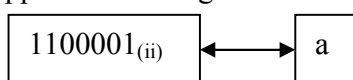


Chapter 2 Data Type

In computer programming, **data type** is very important, because a computer can store only a branch of 0 and 1. Whenever it stores **value** others than **integer**, it must use some other method to represent that **value**.

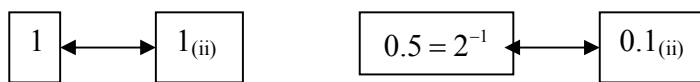
Example:

- 1) For storing **integer**, we can directly store it in binary representation.
97 is stored as 1100001_(ii). (Just convert 97 to binary)
- 2) To store a **character** like small letter 'a', we can map the letter to a number.
Small letter 'a' is mapped to the integer 97 in nowadays computers.



Note: **character** means all symbols, letters, numbers that you can found in the keyboard and some special symbols like the 'ctrl + c', there are total 255 of them in C.

- 3) The representation of **real numbers**, i.e. numbers with decimal places.
To store **real numbers** like 1.5, we break down the number into its integral part and fractional part, and convert them to binary numbers.



- 4) Store the **truth value** of some statement, or some **on-off** status.
This kind of value is called **Boolean**, and is very frequently used.
e.g. store whether the user has found a exit path in a maze.
Computer will use 1 for true and 0 for false.

Questions:

Try to find out the answer yourself

- 1) When we see a branch of 0 and 1, like 1100001, how do we know whether it does represent the small letter 'a' or the integer 97? (Data type can help us)
- 2) How can we represent a **string**? (Very difficult) (To be taught in chapter 9)
That's why I mentioned, to computer number is their friend but string is like a monster.
- 3) If a computer doesn't know about the **data type** of the **binary numbers**, can it display the actually meaning correctly? (Therefore we need the **format string** in the **printf**.)
- 4) Can you assign a **char** type value to **int variables**?

Programming Examples:

[Ch2_01.cpp](#), [Ch2_02.cpp](#), [Ch2_03.cpp](#), [Ch2_04.cpp](#), [Ch2_05.cpp](#)

Data Type in C:

| Basic Data Type | Example | Description |
|-----------------|-------------|-----------------------------------------|
| char | 'c' | any single key you can find in keyboard |
| int | 10 | Integer |
| float | 1.23 | Any non-integer numeric (real number) |
| bool | true | Either true or false |

| Complex Data Type | Example | Description |
|-------------------|----------|------------------------------------------------|
| int[2] | 2,3 | Integer pair |
| int[3] | 3,4,5 | Integer triple |
| int[] | | Array of integer |
| char[5] | "Fine" | A string of 4 characters |
| char[] | "abcdef" | A string of any number of characters |
| void | | Thing that has no any data type |
| void* | | Pointer , store <i>memory address</i> . |

The above 4 complex data type will be taught later on the chapter "Array"

This is a very useful data type whenever you write a program that uses several variables.

Questions:

- 1) Must addition of two integers always result in an integer?
- 2) What will be the result **data type** of adding one integer and a real number?
- 3) Can you add between a character and a real number? (No!)
- 4) Can you add an integer to a character? (Yes!) (But what is the result?)

| Left Operand | Operator | Right Operand | Result data type |
|--------------|---------------|---------------|------------------|
| int | +, -, *, /, % | int | Int |
| int | +, -, *, / | Real number | Real number |
| Real number | +, -, *, / | int | Real number |
| Real number | +, -, *, / | Real number | Real number |
| char | + | int | Char |
| int | + | char | Char |

| Function name | Return data type |
|-----------------------------|------------------|
| floor , ceil , round , sqrt | Real number |
| abs | Depends |
| main | int |

Examples:

| Left Operand | Operator | Right Operand | Result |
|--------------|----------|---------------|--------|
| 'c' | + | 1 | 'd' |
| 5 | / | 3 | 1 |

References:

For a detail representation of characters, please go to <http://www.asciitable.com/>

Programming Exercises:

There are some problems in the following programs, please correct them so that the program can run normally.

[Ch2_01.cpp](#), [Ch2_02.cpp](#), [Ch2_03.cpp](#), [Ch2_04.cpp](#)

Please guess the output of the following problem without the help of your computer.

```
#include <stdio.h>
#include <math.h>

int main(){
    int a=1,b=1;

    printf("Starting\n");      printf("1, 1");
    a=a+b;
    b=a-b;
    printf("%d",a);
    a=a+b;
    b=a-b;
    printf("%d",a);
    a=a+b;
    b=a-b;
    printf("%d",a);
    a=a+b;
    b=a-b;
    printf("%d",a);
    a=a+b;
    b=a-b;
    printf("%d",a);
    a=a+b;
    b=a-b;
    printf("%d",a);          printf("What sequence is it?\n");

    int pause;
    scanf("%d",&x);
    return 0;
}
```

End of Chapter