

# C Data Types

In this tutorial, you will learn about basic data types such as int, float, char etc. in C programming.

In C programming, data types are declarations for variables. This determines the type and size of data associated with variables. For example,

```
int myVar;
```

Here, `myVar` is a variable of `int` (integer) type. The size of `int` is 4 bytes.

## Basic types

Here's a table containing commonly used types in C programming for quick access.

Type	Size (bytes)	Format Specifier
<code>int</code>	at least 2, usually 4	<code>%d</code> , <code>%i</code>
<code>char</code>	1	<code>%c</code>
<code>float</code>	4	<code>%f</code>
<code>double</code>	8	<code>%lf</code>
<code>short int</code>	2 usually	<code>%hd</code>
<code>unsigned int</code>	at least 2, usually 4	<code>%u</code>
<code>long int</code>	at least 4, usually 8	<code>%ld</code> , <code>%li</code>
<code>long long int</code>	at least 8	<code>%lld</code> , <code>%lli</code>
<code>unsigned long int</code>	at least 4	<code>%lu</code>
<code>unsigned long long int</code>	at least 8	<code>%llu</code>
<code>signed char</code>	1	<code>%c</code>
<code>unsigned char</code>	1	<code>%c</code>
<code>long double</code>	at least 10, usually 12 or 16	<code>%Lf</code>

C Basic Data Types	32-bit CPU		64-bit CPU	
	Size (bytes)	Range	Size (bytes)	Range
char	1	-128 to 127	1	-128 to 127
short	2	-32,768 to 32,767	2	-32,768 to 32,767
int	4	-2,147,483,648 to 2,147,483,647	4	-2,147,483,648 to 2,147,483,647
long	4	-2,147,483,648 to 2,147,483,647	8	-9,223,372,036,854,775,808 to 9,223,372,036,854,775,807
long long	8	9,223,372,036,854,775,808 to 9,223,372,036,854,775,807	8	9,223,372,036,854,775,808 to 9,223,372,036,854,775,807
float	4	3.4E +/- 38	4	3.4E +/- 38
double	8	1.7E +/- 308	8	1.7E +/- 308

## int

Integers are whole numbers that can have both zero, positive and negative values but no decimal values. For example, 0, -5, 10

We can use `int` for declaring an integer variable.

```
int id;
```

Here, `id` is a variable of type integer.

You can declare multiple variables at once in C programming. For example,

```
int id, age;
```

The size of `int` is usually 4 bytes (32 bits). And, it can take  $2^{32}$  distinct states from -2147483648 to 2147483647.

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## float and double

`Float` and `double` are used to hold real numbers.

```
float salary;  
double price;
```

In C, floating-point numbers can also be represented in exponential. For example,

```
float normalizationFactor = 22.442e2;
```

What's the difference between `float` and `double`?

The size of `float` (single precision float data type) is 4 bytes. And the size of `double` (double precision float data type) is 8 bytes.

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## char

Keyword `char` is used for declaring character type variables. For example,

```
char test = 'h';
```

The size of the character variable is 1 byte.

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## void

`void` is an incomplete type. It means "nothing" or "no type". You can think of void as **absent**.

For example, if a function is not returning anything, its return type should be `void`.

Note that, you cannot create variables of `void` type.

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## short and long

If you need to use a large number, you can use a type specifier `long`. Here's how:

```
long a;
long long b;
long double c;
```

Here variables `a` and `b` can store integer values. And, `c` can store a floating-point number. If you are sure, only a small integer ( `[-32,767, +32,767]` range) will be used, you can use `short`.

```
short d;
```

You can always check the size of a variable using the `sizeof()` operator.

```
#include <stdio.h>
int main() {
    short a;
    long b;
    long long c;
    long double d;

    printf("size of short = %d bytes\n", sizeof(a));
    printf("size of long = %d bytes\n", sizeof(b));
    printf("size of long long = %d bytes\n", sizeof(c));
    printf("size of long double= %d bytes\n", sizeof(d));
    return 0;
}
```

## signed and unsigned

In C, `signed` and `unsigned` are type modifiers. You can alter the data storage of a data type by using them:

- `signed` - allows for storage of both positive and negative numbers
- `unsigned` - allows for storage of only positive numbers

For example,

```
// valid codes
unsigned int x = 35;
int y = -35; // signed int
int z = 36; // signed int

// invalid code: unsigned int cannot hold negative integers
unsigned int num = -35;
```

Here, the variables `x` and `num` can hold only zero and positive values because we have used the `unsigned` modifier.

Considering the size of `int` is 4 bytes, variable `y` can hold values from `-231` to `231 - 1`, whereas variable `x` can hold values from `0` to `232 - 1`.

## Derived Data Types

Data types that are derived from fundamental data types are derived types. For example: arrays, pointers, function types, structures, etc.

We will learn about these derived data types in later tutorials.

- bool type
- Enumerated type
- Complex types

