Unit 3

Basic Syntax

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The C Programming Language

The C programming language is an imperative language.

Programs are sequences of instructions.

Trust Your Master

At the beginning, all the programs will have this structure

```
#include <stdio.h>

int main(int argc, char *argv[])
{
    ...


    return 0;
}
```

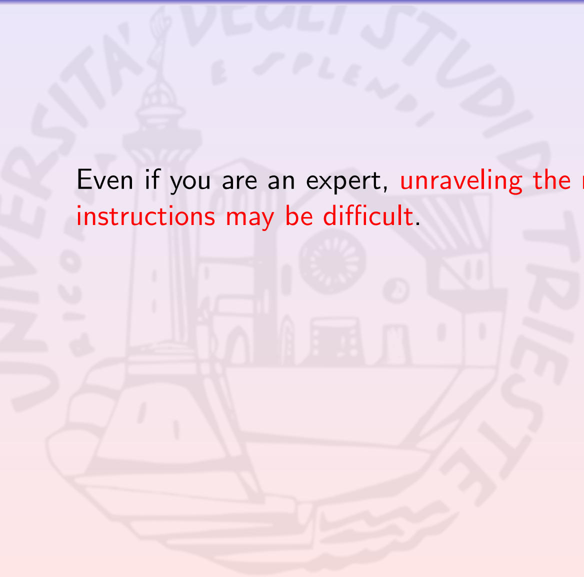
By the end of the course, you'll have all the details.

Instructions

Are basic “commands” for the computer.

- They are syntactically closed by the symbol “;” (semi-column)
- More than one instruction can lay on the same line

Comments



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It is really important to comment code

Comments

In ANSI C everything is preceded by "/*" and followed by "*/" is a comment.

It can be longer that one line.

If you come from either C++ or Java, pay attention: sigle line comment (i.e., //) is not standard.

Commento con "/*" e "*/"

```
...
int y; /* This is a comment
          and as you can see
          it can include more that
          one line */
...
```

Variables

Are “containers” for values.

Each of them is equipped of a name and a type.

The name is used to identify the variable when we want to either “read” or change its content.

The type specifies:

- the set of values that can be store into the variable
- the functions that can be applied on them

Declaring a Variable

Any variable must be declared before its use.

```
...
<variable type> <variable name>;
...
```

From that point on, `<variable name>` will denote the variable having the specified type.

Variable Names

Variables can have as names any word in

[a-zA-Z_][a-zA-Z_0-9]*

excluding reserved words (e.g., "`int`", "`return`")

C is case sensitive, e.g., "ciao" $\neq$ "Ciao"

Basic Data Type

Type	**Values** (at least)	Domain
char	$[-2^7, 2^7 - 1]$ and ASCII Characters	Integer values and Characters
short	$[-2^7, 2^7 - 1]$	Integer values
int	$[-2^{15}, 2^{15} - 1]$	Integer values
long int	$[-2^{31}, 2^{31} - 1]$	Integer values
long long int	$[-2^{63}, 2^{63} - 1]$	Integer values
float	represented by 32 bits	Real values
double	represented by 64 bits	Real values
long double	represented by 128bits	Real values

Basic Data Type

`unsigned` can be used to signal the interest on non-negative values only.

E.g, `unsigned int` variables can assume any value in $[0, 2^{16} - 1]$.

Declaring a Variable

```
/* Integer types */
short s,S; /* at least 16 bits (-2^15,2^15-1) */
int i,I; /* at least 16 bits (-2^15,2^15-1) */
long int li; /* at least 32 bits  (-2^31,2^31-1) */
long long int lli; /* at least 64 bits  (-2^63,2^63-1) *

/* Floating point types */
float f; /* 32 bits */
double d,D; /* 64 bits */
long double ld; /* 128 bits */

/* Character and integer type */
char c;  /* ASCII or integer values in (-2^7, 2^7-1) */
```

Assignments

To store a value in a variable:

```
...
<variable name> = <expr of the same type>;
...
```

Assignment Examples

```
int i; char c; short s; float f;

s=4;  i=s;

c='a'; /* characters are specified between
          apostrophes ', while strings
          between quotation marks " */

i=2*(i+1); /* algebric expressions are
              supported (no power) */

f=4.1;
i=4.1;
```

The last instruction may have weird effects. Why?

Implicit Type Casting

When we assign a value to a variable of different type there is an Implitic type casting.

If the the variable's type is more "general", the value is preserved.

char $\rightarrow$ short $\rightarrow$ int $\rightarrow$ long int $\rightarrow$ long long int $\rightarrow$ float $\rightarrow$ double $\rightarrow$ long double

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Otherwise, the value may be approximated.

Explicit Type Casting

Any value can be approximated and forced to a given type by type casting it.

```
(<new type>) <expression>
```

E.g.,

```
i=(int)4.1;
c=(char)((int)c+1);
i= ((int)(4.1/2))/2;
```

Two Kinds of Division

C implements two different division functions:

- integer division
- floating point division

Their selection depend on the types of operators

```
int i=3, I; float d=3, D;

I=i/2; /* both i and 2 are integers
          => integer division */
D=d/2; /* d is a fp variable
          => floating point division */
```

Boolean Expressions

The supported algebric relations are:

- equality (`==`)
- majority relations (`>` and `<`) and their derivatives (`>=` and `<=`)
- diversity relation (`!=`)

The supported Boolean operators are:

- logic conjuction (`&&`)
- non-exclusive disjunction (`||`)
- logic negation (`!`)

Boolean Expressions (Cont'd)

Their evaluations are natural numbers:

- 0 represents the Boolean value `False`
- any other value is interpreted as `True`

```
char b;

b=(!(i>=3) && (d-2==-1) && b) ||(s!=3);
```

From 1999, C has a Boolean type which is not really used.

Blocks of Instructions

Are either a single instruction or a sequence of instruction between braces “{” “}”

Any variable exists only inside the block in which it is declared.

```
...
{   /* This is a block */
    int h=1;

    h=h+1; /* Here, h does exist *
}

/* Here, it does not */
...
```

Printing on the Standard Output

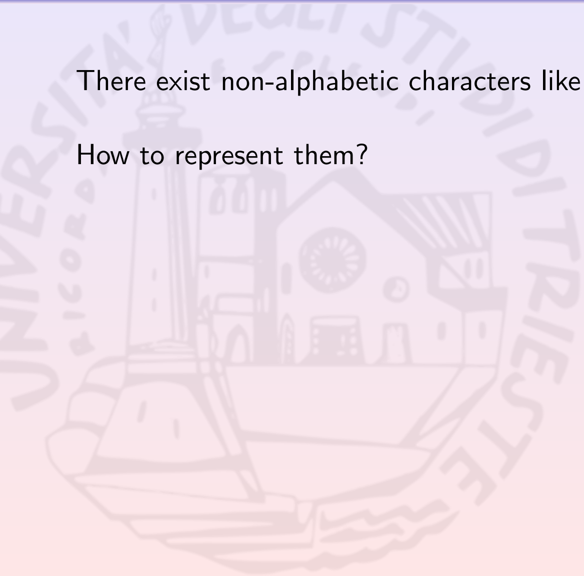
Use the "instruction" printf

```
...
int i=2; long int j=3;
printf("To print numbers: %d %d %d", i, i, j);

float f=2.2, double d=2.2;
printf("To print floats: %f %f", f, d);

char c='Y';
printf("To print characters: %c", c);
```

Non-Alphabetic Characters



There exist non-alphabetic characters like end line or new line.

How to represent them?

Non-Alphabetic Characters

There exist non-alphabetic characters like end line or new line.

How to represent them? by using escape sequences

- `\n` newline
- `\b` backspace
- `\t` horizontal tabulation
- `\\` backslash character
- `\"` double quotation character
- `\a` alert
- `\0` string terminator

Non-Alphabetic Characters (Examples)

```
...
printf("This does not end with a \"new line\"");

printf("This does\nbut this not");

printf("This procudes an alert sound\a");

printf("This is missing the last letter\b");

printf("This line e\0nds before its real end");
...
```

Loop Statements

Blocks of instructions can be repeated many times by using the loop statements:

- while-do
- for

The While-do Statement

Repeats a block while a Boolean condition holds.

```
int i=0;
while (!(i==4)) {

  printf("Here i=%d\n",i);

  i++; // this is equivalent to i=i+1
}
```

The For Statement

Has the syntax:

```
for (<initialization code>;
     <loop condition>;
     <updating code>) <block>
```

E.g.,

```
for (int j=0; j<i; j++) {
  printf("Here j=%d\n",j);
}
```

The Condition Statement If-Then

Executes a block if and only if the Boolean condition holds.

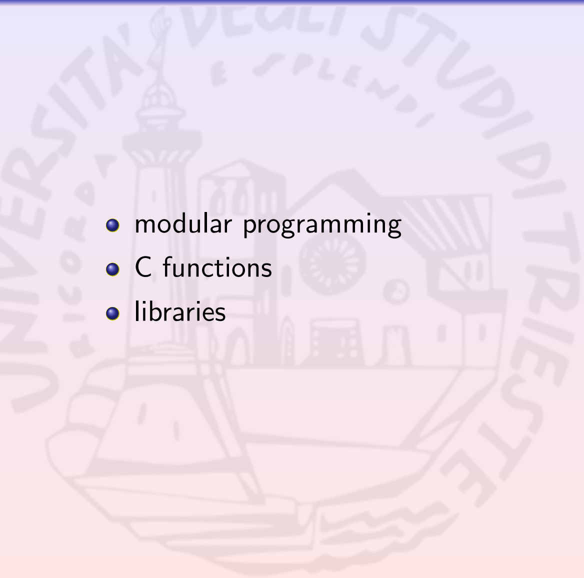
```
if (i==2) {
  printlf("i is equal to 2");
}
```

The Condition Statement If-Then

Decides the execution of one among two blocks.

```
if (i==2) {
  printf("i is equal to 2");
} else {
  printf("i different from 2");
}
```

Coming soon. . .



- modular programming
- C functions
- libraries