Unit -2: Introduction to C++ (Getting Started and Data Types)

C++ Character Set

Character set is a set of valid characters that a language can recognize.

Letters	A-Z, a-z
Digits	0-9
Special Characters	Space + - * / ^ \ () [] {} = != <> ' " $, ; : % ! & ? _ # <= >= @
Formatting characters	backspace, horizontal tab, vertical tab, form feed, and carriage return

TOKENS - The smallest lexical unit in a program is known as token. A token can be any keyword, Identifier , Literals, Punctuators, Operators. C++ has following tokens:

- Identifiers - It is an arbitrarily long sequence of letters and digits .the first character of a identifier must be a letter and '_' underscore can appear in identifiers. Identifiers also start with an underscore. Uppercase and lower case letter are different .all characters in an identifiers are significant .eg; int total; is valid, int 9a ; is invalid.
- Keywords - These are the words that convey a special meaning to a language compiler. These are reserved for special purpose and must not be used as abnormal. Following are some of the keywords:

Auto	signed	friend	Else	volatile	for
Continue	short	long	typedef	inline	if
Float	delete	private	union	template	while
new	catch	sizeof	void	goto	do

- Literals - These are the data items that never change their value during a program run . C++ has several kinds of literals .
  - ✓ Integer constants: These must have at least one digit and must not contain any decimal point . it may contain a '+' or ' - ' sign , a number with no sign is assumed to be positive and commas cannot appear in an integer constant . eg int a = 45 ;

- ✓ Character constants : A character constant in c++ must contain only one character and must be enclosed in single quotes . the single character for eg : ʻcʼ or ʻAʼ have the data type of character which is a c++ dataype eg – char a = ʻcʼ ; Every character has its equivalent ASCII code. A-Z ranges 65-90 , a-z ranges 97-122 and digits ranges 48-57. Non printing characters can also be used with escape sequence as ʻ\nʼ , ʻ\tʼ etc.

- Floating type constant – they are also known as real constant . A real constant in fractional form must have at least one digit before the decimal point and atleast one after the decimal point . it can also have ʻ+ʼ or ʻ- ʻ sign . a real constant with no sign is assumed to have a positive sign . foreg – 7.1 is a floating point number in c++ which has one digit before the decimal and one digit after the decimal. A real constant in the exponent form has 2 parts the maintain is a must be either an integer or a real constant. The mantissa is followed by letter ʻEʼ or ʻeʼ as the partition between the mantissa and the exponent . eg – 5.8 = 0.58*10 =0.58E01
- String literals - a string literal is a sequence of characters surrounded by double quotes (" ") each sting literal is by default added by special character known as the null character (ʻ\0ʼ) which marks the end of the string . Thus, the size of the string is the no. of characters in the string + 1 character for the null character . eg – "abc" . In the given example the string has 3 characters + null character which is automatically added by c++ .therefore total size of the string is 4.
- Operators - These are the tokens that performs same computation when applied to variable and the other digits in the expression . for eg - + , - , *, /, %.

Punctuators

The following characters are used as punctuators which are also known as separators in C++.

Punctuator	Name	Function
[ ]	Brackets	Indicates array subscripts
( )	Parenthesis	Indicates function calls and function parameters.
{ }	Braces	Indicates start and end of

		compound statements.
;	Semicolon	Statement terminator
:	Colon	Indicates a labeled statement
*	Asterisk	Used as a pointer declaration
…	Ellipsis	Indicate a variable number of arguments.
=	Equal to	Assignment Operator
#	Pound sign	Used as preprocessor directives.

Operators

These are those lexical units that trigger some computation when applied to variables and other objects in an expression. Following are some operators used in C++.

Unary Operator – Those which require only one operand to trigger. E.g. &,+,++, -- ,!.

Binary Operators – These require two operands to operate upon. Following are some of the Binary operators.

Arithmetic Operator:

An arithmetic operator is a mathematical function that takes two operands and performs a calculation on them. They are used in common arithmetic and most computer languages contain a set of such operators that can be used within equations to perform a number of types of sequential calculation.

+ Addition, - Subtraction, * Multiplication, / Division, % Remainder

Example : 9+ 7 = 16 , 9-7=2 , 9*7=63, 9/7=1,9%7=2

Logical Operators: Logical operators are typically used with Boolean (logical) values; when they are, they return a Boolean value.

&& - Logical AND – returns 1 if both the conditions are true

|| - Logical OR – returns 1 if any one condition is true

! NOT – negates the condition

(3>4)&&(6<3) evaluates to false , (3>4)||(6<3) evaluates to true

!0 = 1, !1 = 0 , any non zero value is evaluated as TRUE.

Relational Operator – A relational operator compares two operands to determine whether one is greater than, greater than or equal to, less than, less than or equal to the other:

>	greater than
>=	greater than or equal to
<	less than
<=	less than or equal to
==	equal to
!=	not equal to

3>4 returns 0, 5==9 returns 0

Assignment Operator – used to assign values and can be used as shorthand .

=	Assignment operator
*=	Assign Product
/=	Assign quotient
%=	Assign Remainder

Conditional operator : ? :

The conditional operator evaluates an expression returning a value if that expression is true and a different one if the expression is evaluated as false. Its format is :

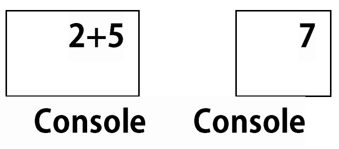
Condition ? result1: result2;

Eg. 7==5 ?4:3;   // returns 3, since 7 is not equal to 5.

Input Output operation

1. Output operation – the output operation is also known as insertion or put -to operator. It is used to direct the value to the standard output i.e. the screen or the console. For eg-

   Cout<<” 2+5” ; cout<<” 245;



2. Input operator(>>)- the input operator also known as extraction or get-from operator is used to read the values from the standard input . For eg. -

```
int a ;

cin >> a ;

cout << a ;
```

The header file <iostream.h > is included in every C++ program to implement the input and output facilities . The line include <iostream.h> instruct the compiler to include the declaration and definition of the standard input or output stream facilities as found in <iostream . h> without this declaration cout statement will make no sense .

Every C++ program must have a function main(). Program execution begins at the main function and continues sequentially by executing the statements within the main function . A program terminates normally following executing of the last statement of the main function.

Every executable statement in C++ must be terminated by a semi-colon;

PREDEFINED STREAMS IN THE INPUT OUTPUT LIBRARY

(i) *cin* (console input) - It is a stream object of the istream class which is used to take the values from the user .

(ii) *cout* (console output) - It is a stream object of the ostream class and is used to print the message or values of the variable or identifiers on the screen.

CASCADING - Multiple use of single cout and cin statement with multiple insertion/extraction operators . for example cin>>a>>b; , cout<<a<<b;

Header file - iomanip.h

This file contains input - output manipulators. For example:

1. **endl - used to display blank line. cout<<a<<endl;**
2. **setw() - Sets the *field width* to be used on output operations. For ex. cout<<setw(5)<<777<<endl<<setw(5)<<77; will display**

```
777
 77
```

C++ Compiler

A C++ compiler is itself a computer program job is to convert the C++ program from our form to a form the computer can read and execute. The original C++ program is called the “source code”, and the resulting compiled code produced by the compiler is usually called an “object file”.
Before compilation the preprocessor performs preliminary operations on C++ source files. Preprocessed form of the source code is sent to compiler.
After compilation object files are combined with predefined libraries by a linker, sometimes called a binder, to produce the final complete file that can be executed by the computer. A library is a collection of pre-compiled “object code” that provides operations that are done repeatedly by many computer programs.

Using Turbo C++ Compiler

1. Now type sample program on Editor
2. Click on Compile menu choose Compile option or press Alt+F9
3. Click on Run menu choose Run option or press Ctrl+F9
4. If there is no error output will be displayed on User Screen

Types of Errors in C++

1. ***Syntax error -*** These errors occur when rules of a programming language are misused or violated i.e. when a grammatical rule for C++ is not followed.

   For e.g. - if semi-colon is missing in an executable statement of a C++ program the error reported is a syntax error.

2. ***Semantic errors*** - These errors occur when statements are not meaningful. Semantics refers to set of rules which give a meaning to a statement.

   For e.g. - the expression X+Y=Z will result in a semantic error as the expression X+Y cannot come to the left side of the assignment operator.

3. ***Type errors -*** Data in C++ has an associated data-type with it. The value 7 for instance is an integer. ′a′ is a character. “abc” is a string in C++. If a function is given wrong type of data-type error is signaled by the compiler.

For e.g. - int a = ′ A′ ;

4. ***Logical errors -*** These are those errors which cause a program to produce incorrect or undesired output.

   For e.g. – in the following code program / fragment

   int i = 1;

   while(i>10) //the while loop will never execute because the expression in while loop

   {cout<<i; // will never be true as the initial value of i is 1 whichiis not greater than 10]

   i++; }

5. ***Run-Time errors -*** It is that error which occurs during the execution of a program. It is caused because of some illegal operations taking place. In availability of desired, or required, conditions for the execution of a program.

   For e.g. if a program is trying to open a file which does not exist or it could not be opened, it results in an execution error or run-time error.

   If we try to divide a number with 0, this type of error is a run-time error.

   Comments – comments are the part of a program but not the part of execution. It is of 2 types:-

   1.Single line comments – Single line comments start with // . following is the example of single line comment

   //this is the very simple example of single line comments

   2.Multi line comments – multi line comments are used to make a block as comment. It begins with /* and ends with */

   /*

   This is the example of

multi line comment

*/

DATA TYPES

Fundamental or Basic data types : These are the data types which are not composed of any other data type.

There are mainly 5 fundamental Data types in c++ which are as follows :

1- Integer – Integer constant are used to store whole numbers .

2- Character – character constant are used to store a single character, escape sequence like '\n' , '\t' etc.

3- Float – floating constant can store decimal numbers with 6 digits of precision.

4- Double – double constant store high range of decimal values.

5- void – only used to specify return type and signify empty values.

Derived data types - These are constructed from fundamental data types.

Example-:

1- arrays 2. Function 3. Pointers 4. References 5.constants

User defined Derived Data Types – Composed of fundamental and derived data types and are user defined.

1. Classes 2.structure 3.Union 4.Enumerators

Data type modifiers - A modifier is used to alter the meaning of the base type so that it more precisely fits the needs of various situations.

1. short – same as int.
2. long – doubles the range of int and occupies 4 bytes.
3. signed – this is by default and only be used with char or int. It can store both +ve and – ve values.
4. unsigned – this modifies the sign and can only store +ve values, hence can store the values nearly to double range.

These are summarized in table along with description and memory requirement

Type	Byte	Range	Description
Int	2	-32768 to +32767	Small whole number
long int	4	-2147483648 to +2147483647	Large whole number
Float	4	3.4x10-38 to 3.4x10+38	Small real number
Double	8	1.7x10-308 to 1.7x10+308	Large real number
long double	10	3.4x10-4932 to 3.4x10+4932	Very Large real number
Char	1	0 to 255	A Single Character

Variables

It is a location in the computer memory which can store data and is given a symbolic name for easy reference. The variables can be used to hold different values at different times during the execution of a program.

To understand more clearly we should study the following statements:
Total = 20.00; In this statement a value 20.00 has been stored in a memory location Total.

Initialization of variable - When we declare a variable it's default value is undetermined. We can declare a variable with some initial value.
int a = 20;

DYNAMIC INITIALISATION - When the initialization of variable is done at run time or execution time, it is known as dynamic initialization.

```
        eg- int a=10;       int b = 20;

            int c;          c = a+b;
```

Assignment statement - A value is assigned to a variable after it is declared. For example :

```
int x;  //declaration

x=10; // assignment
```

CONSTANT VARIABLES

A constant variable is that variable whose value cannot be changed when the program is executing. It has a necessary condition that it has to be initialized at the time of declaration and declared using const keyword. For eg-   const int a =10;

Sample Theory Questions to Learn

1. **Differentiate between**
    a. **Logical and Syntax Errors**
    b. **Signed and Unsigned int**
    c. **Fundamental and Derived Data Types**
    d. **Single line and Multi line comments**
    e. **Arithmetic and Logical Operators**
    f. **Logical and Relational Operators**
2. **What do you understand by Fundamental and Derived data types?**
3. **Why main() is so special? Give reasons.**
4. **What are pre-defined streams in C++ ?**
5. **Explain any two functions of iomanip.h.**
6. **What is dynamic initialization? Explain with example.**
7. **What is constant variable?**
8. **Why we include header file in a program?**
9. **What is cascading?**
10. **Name user defined and derived data types.**