C - Data Types

Data types in c refer to an extensive system used for declaring variables or functions of different types. The type of a variable determines how much space it occupies in storage and how the bit pattern stored is interpreted.

The types in C can be classified as follows −

Sr.No.	Types & Description
1	**Basic Types** They are arithmetic types and are further classified into: (a) integer types and (b) floating-point types.
2	**Enumerated types** They are again arithmetic types and they are used to define variables that can only assign certain discrete integer values throughout the program.
3	**The type void** The type specifier *void* indicates that no value is available.
4	**Derived types** They include (a) Pointer types, (b) Array types, (c) Structure types, (d) Union types and (e) Function types.

The array types and structure types are referred collectively as the aggregate types. The type of a function specifies the type of the function's return value. We will see the basic types in the following section, where as other types will be covered in the upcoming chapters.

Integer Types

The following table provides the details of standard integer types with their stora

sizes and value ranges −

Type	Storage size	Value range
char	1 byte	-128 to 127 or 0 to 255
unsigned char	1 byte	0 to 255
signed char	1 byte	-128 to 127
int	2 or 4 bytes	-32,768 to 32,767 or -2,147,483,648 to 2,147,483,647
unsigned int	2 or 4 bytes	0 to 65,535 or 0 to 4,294,967,295
short	2 bytes	-32,768 to 32,767
unsigned short	2 bytes	0 to 65,535
long	8 bytes or (4bytes for 32 bit OS)	-9223372036854775808 to 9223372036854775807
unsigned long	8 bytes	0 to 18446744073709551615

To get the exact size of a type or a variable on a particular platform, you can use the **sizeof** operator. The expressions *sizeof(type)* yields the storage size of the object or type in bytes. Given below is an example to get the size of various type on a machine using different constant defined in limits.h header file −

Live Demo

```
#include <stdio.h>
#include <stdlib.h>
#include <limits.h>
#include <float.h>

int main(int argc, char** argv) {

    printf("CHAR_BIT    :   %d\n", CHAR_BIT);
    printf("CHAR_MAX    :   %d\n", CHAR_MAX);
    printf("CHAR_MIN    :   %d\n", CHAR_MIN);
    printf("INT_MAX     :   %d\n", INT_MAX);
    printf("INT_MIN     :   %d\n", INT_MIN);
    printf("LONG_MAX    :   %ld\n", (long) LONG_MAX);
    printf("LONG_MIN    :   %ld\n", (long) LONG_MIN);
```

```
    printf("SCHAR_MAX   :   %d\n", SCHAR_MAX);
    printf("SCHAR_MIN   :   %d\n", SCHAR_MIN);
    printf("SHRT_MAX    :   %d\n", SHRT_MAX);
    printf("SHRT_MIN    :   %d\n", SHRT_MIN);
    printf("UCHAR_MAX   :   %d\n", UCHAR_MAX);
    printf("UINT_MAX    :   %u\n", (unsigned int) UINT_MAX);
    printf("ULONG_MAX   :   %lu\n", (unsigned long) ULONG_MAX);
    printf("USHRT_MAX   :   %d\n", (unsigned short) USHRT_MAX);

    return 0;
}
```

When you compile and execute the above program, it produces the following result on Linux −

```
CHAR_BIT    :   8
CHAR_MAX    :   127
CHAR_MIN    :   -128
INT_MAX     :   2147483647
INT_MIN     :   -2147483648
LONG_MAX    :   9223372036854775807
LONG_MIN    :   -9223372036854775808
SCHAR_MAX   :   127
SCHAR_MIN   :   -128
SHRT_MAX    :   32767
SHRT_MIN    :   -32768
UCHAR_MAX   :   255
UINT_MAX    :   4294967295
ULONG_MAX   :   18446744073709551615
USHRT_MAX   :   65535
```

Floating-Point Types

The following table provide the details of standard floating-point types with storage sizes and value ranges and their precision −

Type	Storage size	Value range	Precision
float	4 byte	1.2E-38 to 3.4E+38	6 decimal places
double	8 byte	2.3E-308 to 1.7E+308	15 decimal places
long double	10 byte	3.4E-4932 to 1.1E+4932	19 decimal places

The header file float.h defines macros that allow you to use these values and other details about the binary representation of real numbers in your programs. The following example prints the storage space taken by a float type and its range values −

Live Demo

```
#include <stdio.h>
#include <stdlib.h>
#include <limits.h>
#include <float.h>

int main(int argc, char** argv) {

    printf("Storage size for float : %d \n", sizeof(float));
    printf("FLT_MAX     :   %g\n", (float) FLT_MAX);
    printf("FLT_MIN     :   %g\n", (float) FLT_MIN);
    printf("-FLT_MAX    :   %g\n", (float) -FLT_MAX);
    printf("-FLT_MIN    :   %g\n", (float) -FLT_MIN);
    printf("DBL_MAX     :   %g\n", (double) DBL_MAX);
    printf("DBL_MIN     :   %g\n", (double) DBL_MIN);
    printf("-DBL_MAX     :  %g\n", (double) -DBL_MAX);
    printf("Precision value: %d\n", FLT_DIG );

    return 0;
}
```

When you compile and execute the above program, it produces the following result on Linux −

```
Storage size for float : 4
FLT_MAX      :   3.40282e+38
FLT_MIN      :   1.17549e-38
-FLT_MAX     :   -3.40282e+38
-FLT_MIN     :   -1.17549e-38
DBL_MAX      :   1.79769e+308
DBL_MIN      :   2.22507e-308
-DBL_MAX     :  -1.79769e+308
Precision value: 6
```

The void Type

The void type specifies that no value is available. It is used in three kinds ...

situations −

Sr.No.	Types & Description
1	**Function returns as void** There are various functions in C which do not return any value or you can say they return void. A function with no return value has the return type as void. For example, **void exit (int status);**
2	**Function arguments as void** There are various functions in C which do not accept any parameter. A function with no parameter can accept a void. For example, **int rand(void);**
3	**Pointers to void** A pointer of type void * represents the address of an object, but not its type. For example, a memory allocation function **void *malloc(size_t size);** returns a pointer to void which can be casted to any data type.

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