MEPL

IBPS SO PREPRATION

Programming Language

SHOBHIT BANDHU

2015

Computer Programming Overview

I assume today is your first day when you heard about computer programming. You are curious to know what exactly computer programming is. Before you understand what computer programming is, you need to understand what is computer program?

I'm making an assumption that you know a little about what is computer and how to use it for Internet browsing, Exploring Face book or Checking e-mail using Gmail, etc.

What is Computer Program?

A computer program is a sequence of instructions written using a Computer Programming Language to perform a specified task by the computer

I assume, you did not understand what I have written about computer program but let's see two important terms, which I have used in the above definition:

- Sequence of instructions
- Computer Programming Language

To understand these terms, consider a situation when someone asks you about how to go to a nearby KFC. What exactly do you do to tell him the way to go to KFC?

You will use Human Language to tell the way to go to KFC something as follows:

First go straight, after half kilometer, take left from the red light and then drive around one kilometer and you will find KFC at the right.

Here, you have used English Language to give several steps to be taken to reach to KFC. If they will be followed in the following sequence, then you will reach KFC:

1. Go straight
2. Drive half kilometer
3. Take left
4. Drive around one kilometer
5. Search for KFC at your right side

Now, try to map the situation with computer program. Above sequence of instructions is actually a **Human Program** written in **English Language**, which instructs on how to reach to KFC from a given starting point. This same sequence could have been given in Spanish Language, Hindi Language, Arabic or any other human language provided someone, who is asking about the way, knows about such languages.

Now, let's go back and try to understand about a computer program, which is a sequence of instructions written in a Computer Language to perform a specified task by the computer. Following is a simple program written in **Python** programming Language:

```
print "Hello, World!"
```

Above computer program instructs computer to print "Hello, World!" on computer screen.

- A computer program is also called a **computer software**, which can range from two lines to millions of lines of instructions.
- Computer program instructions are also called program source code and **computer programming** is also called **program coding**.
- A computer machine without a computer program is just a dump box and thus computer program brings a computer machine to live state.

Like human has several languages to communicate their message, computer scientists have developed several computer-programming languages to provide instructions to the computer (i.e., to write computer programs). We will see several computer programming languages in subsequent chapters.

What is Computer Programming?

If you understood what computer program is, then I will say *the act of writing computer programs is called computer programming.*

As I mentioned earlier, there are 100s of programming languages, which can be used to write computer programs and following are few of them:

- Java
- C
- C++
- Python
- PHP
- Perl
- Ruby

What Computer Program can do?

Today computer programs are being used in almost every field, household, agriculture, medical, entertainment, defense, communication, etc. Following are few applications of computer programs:

- MS Word, MS Excel, Adobe Photoshop, Internet Explorer, Chrome, etc., are example of computer programs.

- Computer programs are being used to develop graphics and special effects in movie making.
- Computer programs are being used to perform Ultrasounds, X-Rays, and other medical examinations.
- Computer programs are being used in our mobile phones for SMS, Chat, and voice communication.

Who is Computer Programmer?

If you understood what is computer program and what is computer programming, then simply apply common sense to understand who is computer programmer?

Someone, who can write computer programs or in other words, someone who can do computer programming is called Computer Programmer

Based on computer programming language expertise, we can name computer programmers as follows:

- C Programmer
- C++ Programmer
- Java Programmer
- Python Programmer
- PHP Programmer
- Perl Programmer
- Ruby Programmer

What is Algorithm?

From programming point of view, an **algorithm** is a step-by-step procedure to resolve any problem. An algorithm is an effective method expressed as a finite set of well-defined instructions.

Thus, a computer programmer lists down all the steps required to resolve a problem before jumping to write actual code. Following is a simple example of an algorithm to find out a largest number from a given list of numbers:

```
1.  Get a list of numbers $L_1$, $L_2$, $L_3$....$L_N$
2.  Assume $L_1$ is the largest, Largest = $L_1$
3.          Take next number $L_i$ from the list and do the following
4.  If Largest is less than $L_i$
5.     Largest = $L_i$
6.  If $L_i$ is last number from the list then
7.     Print value stored in Largest and come out
8.  Else repeat same process starting from step 3
```

Above algorithm has been written in very crude way just because to make it clear to beginners, otherwise if you will study computer algorithm subject then you will find standardized way of writing computer algorithm.

Computer Programming Basics

I assume you are well aware of English Language, which is a well-known **Human Interface Language**. English has a predefined grammar, which needs to be followed to write English statements in a correct way. Likewise, most of the Human Interface Languages (Hindi, English, Spanish, French, etc.) are made of several elements like verbs, nouns, adjectives, adverbs, propositions, and conjunctions, etc.

Similar to Human Interface Languages, Computer Programming Languages are also made of several elements. I will take you through the basics of those elements and put some effort to make you comfortable to use them in various programming languages. These basic elements are:

- Programming Environment
- Basic Syntax
- Data Types
- Variables
- Keywords
- Basic Operators
- Decision Making
- Loops
- Numbers
- Characters
- Arrays
- Strings
- Functions
- File I/O

I will explain all these elements in subsequent chapters with examples using different programming languages. First we will try to understand meaning of all these terms in general and then we will see how these terms can be used in different programming language.

I believe if you understood above-mentioned elements related to any programming language, then you are almost ready to write big enough programs in that programming language.

I designed this tutorial to give you an idea about the following most popular programming languages:

- C Programming
- Java Programming
- Python Programming

Major part of the tutorial has been explained by taking C as programming language and then I tried to show how similar concepts work in Java and Python. So after completion of this tutorial, you will find yourself familiar with these popular programming languages.

Computer Programming Environment

Though Environment Setup is not an element of any Programming Language, it is the first thing we need to start programming with any Programming Language.

When we are saying Environment Setup, it simply means we need to have a base on top of which we can do our programming. Thus, we need to have required software setup, i.e., installation on our PC which will be used to write our Computer Program, Compile and Execute it. For example, if you need to browse Internet, then you need the following setup on your machine:

- A working Internet Connection to connect to the Internet.
- Web Browser like Internet Explorer, Chrome, or Safari, etc.

If you are a PC user, then you will recognize following screen shot, which I have taken from Internet Explorer while browsing tutorialspoint.com.

http://www.tutorialspoint.com/
Tutorials for Data Mining, J...
tutorialspoint
SIMPLY EASY LEARNING
Search this site...
SVN iOS VB.Net JAVA PHP Python Ruby Perl HTML CSS Javascript MySQL C++ UNIX
REFERENCES | FORUM | ABOUT | CONTACT
Professional Education
Data Communication/Networking
Software Development Life Cycle
Management Information System
Learn Computer Fundamentals
Computer Logical Organization
Digital Image Processing
Learn Mobile Computing
The shortest tutorials on the greatest technologies
Free Web Graphics
Download Free Graphics
Online HTML Editor
Online HTML Editor
White Papers
Submit White Papers
Webmaster Tools
Validate XHTML Page
Validate HTML Page
Check Broken Links
Validate CSS Syntax
RSS Feed Validations

Similar way, you will need following setup to start with programming using any programming language.

- A text editor to create computer program.
- A compiler to compile program into binary format.
- An interpreter to execute program directly.

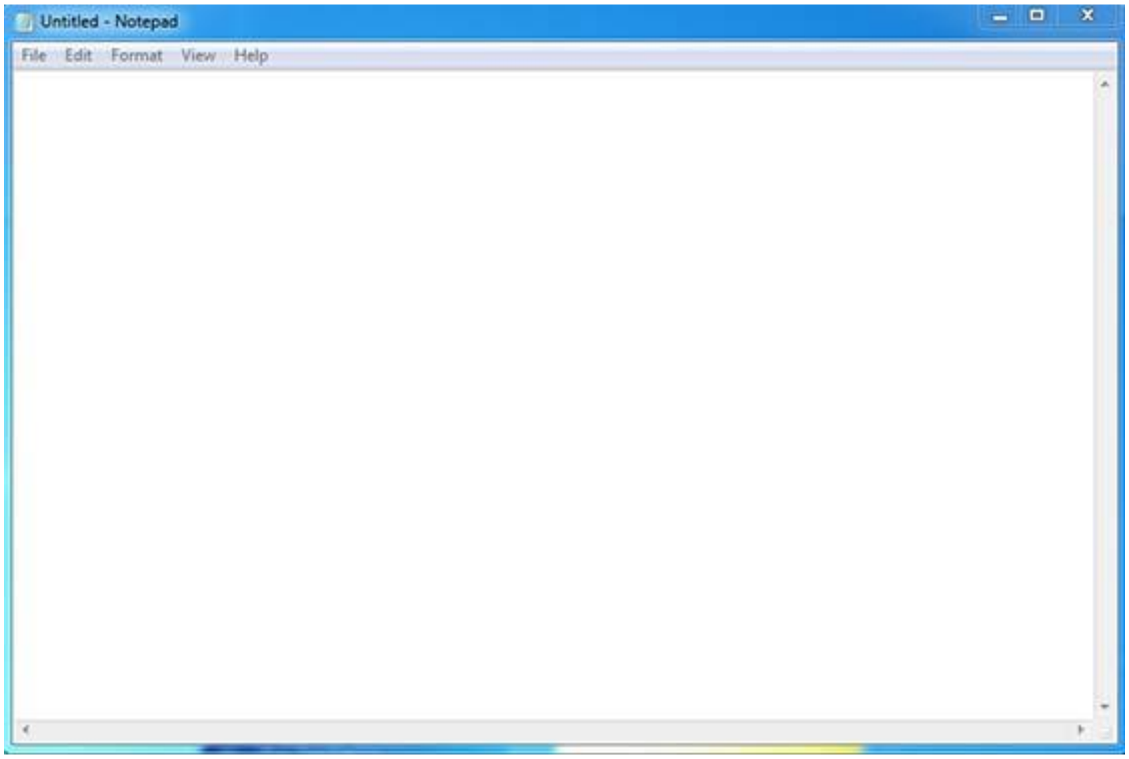
If you are new to the computer, you yourself will not be able to set up either of these Softwares. So, I suggest you take help from any technical person around you to set up programming environment on your machine from where you can start. But for you, this is important to understand what are these items.

What is Text Editor?

This is a Software, which will be used to write your computer program. Your Windows machine must have a Notepad, which can be used to type your program. You can launch it by following these steps:

Start Icon → All Programs → Accessories → Notepad → Mouse Click on Notepad

This will launch Notepad with the following window:



You can use this software to type your computer program and save it in a file at any location. You can download and install other good editors like **Notepad++**, which is freely available.

If you are Mac user, then you will have **TextEdit** or you can install some other commercial editor like **BBEdit**, etc., to start with.

What is Compiler?

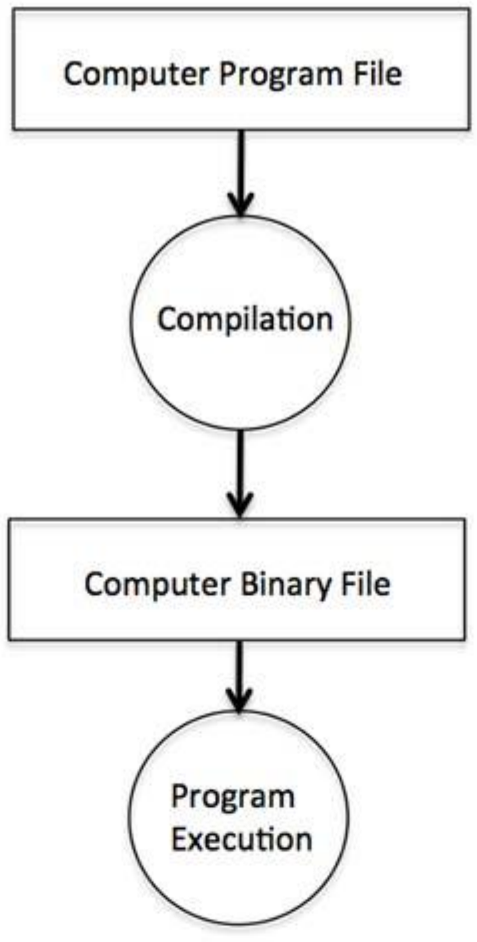
You write your computer program using your favorite programming language and save it in a text file called program file. What is next?

Let's try to get a little more detail on how computer understands a program written by you using a programming language. Actually, computer cannot understand your program directly given in the text format, so we need to convert this program in a binary format, which can be understood by the computer.

The conversion from text program to binary file is done by another software called Compiler and this process of conversion from text formatted program to binary format file is called program compilation. Finally, you can execute binary file to perform the programmed task.

We are not going into detail of different constituents of a compiler and different phases of compilation.

Following flow diagram gives an illustration of the process:

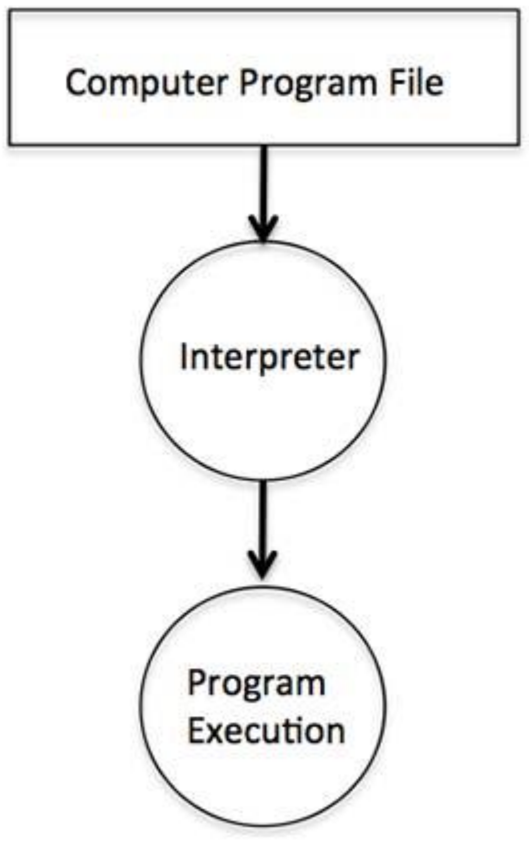


So, if you are going to write your program in any such language, which needs compilation like C, C++, Java and Pascal, etc., then you will need to install their compilers before you start programming in such languages.

What is Interpreter?

We just discussed about Compiler and Compilation Process. This is required in case you are going to write your program in a programming language, which needs compilation into binary format before its execution. Few examples of such programming languages are C, C++, Java.

There are programming languages like Python, PHP and Perl, which do not need any compilation into binary format, rather an interpreter can be used to read such program line by line and execute it directly without any further conversion.



So, if you are going to write your program in any such language, which does not need compilation like PHP, Python, Perl, and Ruby, etc., then you will need to install their interpreters before you start programming in such languages.

Online Compilation

If you are not able to set up any editor, compiler or interpreter on your machine, then *tutorialspoint.com* provides a facility to compile and run almost all the programs online with an ease of a single click.

So do not worry and let's proceed further to have thrilling experience to become a computer programmer in simple and easy steps.

Computer Programming Basic Syntax

Let's start with little coding, which will really make you computer programmer. I'm going to write a single-line computer program to write **Hello, World!** on your screen. Let's see how it can be written using different programming languages:

Hello World Program in C

Try to click **Try It** option to see the output of the following program. This Try it option is available at the top right-corner of the following code box. Try to change the content inside printf() instead of **Hello World!** and then check its result. It just prints whatever you keep inside two double quotes.

```
#include <stdio.h>

main()
{
  /* printf() function to write Hello, World! */
  printf( "Hello, World!" );
}
```

This little Hello World program will help us in understanding various basic concepts related to C Programming.

Program Entry Point

For now just forget about **#include <stdio.h>** statement, but keep a note that you have to put this statement at the top of a C program.

So, every C program starts with main(), which is called main function and then it is followed by a left curly brace. Rest of the program instruction is written in between and finally a right curly brace ends the program.

The coding part inside these two curly braces is called program body. The left curly brace can be in the same line as main(){ or in the next line like it has been mentioned in the above program.

Functions

Functions are small units of programs and they are used to carry out a specific task. For example, above program makes use of two functions **(a) main()** and **(b) printf()**. Here, function main() provides the entry point for the program execution and another function printf() is being used to print an information on computer screen.

You can write your own functions which we will see in separate chapter, but C programming itself provides various built-in functions like main(), printf(), etc., which we can use in our programs based on our need.

Few programming languages use word **sub-routine** instead of function but their functionality is more or less same.

Comments

A C program can have statements enclosed inside **/*.....*/**. Such statements are called comments and these comments are used to make program user friendly and easy to understand the program. Good thing about comments is that they are completely ignored by compilers and interpreters. So you can whatever language you want to write your comments.

Whitespaces

When we write a program using any programming language, we use various printable characters to prepare programming statements. These printable characters are **a, b, c,......z, A, B, C,.....Z, 1, 2, 3,...... 0, !, @, #, $, %, ^, &, *, (,), -, _, +, =, \, |, {, }, [,], :, ;, <, >, ?, /, \, ~. `. ", '**. Hope I'm not missing any printable characters from your keyboard.

Apart from these characters, there are some characters which we use very frequently but they are invisible in your program and these characters are spaces, tabs (\t), new lines(\n). These characters are called **whitespaces**.

These three important whitespace characters are common in all the programming languages and they remain invisible in your text document having your program:

Whitespace	Explanation	Representation
New Line	This will be used to create a new line.	\n
Tab	This will be used to create a tab.	\t
Space	This will be used to create a space.	empty space

A line containing only whitespace, possibly with a comment, is known as a blank line, and a C compiler totally ignores it. Whitespace is the term used in C to describe blanks, tabs, newline characters and comments. So you can write **printf("Hello, World!");** as follows. Here all the created spaces around "Hello, World!" are useless and the compiler will ignore them at the time of compilation.

```
#include <stdio.h>

main()
{

   /* printf() function to write Hello, World! */

   printf(    "Hello, World!"      );

}
```

Assuming, I make all these whitespace characters visible, then your above program will look like something below and you will not be able to compile it:

```
#include <stdio.h>\n
\n
main()\n
{
\n
\t/* printf() function to write Hello, World! */
\n
\tprintf(\t"Hello, World!"\t);\n
\n
}\n
```

Semicolons

Every individual statement in C Program, must be ended with a semicolon **;** For example, if you want to write "Hello, World!" twice, then it will be written as follows:

```
#include <stdio.h>

main()
{
   /* printf() function to write Hello, World! */
   printf( "Hello, World!\n" );
   printf( "Hello, World!" );
}
```

This program will produce the following result:

```
Hello, World!
Hello, World!
```

Here, I'm using new line character **\n** in first printf() function to create a new line. Let us see what happens if I do not use this new line character:

```
#include <stdio.h>

main()
{
   /* printf() function to write Hello, World! */
```

```
  printf( "Hello, World!" );
  printf( "Hello, World!" );
}
```

This program will produce following result:

```
Hello, World! Hello, World!
```

I'm skipping explanation about identifiers and keywords and will take them in next few chapters.

Program Explanation

Let's try to understand how the above C program to print “Hello, World!” works. First of above program is converted into a binary format using C compiler. So let’s put this code in test.c file and compile it as follows:

```
$gcc test.c -o demo
```

If there is any grammatical error (Syntax errors in computer terminologies), then we fix it before converting it into binary format. If everything goes fine then it produces binary file called **demo**. Finally we execute produced binary demo as follows:

```
$./demo
```

Which produces following result:

```
Hello, World!
```

Here, when we execute binary **a.out** file, what computer does is, it enters inside the program starting from main() and encounters a printf() statements. Keep a note about line inside /*....*/ is a comment so it is filtered at the time of compilation. So printf() function instructs computer to print the given line at the computer screen. Finally it encounters a right curly brace which indicates the end of main() function and exit of the program.

Syntax Error

If you do not follow rules defined by the programing language then at the time of compilation you will get syntax error and program will not be compiled. From syntax point of view, even a single dot or comma or single semicolon matters and you should take care of such small syntax as well. Following is Hello, World! program but here I'm not using semicolon, let's try to compile following program:

```
#include <stdio.h>

main()
{
  printf("Hello, World!")
}
```

This program will produce following result:

```
main.c: In function 'main':
main.c:7:1: error: expected ';' before '}' token
 }
 ^
```

So bottom-line is that if you are not following proper syntax defined by the programming language in your program then you will get similar type of syntax errors and before trying next compilation you will need to fix them and then proceed.

Hello World Program in Java

Following is the equivalent program written in Java. This program will also produce same result **Hello, World!**.

```
public class HelloWorld
{
   public static void main(String []args)
   {
      /* println() function to write Hello, World! */
      System.out.println("Hello, World!");
   }
}
```

Hello World Program in Python

Following is the equivalent program written in Python. This program will also produce same result **Hello, World!**.

```
#  print function to write Hello, World! */
print "Hello, World!"
```

Hope you noted that for C and Java examples, first we are compiling programs and then executing produced binaries but in Python program we are directly executing it. As I explained in previous chapter, Python is an interpreted language and it does not need intermediate step called compilation.

Python programming languages does not require a semicolon (;) to terminate a statement like we used in C and Java, rather a new line always means termination of the statement.

Conclusion

Not sure if you understood what I taught you above in this chapter, but if you did not understand then I will suggest to go through it once again and make sure you understood all the above concepts. But if you understood these concepts, then you are almost done and let's proceed to the next chapter, which you are going to enjoy a lot.

Computer Programming - Data Types

Let's discuss about a very simple but very important concept available in almost all the programming languages which is called **data types**. As its name indicates, a data type represents a type of the data which you can process using your computer program. It can be numeric, alphanumeric, decimal, etc.

Apart from Computer Programming, let's take a nursery class problem to add two whole numbers 10 & 20, which we can do simply as follows:

```
10 + 20
```

Let's take another problem where we want to add two decimal numbers 10.50 & 20.50, which will be written as follows:

```
10.50 + 20.50
```

Above two examples are straight forward now let's take one example where we want to record student information in a notebook. Here is following important information, which we can record:

- Name:
- Class:
- Section:
- Age:

- Sex:

Now, let's put one student record as per the given requirement:

- Name: Zara Ali
- Class: 6th
- Section: J
- Age: 13
- Sex: F

First example dealt whole numbers and second example added two numbers with decimals where as third example is dealing with a mix of different data. Let's put it as follows:

- Student name "Zara Ali" is a sequence of characters which is also called a string.
- Student class "6th" has been represented by a mix of whole number and a string of two characters. Such a mix is called alphanumeric.
- Student section has been represented by single character which is 'J'.
- Student age has been represented by whole number which is 13.
- Student sex has been represented by a single character which is 'F'.

This way we realized that in our day-2-day life we deal with different types of data like strings, characters, whole numbers which is also called integers, decimal numbers which is also called floating point numbers.

Similar way when we write our computer program to process different types of data, we need to specify its type clearly otherwise computer does not understand how different operations can be performed on that given data. Different programming languages use different keywords to specify different data types. For example C and Java programming languages use **int** to specify integer data whereas **char** specifies a character data type.

Subsequent chapters will show you how to use different data types in different situations. For now let's check what are the important data types available in C, Java and Python programming languages and what are the keywords we will use to specify those data types.

C & Java Data Types

Programming languages C and Java support almost same set of data types, though Java supports additional data types. For now, we are taking few common data types supported by both the programming languages:

Type	**Keyword**	**Value range which can be represented by this data type**
Character	char	-128 to 127 or 0 to 255
Number	int	-32,768 to 32,767 or -2,147,483,648 to 2,147,483,647
Small Number	short	-32,768 to 32,767
Long Number	long	-2,147,483,648 to 2,147,483,647
Decimal Number	float	1.2E-38 to 3.4E+38 till 6 decimal places

These data types are called primitive data types and you can use these data types to build more complex data types, which are called user-defined data type, for example a string will be a sequence of characters.

Python Data Types

Python has five standard data types but this programming language does not make use of any keyword to specify a particular data type rather Python is intelligent enough to understand given data type automatically.

- Numbers
- String
- List
- Tuple
- Dictionary

Here, Number specifies all types of numbers including decimal numbers and string represents a sequence of characters with a length of 1 or more characters. For now, let's proceed with these two data types and skip List, Tuple and Dictionary, which are advanced data types in Python.

Computer Programming - Variables

This session will teach you another most important concept of computer programming which is called **variables**. Actually, variables are the names you give to computer memory locations which are used to store values in a computer program.

For example, assume you want to store two values 10 and 20 in your program and at later stage you want to use these two values. Let's see how you will do it, here are the following three simple steps:

- Create variables with appropriate names.
- Store your values in those two variables.
- Retrieve and use stored values from the variables.

Creating variables

Creating variables is also called **declaring variables** in C programming language. Different programming languages have different ways of creating variables inside your program. For example, C programming language has the following simple way of creating variables:

```
#include <stdio.h>

main()
{
   int a;
   int b;
}
```

Above program creates two variables, i.e., reserves two memory locations with names a and b. We created these variables using **int** keyword to specify variable **data type** which means we want to store integer values in these two variables. Similar way, you can create variables to store **long**, **float**, **char** or any other data type. For example:

```
/* variable to store long value */
long a;

/* variable to store float value */
float b;
```

You can create variables of similar type by putting them in a single line but separated by comma as follows:

```
#include <stdio.h>

main()
{
   int a, b;
}
```

Following are few important points to remember about variables:

- A variable name can hold a single type of value. For example, if variable a has been defined **int** type, then it can store only integer.
- C programming language requires a variable creation, i.e., declaration before its usage in your program. You can not use a variable name in your program without creating it, though programming language like Python allows you to use a variable name without creating it.
- You can use a variable name only once inside your program. For example, if a variable **a** has been defined to store an integer value, then you can not define **a** again to store any other type of value.
- There are programming languages like Python, PHP, Perl, etc., which do not want you to specify data type at the time of creating variables. So you can store integer, float or long without specifying their data type.
- You can give any name to a variable like **age, sex, salary, year1990** or anything else you like to give, but most of the programming languages allow to use only limited characters in their variables names. For now, I will suggest to use only **a....z, A....Z, 0....9** in your variable names and start their names using alphabets only instead of digit.
- Almost none of the programming languages allow to start their variable names with a digit, so **1990year** will not be a valid variable name where as **year1990** or **ye1990ar** are valid variable names.

Every programming language provides more rules related to variables and you will learn them when you will go in further detail of that programming language. But for now above rules are enough to proceed and let's see next section, which will teach you how to store values in defined variables.

Store values in variables

You have seen how we created variables in previous section. Now, let's store some values in those variables:

```
#include <stdio.h>

main()
{
  int a;
  int b;

  a = 10;
  b = 20;
}
```

Above program has two additional statements where we are storing 10 in variable **a** and 20 is being stored in variable **b**. Almost all the programming languages have similar way of storing values in variable where we keep variable name in the left hand side of an equal sign = and whatever value we want to store in the variable, we keep that value in the right hand side.

Now, we have completed two steps, first we created two variables and then we stored required values in those variables. Now variable a has value 10 and variable b has value 20. In other words we can say, when above program is executed, the memory location named a will hold 10 and memory location b will hold 20.

Access stored values in variables

If we do not make use of stored values in the variables then there is no point in creating variables and storing values in them. We know that above program has two variables **a** and **b** and they store values 10 and 20, respectively. So let's try to print the values stored in these two variables. Following is a C program, which prints the values stored in variables:

```
#include <stdio.h>

main()
{
   int a;
   int b;

   a = 10;
   b = 20;

   printf( "Value of a = %d\n", a );
   printf( "Value of b = %d\n", b );

}
```

When above program is executed, it produces the following result:

```
Value of a = 10
Value of b = 20
```

You must have seen **printf()** function in previous chapter where we had used it to print "Hello, World!". This time, we are using it to print the values of variables. We are making use of **%d**, which will be replaced with the values of given variable in printf() statements. We can print both values using a single printf() statement as follows:

```
#include <stdio.h>

main()
{
   int a;
   int b;

   a = 10;
   b = 20;

   printf( "Value of a = %d and value of b = %d\n", a, b );
}
```

When above program is executed, it produces the following result:

```
Value of a = 10 and value of b = 20
```

If you want to use float variable in C programming, then you will have to use **%f** instead of **%d**, and if you want to print a character value, then you will have to use **%c**. Similar way, different data types can be printed using different % and characters.

Variables in Java

Following is the equivalent program written in Java programming language. This program will create two variables a and b and very similar to C programming, then we assign 10 and 20 in these variables and finally print the values of the two variables in two ways:

```
public class DemoJava
{
  public static void main(String []args)
  {

    int a;
    int b;

    a = 10;
    b = 20;

    System.out.println("Value of a = " + a);
    System.out.println("Value of b = " + b);

    System.out.println("Value of a = " + a + " and value of b = " + b);
  }
}
```

Variables in Python

Following is the equivalent program written in Python. This program will create two variables a and b and same time assign 10 and 20 in those variables.

Python does not want you to specify data type at the time of variable creation and there is also no need of creating variable in advance before using it.

```
a = 10
b = 20

print "Value of a = ", a
print "Value of b = ", b

print "Value of a = ", a, " and value of b = ", b
```

Though you can use the following syntax in C and Java programming to declare variables and assign values at the same time:

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

```
main()
{
  int a = 10;
  int b = 20;

  printf( "Value of a = %d and value of b = %d\n", a, b );
}
```

Computer Programming - Keywords

So far, you have covered two important concepts called variables and their data types. You have seen how we have used **int, long** and **float** keywords to specify different data types. You also have seen how we named our variables to store different values.

Though this chapter is not required separately because reserved keywords are part of basic programming syntax but I kept it separate to explain it right after data types and variables to make it easy to understand.

Like int, long, and float, there are many other keywords supported by C programming language which we will use for different purpose. Different programming languages provide different set of reserved keywords, but there is one important & common rule in all the programming languages that we cannot use a reserved keyword to name our variables, which means we cannot name our variable like **int** or **float** rather these keywords can only be used to specify a variable data type.

For example, if you will try to use any reserved keyword for the purpose of variable name, then you will get syntax error, as follows:

```
#include <stdio.h>

main()
{
  int float;

  float = 10;

  printf( "Value of float = %d\n", float);
}
```

When you compile above program, it produces the following error:

```
main.c: In function 'main':
main.c:5:8: error: two or more data types in declaration specifiers
   int float;
......
```

But now let's give proper name to our integer variable, then above program should compile and execute successfully:

```
#include <stdio.h>

main()
{
  int count;

  count = 10;

  printf( "Value of count = %d\n", count);
}
```

C programming reserved keywords

Here is a table having almost all the keywords supported by C Programming language:

auto	else	long	switch
break	enum	register	typedef
case	extern	return	union
char	float	short	unsigned
const	for	signed	void
continue	goto	sizeof	volatile
default	if	static	while
do	int	struct	_Packed
double			

Java programming reserved keywords

Here is a table having almost all the keywords supported by Java Programming language:

abstract	assert	boolean	break
byte	case	catch	char
class	const	continue	default
do	double	else	enum
extends	final	finally	float
for	goto	if	implements
import	instanceof	int	interface
long	native	new	package
private	protected	public	return
short	static	strictfp	super
switch	synchronized	this	throw
throws	transient	try	void
volatile	while		

Python programming reserved keywords

Here is a table having almost all the keywords supported by Java Programming language:

and	exec	not
assert	finally	or
break	for	pass
class	from	print
continue	global	raise
def	if	return
del	import	try
elif	in	while
else	is	with
except	lambda	yield

I know you cannot memorize all these keywords, but I listed them down for your reference purpose and to explain the concept of **reserved keywords**. So just be careful while giving a name to your variable, you should not use any reserved keyword for that programming language.

Computer Programming - Operators

An operator in a programming language is a symbol that tells the compiler or interpreter to perform specific mathematical, relational or logical operation and produce final result. This chapter will explain you what are the **operators** and will take you through important arithmetic and relational operators available in C, Java and Python programming languages.

Arithmetic Operators

Computer programs are widely used for mathematical calculations. We can write a computer program which can do simple calculation like adding two numbers (2 + 3) and we can also write a program, which can solve a complex equation like $P(x) = x^4 + 7x^3 - 5x + 9$. If you have been even a poor student, you must be aware that in first expression 2 and 3 are operands and + is an operator. Similar concept exists in Computer Programming.

Here we took following two mathematics examples:

2 + 3

$P(x) = x^4 + 7x^3 - 5x + 9$.

These two statements are called arithmetic expressions in a programming language and **plus**, **minus** used in these expressions are called arithmetic operators and values used in these expressions like 2, 3 and x, etc., are called operands. In their simplest form such expressions produce numerical results.

Similar way, a programming language provides various arithmetic operators. Following table lists down few of the important arithmetic operators available in C programming language. Assume variable A holds 10 and variable B holds 20, then:

Operator	**Description**	**Example**
+	Adds two operands	A + B will give 30
-	Subtracts second operand from the first	A - B will give -10
*	Multiplies both operands	A * B will give 200
/	Divides numerator by de-numerator	B / A will give 2
%	This gives remainder of an integer division	B % A will give 0

Following is a simple example of C Programming to understand above mathematical operators:

```
#include <stdio.h>

main()
{
  int a, b, c;

  a = 10;
  b = 20;

  c = a + b;
  printf( "Value of c = %d\n", c);

  c = a - b;
  printf( "Value of c = %d\n", c);

  c = a * b;
  printf( "Value of c = %d\n", c);

  c = b / a;
  printf( "Value of c = %d\n", c);

  c = b % a;
  printf( "Value of c = %d\n", c);
}
```

When above program is executed, it produces the following result:

```
Value of c = 30
Value of c = -10
Value of c = 200
Value of c = 2
Value of c = 0
```

Relational Operators

Consider a situation where we create two variables and assign them some values as follows:

```
A = 20
B = 10
```

Here, it is obvious that variable A is greater than B in values. But how do we write this in a computer programming language? So, we need help of some symbols to write this kind of expressions which are called relational expressions. If we make use of C programming language, then it will be written as follows:

```
(A > B)
```

Here, we used a symbol > and it is called relational operator and in their simplest form they produce boolean results which means result will be either true or false. Similar way, a programming language provides various relational operators. Following table lists down few of the important relational operators available in C programming language.Assume variable **A** holds 10 and variable **B** holds 20, then:

Operator	Description	Example
==	Checks if the values of two operands are equal or not, if yes then condition becomes true.	(A == B) is not true.
!=	Checks if the values of two operands are equal or not, if values are not equal then condition becomes true.	(A != B) is true.
>	Checks if the value of left operand is greater than the value of right operand, if yes then condition becomes true.	(A > B) is not true.
<	Checks if the value of left operand is less than the value of right operand, if yes then condition becomes true.	(A < B) is true.
>=	Checks if the value of left operand is greater than or equal to the value of right operand, if yes then condition becomes true.	(A >= B) is not true.
<=	Checks if the value of left operand is less than or equal to the value of right operand, if yes then condition becomes true.	(A <= B) is true.

Here, I'm going to show you one example of C Programming which makes use of **if conditional statement**. Though this statement will be discussed later in a separate chapter, but in short we use **if statement** to check a condition and if condition is true then body of if statement is executed otherwise body of if statement is skipped.

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

```
main()
{
  int a, b;

  a = 10;
  b = 20;

  /* Here we check whether a is equal to 10 or not */
  if( a == 10 )
  {
    /* if a is equal to 10 then this body will be executed */
    printf( "a is equal to 10\n");
  }

  /* Here we check whether b is equal to 10 or not */
  if( b == 10 )
  {
    /* if b is equal to 10 then this body will be executed */
    printf( "b is equal to 10\n");
  }

  /* Here we check if a is less b than or not */
  if( a < b )
  {
    /* if a is less than b then this body will be executed */
    printf( "a is less than b\n");
  }

  /* Here we check whether a and b are not equal */
  if( a != b )
  {
    /* if a is not equal to b then this body will be executed */
    printf( "a is not equal to b\n");
  }
}
```

When above program is executed, it produces the following result:

```
a is equal to 10
a is less than b
a is not equal to b
```

Logical Operators

Logical operators are very important in any programming language and they help us in taking decision based on certain conditions. Suppose we want to combine the result of two conditions, then logical AND and OR logical operators help us in giving final result.

Following table shows all the logical operators supported by C language. Assume variable **A** holds 1 and variable **B** holds 0, then:

Operator	Description	Example
&&	Called Logical AND operator. If both the operands are non-zero, then condition becomes true.	(A && B) is false.
||	Called Logical OR Operator. If any of the two operands is non-zero, then condition becomes true.	(A || B) is true.
!	Called Logical NOT Operator. Use to reverses the logical state of its operand. If a condition is true then Logical NOT operator will make false.	!(A && B) is true.

Try the following example to understand all the logical operators available in C programming language:

```
#include <stdio.h>

main()
{
  int a = 1;
  int b = 0;

  if ( a && b )
  {
     printf("This will never print because condition is false\n" );
  }
  if ( a || b )
  {
    printf("This will be printed print because condition is true\n" );
  }

  if ( !(a && b) )
  {
    printf("This will be printed print because condition is true\n" );
  }
}
```

When you compile and execute the above program, it produces the following result:

```
This will be printed print because condition is true
This will be printed print because condition is true
```

Operators in Java

Following is the equivalent program written in Java programming language. C programming and Java programming languages provide almost identical set of operators and conditional statements. This program will create two variables a and b and very similar to C programming, then we assign 10 and 20 in these variables and finally we will use different arithmetic and relation operators:

You can try to execute the following program to see the output, which must be identical to the result generated by the above example.

```
public class DemoJava
{
  public static void main(String []args)
  {

    int a, b, c;

    a = 10;
    b = 20;

    c = a + b;
    System.out.println("Value of c = " + c );

    c = a - b;
    System.out.println("Value of c = " + c );


    c = a * b;
    System.out.println("Value of c = " + c );

    c = b / a;
    System.out.println("Value of c = " + c );

    c = b % a;
    System.out.println("Value of c = " + c );

    if( a == 10 )
    {
      System.out.println("a is equal to 10" );
    }

  }
}
```

Operators in Python

Following is the equivalent program written in Python. This program will create two variables a and b and same time assign 10 and 20 in those variables. Fortunately, again C programming and Python programming languages provide almost identical set of operators. This program will create two variables a and b and very similar to C programming, then we assign 10 and 20 in these variables and finally we will use different arithmetic and relation operators.

You can try to execute following program to see the output, which must be identical to the result generated by the above example.

```
a = 10
b = 20

c = a + b
print "Value of c = ", c

c = a - b
print "Value of c = ", c
```

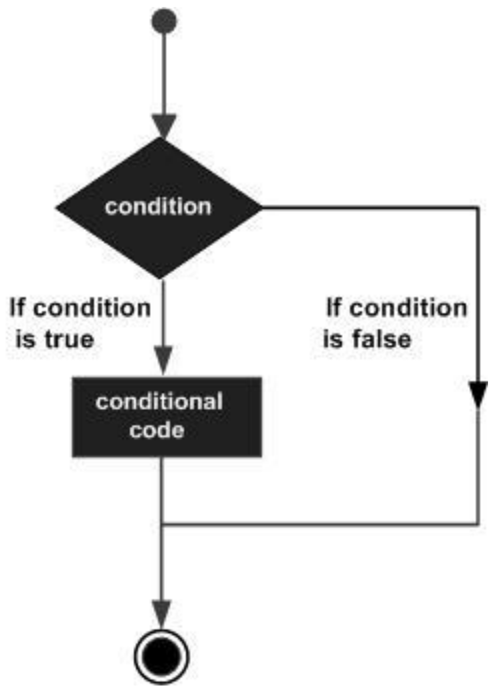
```
c = a * b
print "Value of c = ", c

c = a / b
print "Value of c = ", c

c = a % b
print "Value of c = ", c

if( a == 10 ):
   print "a is equal to 10"
```

Computer Programming - Decision Statements

Decision making is critical to computer programming. There will be many situations when you will be given two or more options and you will have to select an option based on the given conditions. For example, we want to print a remark about a student based on secured marks and following is the situation:

```
1. Assume given marks are x for a student

2. If given marks are more than 95 then
3.     Student is brilliant

4. If given marks are less than 30 then
5.     Student is poor

6. If given marks are less than 95 and more than 30 then
7.     Student is average
```

Now, question is how to write programming code to handle such situation. Almost all the programming languages provide conditional i.e., decision making statements which work based on the following flow diagram:



Let's write a C program with the help of **if conditional statements** to convert above given situation into programming code:

```
#include <stdio.h>

main()
{
  int x = 45;

  if( x > 95)
  {
    printf( "Student is brilliant\n");
  }

  if( x < 30)
  {
    printf( "Student is poor\n");
  }

  if( x < 95 && x > 30 )
  {
    printf( "Student is average\n");
  }
}
```

When above program is executed, it produces the following result:

```
Student is average
```

Above program makes use of **if conditional statements**. Here, first if statement checks whether given condition i.e., variable x is greater than 95 or not and if it finds condition is true, then the conditional body is entered to execute given statements. Here we have only one *printf()* statement to print a remark about the student.

Similar way, second if statement works. Finally, third if statement is executed, here we have following two conditions:

- First condition is **x > 95**
- Second condition is **x < 30**

Computer evaluates both the given conditions and then overall result is combined with the help of binary operator **&&**. If final result is true then conditional statement will be executed, otherwise no statement will be executed.

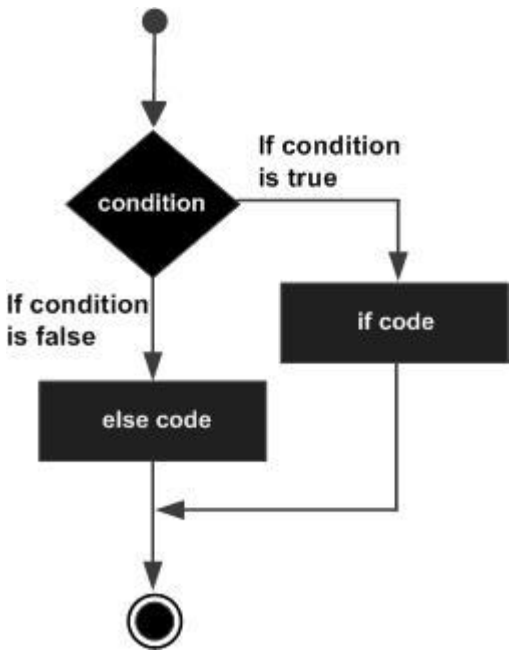
This tutorial will give you basic idea on various forms of **if statements** and an introduction of **switch** statements available in C programming language. Different programming languages provide different type of decision making statements but basic concept will remain same as explained in this tutorial.

if...else statement

An **if** statement can be followed by an optional **else** statement, which executes when the boolean expression is false. The syntax of an **if...else** statement in C programming language is:

```
if(boolean_expression)
{
   /* Statement(s) will execute if the boolean expression is true */
}
else
{
  /* Statement(s) will execute if the boolean expression is false */
}
```

Above syntax can be represented in the form of a flow diagram as shown below:



An **if...else** statement is useful when we have to take a decision out of two options. For example, if student secures more marks than 95, then student is brilliant otherwise no, such situation can be coded as follows:

```
#include <stdio.h>

main()
{
  int x = 45;

  if( x > 95)
  {
    printf( "Student is brilliant\n");
  }
  else
  {
    printf( "Student is not brilliant\n");
  }
}
```

When above program is executed, it produces the following result:

```
Student is not brilliant
```

if...elseif...else statement

An **if** statement can be followed by an optional **else if...else** statement, which is very useful to test various conditions using single if...else if statement.

When using if , else if , else statements, there are few points to keep in mind:

- An if can have zero or one else's and it must come after any else if's.
- An if can have zero to many else if's and they must come before the else.
- Once an else if succeeds, none of the remaining else if's or else's will be tested.

The syntax of an **if...else if...else** statement in C programming language is:

```
if(boolean_expression 1)
{
  /* Executes when the boolean expression 1 is true */
}
else if( boolean_expression 2)
{
  /* Executes when the boolean expression 2 is true */
}
else if( boolean_expression 3)
{
  /* Executes when the boolean expression 3 is true */
}
else
{
  /* Executes when the none of the above condition is true */
}
```

Now with the help of **if...elseif...else** statement, very first program can be coded as follows:

```
#include <stdio.h>

main()
{
  int x = 45;

  if( x > 95)
  {
    printf( "Student is brilliant\n");
  }
  else if( x < 30)
  {
    printf( "Student is poor\n");
  }
  else if( x < 95 && x > 30 )
  {
    printf( "Student is average\n");
  }
}
```

When above program is executed, it produces the following result:

```
Student is average
```

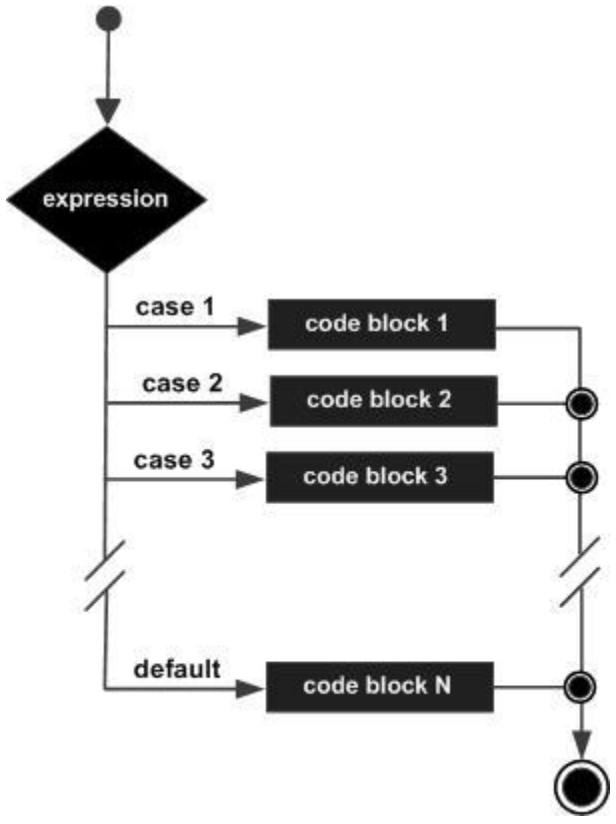
The switch statement

A **switch** statement is an alternative of **if statements** which allows a variable to be tested for equality against a list of values. Each value is called a **case**, and the variable being switched on is checked for each switch case. This has following syntax:

```
switch(expression){
   case ONE  :
     statement(s);
     break;
   case TWO:
     statement(s);
     break;
    ......

   default :
     statement(s);
}
```

The **expression** used in a **switch** statement must give an integer value, which will be compared for equality with different cases given. Wherever, expression value matches with case value, the body of that case will be executed and finally switch will be terminated using **break** statement. If break statement is not provided, then computer continues executing other statements available below to the matched case. If none of the cases matches, then default case body is executed.

Above syntax can be represented in the form of a flow diagram as shown below:



Now, let's consider another example where we want to write equivalent English word for the given number. Then, it can be coded as follows:

```
#include <stdio.h>

main()
{
  int x = 2;

  switch( x ){
     case 1 :
       printf( "One\n");
       break;
     case 2 :
       printf( "Two\n");
       break;
     case 3 :
       printf( "Three\n");
       break;
     case 4 :
       printf( "Four\n");
       break;
      default :
       printf( "None of the above...\n");
  }
}
```

When above program is executed, it produces the following result:

```
Two
```

Decisions in Java

Following is the equivalent program written in Java programming language. Java programming language also provides **if**, **if...else**, **if...elseif...else** and **switch** statements.

You can try to execute the following program to see the output, which must be identical to the result generated by the above C example.

```
public class DemoJava
{
  public static void main(String []args)
  {

    int x = 45;

    if( x > 95)
    {
      System.out.println( "Student is brilliant");
    }
    else if( x < 30)
    {
      System.out.println( "Student is poor");
    }
    else if( x < 95 && x > 30 )
    {
      System.out.println( "Student is average");
    }

  }
}
```

Decisions in Python

Following is the equivalent program written in Python. Python provides **if**, **if...else**, **if...elif...else** and **switch** statements. Here, you must note that Python programming does not make use of curly braces for conditional body, instead it simply identifies the body of the block using indentation of the statements.

You can try to execute following program to see the output:

```
x = 45

if x > 95:
   print "Student is brilliant"
elif x < 30:
   print "Student is poor"
elif x < 95 and x > 30:
   print "Student is average"

print "The end"
```

When above program is executed, it produces the following result:

```
Student is average
The end
```

Computer Programming - Loops

Let's consider a situation when you want to write **Hello, World!** five times. Here is a simple C program to do the same:

```
#include <stdio.h>

main()
{

   printf( "Hello, World!\n");
   printf( "Hello, World!\n");
   printf( "Hello, World!\n");
   printf( "Hello, World!\n");
   printf( "Hello, World!\n");
}
```

When above program is executed, it produces the following result:

```
Hello, World!
Hello, World!
Hello, World!
Hello, World!
Hello, World!
```

It was simple, but again let's consider another situation when you want to write **Hello, World!** thousand times, what you will do in such situation? Are we going to write printf() statement thousand times? No, not at all. Almost all the programming languages provide a concept called **loop**, which helps in executing one or more statements up to desired number of times. All high-level programming languages provide various forms of loops, which can be used to execute one or more statements repeatedly.

Let's write above C program with the help of a **while loop** and later we will discuss how does this loop work:

```
#include <stdio.h>

main()
{
  int i = 0;

  while ( i < 5 )
  {
    printf( "Hello, World!\n");
    i = i + 1;
  }
}
```

When above program is executed, it produces the following result:

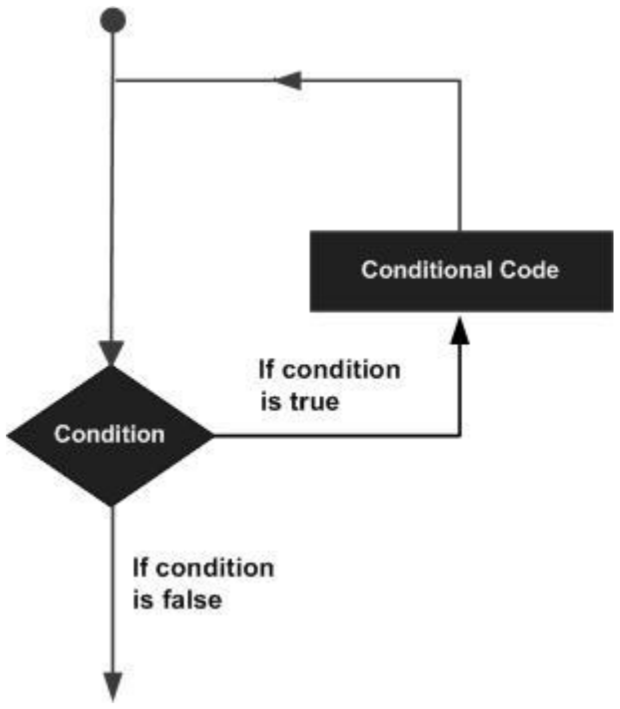
```
Hello, World!
Hello, World!
Hello, World!
Hello, World!
Hello, World!
```

Above program makes use of **while loop**, which is being used to execute a set of programming statements enclosed within {....}. Here, computer first checks whether given condition, i.e., variable "a" is less than 5 or not and if it finds condition is true then the loop body is entered to execute given statements. Here, we have the following two statements in the loop body:

- First statement is *printf()* function, which prints Hello World!
- Second statement is *i = i + 1*, which is used to increase the value of variable **i**

After executing all the statements given in the loop body, computer goes back to while(i < 5) and given condition, (i < 5), is checked again, and the loop is executed again if condition is true. This process repeats till the given condition remains true which means variable "a" has a value less than 5.

To conclude, a loop statement allows us to execute a statement or group of statements multiple times and following is the general form of a loop statement in most of the programming languages:



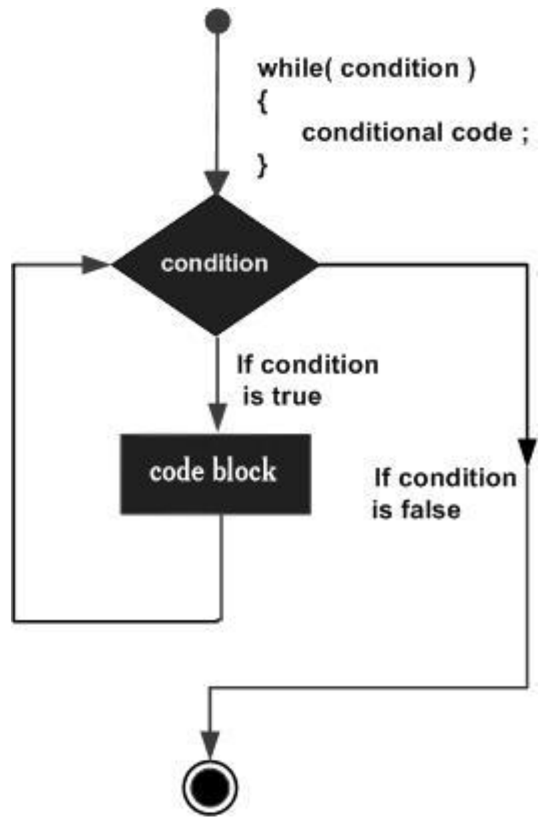
This tutorial has been designed to present programming's basic concepts to non-programmers, so let's discuss about two important loops available in C programming language. Once you are clear about these two loops, then you can pickup C programming tutorial or a reference book and check what are other loops available in C and how do they work.

The while Loop

A **while loop** available in C Programming language has following syntax:

```
while ( condition )
{
   /*....while loop body ....*/
}
```

Above code can be represented in the form of a flow diagram as shown below:



There are following important points to note about a while loop:

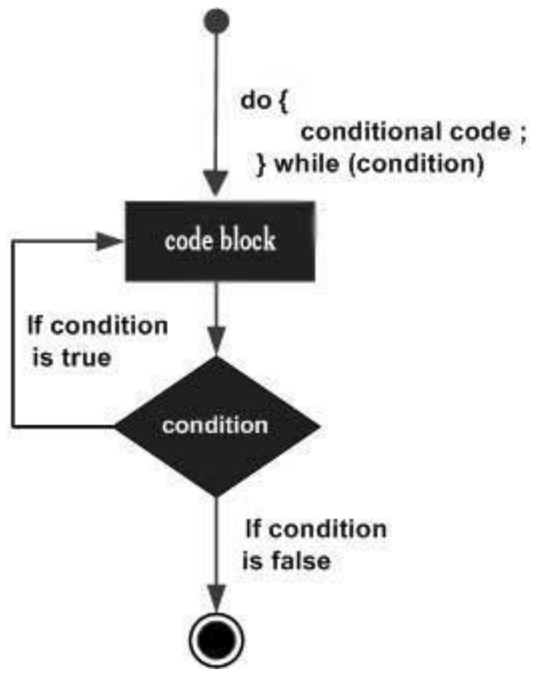
- A while loop starts with a keyword **while** followed by a **condition** enclosed in ( ).
- Further to while() statement you will have body of the loop enclosed in curly braces **{...}**.
- A while loop body can have one or more lines of source code to be executed repeatedly.
- If while loop body has just one line, then its optional to use curly braces **{...}**.
- A while loop keeps executing its body till given **condition** is true. As soon as condition becomes fast, while loop comes out and continue executing from immediate next statement after while loop body.
- A condition is usually a relational statement, which is evaluated to either true or false values. A value equal to zero is treated as false and any non-zero value works like a true for the condition.

The do...while Loop

If you have noted while loop, it checks given condition before it executes given statements of the code. C programming provides another form of loop, which is called **do...while** loop and allows to execute a loop body before checking given condition. This has following syntax:

```
do
{
   /*....do...while loop body ....*/
} while ( condition );
```

Above code can be represented in the form of a flow diagram as shown below:



If you will write above example using **do...while** loop, then **Hello, World** will produce the same result:

```
#include <stdio.h>

main()
{
  int i = 0;

  do
  {
    printf( "Hello, World!\n");
    i = i + 1;
  }while ( i < 5 );
}
```

When above program is executed, it produces the following result:

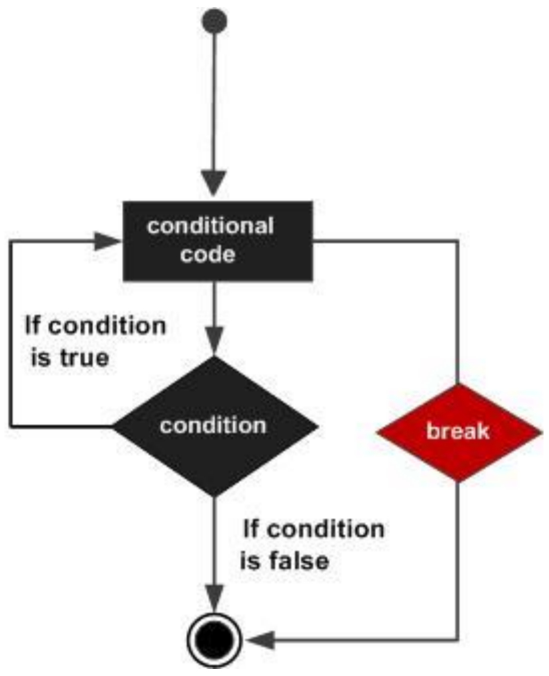
```
Hello, World!
Hello, World!
Hello, World!
Hello, World!
Hello, World!
```

The break statement

When the **break** statement is encountered inside a loop, the loop is immediately terminated and program control resumes at the next statement following the loop. The syntax for a **break** statement in C is as follows:

```
break;
```

A **break** statement can be represented in the form of a flow diagram as shown below:



Following is a variant of the above program, but it will come out after printing Hello World! only three times:

```
#include <stdio.h>

main()
{
  int i = 0;

  do
  {
    printf( "Hello, World!\n");
    i = i + 1;
    if( i == 3 )
    {
      break;
    }
  }while ( i < 5 );
}
```

When above program is executed, it produces the following result:

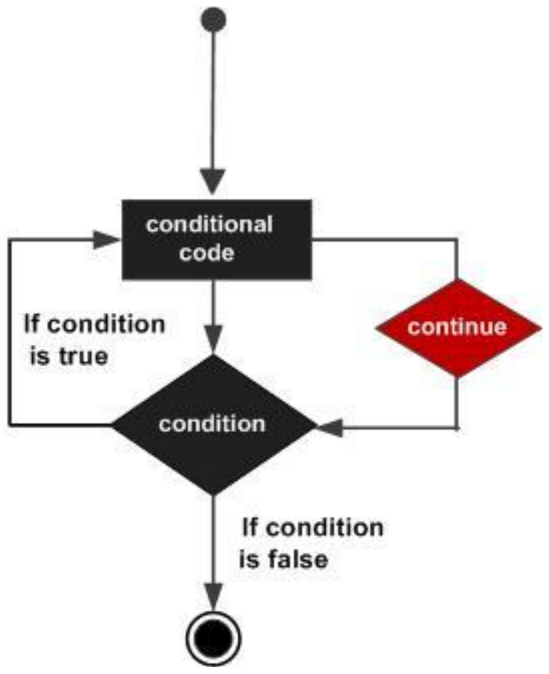
```
Hello, World!
Hello, World!
Hello, World!
```

The continue statement

The **continue** statement in C programming language works somewhat like the **break** statement. Instead of forcing termination, however, **continue** forces the next iteration of the loop to take place, skipping any code in between. The syntax for a **continue** statement in C is as follows:

```
continue;
```

A **continue** statement can be represented in the form of a flow diagram as shown below:



Following is a variant of the above program but it will skip printing when variable has a value equal to 3:

```
#include <stdio.h>

main()
{
  int i = 0;

  do
  {
    if( i == 3 )
    {
      i = i + 1;
      continue;
    }
    printf( "Hello, World!\n");
    i = i + 1;
  }while ( i < 5 );
}
```

When above program is executed, it produces the following result:

```
Hello, World!
Hello, World!
Hello, World!
Hello, World!
```

Loops in Java

Following is the equivalent program written in Java programming language. Java programming language also provides **while** and **do...while** loops. Following program will be used to print **Hello, World!** five times as we did in case of C Programming:

You can try to execute following program to see the output, which must be identical to the result generated by the above example.

```
public class DemoJava
{
  public static void main(String []args)
  {

    int i = 0;

    while ( i < 5 )
    {
      System.out.println("Hello, World!");
      i = i + 1;
    }

  }
}
```

The **break** and **continue** statements in Java programming work very similar way, what they work in C programming.

Loops in Python

Following is the equivalent program written in Python. Python also provides **while** and **do...while** loops. Following program will be used to print **Hello, World!** five times as we did in case of C Programming. Here you must note that Python programming does not make use of curly braces for loop body, instead it simply identifies the body of the loop using indentation of the statements.

You can try to execute following program to see the output. To show the difference I used one more print statement, which will be executed when loop will be over.

```
i = 0

while (i < 5):
   print "Hello, World!"
   i = i + 1
print "Loop ends"
```

When above program is executed, it produces the following result:

```
Hello, World!
Hello, World!
Hello, World!
Hello, World!
Hello, World!
Loop ends
```

The **break** and **continue** statements in Python programming work very similar way as they work in C programming.

Computer Programmng - Numbers

Every programming language provides support for manipulating different types of numbers like simple whole integer, floating point number. The programming languages like C, Java and Python categorize these numbers in several categories based on their nature.

Let's go back and check data types chapter, where we listed down core data types related to numbers:

Type	**Keyword**	**Value range which can be represented by this data type**
Number	int	-32,768 to 32,767 or -2,147,483,648 to 2,147,483,647
Small Number	short	-32,768 to 32,767
Long Number	long	-2,147,483,648 to 2,147,483,647
Decimal Number	float	1.2E-38 to 3.4E+38 till 6 decimal places

These data types are called primitive data types and you can use these data types to build more data types, which are called user-defined data type.

We have seen various mathematical and logical operations on numbers during a discussion on operators. So we know how to add numbers, subtract numbers, divide numbers, etc.

First let's see how to print various types of numbers available in C programming language:

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

```
main()
{
   short  s;
   int    i;
   long   l;
   float  f;
   double d;

   s = 10;
   i = 1000;
   l = 1000000;
   f = 230.47;
   d = 30949.374;

   printf( "s: %d\n", s);
   printf( "i: %d\n", i);
   printf( "l: %ld\n", l);
   printf( "f: %.3f\n", f);
   printf( "d: %.3f\n", d);
}
```

Rest of the coding is very obvious but we used **%.3f** to print float and double, which indicates number of digits after decimal to be printed. When above program is executed, it produces the following result:

```
s: 10
i: 1000
l: 1000000
f: 230.470
d: 30949.374
```

Math Operations on Numbers

Following table lists down various useful built-in mathematical **functions** available in C programming language which can be used for various important mathematical calculations.

For example, if you want to calculate square root of a number for example, 2304, then you have built-in function available to calculate square root for this number.

S.N.	Function & Purpose
1	**double cos(double);** This function takes an angle (as a double) and returns the cosine.
2	**double sin(double);** This function takes an angle (as a double) and returns the sine.
3	**double tan(double);** This function takes an angle (as a double) and returns the tangent.
4	**double log(double);** This function takes a number and returns the natural log of that number.

5	**double pow(double, double);** The first is a number you wish to raise and the second is the power you wish to raise it to.
6	**double hypot(double, double);** If you pass this function the length of two sides of a right triangle, it will return you the length of the hypotenuse.
7	**double sqrt(double);** You pass this function a number and it gives you this square root.
8	**int abs(int);** This function returns the absolute value of an integer that is passed to it.
9	**double fabs(double);** This function returns the absolute value of any decimal number passed to it.
10	**double floor(double);** Finds the integer which is less than or equal to the argument passed to it.

Following a simple example to show few of the mathematical operations. To utilize these functions, you need to include the math header file **<math.h>** header file in your program in similar way you have included **stdio.h**:

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

main()
{
   short  s;
   int    i;
   long   l;
   float  f;
   double d;

   s = 10;
   i = 1000;
   l = 1000000;
   f = 230.47;
   d = 2.374;

   printf( "sin(s): %f\n", sin(s));
   printf( "abs(i): %f\n", abs(i));
   printf( "floor(f): %f\n", floor(f));
   printf( "sqrt(f): %f\n", sqrt(f));
   printf( "pow(d, 2): %f\n", pow(d, 2));

}
```

When above program is executed, it produces the following result:

```
sin(s): -0.544021
abs(i): -0.544021
floor(f): 230.000000
sqrt(f): 15.181238
pow(d, 2): 5.635876
```

Other than above usage, you will use numbers in loop counting, flag representation, true or false values in C programming.

Numbers in Java

Following is the equivalent program written in Java programming language. Java programming language also provides almost all numeric data types available in C programming.

You can try to execute the following program to see the output, which is identical to the result generated by the above C example.

```
public class DemoJava
{
  public static void main(String []args)
  {

    short  s;
    int    i;
    long   l;
    float  f;
    double d;

    s = 10;
    i = 1000;
    l = 1000000L;
    f = 230.47f;
    d = 30949.374;

    System.out.format( "s: %d\n", s);
    System.out.format( "i: %d\n", i);
    System.out.format( "l: %d\n", l);
    System.out.format( "f: %f\n", f);
    System.out.format( "d: %f\n", d);

  }
}
```

When above program is executed, it produces the following result:

```
s: 10
i: 1000
l: 1000000
f: 230.470001
d: 30949.374000
```

Java also provides a full range of built-in functions for mathematical calculation and you can use them in very similar way you have used them in C programming.

Numbers in Python

Python is little different from C and Java and categorize numbers in **int**, **long**, **float** and **complex**. Here are some examples of numbers in Python:

int	**long**	**float**	**complex**
10	51924361L	0.0	3.14j
100	-0x19323L	15.20	45.j
-786	0122L	-21.9	9.322e-36j
080	0xDEFABCECBDAECBFBAEl	32.3+e18	.876j
-0490	535633629843L	-90.	-.6545+0J
-0x260	-052318172735L	-32.54e100	3e+26J
0x69	-4721885298529L	70.2-E12	4.53e-7j

Following is the equivalent program written in Python:

```
s = 10
i = 1000
l = 1000000
f = 230.47
d = 30949.374

print "s: ", s
print "i: ", i
print "l: ", l
print "f: ", f
print "d: ", d
```

When above program is executed, it produces the following result:

```
s:  10
i:  1000
l:  1000000
f:  230.47
d:  30949.374
```

Python also provides a full range of built-in functions for mathematical calculation and you can use them in very similar way you have used them in C programming.

Computer Programming - Characters

It was easy to learn about numbers in computer because we are playing with numbers from childhood. Numbers are simple 1, 2, 3.....10.20, 300.345, etc.

It's even further easy to learn about characters in computer programming because you are playing with characters even before you started playing with numbers. Yes these are simple alphabets like a, b, c, d....A, B, C, D, ...but with an exception that in computer programming any single digit number like 0, 1, 2,....and special characters like $, %, +, -.... etc., are also treated as characters and to assign them in a character type variable you simply need to put them inside a **single quotes**. For example, following statement defines a character type variable **ch** and we assign a value 'a' to it:

```
char ch = 'a';
```

Here, **ch** is a variable of character type which can hold a character of the implementation's character set and **'a'** is called **character literal** or a character constant. Not only a, b, c,....but when any number like 1, 2, 3.... or any special character like !, @, #, #, $,.... is kept inside a single quotes, then they will be treated as a character literal and can be assigned to a variable of character type, so following is a valid statement:

```
char ch = '1';
```

A character data type consumes 8 bits of memory which means you can store anything in a character whose ASCII value lies in between -127 to 127, so in total it can hold one of 256 different values. Bottom-line is that a character data type can store any of the characters available on your keyboard including special characters like !, @, #, #, $, %, ^, &, *, (,), _, +, {, }, etc.

It's worth to explain it little further that you can keep only a single alphabet or single digit number inside single quotes and more than one alphabets or digits are not allowed inside single quotes. So following statements are invalid in C programming:

```
char ch1 = 'ab';
char ch2 = '10';
```

Following is a simple example, which shows how to define, assign and print characters in C Programming language:

```
#include <stdio.h>

main()
{
  char  ch1;
  char  ch2;
  char  ch3;
  char  ch4;

  ch1 = 'a';
  ch2 = '1';
  ch3 = '$';
  ch4 = '+';

  printf( "ch1: %c\n", ch1);
  printf( "ch2: %c\n", ch2);
  printf( "ch3: %c\n", ch3);
  printf( "ch4: %c\n", ch4);
}
```

Here, we used **%c** to print a character data type. When above program is executed, it produces the following result:

```
ch1: a
ch2: 1
ch3: $
ch4: +
```

Escape Sequences:

Many programming languages support a concept called **Escape Sequence**. So when a character is preceded by a backslash (\), then it is called an escape sequence and has special meaning to the compiler. For example, following is a valid character and it is called new line character:

```
char ch = '\n';
```

Here, character **n** has been preceded by a backslash (\), so now it has special meaning which is a new line but keep in mind that backslash (\) has special meaning with few characters only, so following will not have any meaning in C programming and it will be assumed as an invalid statement:

```
char ch = '\1';
```

Following table shows correct escape sequences available in C programming language:

Escape Sequence	**Description**
\t	Inserts a tab in the text at this point.
\b	Inserts a backspace in the text at this point.
\n	Inserts a newline in the text at this point.
\r	Inserts a carriage return in the text at this point.
\f	Inserts a form feed in the text at this point.
\'	Inserts a single quote character in the text at this point.
\"	Inserts a double quote character in the text at this point.
\\	Inserts a backslash character in the text at this point.

Following is a simple example which shows how the compiler interprets an escape sequence in a print statement:

```
#include <stdio.h>

main()
{
  char  ch1;
  char  ch2;
  char  ch3;
  char  ch4;
```

```
   ch1 = '\t';
   ch2 = '\n';


   printf( "Test for tabspace %c and a newline %c will start here", ch1, ch2);
}
```

When above program is executed, it produces the following result:

```
Test for tabspace     and a newline
 will start here
```

Characters in Java

Following is the equivalent program written in Java programming language. Java programming language handles character data type in similar way as we have seen in C programming language. Though Java provides additional support for character manipulation which you will to know when you will drill down this programming language.

You can try to execute the following program to see the output, which must be identical to the result generated by the above C example.

```
public class DemoJava
{
   public static void main(String []args)
   {

      char  ch1;
      char  ch2;
      char  ch3;
      char  ch4;

      ch1 = 'a';
      ch2 = '1';
      ch3 = '$';
      ch4 = '+';

      System.out.format( "ch1: %c\n", ch1);
      System.out.format( "ch2: %c\n", ch2);
      System.out.format( "ch3: %c\n", ch3);
      System.out.format( "ch4: %c\n", ch4);

   }
}
```

When above program is executed, it produces the following result:

```
ch1:  a
ch2:  1
ch3:  $
ch4:  +
```

Java also supports escape sequence in very similar way you have used them in C programming.

Characters in Python

Python does not support any character data type but all the characters are treated as string, which is a sequence of characters and we will study strings in a separate chapter. But you do not need to have any special arrangement while using a single character in Python.

Following is the equivalent program written in Python:

```
ch1 = 'a';
ch2 = '1';
ch3 = '$';
ch4 = '+';

print "ch1: ", ch1
print "ch2: ", ch2
print "ch3: ", ch3
print "ch4: ", ch4
```

When above program is executed, it produces the following result:

```
ch1:  a
ch2:  1
ch3:  $
ch4:  +
```

Python also supports escape sequence in very similar way you have used them in C programming.

Computer Programming - Arrays

Consider a situation, where we need to store 5 integer numbers. If we use programming's simple variable and data type concepts, then we need 5 variables of **int** data type and program will be something as follows:

```
#include <stdio.h>

main()
{
   int  number1;
   int  number2;
   int  number3;
   int  number4;
   int  number5;

   number1 = 10;
   number2 = 20;
   number3 = 30;
```

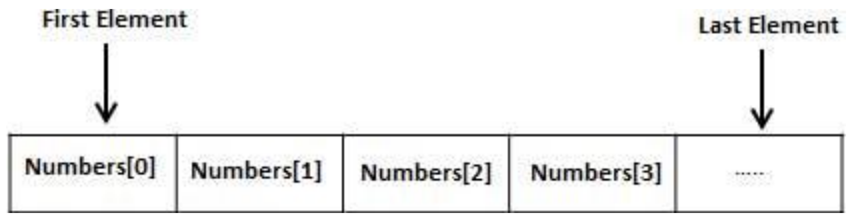
```
  number4 = 40;
  number5 = 50;

  printf( "number1: %d\n", number1);
  printf( "number2: %d\n", number2);
  printf( "number3: %d\n", number3);
  printf( "number4: %d\n", number4);
  printf( "number5: %d\n", number5);
}
```

It was simple, because we had to store just 5 integer numbers. Now let's assume we have to store 5000 integer numbers, so what is next? Are we going to use 5000 variables?

To handle such situation, almost all the programming languages provide a concept called **the array**. An array is a data structure, which can store a fixed-size collection of elements of the same data type. An array is used to store a collection of data, but it is often more useful to think of an array as a collection of variables of the same type.

So instead of declaring individual variables, such as number1, number2, ..., and number99, you just declare one array variable **number** of integer type and use number1[0], number1[1], and ..., number1[99] to represent individual variables. Here, 0, 1, 2, ...99 are **index** associated with var variable and they are being used to represent individual elements available in the array.

All arrays consist of contiguous memory locations. The lowest address corresponds to the first element and the highest address to the last element.



Create Arrays

To create an array variable in C, a programmer specifies the type of the elements and the number of elements to be stored in that array. Following is a simple syntax to create an array in C programming:

```
type arrayName [ arraySize ];
```

This is called a *single-dimensional* array. The **arraySize** must be an integer constant greater than zero and **type** can be any valid C data type. For example, now to declare a 10-element array called **number** of type **int** , use this statement:

```
int number[10];
```

Now, *number* is a variable array, which is sufficient to hold up to 10 integer numbers.

Initializing Arrays

You can initialize array in C either one by one or using a single statement as follows:

```
int number[5] = {10, 20, 30, 40, 50};
```

The number of values between braces { } cannot be larger than the number of elements that we declare for the array between square brackets [ ].

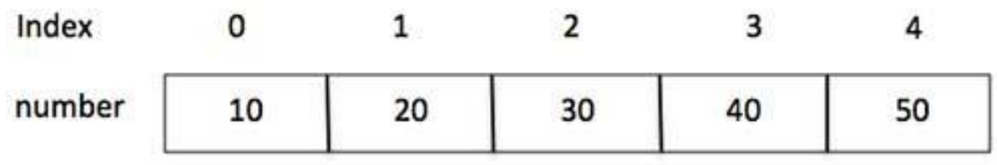
If you omit the size of the array, an array just big enough to hold the initialization is created. Therefore, if you write:

```
int number[] = {10, 20, 30, 40, 50};
```

You will create exactly the same array as you did in the previous example. Following is an example to assign a single element of the array:

```
number[4] = 50;
```

The above statement assigns element number 5th in the array with a value of 50. All arrays have 0 as the index of their first element which is also called base index and last index of an array will be total size of the array minus 1. Following is the pictorial representation of the same array we discussed above:



Accessing Array Elements

An element is accessed by indexing the array name. This is done by placing the index of the element within square brackets after the name of the array. For example:

```
int var = number[9];
```

The above statement will take 10th element from the array and assign the value to **var** variable. Following is an example, which will use all the above-mentioned three concepts viz. creation, assignment and accessing arrays:

```
#include <stdio.h>

int main ()
{
  int number[10]; /* number is an array of 10 integers */
  int i = 0;
```

```
   /* Initialize elements of array n to 0 */
   while( i < 10 )
   {
      /* Set element at location i to i + 100 */
      number[ i ] = i + 100;
      i = i + 1;
   }

   /* Output each array element's value */
   i = 0;
   while( i < 10 )
   {
      printf("number[%d] = %d\n", i, number[i] );
      i = i + 1;
   }

   return 0;
}
```

When the above code is compiled and executed, it produces the following result:

```
number[0] = 100
number[1] = 101
number[2] = 102
number[3] = 103
number[4] = 104
number[5] = 105
number[6] = 106
number[7] = 107
number[8] = 108
number[9] = 109
```

Arrays in Java

Following is the equivalent program written in Java programming language. Java programming language also supports array, but there is a little difference to create them in different ways using **new** operator available in Java programming language.

You can try to execute the following program to see the output, which must be identical to the result generated by the above C example.

```
public class DemoJava
{
   public static void main(String []args)
   {
      int[] number = new int[10];
      int i = 0;

      while( i < 10 )
      {
         number[ i ] = i + 100;
         i = i + 1;
      }

      i = 0;
      while( i < 10 )
      {
        System.out.format( "number[%d] = %d\n", i, number[i] );
        i = i + 1;
      }
    }
}
```

When above program is executed, it produces the following result:

```
number[0] = 100
number[1] = 101
number[2] = 102
number[3] = 103
number[4] = 104
number[5] = 105
number[6] = 106
number[7] = 107
number[8] = 108
number[9] = 109
```

Arrays (Lists) in Python

Python does not have a concept of Array, instead Python provides another data structure called **list,** which provides similar functionality as arrays in any other language.

Following is the equivalent program written in Python:

```
# Following defines an empty list.
number = []
i = 0

while i < 10:
   # Appending elements in the list
   number.append(i + 100)
   i = i + 1

i = 0
while i < 10:
   # Accessing elements from the list
   print "number[", i,  "] = ", number[ i ]
   i = i + 1
```

When above program is executed, it produces the following result:

```
number[ 0 ] =  100
number[ 1 ] =  101
number[ 2 ] =  102
number[ 3 ] =  103
```

```
number[ 4 ] =  104
number[ 5 ] =  105
number[ 6 ] =  106
number[ 7 ] =  107
number[ 8 ] =  108
number[ 9 ] =  109
```

Computer Programming Strings

During our discussion about **characters** in computer programming, we learnt that character data type deals with a single character and you can assign any character from your keyboard to a character type variable.

Now, let's move a little bit ahead and consider a situation where we need to store more than one character in a variable. We have seen that C programming does not allow to store more than one character in a character type variable. So following statements are invalid in C programming and produce syntax error:

```
char ch1 = 'ab';
char ch2 = '10';
```

We also have seen how we can store more than one value of similar data type in a variable using **array** concept. If recap then, here is the syntax to store and print 5 numbers in an array of int type:

```
#include <stdio.h>

main()
{
   int number[5] = {10, 20, 30, 40, 50};
   int i = 0;

   while( i < 5 )
   {
      printf("number[%d] = %d\n", i, number[i] );
      i = i + 1;
   }
}
```

When the above code is compiled and executed, it produces the following result:

```
number[0] = 10
number[1] = 20
number[2] = 30
number[3] = 40
number[4] = 50
```

Now, let's define an array of 5 characters in the similar way as we did for numbers and try to print them:

```
#include <stdio.h>

main()
{
   char ch[5] = {'H', 'e', 'l', 'l', 'o'};
   int i = 0;

   while( i < 5 )
   {
      printf("ch[%d] = %c\n", i, ch[i] );
      i = i + 1;
  }
}
```

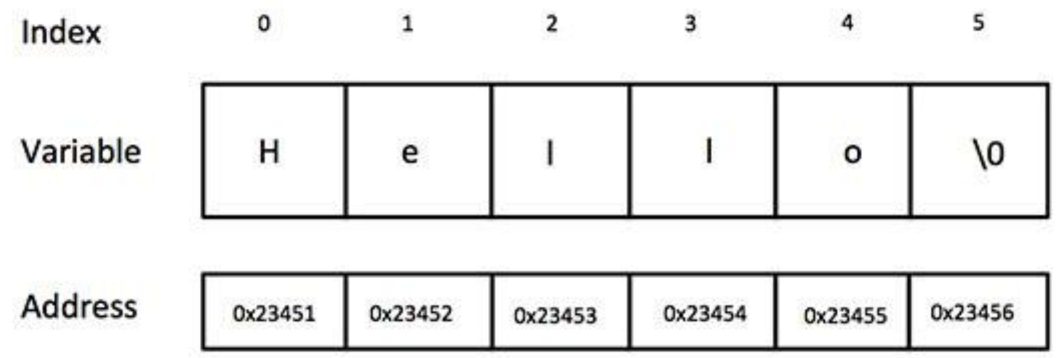
Here, we used %c to print character value. When the above code is compiled and executed, it produces the following result:

```
ch[0] = H
ch[1] = e
ch[2] = l
ch[3] = l
ch[4] = o
```

If you are done with the above example, then I think you understood about strings in C programming, because **strings in C are represented as arrays of characters**. C programming simplified the assignment and printing of strings. Let's check same example once again with simplified syntax:

```
#include <stdio.h>

main()
{
   char ch[5] = "Hello";
   int i = 0;

   /* Print as a complete string */
   printf("String = %s\n", ch);

   /* Print character by character */
   while( i < 5 )
   {
      printf("ch[%d] = %c\n", i, ch[i] );
      i = i + 1;
  }
}
```

Here, we used %s to print full string value using array name **ch**, which is actually beginning of the memory address holding ch variable as shown below:



Though it's not visible from the above examples, but internally C program assigns null character **'\0'** as the last character of every string. This indicates the end of the string and it means if you want to store a 5 character string in an array then you must define array size of 6 as a good practice, though C does not complain about it.

Now if the above code is compiled and executed, it produces the following result:

```
String = Hell
ch[0] = H
ch[1] = e
ch[2] = l
ch[3] = l
ch[4] = o
```

Basic String Concepts

Based on the above discussion we can conclude the following important points to remember about strings in C programming language:

- Strings in C are represented as arrays of characters.
- We can constitute a string in C programming by assigning character by character into an array of characters.
- We can constitute a string in C programming by assigning a complete string enclosed in double quote.
- We can print a string character by character using array subscript or a complete string by using array name without subscript.
- Though it's not visible from the above examples, but internally C program assigns null character **'\0'** as the last character of every string. This indicates the end of the string and it means if you want to store a 5-character string in an array then you must define array size of 6 as a good practice, though C does not complain about it.
- Most of the programming languages provide built-in functions to manipulate strings, i.e., you can concatenate strings, you can search from a string, you can take sub string from the string. For a detail you can check detailed tutorial for C or other programming languages.

Strings in Java

Though you can use character array to store strings but Java is an advanced programming language and its designers tried to provide additional functionality like Java provides string as a built-in data type like any other data type. So it means you can define strings directly instead of defining them array of characters.

Following is the equivalent program written in Java programming language. Java programming makes use of **new** operator to create string variable as shown below in the program:

You can try to execute the following program to see the output:

```
public class DemoJava
{
   public static void main(String []args)
   {
       String str = new String("Hello");

       System.out.println( "String = " + str );
   }
}
```

When above program is executed, it produces the following result:

```
String = Hello
```

Strings in Python

Creating strings in Python is as simple as simply assigning a string into a Python variable using single or double quote as shown below:

Following is a simple program, which creates two strings and print them using print() function:

```
var1 = 'Hello World!'
var2 = "Python Programming"

print "var1 = ", var1
print "var2 = ", var2
```

When above program is executed, it produces the following result:

```
var1 =  Hello World!
var2 =  Python Programming
```

Python does not support a character type; these are treated as strings of length one, thus also considered a substring.

To access substrings, use the square brackets for slicing along with the index or indices to obtain your substring. Following is a simple example:

```
var1 = 'Hello World!'
var2 = "Python Programming"

print "var1[0]: ", var1[0]
print "var2[1:5]: ", var2[1:5]
```

When the above code is executed, it produces the following result:

```
var1[0]:  H
var2[1:5]:  ytho
```

Computer Programming - Functions

A function is a block of organized, reusable code that is used to perform a single, related action. Functions provide better modularity for your application and a high degree of code reusing. You already have seen various functions like **printf()** and **main()**. These are called built-in functions provided by the language itself, but we can write our own functions as well and this tutorial will teach you how to write and use those functions in C programming language.

Good thing about functions is that they are famous with several names. Different programming languages name them differently like functions, methods, sub-routines, procedures, etc. So when you come across any such terminology, then just imagine about the same concept, which we are going to discuss in this tutorial.

Let's start with a program where we will define two arrays of numbers and then from each array, we will find the biggest number. As we already have seen following are the steps to find out maximum number from a given set of numbers:

```
1.  Get a list of numbers $L_1$, $L_2$, $L_3$....$L_N$
2.  Assume $L_1$ is the largest,  Set max = $L_1$
3.          Take next number $L_i$ from the list and do the following
4.  If max is less than $L_i$
5.     Set max = $L_i$
6.  If $L_i$ is last number from  the list then
7.     Print value stored in max and come out
8.  Else prepeat same process starting from step 3
```

Let's translate above program in C programming language:

```
#include <stdio.h>

main()
{
   int set1[5] = {10, 20, 30, 40, 50};
   int set2[5] = {101, 201, 301, 401, 501};
   int i, max;
   /* Process first set of numbers available in set1[] */
   max = set1[0];
   i = 1;
   while( i < 5 )
   {
      if( max <  set1[i] )
      {
         max = set1[i];
      }
      i = i + 1;
   }
   printf("Max in first set = %d\n", max );

   /* Now process second set of numbers available in set2[] */
   max = set2[0];
   i = 1;
   while( i < 5 )
   {
      if( max <  set2[i] )
      {
         max = set2[i];
      }
      i = i + 1;
   }
   printf("Max in second set = %d\n", max );
}
```

When the above code is compiled and executed, it produces the following result:

```
Max in first set = 50
Max in second set = 501
```

If you are clear about the above example, then it will become easy to understand why do we need a function. Here in above example, I took only two sets of numbers set1, and set2 but consider a situation we have 10 or more similar sets of numbers to find out maximum numbers from each set. In such situation, we will have to repeat same processing 10 or more times and ultimately program will become too large with repeated code. To handle such situation, we write our functions where we try to keep source code which will be used again and again in our programming.

Now, let's see how to define a function in C programming language and then subsequent section will explain how to use that function:

Defining a Function:

The general form of a function definition in C programming language is as follows:

```
return_type function_name( parameter list )
{
  body of the function
```

```
   return [expression];
}
```

A function definition in C programming language consists of a *function header* and a *function body*. Here are all the parts of a function:

- **Return Type**: A function may return a value. The **return_type** is the data type of the value the function returns. Some functions perform the desired operations without returning a value. In this case, the return_type is the keyword **void**.
- **Function Name:** This is the actual name of the function. The function name and the parameter list together constitute the function signature.
- **Parameter List:** A parameter is like a placeholder. When a function is invoked, you pass a value as a parameter. This value is referred to as actual parameter or argument. The parameter list refers to the type, order, and number of the parameters of a function. Parameters are optional; that is, a function may contain no parameters.
- **Function Body:** The function body contains a collection of statements that define what the function does.

Calling a Function:

While creating a C function, you give a definition of what the function has to do. To use a function, you will have to call that function to perform the defined task.

Now, let's write above example with the help of a function:

```
#include <stdio.h>

int getMax( int set[] )
{
   int i, max;

    max = set[0];
    i = 1;
    while( i < 5 )
    {
        if( max <  set[i] )
        {
            max = set[i];
        }
        i = i + 1;
    }

    return max;
}

main()
{
    int set1[5] = {10, 20, 30, 40, 50};
    int set2[5] = {101, 201, 301, 401, 501};
    int max;
    /* Process first set of numbers available in set1[] */
    max = getMax(set1);
    printf("Max in first set = %d\n", max );

    /* Now process second set of numbers available in set2[] */
    max = getMax(set2);
    printf("Max in second set = %d\n", max );
}
```

When the above code is compiled and executed, it produces the following result:

```
Max in first set = 50
Max in second set = 501
```

For now, its enough for you to know about what are functions and how do they work. If you understood this concept then you can proceed for a detailed tutorial to drill it down further.

Functions in Java

If you are clear about functions in C programming, then its easy to understand them in Java as well. Java programming names them as **methods** , but rest of the concepts remain more or less same as we discussed in C programming.

Following is the equivalent program written in Java programming language. You can try to execute the following program to see the output:

```
public class DemoJava
{
  public static void main(String []args)
  {
    int[] set1 = {10, 20, 30, 40, 50};
    int[] set2 = {101, 201, 301, 401, 501};
    int max;

    /* Process first set of numbers available in set1[] */
    max = getMax(set1);
    System.out.format("Max in first set = %d\n", max );

    /* Now process second set of numbers available in set2[] */
    max = getMax(set2);
    System.out.format("Max in second set = %d\n", max );
  }

  public static int getMax( int set[] )
  {
     int i, max;

     max = set[0];
     i = 1;
     while( i < 5 )
     {
          if( max <  set[i] )
          {
             max = set[i];
          }
          i = i + 1;
       }

       return max;
   }
}
```

When above program is executed, it produces the following result:

```
Max in first set = 50
Max in second set = 501
```

Functions in Python

Once again, if you already understood the concept of functions in C and Java programming, then Python is not much different in defining and calling functions. Following is basic syntax of defining a function in Python:

```
def function_name( parameter list ):
   body of the function

   return [expression]
```

So using this syntax of function in Python, above example can be written as follows:

```
def getMax( set ):
    max = set[0]
    i = 1
    while( i < 5 ):
        if( max <  set[i] ):
            max = set[i]
        i = i + 1
    return max


set1 = [10, 20, 30, 40, 50]
set2 = [101, 201, 301, 401, 501]

# Process first set of numbers available in set1[]
max = getMax(set1)
print "Max in first set = ", max

# Now process second set of numbers available in set2[]
max = getMax(set2)
print "Max in second set = ", max
```

When the above code is executed, it produces the following result:

```
Max in first set =  50
Max in second set =  501
```

Computer Programming - File I/O

Though it's simple to handle file I/O in computer programming, it's really difficult to teach what are the files and how we perform input and output into those files, especially when I promised in pre-requisite of the tutorial that you do not need to know anything about computer.

OK, let's start with learning what are files in computer terminology?

Computer Files

A computer file is used to store data in digital format like plain text, image data or any other content. If you will have a look at this HTML file, name is **computer_programming_file_io.htm** and it's keeping HTML text, which you are reading. Similar way, we use digital image data in the form of files. This tutorial is using minilogo image with a file name **cp-mini-logo.png**. Computer files can be organized inside different directories. So, files are used to keep digital data where as directories are used to keep files.

Computer files can be considered as the digital counterpart of paper documents, which traditionally are kept in office. While doing programming, you keep your source code in text files with different extensions, for example, C programming files have **.c** extension, Java programming files have **.java** extension and Python programming file have extension as **.py**.

File Input/Output

Usually, you create files using text editors like notepad, MS Word, MS Excel or MS Powerpoint, etc., but many times, we need to create files using computer program as well. We can modify existing file using a computer program.

File input means data, which we write into a file and file output means data, which we read from a file. Actually, input and output terms are more related to screen input and output where we display our result on the screen which is called output and if we provide some input to our program from command prompt, then it's called input.

For now, it's enough to remember that writing into a file is file input and reading something from the file is file output.

File Operation Modes

Before we start playing with any file using our program, either we need to create a new file if it does not exist or open an already existing file. In either case, we can open a file in the following modes:

- **Read Only Mode:** If you are going just to read an existing file and you do not want to write any further content in the file, then you will open file in read only mode. Almost, all the programming languages provide syntax to open file in read only mode.
- **Write Only Mode:** If you are going to write into either an existing file or newly created file but you do not want to read any written content in the file, then you will open file in write only mode. All the programming languages provide syntax to open file in write only mode.
- **Read & Write Mode:** If you are going to read as well as write into the same file, then you will open file in read & write mode. Almost, all the programming languages provide syntax to open file in read & write mode.
- **Append Mode:** When you open a file for writing, it allows you to start writing your content from the beginning of the file but writing content from the beginning in a file, which already has some content, will overwrite already existing content. We prefer to open a file in such a way that we should start appending content in already existing content of the file. So in such situation, we open file in append mode. Append mode is ultimately a write mode, which allows content to be appended in the last of the file. Almost, all the programming languages provide syntax to open file in append mode.

Now, following section will teach you how to open a fresh new file, how to write content in that file and later how to read and append more content into the same file.

Opening Files

You can use the **fopen( )** function to create a new file or to open an existing file, this call will initialize an object of the type **FILE**, which contains all the information necessary to control the stream. Following is the prototype, i.e., signature of this function call:

```
FILE *fopen( const char * filename, const char * mode );
```

Here, **filename** is string literal, which you will use to name your file and access **mode** can have one of the following values:

Mode	**Description**
r	Opens an existing text file for reading purpose.
w	Opens a text file for writing, if it does not exist then a new file is created. Here, your program will start writing content from the beginning of the file.
a	Opens a text file for writing in appending mode, if it does not exist then a new file is created. Here, your program will start appending content in the existing file content.
r+	Opens a text file for reading and writing both.
w+	Opens a text file for reading and writing both. It first truncate the file to zero length if it exists otherwise create the file if it does not exist.
a+	Opens a text file for reading and writing both. It creates the file if it does not exist. The reading will start from the beginning but writing can only be appended.

Closing a File

To close a file, use the **fclose( )** function. The prototype i.e. signature of this function is:

```
 int fclose( FILE *fp );
```

The **fclose( )** function returns zero on success, or **EOF**, special character, if there is an error in closing the file. This function actually flushes any data still pending in the buffer to the file, closes the file, and releases any memory used for the file. The EOF is a constant defined in the header file **stdio.h**.

There are various functions provided by C standard library to read and write a file character by character or in the form of a fixed length string. Let us see few of them in the next section.

Writing a File

Following is the simplest function to write individual characters to a stream:

```
int fputc( int c, FILE *fp );
```

The function **fputc()** writes the character value of the argument c to the output stream referenced by fp. It returns the written character written on success, otherwise **EOF** if there is an error. You can use the following functions to write a null-terminated string to a stream:

```
int fputs( const char *s, FILE *fp );
```

The function **fputs()** writes the string **s** into the file referenced by fp. It returns a non-negative value on success, otherwise **EOF** is returned in case of any error. You can use **int fprintf(FILE *fp,const char *format, ...)** function as well to write a string into a file. Try the following example:

```
#include <stdio.h>

main()
{
  FILE *fp;

  fp = fopen("/tmp/test.txt", "w+");
  fprintf(fp, "This is testing for fprintf...\n");
  fputs("This is testing for fputs...\n", fp);
  fclose(fp);
}
```

When the above code is compiled and executed, it creates a new file **test.txt** in **/tmp** directory and writes two lines using two different functions. Let us read this file in next section.

Reading a File

Following is the simplest function to read a text file character by character:

```
int fgetc( FILE * fp );
```

The **fgetc()** function reads a character from the input file referenced by fp. The return value is the character read, or in case of any error it returns **EOF**. The following functions allow you to read a string from a stream:

```
char *fgets( char *buf, int n, FILE *fp );
```

The functions **fgets()** reads up to n - 1 characters from the input stream referenced by fp. It copies the read string into the buffer **buf**, appending a **null** character to terminate the string.

If this function encounters a newline character '\n' or the end of the file EOF before they have read the maximum number of characters, then it returns only the characters read up to that point including new line character. You can also use **int fscanf(FILE *fp, const char *format, ...)** function to read strings from a file but it stops reading after the first space character encounters.

```
#include <stdio.h>

main()
{
  FILE *fp;
  char buff[255];

  fp = fopen("/tmp/test.txt", "r");
  fscanf(fp, "%s", buff);
  printf("1 : %s\n", buff );

  fgets(buff, 255, (FILE*)fp);
  printf("2: %s\n", buff );

  fgets(buff, 255, (FILE*)fp);
  printf("3: %s\n", buff );
  fclose(fp);

}
```

When the above code is compiled and executed, it reads the file created in previous section and produces the following result:

```
1 : This
2: is testing for fprintf...

3: This is testing for fputs...
```

Let's see a little more detail about what happened here. First **fscanf()** method read just **This** because after that it encountered a space, second call is for **fgets()**, which reads the remaining line till it encountered end of line. Finally, last call **fgets()** reads second line completely.

File I/O in Java

Java programming language provides even richer set of functions to handle File I/O. For a complete detail, I will suggest you to check Java Tutorial.

Here, we will see a simple Java program, which is equal to C program explained above. This program will open a text file and will write few text lines into that file and close the file. Finally, same file is opened and then read that text from already created file. You can try to execute following program to see the output:

```
import java.io.*;

public class DemoJava
{
  public static void main(String []args) throws IOException
  {

    File file = new File("/tmp/java.txt");

    // Create a File
    file.createNewFile();

    //  Creates a FileWriter Object using file object
    FileWriter writer = new FileWriter(file);

    // Writes the content to the file
    writer.write("This is testing for Java write...\n");
    writer.write("This is second line...\n");

    // Flush the memory and close the file
    writer.flush();
    writer.close();

    // Creates a FileReader Object
    FileReader reader = new FileReader(file);
    char [] a = new char[100];

    // Read file content in the array
    reader.read(a);
    System.out.println( a );

    // Close the file
    reader.close();
  }
}
```

When above program is executed, it produces the following result:

```
This is testing for Java write...
This is second line...
```

File I/O in Python

Following program shows the same functionality to open new file, write some content into the file and finally read the same file:

```
# Create a new file
fo = open("/tmp/python.txt", "w")

# Writes the content to the file
fo.write( "This is testing for Python write...\n");
fo.write( "This is second line...\n");

# Close the file
fo.close()

# Open existing file
fo = open("/tmp/python.txt", "r")

# Read file content in a variable
str = fo.read(100);
print str

# Close opened file
fo.close()
```

When the above code is executed, it produces the following result:

```
This is testing for Python write...
This is second line...
```