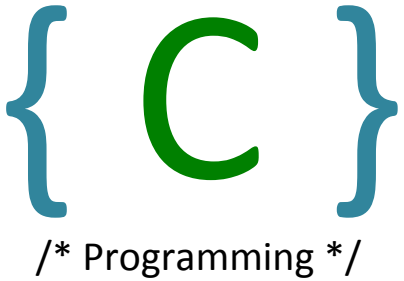
Computer Programming Using C
COP 3275 - Summer 2017

Lecture 3: C Fundamentals



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Recap to previous lecture !

- the development environment
- Structure of any C program

The General Form of a Simple Program

- C programs rely on *three key language features*:
  - Directives
  - Functions
  - Statements

The General Form of a simple program

```
directives


main()
{
   statements
}
```

Create simple C program

```
#include <stdio.h>


main()
{
  printf(“Hello World\n”);
}
```

Compiling and Linking

- Before a program can be executed, three steps are usually necessary:
  - ***Preprocessing:*** The ***preprocessor*** obeys commands that begin with # (known as ***directives***)
  - ***Compiling:*** A ***compiler*** translates then translates the program into *machine instructions* (***object code***).
  - ***Linking:*** A ***linker*** combines the object code produced by the compiler with any *additional code* needed to yield a *complete executable program*.

- The preprocessor is usually integrated with the compiler.

Lecture 3: C Fundamentals

- Printing Strings
- Comments
- Variables and Types
- Declaration and assignment
- Printing variables

Printing Strings

- `printf` function displays a ***string literal***
- String is a set of characters enclosed in double quotation marks—it doesn't show the quotation marks.
- `printf` doesn't automatically advance to the *next output line* when it finishes printing.
- To make `printf` advance one line, include `\n` (the ***new-line character***) in the string to be printed.

Printing Strings

- The statement

```
printf(”Hello World.\n");
```

  could be replaced by two calls of `printf`:

```
printf(”Hello World.");
printf(“\n");
```

- The new-line character can appear more than once in a string literal:

```
printf(”Hello World: \n C fundamentals\n");
```

Comments

- Our application source files, still lack something important which is "*Documentation*".

- Any program should contain some information that include: the author, the purpose of this program, and some details.

- In programming languages, such information is placed in "*Comments*"

Comments

- A ***comment*** begins with /* and end with */.

```
/* This is a comment */
```

- Comments may appear almost anywhere in a program, either on *separate lines* or on the same lines as *other program text*.

- `printf(”Cat");` /* Printing Cat */

Comments

- Comments may extend *over more than one line*.

```
/* Name: HelloWorld.c
   Purpose: Prints a greeting message.
   Author: XXX */

#include <stdio.h>
main()
{
  printf("Hello World\n");
}
```

Comments

- *Warning:* Forgetting to terminate a comment may cause the *compiler to ignore part of your program*:

```
printf("My ");    /* forgot to close this comment...
printf("cat ");
printf("has ");   /* so it ends here */
printf("fleas");
```

Comments

- Single line comment can also be written in the following way:

```
// This is a comment
```

```
printf("Cat");    // Printing Cat
```

- This style of comment ends automatically at the *end of a line*.
- Advantages of / / comments:
  - Safer: there's no chance that an un-terminated comment will accidentally consume part of a program.

Guess the output in these cases

```
printf(”Cat");     // Printing Cat

//printf(”Dog");   Printing Cat

//printf(“house”);   //printing house

/*
    printf(“Cat”); //printing cat
*/
```

Variables

- Most programs need to perform a series of calculations before producing outputs.
- Such programs need a way to store data *temporarily* during *program execution*.
- In most of the programming languages, such storage locations are called ***variables*.**

Variables

- Variables are used to store information to be *referenced and manipulated* in a computer program.

- They also provide a way of *labeling data* with a descriptive name, so our programs can be understood more clearly by the reader and ourselves.

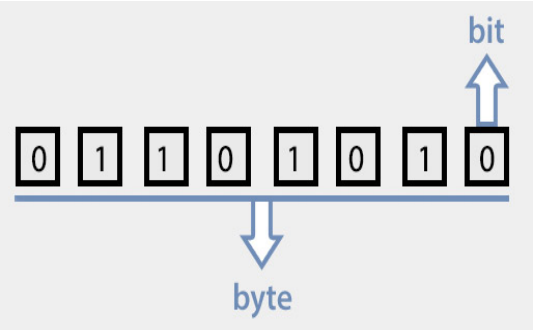
- It is helpful to think of variables as *containers* that hold information and store data in memory. Such data can then be used *throughout your program*.

Types

- Every variable must have a *Type*.
- The type of the variable specifies *what kind of data* such variable can *hold*.
- Proper selection of the variable type is very important, since the type affects:
  - How the variable is *stored in memory*
  - What *operations* can be performed on the variable

Bits and Bytes !

- Computer is nothing more than a *set of switches*, either on / off.
- These 0's and 1's are interpreted as *digits in the binary number system* and are called *bits*.
- Eight bits form *Byte*, which is the minimum storage unit in a computer.



- Data of various kinds (numbers and characters), are encoded as *a series of bytes*. E.g. character C is represented as 01000011 in *one byte*.

- A computer's storage capacity is measured in *multiples of the byte*:
  - Kilobyte (KB) is about 1,000 bytes.
  - Megabyte (MB) is about 1 million bytes.
  - Gigabyte (GB) is about 1 billion bytes.
  - Terabyte (TB) is about 1 trillion bytes.

Types

- Type for a numeric variable determines the *range of values* that this variable can store, and whether or not *digits are allowed after the decimal point*.

Types

- C language has a wide variety of types, for today's lecture we will introduce `int` and `float`.

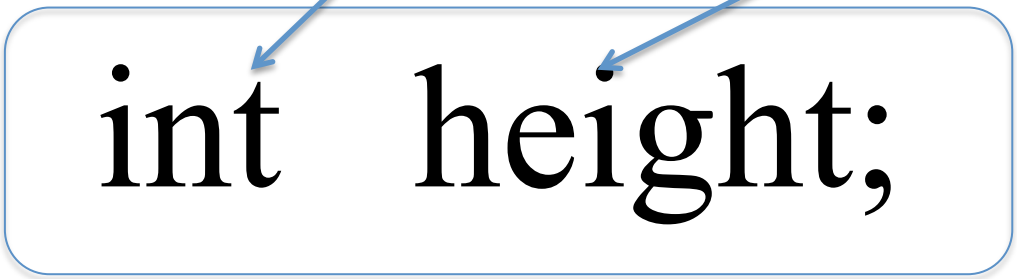
- A variable of type `int` (short for *integer*) can store a *whole number* such as 0, 1, 392, or –2553.
  - The range `int` value is typically -32,768 to 32,767, to be stored in *2 bytes*

Types

- A variable of type `float` (short for *floating-point*) can store much larger numbers than an `int` variable.
- Also, a `float` variable can store numbers with *digits after the decimal point*, like 379.125.
- The float variable is stored in *4 bytes*.
- Drawbacks of `float` variables:
  - Slower arithmetic
  - Approximate nature of `float` values

Declarations

- Variables must be ***declared*** before they are used, for the benefit of the compiler.
- Variables are declared by *specify the type,* give a *name* for the variable and end with a *semicolon* as follows:



Declarations

```
int height;
```

The compiler created variable named height, of type int (this variable can store an integer value).

```
float profit;
```

The compiler now creates variable named profit, of type float (this variable can store a floating point value).

Declarations

- Any statement in C ends with *semicolon*.
- Alternatively, several can be declared at the same time:

```
int height, length, width, volume;
float profit, loss;
```

Assignment

- A variable can be given a *value* by means of ***assignment:***

```
height = 8;
```

the compiler *assign* value of 8 to the variable height, that is of type int (how?).

Assignment

- Before a variable can be assigned a value—or used in any other way—it must first be *declared*.

Assignment

```
int height;      //declare height
int width;      //declare width
height = 8;      //assign value to height
Width = 5;      //assign value to width
```

```
float profit;      //declare variable profit
Profit = 58.4;   //assign a float value to profit
```

Assignment

```
int height;      //declare height

//what is the value of height ?
(it has an indeterminate value)

height = 8;      //assign value to height
//what is the value of height ?

height = 10;     //assign value to height
//what is the value of height ?
```

Assignment

- Once a variable has been assigned a value, it can be used to help *compute the value of another variable*:

```
int x;
int y;
x= 8;
y= x + 2;    // y holds the value of 10
```

Assignment

- The right side of an assignment can be a formula (or ***expression***, in C terminology) involving constants, variables, and operators.

```
int x;
int y;
int z;
x = 8;
y = 10;
z = x * y;    // z holds the value of 8 X 10 = 80
```

Declare and Assign

Some time to avoid the *undetermined values* of the variable, you can assign value during the *declaration phase*.

```
int X;              =       int X = 10;
X = 10;
```

```
float profit;       =       float profit = 50.23;
profit = 50.23;
```

Printing the Value of a Variable

- To write the message `Height:` *h*

  where *h* is the current value of the `height` variable, we'd use the following call of `printf`:

```
printf("Height: %d\n", height);
```

- `%d` is a placeholder indicating where the value of *`height` is to be filled in*.

Printing the Value of a Variable

- There's *no limit to the number of variables* that can be printed by a single call of `printf`:

```
printf("Height: %d  Length: %d\n",
height, length);
```