SNS COLLEGE OF TECHNOLOGY

Coimbatore-35.
An Autonomous Institution

COURSE NAME : 19CST101 PROGRAMMING FOR PROBLEM SOLVING

I YEAR/ I SEMESTER

UNIT-II C PROGRAMMING BASICS

Topic: C Data Types

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C Data Types

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

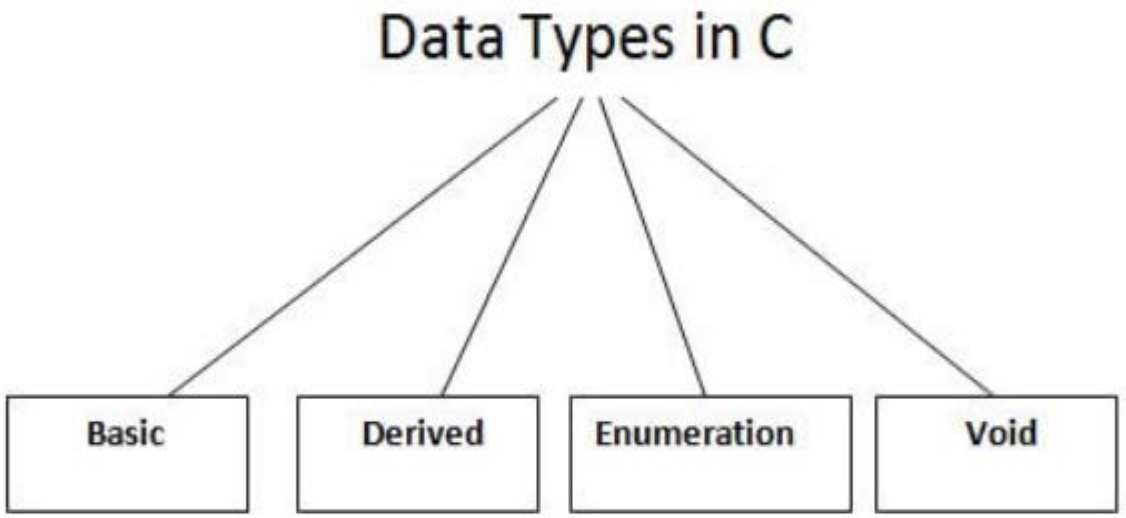
```
int myVar;
```

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

C Data Types are used to:

- Identify the type of a variable when it declared.
- Identify the type of the return value of a function.
- Identify the type of a parameter expected by a function.

C Data Types



ANSI C provides three types of data types:

1. **Primary(Built-in) Data Types:**
   `void` , `int` , `char` , `double` and `float` .
2. **Derived Data Types:**
   `Array` , `References` , and `Pointers` .
3. **User Defined Data Types:**
   `Structure` , `Union` , and `Enumeration` .

C Data Types

There are five primary fundamental data types,

1. int for integer data
2. char for character data
3. float for floating point numbers
4. double for double precision floating point numbers
5. void

C Data Types

Following table displays the size and range of each data type.

Data type	Size in bytes	Range
Char or signed char	1	-128 to 127
Unsigned char	1	0 to 255
int or signed int	2	-32768 to 32767
Unsigned int	2	0 to 65535
Short int or Unsigned short int	2	0 to 255
Signed short int	2	-128 to 127
Long int or Signed long int	4	-2147483648 to 2147483647
Unsigned long int	4	0 to 4294967295
float	4	3.4E-38 to 3.4E+38
double	8	1.7E-308 to 1.7E+308
Long double	10	3.4E-4932 to 1.1E+4932

Note: In C, there is no Boolean data type.

C Data Types

Primary Data Types

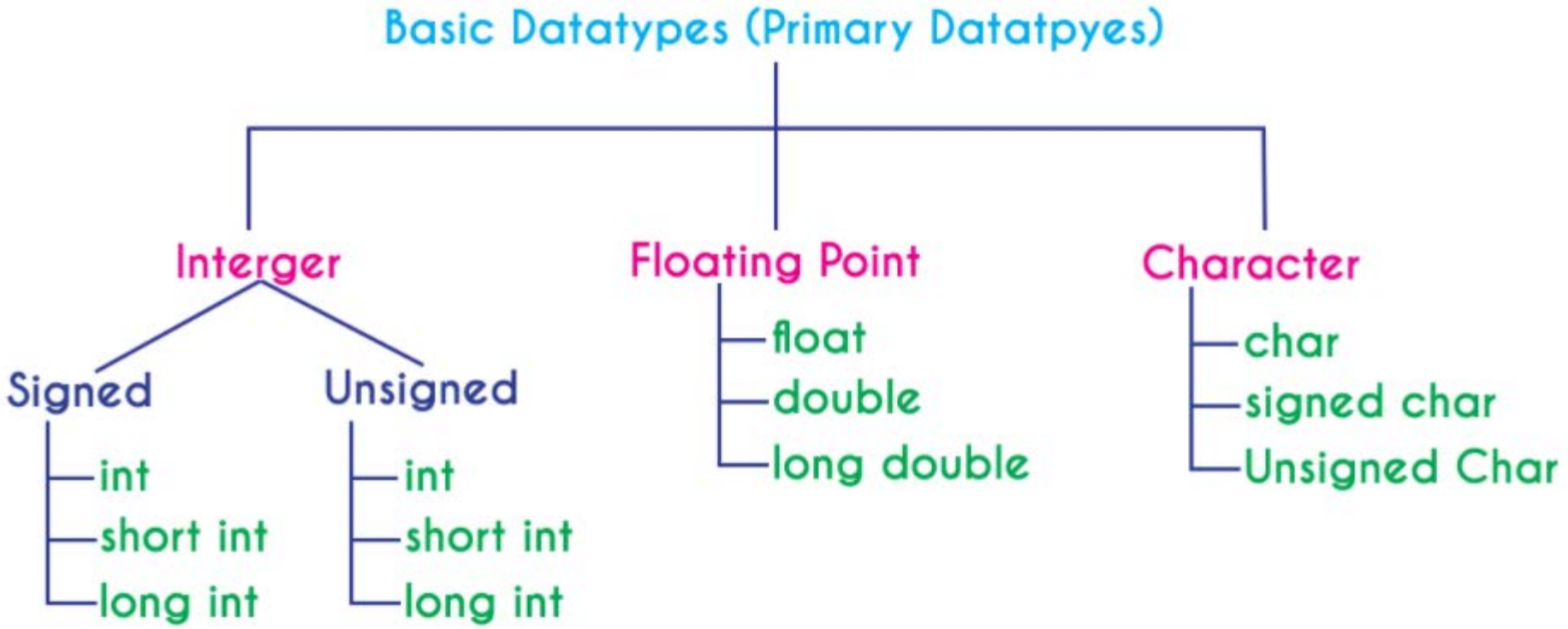
Every C compiler supports five primary data types:

void	As the name suggests, it holds no value and is generally used for specifying the type of function or what it returns. If the function has a void type, it means that the function will not return any value.
int	Used to denote an integer type.
char	Used to denote a character type.
float, double	Used to denote a floating point type.
int *, float *, char *	Used to denote a pointer type.

Three more data types have been added in C99:

- _Bool
- _Complex
- _Imaginary

C Data Types


Basic Datatypes (Primary Datatpyes)
Interger
Signed
int
short int
long int
Unsigned
int
short int
long int
Floating Point
float
double
long double
Character
char
signed char
Unsigned Char

C Data Types

Integer Data type

The integer data type is a set of whole numbers. Every integer value does not have the decimal value. We use the keyword "**int**" to represent integer data type in c. We use the keyword int to declare the variables and to specify the return type of a function. The integer data type is used with different type modifiers like short, long, signed and unsigned. The following table provides complete details about the integer data type.

Type	Size (Bytes)	Range	Specifier
int (signed short int)	2	-32768 to +32767	%d
short int (signed short int)	2	-32768 to +32767	%d
long int (signed long int)	4	-2,147,483,648 to +2,147,483,647	%d
unsigned int (unsigned short int)	2	0 to 65535	%u
unsigned long int	4	0 to 4,294,967,295	%u

C Data Types

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`.

C Data Types

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;
```

C Data Types

signed and unsigned

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

```
unsigned int x;
int y;
```

Here, the variable `x` 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 -2^{31} to $2^{31}-1$, whereas variable `x` can hold values from `0` to $2^{32}-1$.

C Data Types

Floating Point data types

Floating-point data types are a set of numbers with the decimal value. Every floating-point value must contain the decimal value. The floating-point data type has two variants...

- float
- double

We use the keyword "**float**" to represent floating-point data type and "**double**" to represent double data type in c. Both float and double are similar but they differ in the number of decimal places. The float value contains 6 decimal places whereas double value contains 15 or 19 decimal places. The following table provides complete details about floating-point data types.

Type	Size (Bytes)	Range	Specifier
float	4	1.2E - 38 to 3.4E + 38	%f
double	8	2.3E-308 to 1.7E+308	%ld
long double	10	3.4E-4932 to 1.1E+4932	%ld

C Data Types

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.

C Data Types

Character data type

The character data type is a set of characters enclosed in single quotations. The following table provides complete details about the character data type.

Type	Size (Bytes)	Range	Specifier
char (signed char)	1	-128 to +127	%c
unsigned char	1	0 to 255	%c

char

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

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

The size of the character variable is 1 byte.

C Data Types

The following table provides complete information about all the data types in c programming language...

	Integer	Floating Point	Double	Character
What is it?	Numbers without decimal value	Numbers with decimal value	Numbers with decimal value	Any symbol enclosed in single quotation
Keyword	int	float	double	char
Memory Size	2 or 4 Bytes	4 Bytes	8 or 10 Bytes	1 Byte
Range	-32768 to +32767 (or) 0 to 65535 (Incase of 2 bytes only)	1.2E - 38 to 3.4E + 38	2.3E-308 to 1.7E+308	-128 to + 127 (or) 0 to 255
Type Specifier	%d or %i or %u	%f	%ld	%c or %s
Type Modifier	short, long signed, unsigned	No modifiers	long	signed, unsigned
Type Qualifier	const, volatile	const, volatile	const, volatil	const, volatile

C Data Types

Declaration of Primary Data Types with Variable Names

After taking suitable variable names, they need to be assigned with a data type. This is how the data types are used along with variables:

Example:

```
int    age;
char   letter;
float  height, width;
```

C Data Types

SIZEOF() FUNCTION IN C LANGUAGE:

sizeof() function is used to find the memory space allocated for each C data types.

```c
#include <stdio.h>
#include <limits.h>
int main()
{
   int a;
   char b;
   float c;
   double d;
   printf("Storage size for int data type:%d \n",sizeof(a));
   printf("Storage size for char data type:%d \n",sizeof(b));
   printf("Storage size for float data type:%d \n",sizeof(c));
   printf("Storage size for double data type:%d\n",sizeof(d));
   return 0;
}
```

C Data Types

SIZEOF() FUNCTION IN C LANGUAGE:

OUTPUT:

```
Storage size for int data type:4
Storage size for char data type:1
Storage size for float data type:4
Storage size for double data type:8
```

C Data Types

Data Types and Variable Declarations in C

Example:

```c
#include <stdio.h>
int main()
{
    int a = 4000; // positive integer data type
    float b = 5.2324; // float data type
    char c = 'Z'; // char data type
    long d = 41657; // long positive integer data type
    long e = -21556; // long -ve integer data type
    int f = -185; // -ve integer data type
    short g = 130; // short +ve integer data type
    short h = -130; // short -ve integer data type
    double i = 4.1234567890; // double float data type
    float j = -3.55; // float data type
}
```

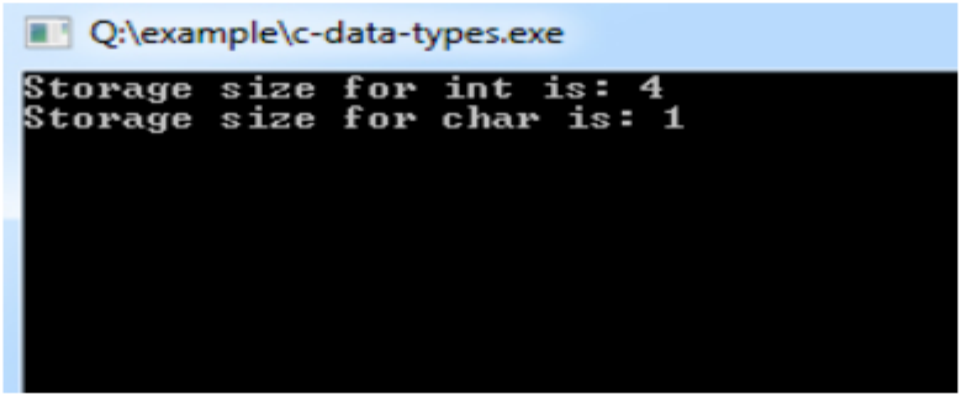
The storage representation and machine instructions differ from machine to machine. **sizeof** operator can use to get the exact size of a type or a variable on a particular platform.

C Data Types

Example:

```c
#include <stdio.h>
#include <limits.h>
int main()
{
    printf("Storage size for int is: %d \n", sizeof(int));
    printf("Storage size for char is: %d \n", sizeof(char));
    return 0;
}
```

Program Output:



C Data Types

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.

C Data Types

The void Type

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

C Data Types

Derived Data Types

C supports three derived data types:

Data Types	Description
Arrays	Arrays are sequences of data items having homogeneous values. They have adjacent memory locations to store values.
References	Function pointers allow referencing functions with a particular signature.
Pointers	These are powerful C features which are used to access the memory and deal with their addresses.

C Data Types

User Defined Data Types

C allows the feature called `type definition` which allows programmers to define their identifier that would represent an existing data type. There are three such types:

Data Types	Description
Structure	It is a package of variables of different types under a single name. This is done to handle data efficiently. "struct" keyword is used to define a structure.
Union	These allow storing various data types in the same memory location. Programmers can define a union with different members, but only a single member can contain a value at a given time. It is used for
Enum	Enumeration is a special data type that consists of integral constants, and each of them is assigned with a specific name. "enum" keyword is used to define the enumerated data type.


Thank You!