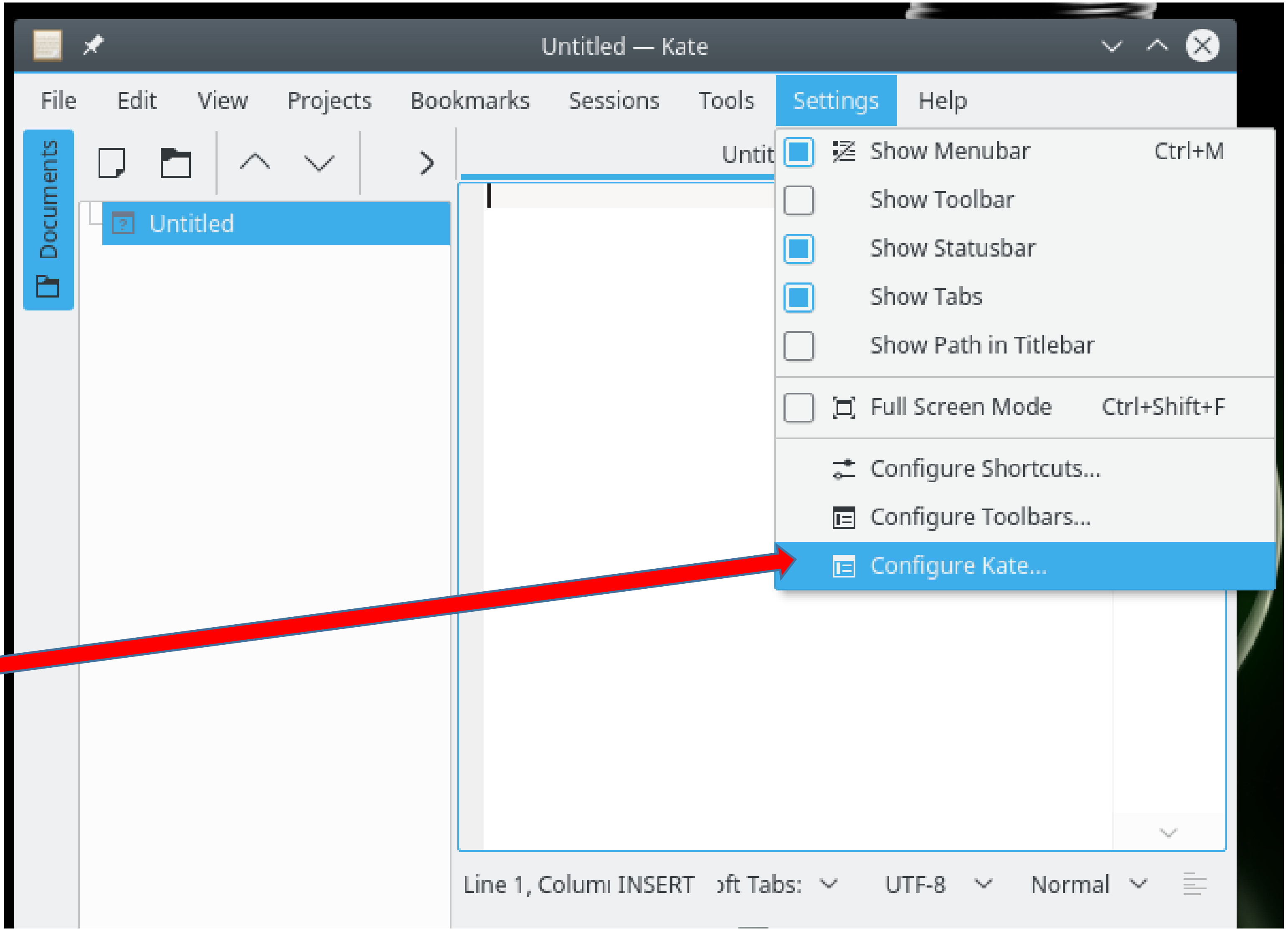
- Programs must be written on a plain text editor.
- Linux offers several of them (emacs, kwrite, TextEditor, ...).
- We recommend *kate*. Launch it from

Menu→Utilities→kate

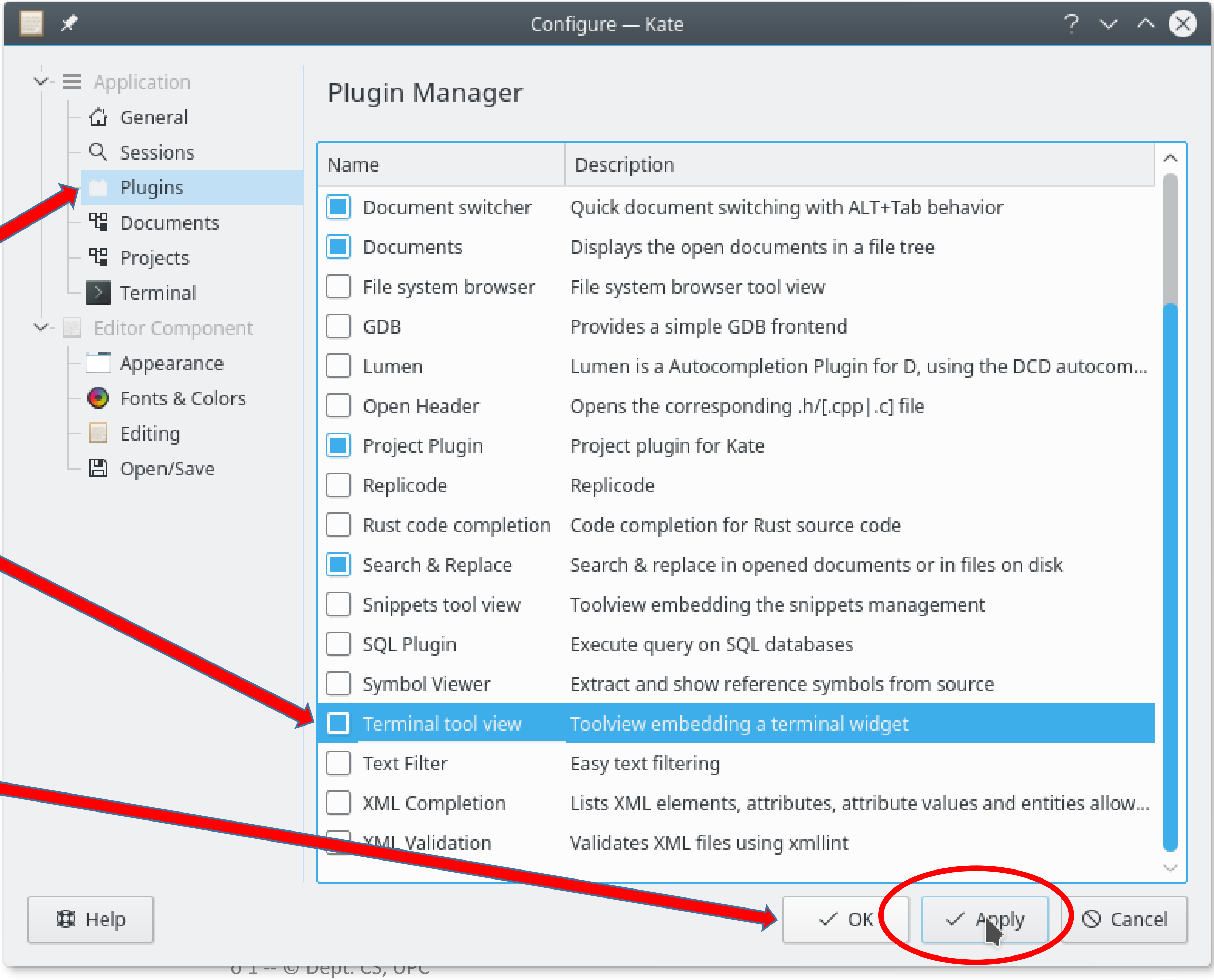


Set up programming environment

- We will need a terminal too, to compile and run our programs
- We can run it in a separate window with:
  Menu→System→Konsole
- Or we can configure *kate* to show an integrated terminal



- In *kate* configuration, select *Plugins*
- Mark *terminal tool view*, near the end of the list.
- Click Apply and then OK.

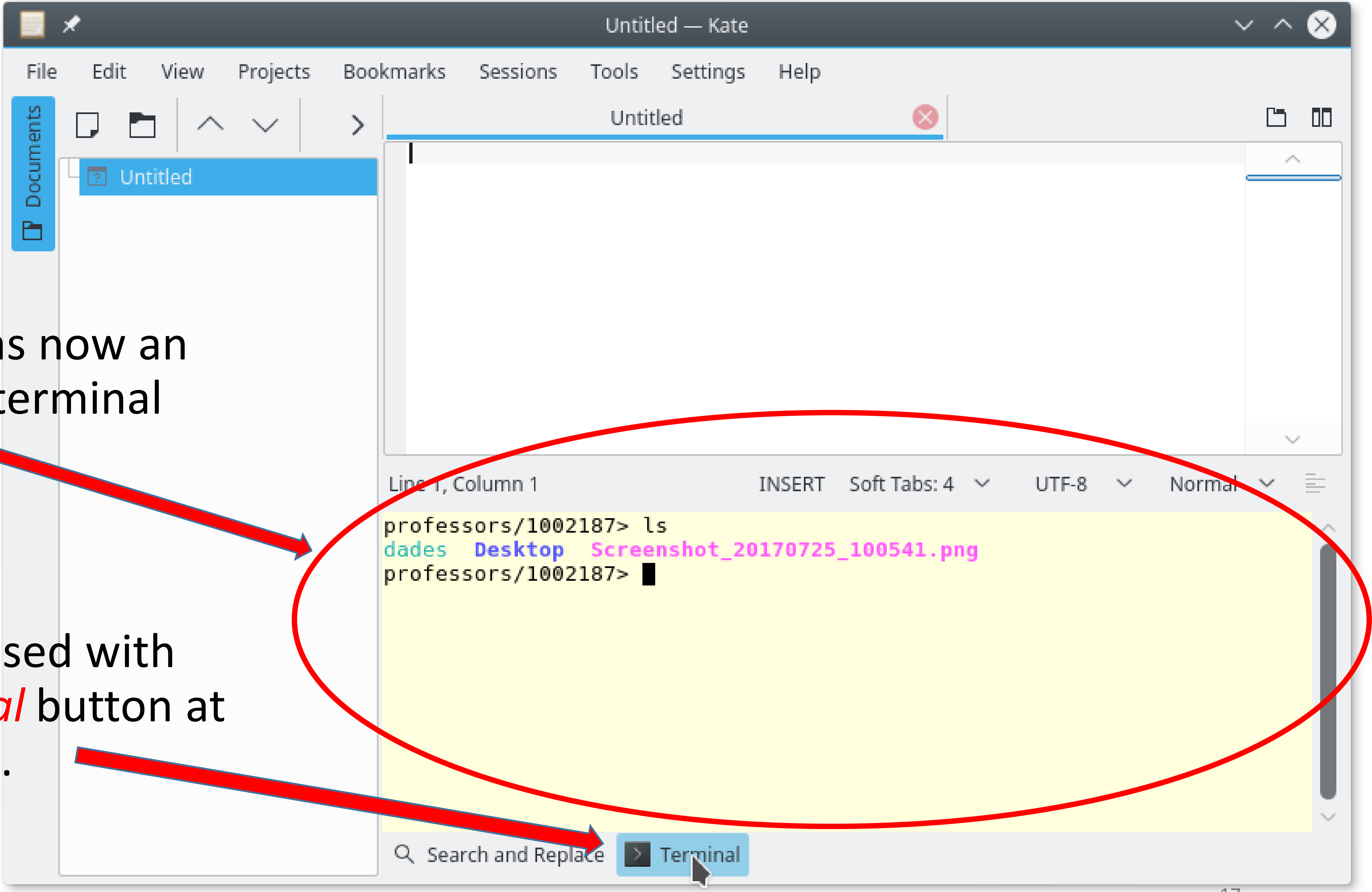


Plugin Manager

	Name	Description
☑	Document switcher	Quick document switching with ALT+Tab behavior
☑	Documents	Displays the open documents in a file tree
□	File system browser	File system browser tool view
□	GDB	Provides a simple GDB frontend
□	Lumen	Lumen is a Autocompletion Plugin for D, using the DCD autocom...
□	Open Header	Opens the corresponding .h/[.cpp|.c] file
☑	Project Plugin	Project plugin for Kate
□	Replicode	Replicode
□	Rust code completion	Code completion for Rust source code
☑	Search & Replace	Search & replace in opened documents or in files on disk
□	Snippets tool view	Toolview embedding the snippets management
□	SQL Plugin	Execute query on SQL databases
□	Symbol Viewer	Extract and show reference symbols from source
□	Terminal tool view	Toolview embedding a terminal widget
□	Text Filter	Easy text filtering
□	XML Completion	Lists XML elements, attributes, attribute values and entities allow...
□	XML Validation	Validates XML files using xmllint

- Our *kate* has now an integrated terminal window

- It can be opened/closed with the *Terminal* button at the bottom.



```
professors/1002187> ls
dades  Desktop  Screenshot_20170725_100541.png
professors/1002187> 
```

How to write a program

- Launch kate
- Create a new document
- write a sample program:

```
#include <iostream>
using namespace std;

int main() {
  cout << "Hello everybody!" << endl;
}
```

Save the program with a name that ends in `.cc` (e.g. hello.cc) and notice how *kate* syntax-colored the program.

How to compile a program

- Navigate in the terminal to the directory where you saved the file `hello.cc`
- Compile the program:

```
p1++ -o hello.x hello.cc
```

- If there are errors, fix them and compile again.
- Execute the program

```
./hello.x
```

Example: squares.cc

```
#include <iostream>
using namespace std;

int main() {
  int a,b,c;
  cin >> a >> b >> c;
  cout << a*a << " " << b*b << " " << c*c << endl;
}
```

```
$ p1++ -o squares.x squares.cc
$ ./squares.x
6 3 12
36 9 144
$
```

Example: nif.cc

```cpp
#include <iostream>
using namespace std;

int main() {
  int dni;
  cin >> dni;
  const string data("TRWAGMYFPDXBNJZSQVHLCKE")
  cout << "NIF letter: " << data[dni%23] << endl;
}
```

```
$ p1++ -o nif.x nif.cc
$ ./nif.x
45678901
NIF letter: G
$
```

Handling compilation errors

- If there are errors, the executable is not created. We must fix the errors and compile again.

```
#include <iostream>
using namespace std;

int main() {
  int a,b;
  cin >> a >> b >> c
  cout << a*a << " " << b*b << " " << c*c << endl;
}
```

```
$ p1++ -o squares.x squares.cc
squares.cc:6:30: error: ‘c’ was not declared
squares.cc:7:3: error: expected
```

Organize your work

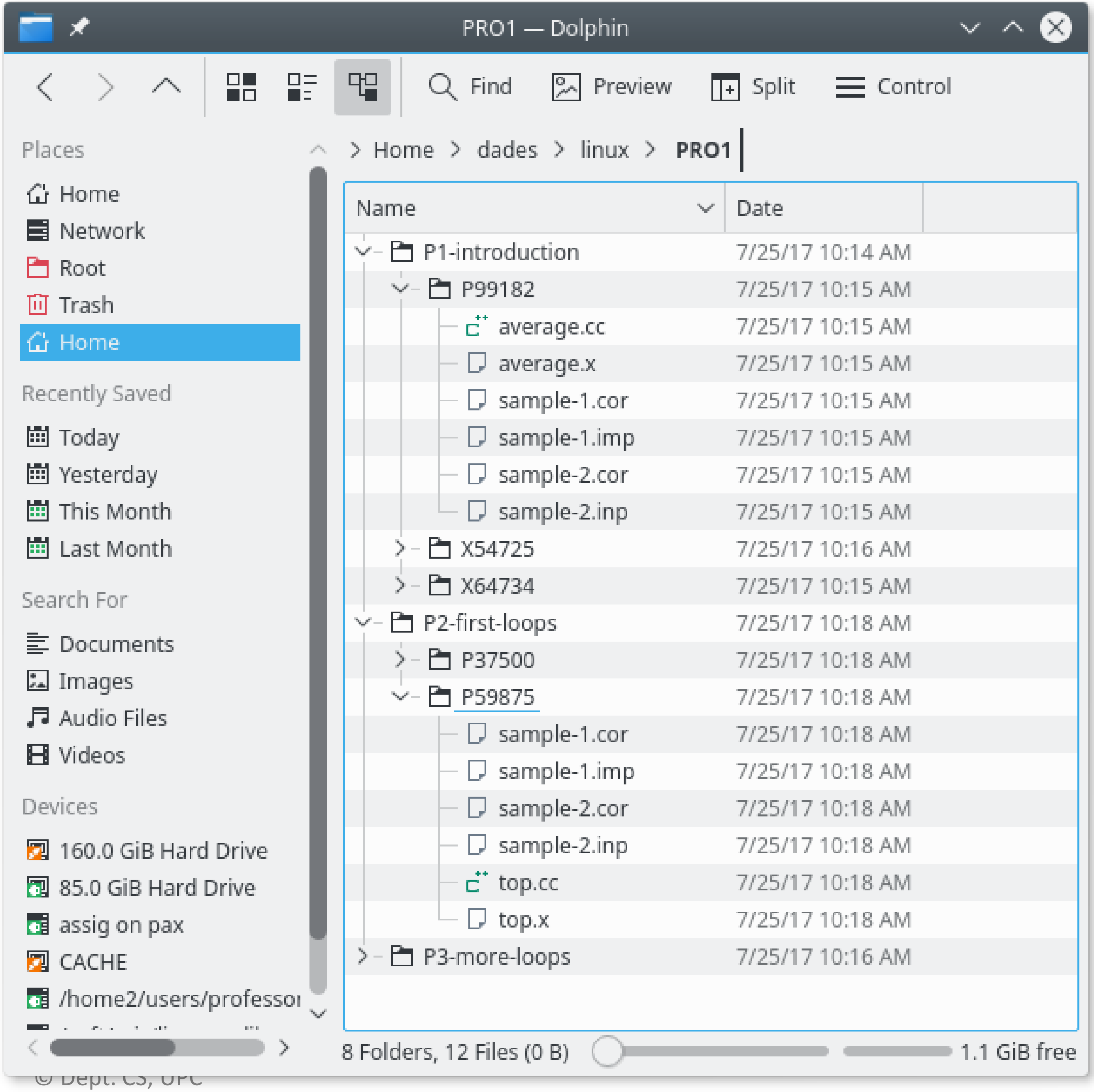
Organize your exercises

- During the course there will be three lab exams.
- There are dozens of exercises in the course.
- Exercises are organized in lists, by course chapters.
- To be allowed to take each exam, a minimum number of exercises must be solved in each list.

- It is crucial to have exercises organized to avoid getting lost.

Organize your exercises

- We recommend having a folder for each problem.
- It is also useful to group problem folders depending on the list they belong to.
- In each problem folder, you can have the C++ program, the executable, and its input and output files.



Name	Date
P1-introduction	7/25/17 10:14 AM
P99182	7/25/17 10:15 AM
average.cc	7/25/17 10:15 AM
average.x	7/25/17 10:15 AM
sample-1.cor	7/25/17 10:15 AM
sample-1.imp	7/25/17 10:15 AM
sample-2.cor	7/25/17 10:15 AM
sample-2.inp	7/25/17 10:15 AM
X54725	7/25/17 10:16 AM
X64734	7/25/17 10:15 AM
P2-first-loops	7/25/17 10:18 AM
P37500	7/25/17 10:18 AM
P59875	7/25/17 10:18 AM
sample-1.cor	7/25/17 10:18 AM
sample-1.imp	7/25/17 10:18 AM
sample-2.cor	7/25/17 10:18 AM
sample-2.inp	7/25/17 10:18 AM
top.cc	7/25/17 10:18 AM
top.x	7/25/17 10:18 AM
P3-more-loops	7/25/17 10:16 AM

8 Folders, 12 Files (0 B)

1.1 GiB free

The *Jutge*

Automatic scoring of programs

- http://jutge.org is the environment where we will grade the lab exercises and we will take the course exams.
- You have been invited to this course. Find it in the list, and click "*enroll this course*".
- You can submit your programs to the *jutge* and find out whether they work.
- You can also download the input files and expected outputs for each problem, to check them in your PC.
- It is important to be able to work locally: In the exams, penalizations are applied after three requests to the *jutge*.

Important things to know

- At http://www.cs.upc.edu/~pro1 you will find important information about this course.
- In particular, check the tab
- "*Entregues problemes*", which is updated frequently, and contains:
    - The lists of problems in the *jutge* you must solve to be admitted to each exam.
    - The range of dates when each list must be solved.
    - Which problems of each list the you have solved in the required dates.
- Check this page often! No claims will be accepted about problems submited out of the required dates.

Example

- Now your professor will do an example problem on the *jutge*. Try to follow it in your computer.

Checking program results

Input/output in C++

- Read data

```
int a,b,c;
cin >> a >> b >> c;
```

- Write data

```
int a;
cout << "Value: " << a << endl;
```

- The output must be **exactly** as the expected for the problem to be accepted by the *jutge*.

Problems with manual input/output

- Manual input
  - We can not change the input once we press `return`.
  - Time-consuming and error-prone when the input is long.
  - We must press `ctl-D` to end the input.

- Manual check of the output
  - If the output is long, it is difficult to spot small differences with respect to expected output.

“Automatic” input/output

- Run program redirecting input and output

  ```
  ./squares.x <sample-1.inp >sample-1.out
  ```

  Symbol < will read input from given file instead of keyboard.

  Symbol > will write output to given file instead of display.

- Compare obtained output with expected output

  ```
  kompare sample-1.out sample-1.cor
  ```