PHP & PYTHON

- Introduction

PHP started out as a small open source project that evolved as more and more people found out how useful it was. Rasmus Lerdorf unleashed the first version of PHP way back in 1994.

- PHP is a recursive acronym for "PHP: Hypertext Preprocessor".
- PHP is a server side scripting language that is embedded in HTML. It is used to manage dynamic content, databases, session tracking, even build entire e-commerce sites.
- It is integrated with a number of popular databases, including MySQL, PostgreSQL, Oracle, Sybase, Informix, and Microsoft SQL Server.
- PHP is pleasingly zippy in its execution, especially when compiled as an Apache module on the Unix side. The MySQL server, once started, executes even very complex queries with huge result sets in record-setting time.
- PHP supports a large number of major protocols such as POP3, IMAP, and LDAP. PHP4 added support for Java and distributed object architectures (COM and CORBA), making n-tier development a possibility for the first time.
- PHP is forgiving: PHP language tries to be as forgiving as possible.
- PHP Syntax is C-Like.

Common uses of PHP

- PHP performs system functions, i.e. from files on a system it can create, open, read, write, and close them.
- PHP can handle forms, i.e. gather data from files, save data to a file, through email you can send data, return data to the user.
- You add, delete, modify elements within your database through PHP.
- Access cookies variables and set cookies.
- Using PHP, you can restrict users to access some pages of your website.
- It can encrypt data.

Characteristics of PHP

Five important characteristics make PHP's practical nature possible −

- Simplicity
- Efficiency
- Security
- Flexibility
- Familiarity

"Hello World" Script in PHP

To get a feel for PHP, first start with simple PHP scripts. Since "Hello, World!" is an essential example, first we will create a friendly little "Hello, World!" script.

As mentioned earlier, PHP is embedded in HTML. That means that in amongst your normal HTML (or XHTML if you're cutting-edge) you'll have PHP statements like this −

```
<html>


  <head>
    <title>Hello World</title>
  </head>
    <body>
    <?php echo "Hello, World!";?>
  </body>
</html>
```

It will produce following result −

```
Hello, World!
```

If you examine the HTML output of the above example, you'll notice that the PHP code is not present in the file sent from the server to your Web browser. All of the PHP present in the Web page is processed and stripped from the page; the only thing returned to the client from the Web server is pure HTML output.

All PHP code must be included inside one of the three special markup tags ate are recognised by the PHP Parser.

```
<?php PHP code goes here ?>

<?   PHP code goes here ?>

<script language="php"> PHP code goes here </script>
```

A most common tag is the <?php...?> and we will also use the same tag in our tutorial.

ENVIRONMENT SETUP

In order to develop and run PHP Web pages three vital components need to be installed on your computer system.

- **Web Server** − PHP will work with virtually all Web Server software, including Microsoft's Internet Information Server (IIS) but then most often used is freely available Apache Server. Download Apache for free here − https://httpd.apache.org/download.cgi
- **Database** − PHP will work with virtually all database software, including Oracle and Sybase but most commonly used is freely available MySQL database. Download MySQL for free here − https://www.mysql.com/downloads/
- **PHP Parser** − In order to process PHP script instructions a parser must be installed to generate HTML output that can be sent to the Web Browser. This tutorial will guide you how to install PHP parser on your computer.

PHP Parser Installation

Before you proceed it is important to make sure that you have proper environment setup on your machine to develop your web programs using PHP.

Type the following address into your browser's address box.

```
http://127.0.0.1/info.php
```

If this displays a page showing your PHP installation related information then it means you have PHP and Webserver installed properly. Otherwise you have to follow given procedure to install PHP on your computer.

This section will guide you to install and configure PHP over the following four platforms −

- PHP Installation on Linux or Unix with Apache
- PHP Installation on Mac OS X with Apache
- PHP Installation on Windows NT/2000/XP with IIS
- PHP Installation on Windows NT/2000/XP with Apache

Apache Configuration

If you are using Apache as a Web Server then this section will guide you to edit Apache Configuration Files.

Just Check it here − PHP Configuration in Apache Server

PHP.INI File Configuration

The PHP configuration file, php.ini, is the final and most immediate way to affect PHP's functionality.

Just Check it here − PHP.INI File Configuration

Windows IIS Configuration

To configure IIS on your Windows machine you can refer your IIS Reference Manual shipped along with IIS.

PHP - Syntax Overview

Canonical PHP tags

The most universally effective PHP tag style is −

```
<?php...?>
```

Commenting PHP Code

A *comment* is the portion of a program that exists only for the human reader and stripped out before displaying the programs result. There are two commenting formats in PHP −

Single-line comments − They are generally used for short explanations or notes relevant to the local code. Here are the examples of single line comments.

```
<?
  # This is a comment, and
  # This is the second line of the comment
    // This is a comment too. Each style comments only
  print "An example with single line comments";
?>
```

Multi-lines printing − Here are the examples to print multiple lines in a single print statement −

```
<?
  # First Example
  print <<<END
  This uses the "here document" syntax to output
  multiple lines with $variable interpolation. Note
  that the here document terminator must appear on a
  line with just a semicolon no extra whitespace!
  END;
    # Second Example
  print "This spans
  multiple lines. The newlines will be
  output as well"; ?>
```

Multi-lines comments − They are generally used to provide pseudocode algorithms and more detailed explanations when necessary. The multiline style of commenting is the same as in C. Here are the example of multi lines comments.

```
<?
  /* This is a comment with multiline
     Author : Mohammad Mohtashim
     Purpose: Multiline Comments Demo
     Subject: PHP
  */
  print "An example with multi line comments";
?>
```

PHP is whitespace insensitive

Whitespace is the stuff you type that is typically invisible on the screen, including spaces, tabs, and carriage returns (end-of-line characters).

PHP whitespace insensitive means that it almost never matters how many whitespace characters you have in a row.one whitespace character is the same as many such characters.

For example, each of the following PHP statements that assigns the sum of 2 + 2 to the variable $four is equivalent −

```
$four = 2 + 2; // single spaces
$four <tab>=<tab2<tab>+<tab>2 ; // spaces and tabs
$four =
2+
2; // multiple lines
```

PHP is case sensitive

Yeah it is true that PHP is a case sensitive language. Try out following example −

```
<html>
  <body>
```

```
    <?php
      $capital = 67;
      print("Variable capital is $capital<br>");
      print("Variable CaPiTaL is $CaPiTaL<br>");
    ?>

  </body>
</html>
```

This will produce the following result −

```
Variable capital is 67
Variable CaPiTaL is
```

Statements are expressions terminated by semicolons

A *statement* in PHP is any expression that is followed by a semicolon (;).Any sequence of valid PHP statements that is enclosed by the PHP tags is a valid PHP program. Here is a typical statement in PHP, which in this case assigns a string of characters to a variable called $greeting −

```
$greeting = "Welcome to PHP!";
```

Expressions are combinations of tokens

The smallest building blocks of PHP are the indivisible tokens, such as numbers (3.14159), strings (.two.), variables ($two), constants (TRUE), and the special words that make up the syntax of PHP itself like if, else, while, for and so forth

Braces make blocks

Although statements cannot be combined like expressions, you can always put a sequence of statements anywhere a statement can go by enclosing them in a set of curly braces.

Here both statements are equivalent −

```
if (3 == 2 + 1)
  print("Good - I haven't totally lost my mind.<br>");

if (3 == 2 + 1) {
```

```
  print("Good - I haven't totally");
  print("lost my mind.<br>");
}
```

Running PHP Script from Command Prompt

Yes you can run your PHP script on your command prompt. Assuming you have following content in test.php file

```
<?php
  echo "Hello PHP!!!!!";
?>
```

Now run this script as command prompt as follows −

```
$ php test.php
```

It will produce the following result −

```
Hello PHP!!!!!
```

VARIABLE / DATA TYPES

The main way to store information in the middle of a PHP program is by using a variable.

Here are the most important things to know about variables in PHP.

- All variables in PHP are denoted with a leading dollar sign ($).
- The value of a variable is the value of its most recent assignment.
- Variables are assigned with the = operator, with the variable on the left-hand side and the expression to be evaluated on the right.
- Variables can, but do not need, to be declared before assignment.
- Variables in PHP do not have intrinsic types - a variable does not know in advance whether it will be used to store a number or a string of characters.
- Variables used before they are assigned have default values.
- PHP does a good job of automatically converting types from one to another when necessary.
- PHP variables are Perl-like.

Variable Scope

Scope can be defined as the range of availability a variable has to the program in which it is declared. PHP variables can be one of four scope types −

- Local variables
- Function parameters
- Global variables
- Static variables

Variable Naming

Rules for naming a variable is −

- Variable names must begin with a letter or underscore character.

- A variable name can consist of numbers, letters, underscores but you cannot use characters like + , - , % , (,) . & , etc

There is no size limit for variables.

PHP has a total of eight data types which we use to construct our variables −

- **Integers** − are whole numbers, without a decimal point, like 4195.
- **Doubles** − are floating-point numbers, like 3.14159 or 49.1.
- **Booleans** − have only two possible values either true or false.
- **NULL** − is a special type that only has one value: NULL.
- **Strings** − are sequences of characters, like 'PHP supports string operations.'
- **Arrays** − are named and indexed collections of other values.
- **Objects** − are instances of programmer-defined classes, which can package up both other kinds of values and functions that are specific to the class.
- **Resources** − are special variables that hold references to resources external to PHP (such as database connections).

The first five are *simple types*, and the next two (arrays and objects) are compound - the compound types can package up other arbitrary values of arbitrary type, whereas the simple types cannot.

We will explain only simple data type in this chapters. Array and Objects will be explained separately.

Integers

They are whole numbers, without a decimal point, like 4195. They are the simplest type .they correspond to simple whole numbers, both positive and negative. Integers can be assigned to variables, or they can be used in expressions, like so −

```
$int_var = 12345;
$another_int = -12345 + 12345;
```

Integer can be in decimal (base 10), octal (base 8), and hexadecimal (base 16) format. Decimal format is the default, octal integers are specified with a leading 0, and hexadecimals have a leading 0x.

For most common platforms, the largest integer is (2**31 . 1) (or 2,147,483,647), and the smallest (most negative) integer is . (2**31 . 1) (or .2,147,483,647).

Doubles

They like 3.14159 or 49.1. By default, doubles print with the minimum number of decimal places needed. For example, the code −

```
<?php
  $many = 2.2888800;
  $many_2 = 2.2111200;
  $few = $many + $many_2;

  print("$many + $many_2 = $few <br>");
?>
```

It produces the following browser output −

```
2.28888 + 2.21112 = 4.5
```

Boolean

They have only two possible values either true or false. PHP provides a couple of constants especially for use as Booleans: TRUE and FALSE, which can be used like so −

```
if (TRUE)
  print("This will always print<br>");

else
  print("This will never print<br>");
```

Interpreting other types as Booleans

Here are the rules for determine the "truth" of any value not already of the Boolean type −

- If the value is a number, it is false if exactly equal to zero and true otherwise.
- If the value is a string, it is false if the string is empty (has zero characters) or is the string "0", and is true otherwise.
- Values of type NULL are always false.
- If the value is an array, it is false if it contains no other values, and it is true otherwise. For an object, containing a value means having a member variable that has been assigned a value.
- Valid resources are true (although some functions that return resources when they are successful will return FALSE when unsuccessful).
- Don't use double as Booleans.

Each of the following variables has the truth value embedded in its name when it is used in a Boolean context.

```
$true_num = 3 + 0.14159;
$true_str = "Tried and true"
$true_array[49] = "An array element";
$false_array = array();
$false_null = NULL;
$false_num = 999 - 999;
$false_str = "";
```

NULL

NULL is a special type that only has one value: NULL. To give a variable the NULL value, simply assign it like this −

```
$my_var = NULL;
```

The special constant NULL is capitalized by convention, but actually it is case insensitive; you could just as well have typed −

```
$my_var = null;
```

A variable that has been assigned NULL has the following properties −

- It evaluates to FALSE in a Boolean context.
- It returns FALSE when tested with IsSet() function.

STRINGS

They are sequences of characters, like "PHP supports string operations". Following are valid examples of string

```
$string_1 = "This is a string in double quotes";
$string_2 = 'This is a somewhat longer, singly quoted string';
$string_39 = "This string has thirty-nine characters";
$string_0 = ""; // a string with zero characters
```

Singly quoted strings are treated almost literally, whereas doubly quoted strings replace variables with their values as well as specially interpreting certain character sequences.

```
<?php
  $variable = "name";
  $literally = 'My $variable will not print!';

  print($literally);
  print "<br>";

  $literally = "My $variable will print!";
  print($literally);
?>
```

This will produce following result −

```
My $variable will not print!\n
My name will print
```

There are no artificial limits on string length - within the bounds of available memory, you ought to be able to make arbitrarily long strings.

Strings that are delimited by double quotes (as in "this") are preprocessed in both the following two ways by PHP −

- Certain character sequences beginning with backslash (\) are replaced with special characters
- Variable names (starting with $) are replaced with string representations of their values.

The escape-sequence replacements are −

- \n is replaced by the newline character
- \r is replaced by the carriage-return character
- \t is replaced by the tab character
- \$ is replaced by the dollar sign itself ($)
- \" is replaced by a single double-quote (")
- \\ is replaced by a single backslash (\)

CONSTANTS TYPES

A constant is a name or an identifier for a simple value. A constant value cannot change during the execution of the script. By default, a constant is case-sensitive. By convention, constant identifiers are always uppercase. A constant name starts with a letter or underscore, followed by any number of letters, numbers, or underscores. If you have defined a constant, it can never be changed or undefined.

To define a constant you have to use define() function and to retrieve the value of a constant, you have to simply specifying its name. Unlike with variables, you do not need to have a constant with a $. You can also use the function constant() to read a constant's value if you wish to obtain the constant's name dynamically.

constant() function

As indicated by the name, this function will return the value of the constant.

This is useful when you want to retrieve value of a constant, but you do not know its name, i.e. It is stored in a variable or returned by a function.

constant() example

```
<?php
```

```
  define("MINSIZE", 50);


  echo MINSIZE;
  echo constant("MINSIZE"); // same thing as the previous line
?>
```

Only scalar data (boolean, integer, float and string) can be contained in constants.

Differences between constants and variables are

- There is no need to write a dollar sign ($) before a constant, where as in Variable one has to write a dollar sign.
- Constants cannot be defined by simple assignment, they may only be defined using the define() function.
- Constants may be defined and accessed anywhere without regard to variable scoping rules.
- Once the Constants have been set, may not be redefined or undefined.

Valid and invalid constant names

```
// Valid constant names
define("ONE",     "first thing");
define("TWO2",    "second thing");
define("THREE_3", "third thing");

// Invalid constant names
define("2TWO",    "second thing");
define("__THREE__", "third value");
```

PHP Magic constants

PHP provides a large number of predefined constants to any script which it runs.

There are five magical constants that change depending on where they are used. For example, the value of __LINE__ depends on the line that it's used on in your script. These special constants are case-insensitive and are as follows −

A few "magical" PHP constants ate given below −

Sr.No	Name & Description
1	**__LINE__** The current line number of the file.
2	**__FILE__** The full path and filename of the file. If used inside an include,the name of the included file is returned. Since PHP 4.0.2, **__FILE__** always contains an absolute path whereas in older versions it contained relative path under some circumstances.
3	**__FUNCTION__** The function name. (Added in PHP 4.3.0) As of PHP 5 this constant returns the function name as it was declared (case-sensitive). In PHP 4 its value is always lowercased.
4	**__CLASS__** The class name. (Added in PHP 4.3.0) As of PHP 5 this constant returns the class name as it was declared (case-sensitive). In PHP 4 its value is always lowercased.
5	**__METHOD__** The class method name. (Added in PHP 5.0.0) The method name is returned as it was declared (case-sensitive).

OPERATOR TYPES

What is Operator? Simple answer can be given using expression *4 + 5 is equal to 9*. Here 4 and 5 are called operands and + is called operator. PHP language supports following type of operators.

- Arithmetic Operators
- Comparison Operators
- Logical (or Relational) Operators
- Assignment Operators
- Conditional (or ternary) Operators

Lets have a look on all operators one by one.

Arithmetic Operators

There are following arithmetic operators supported by PHP language −

Assume variable A holds 10 and variable B holds 20 then −

Show Examples

Operator	Description	Example
+	Adds two operands	A + B will give 30
-	Subtracts second operand from the first	A - B will give -10
*	Multiply both operands	A * B will give 200
/	Divide numerator by de-numerator	B / A will give 2
%	Modulus Operator and remainder of after an integer division	B % A will give 0

++	Increment operator, increases integer value by one	A++ will give 11
--	Decrement operator, decreases integer value by one	A-- will give 9

Comparison Operators

There are following comparison operators supported by PHP language

Assume variable A holds 10 and variable B holds 20 then −

Show Examples

Operator	Description	Example
==	Checks if the value of two operands are equal or not, if yes then condition becomes true.	(A == B) is not true.
!=	Checks if the value 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.

Logical Operators

There are following logical operators supported by PHP language

Assume variable A holds 10 and variable B holds 20 then −

Show Examples

Operator	Description	Example
and	Called Logical AND operator. If both the operands are true then condition becomes true.	(A and B) is true.
or	Called Logical OR Operator. If any of the two operands are non zero then condition becomes true.	(A or B) is true.
&&	Called Logical AND operator. If both the operands are non zero then condition becomes true.	(A && B) is true.
||	Called Logical OR Operator. If any of the two operands are 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 false.

Assignment Operators

There are following assignment operators supported by PHP language −

Show Examples

Operator	Description	Example
=	Simple assignment operator, Assigns values from right side operands to left side operand	C = A + B will assign value of A + B into C
+=	Add AND assignment operator, It adds right operand to the left operand and assign the result to left operand	C += A is equivalent to C = C + A
-=	Subtract AND assignment operator, It subtracts right operand from the left operand and assign the result to left operand	C -= A is equivalent to C = C - A
*=	Multiply AND assignment operator, It multiplies right operand with the left operand and assign the result to left operand	C *= A is equivalent to C = C * A
/=	Divide AND assignment operator, It divides left operand with the right operand and assign the result to left operand	C /= A is equivalent to C = C / A
%=	Modulus AND assignment operator, It takes modulus using two operands and assign the result to left operand	C %= A is equivalent to C = C % A

Conditional Operator

There is one more operator called conditional operator. This first evaluates an expression for a true or false value and then execute one of the two given statements depending upon the result of the evaluation. The conditional operator has this syntax −

Show Examples

Operator	Description	Example
? :	Conditional Expression	If Condition is true ? Then value X : Otherwise value Y

Operators Categories

All the operators we have discussed above can be categorised into following categories −

- Unary prefix operators, which precede a single operand.
- Binary operators, which take two operands and perform a variety of arithmetic and logical operations.
- The conditional operator (a ternary operator), which takes three operands and evaluates either the second or third expression, depending on the evaluation of the first expression.
- Assignment operators, which assign a value to a variable.

Precedence of PHP Operators

Operator precedence determines the grouping of terms in an expression. This affects how an expression is evaluated. Certain operators have higher precedence than others; for example, the multiplication operator has higher precedence than the addition operator −

For example x = 7 + 3 * 2; Here x is assigned 13, not 20 because operator * has higher precedence than + so it first get multiplied with 3*2 and then adds into 7.

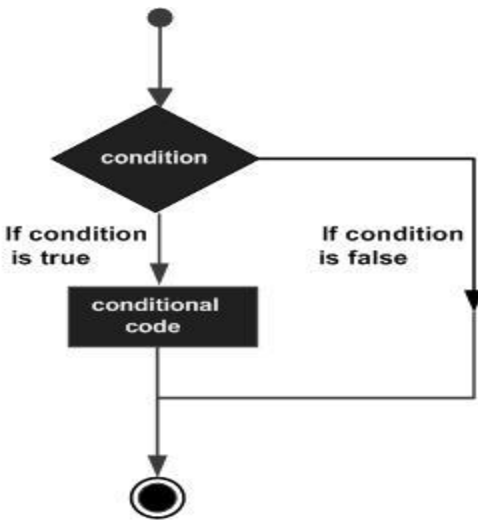
Here operators with the highest precedence appear at the top of the table, those with the lowest appear at the bottom. Within an expression, higher precedence operators will be evaluated first.

<table>
<tr><th>Category</th><th>Operator</th><th>Associativity</th></tr>
<tr><td>Unary</td><td>! ++ --</td><td>Right to left</td></tr>
<tr><td>Multiplicative</td><td>* / %</td><td>Left to right</td></tr>
<tr><td>Additive</td><td>+ -</td><td>Left to right</td></tr>
<tr><td>Relational</td><td>< <= > >=</td><td>Left to right</td></tr>
<tr><td>Equality</td><td>== !=</td><td>Left to right</td></tr>
<tr><td>Logical AND</td><td>&&</td><td>Left to right</td></tr>
<tr><td>Logical OR</td><td>||</td><td>Left to right</td></tr>
<tr><td>Conditional</td><td>?:</td><td>Right to left</td></tr>
<tr><td>Assignment</td><td>= += -= *= /= %=</td><td>Right to left</td></tr>
</table>

DECISION MAKING

The if, elseif ...else and switch statements are used to take decision based on the different condition.

You can use conditional statements in your code to make your decisions. PHP supports following three decision making statements −



- **if...else statement** − use this statement if you want to execute a set of code when a condition is true and another if the condition is not true
- **elseif statement** − is used with the if...else statement to execute a set of code if **one** of the several condition is true
- **switch statement** − is used if you want to select one of many blocks of code to be executed, use the Switch statement. The switch statement is used to avoid long blocks of if..elseif..else code.

The If...Else Statement

If you want to execute some code if a condition is true and another code if a condition is false, use the if....else statement.

Syntax

```
if (condition)
   code to be executed if condition is true;
else
   code to be executed if condition is false;
```

Example

The following example will output "Have a nice weekend!" if the current day is Friday, Otherwise, it will output "Have a nice day!":

```
<html>
  <body>

    <?php
      $d = date("D");

      if ($d == "Fri")
        echo "Have a nice weekend!";

      else
        echo "Have a nice day!";
    ?>

  </body>
</html>
```

It will produce the following result −

```
Have a nice day!
```

The ElseIf Statement

If you want to execute some code if one of the several conditions are true use the elseif statement

Syntax

```
if (condition)
  code to be executed if condition is true;
elseif (condition)
  code to be executed if condition is true;
else
  code to be executed if condition is false;
```

Example

The following example will output "Have a nice weekend!" if the current day is Friday, and "Have a nice Sunday!" if the current day is Sunday. Otherwise, it will output "Have a nice day!" −

```
<html>
  <body>

    <?php
      $d = date("D");

      if ($d == "Fri")
        echo "Have a nice weekend!";

      elseif ($d == "Sun")
        echo "Have a nice Sunday!";

      else
        echo "Have a nice day!";
    ?>

  </body>
</html>
```

It will produce the following result −

```
Have a nice day!
```

The Switch Statement

If you want to select one of many blocks of code to be executed, use the Switch statement.

The switch statement is used to avoid long blocks of if..elseif..else code.

Syntax

```
switch (expression){
  case label1:
    code to be executed if expression = label1;
    break;

  case label2:
    code to be executed if expression = label2;
    break;
    default:

  code to be executed
  if expression is different
  from both label1 and label2;
}
```

Example

The *switch* statement works in an unusual way. First it evaluates given expression then seeks a lable to match the resulting value. If a matching value is found then the code associated with the matching label will be executed or if none of the lable matches then statement will execute any specified default code.

```
<html>
  <body>


    <?php
      $d = date("D");


      switch ($d){
        case "Mon":
          echo "Today is Monday";
          break;
```

```
        case "Tue":
          echo "Today is Tuesday";
          break;

        case "Wed":
          echo "Today is Wednesday";
          break;
                case "Thu":
          echo "Today is Thursday";
          break;
                case "Fri":
          echo "Today is Friday";
          break;
                case "Sat":
          echo "Today is Saturday";
          break;

        case "Sun":
          echo "Today is Sunday";
          break;

        default:
          echo "Wonder which day is this ?";
      }
    ?>
      </body>
</html>
```

It will produce the following result –

```
Today is Monday
```

LOOP TYPES

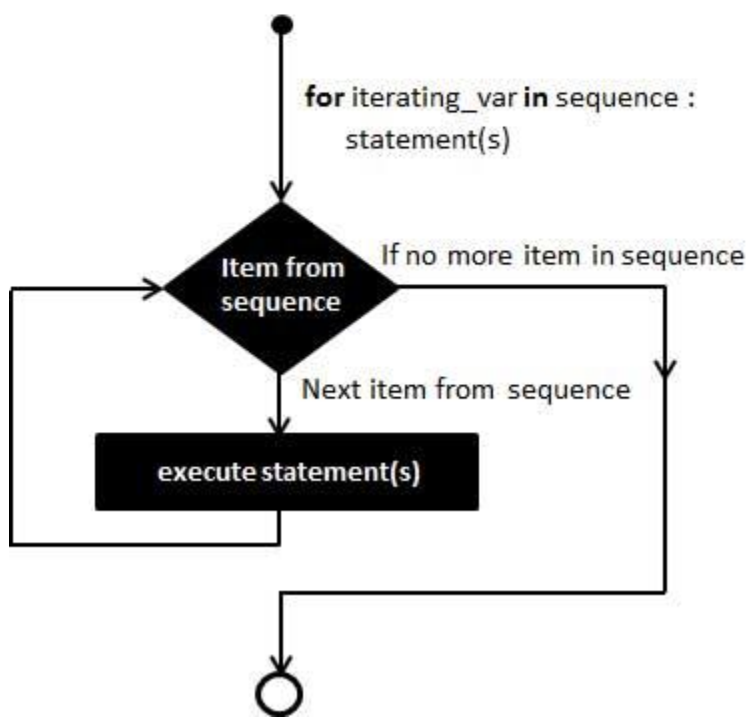
Loops in PHP are used to execute the same block of code a specified number of times. PHP supports following four loop types.

- **for** − loops through a block of code a specified number of times.
- **while** − loops through a block of code if and as long as a specified condition is true.
- **do...while** − loops through a block of code once, and then repeats the loop as long as a special condition is true.
- **foreach** − loops through a block of code for each element in an array.

We will discuss about **continue** and **break** keywords used to control the loops execution.

The for loop statement

The for statement is used when you know how many times you want to execute a statement or a block of statements.



Syntax

```
for (initialization; condition; increment){
  code to be executed;
}
```

The initializer is used to set the start value for the counter of the number of loop iterations. A variable may be declared here for this purpose and it is traditional to name it $i.

Example

The following example makes five iterations and changes the assigned value of two variables on each pass of the loop −

```
<html>
  <body>

    <?php
      $a = 0;
      $b = 0;

      for( $i = 0; $i<5; $i++ ) {
        $a += 10;
        $b += 5;
      }

      echo ("At the end of the loop a = $a and b = $b" );
    ?>

  </body>
</html>
```

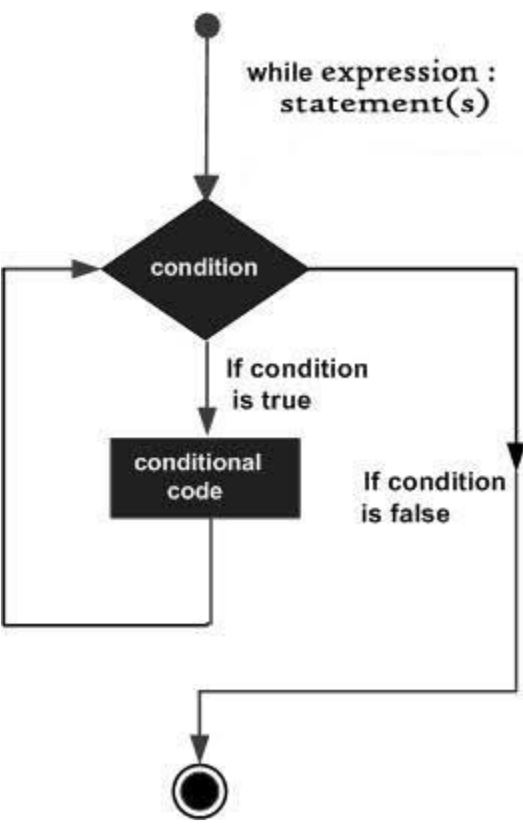
This will produce the following result −

```
At the end of the loop a = 50 and b = 25
```

The while loop statement

The while statement will execute a block of code if and as long as a test expression is true.

If the test expression is true then the code block will be executed. After the code has executed the test expression will again be evaluated and the loop will continue until the test expression is found to be false.



Syntax

```
while (condition) {
  code to be executed;
}
```

Example

This example decrements a variable value on each iteration of the loop and the counter increments until it reaches 10 when the evaluation is false and the loop ends.

```
<html>
  <body>


    <?php
```

```
        $i = 0;
        $num = 50;

        while( $i < 10) {
          $num--;
          $i++;
        }

        echo ("Loop stopped at i = $i and num = $num" );
      ?>

   </body>
</html>
```

This will produce the following result −

```
Loop stopped at i = 10 and num = 40
```

The do...while loop statement

The do...while statement will execute a block of code at least once - it then will repeat the loop as long as a condition is true.

Syntax

```
do {
  code to be executed;
}
while (condition);
```

Example

The following example will increment the value of i at least once, and it will continue incrementing the variable i as long as it has a value of less than 10 −

```
<html>
   <body>
```

```
    <?php
      $i = 0;
      $num = 0;

      do {
        $i++;
      }

      while( $i < 10 );
      echo ("Loop stopped at i = $i" );
    ?>

  </body>
</html>
```

This will produce the following result −

```
Loop stopped at i = 10
```

The foreach loop statement

The foreach statement is used to loop through arrays. For each pass the value of the current array element is assigned to $value and the array pointer is moved by one and in the next pass next element will be processed.

Syntax

```
foreach (array as value) {
  code to be executed;
}
```

Example

Try out following example to list out the values of an array.

```
<html>
  <body>
```

```
    <?php
      $array = array( 1, 2, 3, 4, 5);

      foreach( $array as $value ) {
         echo "Value is $value <br />";
      }
    ?>

  </body>
</html>
```

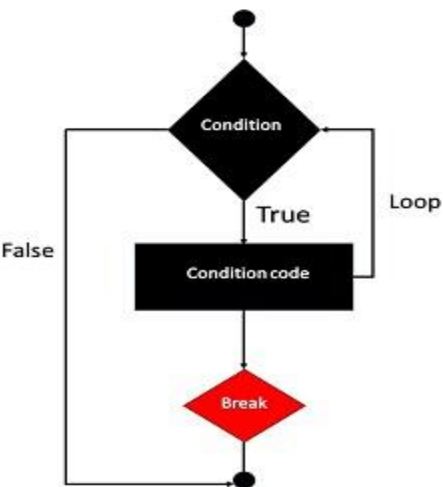
This will produce the following result −

```
Value is 1
Value is 2
Value is 3
Value is 4
Value is 5
```

The break statement

The PHP **break** keyword is used to terminate the execution of a loop prematurely.

The **break** statement is situated inside the statement block. If gives you full control and whenever you want to exit from the loop you can come out. After coming out of a loop immediate statement to the loop will be executed.



Example

In the following example condition test becomes true when the counter value reaches 3 and loop terminates.

```
<html>
  <body>

    <?php
      $i = 0;

      while( $i < 10) {
        $i++;
        if( $i == 3 )break;
      }
      echo ("Loop stopped at i = $i" );
    ?>

  </body>
</html>
```

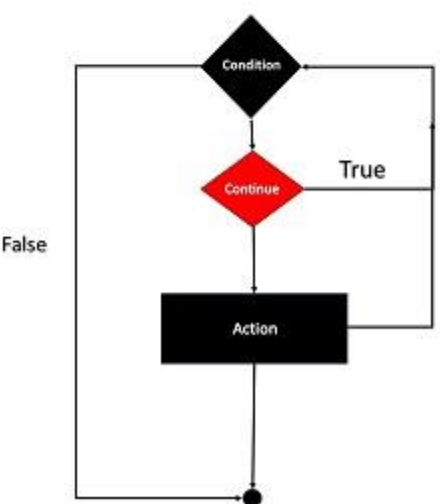
This will produce the following result −

```
Loop stopped at i = 3
```

The continue statement

The PHP **continue** keyword is used to halt the current iteration of a loop but it does not terminate the loop.

Just like the **break** statement the **continue** statement is situated inside the statement block containing the code that the loop executes, preceded by a conditional test. For the pass encountering **continue** statement, rest of the loop code is skipped and next pass starts.



Example

In the following example loop prints the value of array but for which condition becomes true it just skip the code and next value is printed.

```
<html>
  <body>

    <?php
      $array = array( 1, 2, 3, 4, 5);

      foreach( $array as $value ) {
        if( $value == 3 )continue;
        echo "Value is $value <br />";
      }
    ?>
    </body>
</html>
```

This will produce the following result −

```
Value is 1
Value is 2
Value is 4
Value is 5
```

Functions

PHP functions are similar to other programming languages. A function is a piece of code which takes one more input in the form of parameter and does some processing and returns a value.

There are two parts which should be clear to you −

- Creating a PHP Function
- Calling a PHP Function

In fact you hardly need to create your own PHP function because there are already more than 1000 of built-in library functions created for different area and you just need to call them according to your requirement.

Please refer to PHP Function Reference for a complete set of useful functions.

Creating PHP Function

Its very easy to create your own PHP function. Suppose you want to create a PHP function which will simply write a simple message on your browser when you will call it. Following example creates a function called writeMessage() and then calls it just after creating it.

Note that while creating a function its name should start with keyword **function** and all the PHP code should be put inside { and } braces as shown in the following example below −

```
<html>


  <head>
    <title>Writing PHP Function</title>
  </head>
    <body>
        <?php
      /* Defining a PHP Function */
      function writeMessage() {
        echo "You are really a nice person, Have a nice time!";
      }
```

```
      /* Calling a PHP Function */
      writeMessage();
    ?>

  </body>
</html>
```

This will display following result –

```
You are really a nice person, Have a nice time!
```

PHP Functions with Parameters

PHP gives you option to pass your parameters inside a function. You can pass as many as parameters your like. These parameters work like variables inside your function. Following example takes two integer parameters and add them together and then print them.

```
<html>
    <head>
    <title>Writing PHP Function with Parameters</title>
  </head>
    <body>
      <?php
      function addFunction($num1, $num2) {
        $sum = $num1 + $num2;
        echo "Sum of the two numbers is : $sum";
      }
            addFunction(10, 20);
    ?>
      </body>
</html>
```

This will display following result –

```
Sum of the two numbers is : 30
```

Passing Arguments by Reference

It is possible to pass arguments to functions by reference. This means that a reference to the variable is manipulated by the function rather than a copy of the variable's value.

Any changes made to an argument in these cases will change the value of the original variable. You can pass an argument by reference by adding an ampersand to the variable name in either the function call or the function definition.

Following example depicts both the cases.

```
<html>

  <head>
    <title>Passing Argument by Reference</title>
  </head>

  <body>

    <?php
      function addFive($num) {
        $num += 5;
      }

      function addSix(&$num) {
        $num += 6;
      }

      $orignum = 10;
      addFive( $orignum );

      echo "Original Value is $orignum<br />";
```

```
      addSix( $orignum );
      echo "Original Value is $orignum<br />";
   ?>

  </body>
</html>
```

This will display following result −

```
Original Value is 10
Original Value is 16
```

PHP Functions returning value

A function can return a value using the **return** statement in conjunction with a value or object. return stops the execution of the function and sends the value back to the calling code.

You can return more than one value from a function using **return array(1,2,3,4)**.

Following example takes two integer parameters and add them together and then returns their sum to the calling program. Note that **return** keyword is used to return a value from a function.

```
<html>

  <head>
    <title>Writing PHP Function which returns value</title>
  </head>

  <body>

    <?php
      function addFunction($num1, $num2) {
        $sum = $num1 + $num2;
        return $sum;
      }
```

```
        $return_value = addFunction(10, 20);


        echo "Returned value from the function : $return_value";
      ?>
        </body>
</html>
```

This will display following result −

```
Returned value from the function : 30
```

Setting Default Values for Function Parameters

You can set a parameter to have a default value if the function's caller doesn't pass it.

Following function prints NULL in case use does not pass any value to this function.

```
<html>
      <head>
      <title>Writing PHP Function which returns value</title>
   </head>
      <body>
         <?php
        function printMe($param = NULL) {
           print $param;
        }
        printMe("This is test");
        printMe();
      ?>
        </body>
</html>
```

This will produce following result −

```
This is test
```

Dynamic Function Calls

It is possible to assign function names as strings to variables and then treat these variables exactly as you would the function name itself. Following example depicts this behaviour.

```
<html>

  <head>
    <title>Dynamic Function Calls</title>
  </head>

  <body>

    <?php
      function sayHello() {
        echo "Hello<br />";
      }

      $function_holder = "sayHello";
      $function_holder();
    ?>
      </body>
</html>
```

This will display following result −

```
Hello
```

Arrays

An array is a data structure that stores one or more similar type of values in a single value. For example if you want to store 100 numbers then instead of defining 100 variables its easy to define an array of 100 length.

There are three different kind of arrays and each array value is accessed using an ID c which is called array index.

- **Numeric array** − An array with a numeric index. Values are stored and accessed in linear fashion.
- **Associative array** − An array with strings as index. This stores element values in association with key values rather than in a strict linear index order.
- **Multidimensional array** − An array containing one or more arrays and values are accessed using multiple indices

NOTE − Built-in array functions is given in function reference PHP Array Functions

Numeric Array

These arrays can store numbers, strings and any object but their index will be represented by numbers. By default array index starts from zero.

Example

Following is the example showing how to create and access numeric arrays.

Here we have used **array()** function to create array. This function is explained in function reference.

```
<html>
  <body>

    <?php
      /* First method to create array. */
      $numbers = array( 1, 2, 3, 4, 5);

      foreach( $numbers as $value ) {
```

```
         echo "Value is $value <br />";
       }
            /* Second method to create array. */
       $numbers[0] = "one";
       $numbers[1] = "two";
       $numbers[2] = "three";
       $numbers[3] = "four";
       $numbers[4] = "five";

       foreach( $numbers as $value ) {
         echo "Value is $value <br />";
       }
     ?>

  </body>
</html>
```

This will produce the following result −

```
Value is 1
Value is 2
Value is 3
Value is 4
Value is 5
Value is one
Value is two
Value is three
Value is four
Value is five
```

Associative Arrays

The associative arrays are very similar to numeric arrays in term of functionality but they are different in terms of their index. Associative array will have their index as string so that you can establish a strong association between key and values.

To store the salaries of employees in an array, a numerically indexed array would not be the best choice. Instead, we could use the employees names as the keys in our associative array, and the value would be their respective salary.

NOTE − Don't keep associative array inside double quote while printing otherwise it would not return any value.

Example

```
<html>
  <body>


    <?php
      /* First method to associate create array. */
      $salaries = array("mohammad" => 2000, "qadir" => 1000, "zara" => 500);

      echo "Salary of mohammad is ". $salaries['mohammad'] . "<br />";
      echo "Salary of qadir is ".  $salaries['qadir']. "<br />";
      echo "Salary of zara is ".  $salaries['zara']. "<br />";

      /* Second method to create array. */
      $salaries['mohammad'] = "high";
      $salaries['qadir'] = "medium";
      $salaries['zara'] = "low";

      echo "Salary of mohammad is ". $salaries['mohammad'] . "<br />";
      echo "Salary of qadir is ".  $salaries['qadir']. "<br />";
      echo "Salary of zara is ".  $salaries['zara']. "<br />";
    ?>


  </body>
</html>
```

This will produce the following result −

```
Salary of mohammad is 2000
Salary of qadir is 1000
Salary of zara is 500
Salary of mohammad is high
Salary of qadir is medium
Salary of zara is low
```

Multidimensional Arrays

A multi-dimensional array each element in the main array can also be an array. And each element in the sub-array can be an array, and so on. Values in the multi-dimensional array are accessed using multiple index.

Example

In this example we create a two dimensional array to store marks of three students in three subjects −

This example is an associative array, you can create numeric array in the same fashion.

```
<html>
  <body>
        <?php
      $marks = array(
        "mohammad" => array (
          "physics" => 35,
          "maths" => 30,
          "chemistry" => 39
        ),

        "qadir" => array (
          "physics" => 30,
          "maths" => 32,
          "chemistry" => 29
        ),
```

```
        "zara" => array (
          "physics" => 31,
          "maths" => 22,
          "chemistry" => 39
        )
      );
            /* Accessing multi-dimensional array values */
      echo "Marks for mohammad in physics : " ;
      echo $marks['mohammad']['physics'] . "<br />";

      echo "Marks for qadir in maths : ";
      echo $marks['qadir']['maths'] . "<br />";

      echo "Marks for zara in chemistry : " ;
      echo $marks['zara']['chemistry'] . "<br />";
    ?>

  </body>
</html>
```

This will produce the following result −

```
Marks for mohammad in physics : 35
Marks for qadir in maths : 32
Marks for zara in chemistry : 39
```

Strings

They are sequences of characters, like "PHP supports string operations".

NOTE − Built-in string functions is given in function reference PHP String Functions

Following are valid examples of string

```
$string_1 = "This is a string in double quotes";
$string_2 = "This is a somewhat longer, singly quoted string";
```

```
$string_39 = "This string has thirty-nine characters";
$string_0 = ""; // a string with zero characters
```

Singly quoted strings are treated almost literally, whereas doubly quoted strings replace variables with their values as well as specially interpreting certain character sequences.

```
<?php
  $variable = "name";
  $literally = 'My $variable will not print!\\n';

  print($literally);
  print "<br />";

  $literally = "My $variable will print!\\n";

  print($literally);
?>
```

This will produce the following result −

```
My $variable will not print!\n
My name will print
```

There are no artificial limits on string length - within the bounds of available memory, you ought to be able to make arbitrarily long strings.

Strings that are delimited by double quotes (as in "this") are preprocessed in both the following two ways by PHP −

- Certain character sequences beginning with backslash (\) are replaced with special characters
- Variable names (starting with $) are replaced with string representations of their values.

The escape-sequence replacements are −

- \n is replaced by the newline character
- \r is replaced by the carriage-return character

- \t is replaced by the tab character
- \$ is replaced by the dollar sign itself ($)
- \" is replaced by a single double-quote (")
- \\ is replaced by a single backslash (\)

String Concatenation Operator

To concatenate two string variables together, use the dot (.) operator −

```
<?php
  $string1="Hello World";
  $string2="1234";

  echo $string1 . " " . $string2;
?>
```

This will produce the following result −

```
Hello World 1234
```

If we look at the code above you see that we used the concatenation operator two times. This is because we had to insert a third string.

Between the two string variables we added a string with a single character, an empty space, to separate the two variables.

Using the strlen() function

The strlen() function is used to find the length of a string.

Let's find the length of our string "Hello world!":

```
<?php
  echo strlen("Hello world!");
?>
```

This will produce the following result −

```
12
```

The length of a string is often used in loops or other functions, when it is important to know when the string ends. (i.e. in a loop, we would want to stop the loop after the last character in the string)

Using the strpos() function

The strpos() function is used to search for a string or character within a string.

If a match is found in the string, this function will return the position of the first match. If no match is found, it will return FALSE.

Let's see if we can find the string "world" in our string −

```
<?php
  echo strpos("Hello world!","world");
?>
```

This will produce the following result −

```
6
```

As you see the position of the string "world" in our string is position 6. The reason that it is 6, and not 7, is that the first position in the string is 0, and not 1.

Regular Expressions

Regular expressions are nothing more than a sequence or pattern of characters itself. They provide the foundation for pattern-matching functionality.

Using regular expression you can search a particular string inside a another string, you can replace one string by another string and you can split a string into many chunks.

PHP offers functions specific to two sets of regular expression functions, each corresponding to a certain type of regular expression. You can use any of them based on your comfort.

- POSIX Regular Expressions
- PERL Style Regular Expressions

POSIX Regular Expressions

The structure of a POSIX regular expression is not dissimilar to that of a typical arithmetic expression: various elements (operators) are combined to form more complex expressions.

The simplest regular expression is one that matches a single character, such as g, inside strings such as g, haggle, or bag.

Lets give explanation for few concepts being used in POSIX regular expression. After that we will introduce you with regular expression related functions.

Brackets

Brackets ([]) have a special meaning when used in the context of regular expressions. They are used to find a range of characters.

Sr.No	Expression & Description
1	**[0-9]** It matches any decimal digit from 0 through 9.
2	**[a-z]** It matches any character from lower-case a through lowercase z.
3	**[A-Z]** It matches any character from uppercase A through uppercase Z.
4	**[a-Z]** It matches any character from lowercase a through uppercase Z.

The ranges shown above are general; you could also use the range [0-3] to match any decimal digit ranging from 0 through 3, or the range [b-v] to match any lowercase character ranging from b through v.

Quantifiers

The frequency or position of bracketed character sequences and single characters can be denoted by a special character. Each special character having a specific connotation. The +, *, ?, {int. range}, and $ flags all follow a character sequence.

Sr.No	Expression & Description
1	**p+** It matches any string containing at least one p.
2	**p*** It matches any string containing zero or more p's.
3	**p?** It matches any string containing zero or more p's. This is just an alternative way to use p*.
4	**p{N}** It matches any string containing a sequence of **N** p's
5	**p{2,3}** It matches any string containing a sequence of two or three p's.
6	**p{2, }** It matches any string containing a sequence of at least two p's.
7	**p$** It matches any string with p at the end of it.
8	**^p** It matches any string with p at the beginning of it.

Examples

Following examples will clear your concepts about matching characters.

Sr.No	Expression & Description
1	**[^a-zA-Z]** It matches any string not containing any of the characters ranging from a through z and A through Z.
2	**p.p -**It matches any string containing p, followed by any character, in turn followed by another p.
3	**^.{2}$ -**It matches any string containing exactly two characters.
4	**(.*) -**It matches any string enclosed within and .
5	**p(hp)*** It matches any string containing a p followed by zero or more instances of the sequence php.

Predefined Character Ranges

For your programming convenience several predefined character ranges, also known as character classes, are available. Character classes specify an entire range of characters, for example, the alphabet or an integer set −

Sr.No	Expression & Description
1	**[[:alpha:]]** It matches any string containing alphabetic characters aA through zZ.

2	**[[:digit:]]** It matches any string containing numerical digits 0 through 9.
3	**[[:alnum:]]** It matches any string containing alphanumeric characters aA through zZ and 0 through 9.
4	**[[:space:]]** It matches any string containing a space.

PHP's Regexp POSIX Functions

PHP currently offers seven functions for searching strings using POSIX-style regular expressions

Sr.No	Function & Description
1	**ereg()** The ereg() function searches a string specified by string for a string specified by pattern, returning true if the pattern is found, and false otherwise.
2	**ereg_replace()** The ereg_replace() function searches for string specified by pattern and replaces pattern with replacement if found.
3	**eregi()** The eregi() function searches throughout a string specified by pattern for a string specified by string. The search is not case sensitive.
4	**eregi_replace()** The eregi_replace() function operates exactly like ereg_replace(), except that the search for pattern in string is not case sensitive.
5	**split()** The split() function will divide a string into various elements, the boundaries of each element based on the occurrence of pattern in string.
6	**spliti()** The spliti() function operates exactly in the same manner as its sibling split(), except that it is not case sensitive.

7	**sql_regcase()** The sql_regcase() function can be thought of as a utility function, converting each character in the input parameter string into a bracketed expression containing two characters.

PERL Style Regular Expressions

Perl-style regular expressions are similar to their POSIX counterparts. The POSIX syntax can be used almost interchangeably with the Perl-style regular expression functions. In fact, you can use any of the quantifiers introduced in the previous POSIX section. Lets give explanation for few concepts being used in PERL regular expressions. After that we will introduce you wih regular expression related functions.

Meta characters

A meta character is simply an alphabetical character preceded by a backslash that acts to give the combination a special meaning.

For instance, you can search for large money sums using the '\d' meta character: **/([\d]+)000/**, Here **\d** will search for any string of numerical character.Following is the list of meta characters which can be used in PERL Style Regular Expressions.

Character	Description
.	a single character
\s	a whitespace character (space, tab, newline)
\S	non-whitespace character
\d	a digit (0-9)
\D	a non-digit
\w	a word character (a-z, A-Z, 0-9, _)
\W	a non-word character
[aeiou]	matches a single character in the given set
[^aeiou]	matches a single character outside the given set
(foo|bar|baz)	matches any of the alternatives specified

Modifiers

Several modifiers are available that can make your work with regexps much easier, like case sensitivity, searching in multiple lines etc.

Modifier	Description
i	Makes the match case insensitive
m	Specifies that if the string has newline or carriage return characters, the ^ and $ operators will now match against a newline boundary, instead of a string boundary
o	Evaluates the expression only once
s	Allows use of . to match a newline character
x	Allows you to use white space in the expression for clarity
g	Globally finds all matches
cg	Allows a search to continue even after a global match fails

PHP's Regexp PERL Compatible Functions

PHP offers following functions for searching strings using Perl-compatible regular expressions −

Sr.No	Function & Description
1	**preg_match()** This function searches string for pattern, returning true if pattern exists, and false otherwise.
2	**preg_match_all()** The preg_match_all() function matches all occurrences of pattern in string.
3	**preg_replace()** The preg_replace() function operates just like ereg_replace(), except that regular expressions can be used in the pattern and replacement input parameters.
4	**preg_split()** The preg_split() function operates exactly like split(), except that regular expressions are accepted as input parameters for pattern.
5	**preg_grep()** The preg_grep() function searches all elements of input_array, returning all elements matching the regexp pattern.
6	**preg_ quote()** Quote regular expression characters

Object Oriented Programming in PHP

We can imagine our universe made of different objects like sun, earth, moon etc. Similarly we can imagine our car made of different objects like wheel, steering, gear etc. Same way there is object oriented programming concepts which assume everything as an object and implement a software using different objects.

Object Oriented Concepts

Before we go in detail, lets define important terms related to Object Oriented Programming.

- **Class** − This is a programmer-defined data type, which includes local functions as well as local data. You can think of a class as a template for making many instances of the same kind (or class) of object.
- **Object** − An individual instance of the data structure defined by a class. You define a class once and then make many objects that belong to it. Objects are also known as instance.
- **Member Variable** − These are the variables defined inside a class. This data will be invisible to the outside of the class and can be accessed via member functions. These variables are called attribute of the object once an object is created.
- **Member function** − These are the function defined inside a class and are used to access object data.
- **Inheritance** − When a class is defined by inheriting existing function of a parent class then it is called inheritance. Here child class will inherit all or few member functions and variables of a parent class.
- **Parent class** − A class that is inherited from by another class. This is also called a base class or super class.
- **Child Class** − A class that inherits from another class. This is also called a subclass or derived class.
- **Polymorphism** − This is an object oriented concept where same function can be used for different purposes. For example function name will remain same but it make take different number of arguments and can do different task.

- **Overloading** − a type of polymorphism in which some or all of operators have different implementations depending on the types of their arguments. Similarly functions can also be overloaded with different implementation.

- **Data Abstraction** − Any representation of data in which the implementation details are hidden (abstracted).

- **Encapsulation** − refers to a concept where we encapsulate all the data and member functions together to form an object.

- **Constructor** − refers to a special type of function which will be called automatically whenever there is an object formation from a class.

- **Destructor** − refers to a special type of function which will be called automatically whenever an object is deleted or goes out of scope.

Defining PHP Classes

The general form for defining a new class in PHP is as follows −

```
<?php
  class phpClass {
    var $var1;
    var $var2 = "constant string";

    function myfunc ($arg1, $arg2) {
      [..]
    }
    [..]
  }
?>
```

Here is the description of each line −

- The special form **class**, followed by the name of the class that you want to define.

- A set of braces enclosing any number of variable declarations and function definitions.

- Variable declarations start with the special form **var**, which is followed by a conventional $ variable name; they may also have an initial assignment to a constant value.

- Function definitions look much like standalone PHP functions but are local to the class and will be used to set and access object data.

Example

Here is an example which defines a class of Books type −

```
<?php
  class Books {
    /* Member variables */
    var $price;
    var $title;
        /* Member functions */
    function setPrice($par){
      $this->price = $par;
    }
        function getPrice(){
      echo $this->price ."<br/>";
    }
        function setTitle($par){
      $this->title = $par;
    }
        function getTitle(){
      echo $this->title ." <br/>";
    }
  }
?>
```

The variable **$this** is a special variable and it refers to the same object ie. itself.

Creating Objects in PHP

Once you defined your class, then you can create as many objects as you like of that class type. Following is an example of how to create object using **new** operator.

```
$physics = new Books;
$maths = new Books;
$chemistry = new Books;
```

Here we have created three objects and these objects are independent of each other and they will have their existence separately. Next we will see how to access member function and process member variables.

Calling Member Functions

After creating your objects, you will be able to call member functions related to that object. One member function will be able to process member variable of related object only.

Following example shows how to set title and prices for the three books by calling member functions.

```
$physics->setTitle( "Physics for High School" );
$chemistry->setTitle( "Advanced Chemistry" );
$maths->setTitle( "Algebra" );

$physics->setPrice( 10 );
$chemistry->setPrice( 15 );
$maths->setPrice( 7 );
```

Now you call another member functions to get the values set by in above example −

```
$physics->getTitle();
$chemistry->getTitle();
$maths->getTitle();
$physics->getPrice();
$chemistry->getPrice();
$maths->getPrice();
```

This will produce the following result −

```
Physics for High School
Advanced Chemistry
Algebra
10
15
7
```

Constructor Functions

Constructor Functions are special type of functions which are called automatically whenever an object is created. So we take full advantage of this behaviour, by initializing many things through constructor functions.

PHP provides a special function called **__construct()** to define a constructor. You can pass as many as arguments you like into the constructor function.

Following example will create one constructor for Books class and it will initialize price and title for the book at the time of object creation.

```
function __construct( $par1, $par2 ) {
  $this->title = $par1;
  $this->price = $par2;
}
```

Now we don't need to call set function separately to set price and title. We can initialize these two member variables at the time of object creation only. Check following example below −

```
$physics = new Books( "Physics for High School", 10 );

$maths = new Books ( "Advanced Chemistry", 15 );

$chemistry = new Books ("Algebra", 7 );


/* Get those set values */

$physics->getTitle();

$chemistry->getTitle();

$maths->getTitle();


$physics->getPrice();

$chemistry->getPrice();

$maths->getPrice();
```

This will produce the following result −

```
Physics for High School
Advanced Chemistry
Algebra
10
15
7
```

Destructor

Like a constructor function you can define a destructor function using function **__destruct()**. You can release all the resources with-in a destructor.

Inheritance

PHP class definitions can optionally inherit from a parent class definition by using the extends clause. The syntax is as follows −

```
class Child extends Parent {
  <definition body>
}
```

The effect of inheritance is that the child class (or subclass or derived class) has the following characteristics −

- Automatically has all the member variable declarations of the parent class.
- Automatically has all the same member functions as the parent, which (by default) will work the same way as those functions do in the parent.

Following example inherit Books class and adds more functionality based on the requirement.

```
class Novel extends Books {
  var $publisher;

  function setPublisher($par){
    $this->publisher = $par;
  }

  function getPublisher(){
```

```
    echo $this->publisher. "<br />";
  }
}
```

Now apart from inherited functions, class Novel keeps two additional member functions.

Function Overriding

Function definitions in child classes override definitions with the same name in parent classes. In a child class, we can modify the definition of a function inherited from parent class.

In the following example getPrice and getTitle functions are overridden to return some values.

```
function getPrice() {
  echo $this->price . "<br/>";
  return $this->price;
}

function getTitle(){
  echo $this->title . "<br/>";
  return $this->title;
}
```

Public Members

Unless you specify otherwise, properties and methods of a class are public. That is to say, they may be accessed in three possible situations −

- From outside the class in which it is declared
- From within the class in which it is declared
- From within another class that implements the class in which it is declared

Till now we have seen all members as public members. If you wish to limit the accessibility of the members of a class then you define class members as **private** or **protected**.

Private members

By designating a member private, you limit its accessibility to the class in which it is declared. The private member cannot be referred to from classes that inherit the class in which it is declared and cannot be accessed from outside the class.

A class member can be made private by using **private** keyword infront of the member.

```
class MyClass {
  private $car = "skoda";
  $driver = "SRK";

  function __construct($par) {
    // Statements here run every time
    // an instance of the class
    // is created.
  }

  function myPublicFunction() {
    return("I'm visible!");
  }

  private function myPrivateFunction() {
    return("I'm  not visible outside!");
  }
}
```

When *MyClass* class is inherited by another class using extends, myPublicFunction() will be visible, as will $driver. The extending class will not have any awareness of or access to myPrivateFunction and $car, because they are declared private.

Protected members

A protected property or method is accessible in the class in which it is declared, as well as in classes that extend that class. Protected members are not available outside of those two kinds of

classes. A class member can be made protected by using **protected** keyword in front of the member.Here is different version of MyClass −

```
class MyClass {
  protected $car = "skoda";
  $driver = "SRK";
  function __construct($par) {
    // Statements here run every time
    // an instance of the class
    // is created.
  }
  function myPublicFunction() {
    return("I'm visible!");
  }
  protected function myPrivateFunction() {
    return("I'm  visible in child class!");
  }
}
```

Interfaces

Interfaces are defined to provide a common function names to the implementers. Different implementors can implement those interfaces according to their requirements. You can say, interfaces are skeletons which are implemented by developers.

As of PHP5, it is possible to define an interface, like this −

```
interface Mail {
  public function sendMail();
}
```

Then, if another class implemented that interface, like this −

```
class Report implements Mail {
  // sendMail() Definition goes here }
```

Constants

A constant is somewhat like a variable, in that it holds a value, but is really more like a function because a constant is immutable. Once you declare a constant, it does not change.

Declaring one constant is easy, as is done in this version of MyClass –

```
class MyClass {
  const requiredMargin = 1.7;

  function __construct($incomingValue) {
    // Statements here run every time
    // an instance of the class
    // is created.
  }
}
```

In this class, requiredMargin is a constant. It is declared with the keyword const, and under no circumstances can it be changed to anything other than 1.7. Note that the constant's name does not have a leading $, as variable names do.

Abstract Classes

An abstract class is one that cannot be instantiated, only inherited. You declare an abstract class with the keyword **abstract**, like this –

When inheriting from an abstract class, all methods marked abstract in the parent's class declaration must be defined by the child; additionally, these methods must be defined with the same visibility.

```
abstract class MyAbstractClass {
  abstract function myAbstractFunction() {
  }
}
```

Note that function definitions inside an abstract class must also be preceded by the keyword abstract. It is not legal to have abstract function definitions inside a non-abstract class.

Static Keyword

Declaring class members or methods as static makes them accessible without needing an instantiation of the class. A member declared as static can not be accessed with an instantiated class object (though a static method can).

Try out following example −

```
<?php
  class Foo {
    public static $my_static = 'foo';

    public function staticValue() {
      return self::$my_static;
    }
  }
          print Foo::$my_static . "\n";
  $foo = new Foo();

  print $foo->staticValue() . "\n";
?>
```

Final Keyword

PHP 5 introduces the final keyword, which prevents child classes from overriding a method by prefixing the definition with final. If the class itself is being defined final then it cannot be extended.

Following example results in Fatal error: Cannot override final method BaseClass::moreTesting()

```
<?php

  class BaseClass {
    public function test() {
      echo "BaseClass::test() called<br>";
    }
```

```
    final public function moreTesting() {
      echo "BaseClass::moreTesting() called<br>";
    }
  }

  class ChildClass extends BaseClass {
    public function moreTesting() {
      echo "ChildClass::moreTesting() called<br>";
    }
  }
?>
```

Calling parent constructors

Instead of writing an entirely new constructor for the subclass, let's write it by calling the parent's constructor explicitly and then doing whatever is necessary in addition for instantiation of the subclass. Here's a simple example −

```
class Name {
  var $_firstName;
  var $_lastName;

  function Name($first_name, $last_name) {
    $this->_firstName = $first_name;
    $this->_lastName = $last_name;
  }

  function toString() {
    return($this->_lastName .", " .$this->_firstName);
  }
}
class NameSub1 extends Name {
```

```
  var $_middleInitial;

  function NameSub1($first_name, $middle_initial, $last_name) {
    Name::Name($first_name, $last_name);
    $this->_middleInitial = $middle_initial;
  }

  function toString() {
    return(Name::toString() . " " . $this->_middleInitial);
  }
}
```

In this example, we have a parent class (Name), which has a two-argument constructor, and a subclass (NameSub1), which has a three-argument constructor. The constructor of NameSub1 functions by calling its parent constructor explicitly using the :: syntax (passing two of its arguments along) and then setting an additional field. Similarly, NameSub1 defines its non constructor toString() function in terms of the parent function that it overrides.

NOTE − A constructor can be defined with the same name as the name of a class. It is defined in above example.

File Handling

PHP readfile() Function

The readfile() function reads a file and writes it to the output buffer.

Assume we have a text file called "webdictionary.txt", stored on the server, that looks like this:

AJAX = Asynchronous JavaScript and XML
CSS = Cascading Style Sheets
HTML = Hyper Text Markup Language
PHP = PHP Hypertext Preprocessor
SQL = Structured Query Language
SVG = Scalable Vector Graphics
XML = EXtensible Markup Language

The PHP code to read the file and write it to the output buffer is as follows (the readfile() function returns the number of bytes read on success):

Example

```
<?php
echo readfile("webdictionary.txt");
?>
```

following functions related to files −

- Opening a file
- Reading a file
- Writing a file
- Closing a file

Opening and Closing Files

The PHP **fopen()** function is used to open a file. It requires two arguments stating first the file name and then mode in which to operate.

Files modes can be specified as one of the six options in this table.

Mode	Purpose
r	Opens the file for reading only.

	Places the file pointer at the beginning of the file.
r+	Opens the file for reading and writing. Places the file pointer at the beginning of the file.
w	Opens the file for writing only. Places the file pointer at the beginning of the file. and truncates the file to zero length. If files does not exist then it attempts to create a file.
w+	Opens the file for reading and writing only. Places the file pointer at the beginning of the file. and truncates the file to zero length. If files does not exist then it attempts to create a file.
a	Opens the file for writing only. Places the file pointer at the end of the file. If files does not exist then it attempts to create a file.
a+	Opens the file for reading and writing only. Places the file pointer at the end of the file. If files does not exist then it attempts to create a file.

If an attempt to open a file fails then **fopen** returns a value of **false** otherwise it returns a **file pointer** which is used for further reading or writing to that file.

After making a changes to the opened file it is important to close it with the **fclose()** function. The **fclose()** function requires a file pointer as its argument and then returns **true** when the closure succeeds or **false** if it fails.

Reading a file

Once a file is opened using **fopen()** function it can be read with a function called **fread()**. This function requires two arguments. These must be the file pointer and the length of the file expressed in bytes.

The files length can be found using the **filesize()** function which takes the file name as its argument and returns the size of the file expressed in bytes.

So here are the steps required to read a file with PHP.

- Open a file using **fopen()** function.
- Get the file's length using **filesize()** function.
- Read the file's content using **fread()** function.
- Close the file with **fclose()** function.

The following example assigns the content of a text file to a variable then displays those contents on the web page.

```
<html>

  <head>
    <title>Reading a file using PHP</title>
  </head>

  <body>

    <?php
      $filename = "tmp.txt";
      $file = fopen( $filename, "r" );
```

```
      if( $file == false ) {
         echo ( "Error in opening file" );
         exit();
      }

      $filesize = filesize( $filename );
      $filetext = fread( $file, $filesize );
      fclose( $file );

      echo ( "File size : $filesize bytes" );
      echo ( "<pre>$filetext</pre>" );
   ?>

  </body>
</html>
```

It will produce the following result −

```
File size : 278 bytes

The PHP Hypertext Preprocessor (PHP) is a programming
language that allows web developers to create dynamic
content that interacts with databases.
PHP is basically used for developing web based software
applications. This tutorial helps you to build your base
 with PHP.
```

Writing a file

A new file can be written or text can be appended to an existing file using the PHP **fwrite()** function. This function requires two arguments specifying a **file pointer** and the string of data that is to be written. Optionally a third integer argument can be included to specify the length of the data to write. If the third argument is included, writing would will stop after the specified length has been reached.

The following example creates a new text file then writes a short text heading inside it. After closing this file its existence is confirmed using **file_exist()** function which takes file name as an argument

```
<?php
  $filename = "/home/user/guest/newfile.txt";
  $file = fopen( $filename, "w" );

  if( $file == false ) {
    echo ( "Error in opening new file" );
    exit();
  }
  fwrite( $file, "This is  a simple test\n" );
  fclose( $file );
?>
<html>

  <head>
    <title>Writing a file using PHP</title>
  </head>

  <body>

    <?php
      $filename = "newfile.txt";
      $file = fopen( $filename, "r" );

      if( $file == false ) {
        echo ( "Error in opening file" );
        exit();
      }
```

```
        $filesize = filesize( $filename );
        $filetext = fread( $file, $filesize );

        fclose( $file );

        echo ( "File size : $filesize bytes" );
        echo ( "$filetext" );
        echo("file name: $filename");
      ?>
        </body>
</html>
```

It will produce the following result −

```
File size : 23 bytes
This is  a simple test
file name: newfile.txt
```

Sending Emails using PHP

PHP must be configured correctly in the **php.ini** file with the details of how your system sends email. Open php.ini file available in **/etc/** directory and find the section headed **[mail function]**.

Windows users should ensure that two directives are supplied. The first is called SMTP that defines your email server address. The second is called sendmail_from which defines your own email address.

The configuration for Windows should look something like this −

```
[mail function]
; For Win32 only.
SMTP = smtp.secureserver.net

; For win32 only
sendmail_from = webmaster@tutorialspoint.com
```

Linux users simply need to let PHP know the location of their **sendmail** application. The path and any desired switches should be specified to the sendmail_path directive.

The configuration for Linux should look something like this −

```
[mail function]
; For Win32 only.
SMTP =

; For win32 only
sendmail_from =

; For Unix only
sendmail_path = /usr/sbin/sendmail -t -i
```

Now you are ready to go −

Sending plain text email

PHP makes use of **mail()** function to send an email. This function requires three mandatory arguments that specify the recipient's email address, the subject of the the message and the actual message additionally there are other two optional parameters.

```
mail( to, subject, message, headers, parameters );
```

Here is the description for each parameters.

Sr.No	Parameter & Description
1	**to** Required. Specifies the receiver / receivers of the email
2	**subject** Required. Specifies the subject of the email. This parameter cannot contain any newline characters
3	**message**

	Required. Defines the message to be sent. Each line should be separated with a LF (\n). Lines should not exceed 70 characters
4	**headers** Optional. Specifies additional headers, like From, Cc, and Bcc. The additional headers should be separated with a CRLF (\r\n)
5	**parameters** Optional. Specifies an additional parameter to the send mail program

As soon as the mail function is called PHP will attempt to send the email then it will return true if successful or false if it is failed.

Multiple recipients can be specified as the first argument to the mail() function in a comma separated list.

Sending HTML email

When you send a text message using PHP then all the content will be treated as simple text. Even if you will include HTML tags in a text message, it will be displayed as simple text and HTML tags will not be formatted according to HTML syntax. But PHP provides option to send an HTML message as actual HTML message.

While sending an email message you can specify a Mime version, content type and character set to send an HTML email.

Example

Following example will send an HTML email message to xyz@somedomain.com copying it to afgh@somedomain.com. You can code this program in such a way that it should receive all content from the user and then it should send an email.

```
<html>


  <head>
    <title>Sending HTML email using PHP</title>
```

```
  </head>

  <body>

    <?php
      $to = "xyz@somedomain.com";
      $subject = "This is subject";

      $message = "<b>This is HTML message.</b>";
      $message .= "<h1>This is headline.</h1>";

      $header = "From:abc@somedomain.com \r\n";
      $header .= "Cc:afgh@somedomain.com \r\n";
      $header .= "MIME-Version: 1.0\r\n";
      $header .= "Content-type: text/html\r\n";

      $retval = mail ($to,$subject,$message,$header);

      if( $retval == true ) {
        echo "Message sent successfully...";
      }else {
        echo "Message could not be sent...";
      }
    ?>

  </body>
</html>
```

Sending attachments with email

To send an email with mixed content requires to set **Content-type** header to **multipart/mixed**. Then text and attachment sections can be specified within **boundaries**.

A boundary is started with two hyphens followed by a unique number which can not appear in the message part of the email. A PHP function **md5()** is used to create a 32 digit hexadecimal number to create unique number. A final boundary denoting the email's final section must also end with two hyphens.

```
<?php
  // request variables // important
  $from = $_REQUEST["from"];
  $emaila = $_REQUEST["emaila"];
  $filea = $_REQUEST["filea"];

  if ($filea) {
    function mail_attachment ($from , $to, $subject, $message, $attachment){
      $fileatt = $attachment; // Path to the file
      $fileatt_type = "application/octet-stream"; // File Type

      $start = strrpos($attachment, '/') == -1 ?
        strrpos($attachment, '//') : strrpos($attachment, '/')+1;

      $fileatt_name = substr($attachment, $start,
        strlen($attachment)); // Filename that will be used for the
        file as the attachment

      $email_from = $from; // Who the email is from
      $subject = "New Attachment Message";

      $email_subject =  $subject; // The Subject of the email
      $email_txt = $message; // Message that the email has in it
      $email_to = $to; // Who the email is to

      $headers = "From: ".$email_from;
```

```
$file = fopen($fileatt,'rb');
$data = fread($file,filesize($fileatt));
fclose($file);

$msg_txt="\n\n You have recieved a new attachment message from $from";
$semi_rand = md5(time());
$mime_boundary = "==Multipart_Boundary_x{$semi_rand}x";
$headers .= "\nMIME-Version: 1.0\n" . "Content-Type: multipart/mixed;\n" . "
  boundary=\"{$mime_boundary}\"";

$email_txt .= $msg_txt;

$email_message .= "This is a multi-part message in MIME format.\n\n" .
  "--{$mime_boundary}\n" . "Content-Type:text/html;
  charset = \"iso-8859-1\"\n" . "Content-Transfer-Encoding: 7bit\n\n" .
  $email_txt . "\n\n";

$data = chunk_split(base64_encode($data));

$email_message .= "--{$mime_boundary}\n" . "Content-Type: {$fileatt_type};\n" .
  " name = \"{$fileatt_name}\"\n" . //"Content-Disposition: attachment;\n" .
  //" filename = \"{$fileatt_name}\"\n" . "Content-Transfer-Encoding:
  base64\n\n" . $data . "\n\n" . "--{$mime_boundary}--\n";

$ok = mail($email_to, $email_subject, $email_message, $headers);

if($ok) {
  echo "File Sent Successfully.";
  unlink($attachment); // delete a file after attachment sent.
}else {
```

```
        die("Sorry but the email could not be sent. Please go back and try again!");
      }
    }
    move_uploaded_file($_FILES["filea"]["tmp_name"],
      'temp/'.basename($_FILES['filea']['name']));

    mail_attachment("$from", "youremailaddress@gmail.com",
      "subject", "message", ("temp/".$_FILES["filea"]["name"]));
  }
?>

<html>
  <head>

    <script language = "javascript" type = "text/javascript">
      function CheckData45() {
        with(document.filepost) {
          if(filea.value ! = "") {
            document.getElementById('one').innerText =
              "Attaching File ... Please Wait";
          }
        }
      }
    </script>

  </head>
  <body>

    <table width = "100%" height = "100%" border = "0"
      cellpadding = "0" cellspacing = "0">
```

```
<tr>
  <td align = "center">
    <form name = "filepost" method = "post"
      action = "file.php" enctype = "multipart/form-data" id = "file">

      <table width = "300" border = "0" cellspacing = "0"
        cellpadding = "0">

        <tr valign = "bottom">
          <td height = "20">Your Name:</td>
        </tr>

        <tr>
          <td><input name = "from" type = "text"
            id = "from" size = "30"></td>
        </tr>

        <tr valign = "bottom">
          <td height = "20">Your Email Address:</td>
        </tr>

        <tr>
          <td class = "frmtxt2"><input name = "emaila"
            type = "text" id = "emaila" size = "30"></td>
        </tr>

        <tr>
          <td height = "20" valign = "bottom">Attach File:</td>
        </tr>
```

```
            <tr valign = "bottom">
              <td valign = "bottom"><input name = "filea"
                type = "file" id = "filea" size = "16"></td>
            </tr>

            <tr>
              <td height = "40" valign = "middle"><input
                name = "Reset2" type = "reset" id = "Reset2" value = "Reset">
              <input name = "Submit2" type = "submit"
                value = "Submit" onClick = "return CheckData45()"></td>
            </tr>
          </table>
        </form>
                <center>
          <table width = "400">

            <tr>
              <td id = "one">
              </td>
            </tr>
          </table>
        </center>
                </td>
    </tr>
  </table>

 </body>
</html>
```

Error handling is the process of catching errors raised by your program and then taking appropriate action. If you would handle errors properly then it may lead to many unforeseen consequences.

Its very simple in PHP to handle an errors.

Using die() function

While writing your PHP program you should check all possible error condition before going ahead and take appropriate action when required.

Try following example without having **/tmp/test.xt** file and with this file.

```
<?php
  if(!file_exists("/tmp/test.txt")) {
     die("File not found");
  }else {
     $file = fopen("/tmp/test.txt","r");
     print "Opend file sucessfully";
  }
  // Test of the code here.
?>
```

This way you can write an efficient code. Using above technique you can stop your program whenever it errors out and display more meaningful and user friendly message.

Defining Custom Error Handling Function

You can write your own function to handling any error. PHP provides you a framework to define error handling function.

This function must be able to handle a minimum of two parameters (error level and error message) but can accept up to five parameters (optionally: file, line-number, and the error context) −

Syntax

```
error_function(error_level,error_message, error_file,error_line,error_context);
```

Sr.No	Parameter & Description
1	**error_level** Required - Specifies the error report level for the user-defined error. Must be a value number.
2	**error_message** Required - Specifies the error message for the user-defined error
3	**error_file :** Optional - Specifies the file name in which the error occurred
4	**error_line :**Optional - Specifies the line number in which the error occurred
5	**error_context :**Optional - Specifies an array containing every variable and their values in use when the error occurred

Possible Error levels

These error report levels are the different types of error the user-defined error handler can be used for. These values cab used in combination using | operator

Sr.No	Constant & Description	Value
1	**.E_ERROR** Fatal run-time errors. Execution of the script is halted	1
2	**E_WARNING** Non-fatal run-time errors. Execution of the script is not halted	2

3	**E_PARSE** Compile-time parse errors. Parse errors should only be generated by the parser.	4
4	**E_NOTICE** Run-time notices. The script found something that might be an error, but could also happen when running a script normally	8
5	**E_CORE_ERROR** Fatal errors that occur during PHP's initial start-up.	16
6	**E_CORE_WARNING** Non-fatal run-time errors. This occurs during PHP's initial start-up.	32
7	**E_USER_ERROR** Fatal user-generated error. This is like an E_ERROR set by the programmer using the PHP function trigger_error()	256
8	**E_USER_WARNING** Non-fatal user-generated warning. This is like an E_WARNING set by the programmer using the PHP function trigger_error()	512
9	**E_USER_NOTICE** User-generated notice. This is like an E_NOTICE set by the programmer using the PHP function trigger_error()	1024

10	**E_STRICT** Run-time notices. Enable to have PHP suggest changes to your code which will ensure the best interoperability and forward compatibility of your code.	2048
11	**E_RECOVERABLE_ERROR** Catchable fatal error. This is like an E_ERROR but can be caught by a user defined handle (see also set_error_handler())	4096
12	**E_ALL** All errors and warnings, except level E_STRICT (E_STRICT will be part of E_ALL as of PHP 6.0)	8191

All the above error level can be set using following PHP built-in library function where level cab be any of the value defined in above table.

```
int error_reporting ( [int $level] )
```

Following is the way you can create one error handling function −

```
<?php
  function handleError($errno, $errstr,$error_file,$error_line) {
    echo "<b>Error:</b> [$errno] $errstr - $error_file:$error_line";
    echo "<br />";
    echo "Terminating PHP Script";

    die();
  }
?>
```

Once you define your custom error handler you need to set it using PHP built-in library **set_error_handler** function. Now lets examine our example by calling a function which does not exist.

```
<?php
  error_reporting( E_ERROR );

  function handleError($errno, $errstr,$error_file,$error_line) {
    echo "<b>Error:</b> [$errno] $errstr - $error_file:$error_line";
    echo "<br />";
    echo "Terminating PHP Script";

    die();
  }

  //set error handler
  set_error_handler("handleError");

  //trigger error
  myFunction();
?>
```

Exceptions Handling

PHP 5 has an exception model similar to that of other programming languages. Exceptions are important and provides a better control over error handling.

Lets explain there new keyword related to exceptions.

- **Try** − A function using an exception should be in a "try" block. If the exception does not trigger, the code will continue as normal. However if the exception triggers, an exception is "thrown".
- **Throw** − This is how you trigger an exception. Each "throw" must have at least one "catch".
- **Catch** − A "catch" block retrieves an exception and creates an object containing the exception information.

When an exception is thrown, code following the statement will not be executed, and PHP will attempt to find the first matching catch block. If an exception is not caught, a PHP Fatal Error will be issued with an "Uncaught Exception ...

- An exception can be thrown, and caught ("catched") within PHP. Code may be surrounded in a try block.
- Each try must have at least one corresponding catch block. Multiple catch blocks can be used to catch different classes of exceptions.
- Exceptions can be thrown (or re-thrown) within a catch block.

Example

Following is the piece of code, copy and paste this code into a file and verify the result.

```
<?php
  try {
    $error = 'Always throw this error';
    throw new Exception($error);

    // Code following an exception is not executed.
    echo 'Never executed';
  }catch (Exception $e) {
    echo 'Caught exception: ',  $e->getMessage(), "\n";
  }

  // Continue execution
  echo 'Hello World';
?>
```

In the above example $e->getMessage function is used to get error message. There are following functions which can be used from **Exception** class.

- **getMessage()** − message of exception
- **getCode()** − code of exception

- **getFile()** − source filename
- **getLine()** − source line
- **getTrace()** − n array of the backtrace()
- **getTraceAsString()** − formated string of trace

Creating Custom Exception Handler

You can define your own custom exception handler. Use following function to set a user-defined exception handler function.

```
string set_exception_handler ( callback $exception_handler )
```

Here **exception_handler** is the name of the function to be called when an uncaught exception occurs. This function must be defined before calling set_exception_handler().

Example

```
<?php
  function exception_handler($exception) {
    echo "Uncaught exception: " , $exception->getMessage(), "\n";
  }

  set_exception_handler('exception_handler');
  throw new Exception('Uncaught Exception');

  echo "Not Executed\n";
?>
```

Create MySQL Database Using PHP

Creating a Database

To create and delete a database you should have admin privilege. Its very easy to create a new MySQL database. PHP uses **mysql_query** function to create a MySQL database. This function takes two parameters and returns TRUE on success or FALSE on failure.

Syntax

```
bool mysql_query( sql, connection );
```

Sr.No	Parameter & Description
1	**sql** Required - SQL query to create a database
2	**connection** Optional - if not specified then last opend connection by mysql_connect will be used.

Example

Try out following example to create a database −

```
<?php
  $dbhost = 'localhost:3036';
  $dbuser = 'root';
  $dbpass = 'rootpassword';
  $conn = mysql_connect($dbhost, $dbuser, $dbpass);

  if(! $conn ) {
     die('Could not connect: ' . mysql_error());
  }

  echo 'Connected successfully';
```

```
  $sql = 'CREATE Database test_db';
  $retval = mysql_query( $sql, $conn );

  if(! $retval ) {
     die('Could not create database: ' . mysql_error());
  }

  echo "Database test_db created successfully\n";
  mysql_close($conn);
?>
```

Selecting a Database

Once you establish a connection with a database server then it is required to select a particular database where your all the tables are associated.

This is required because there may be multiple databases residing on a single server and you can do work with a single database at a time.

PHP provides function **mysql_select_db** to select a database.It returns TRUE on success or FALSE on failure.

Syntax

```
bool mysql_select_db( db_name, connection );
```

Sr.No	Parameter & Description
1	**db_name :** Required - Database name to be selected
2	**Connection :**Optional - if not specified then last opend connection by mysql_connect will be used.

Example

Here is the example showing you how to select a database.

```
<?php
  $dbhost = 'localhost:3036';
  $dbuser = 'guest';
  $dbpass = 'guest123';
  $conn = mysql_connect($dbhost, $dbuser, $dbpass);

  if(! $conn ) {
    die('Could not connect: ' . mysql_error());
  }

  echo 'Connected successfully';

  mysql_select_db( 'test_db' );
  mysql_close($conn);

?>
```

Creating Database Tables

To create tables in the new database you need to do the same thing as creating the database. First create the SQL query to create the tables then execute the query using mysql_query() function.

Example

Try out following example to create a table −

```
<?php

  $dbhost = 'localhost:3036';
  $dbuser = 'root';
  $dbpass = 'rootpassword';
  $conn = mysql_connect($dbhost, $dbuser, $dbpass);
```

```
  if(! $conn ) {
    die('Could not connect: ' . mysql_error());
  }

  echo 'Connected successfully';

  $sql = 'CREATE TABLE employee( '.
    'emp_id INT NOT NULL AUTO_INCREMENT, '.
    'emp_name VARCHAR(20) NOT NULL, '.
    'emp_address  VARCHAR(20) NOT NULL, '.
    'emp_salary   INT NOT NULL, '.
    'join_date    timestamp(14) NOT NULL, '.
    'primary key ( emp_id ))';
  mysql_select_db('test_db');
  $retval = mysql_query( $sql, $conn );

  if(! $retval ) {
    die('Could not create table: ' . mysql_error());
  }

  echo "Table employee created successfully\n";

  mysql_close($conn);
?>
```

In case you need to create many tables then its better to create a text file first and put all the SQL commands in that text file and then load that file into $sql variable and excute those commands.

Consider the following content in sql_query.txt file

```
CREATE TABLE employee(
   emp_id INT NOT NULL AUTO_INCREMENT,
   emp_name VARCHAR(20) NOT NULL,
   emp_address  VARCHAR(20) NOT NULL,
   emp_salary   INT NOT NULL,
   join_date    timestamp(14) NOT NULL,
   primary key ( emp_id ));
<?php
   $dbhost = 'localhost:3036';
   $dbuser = 'root';
   $dbpass = 'rootpassword';
   $conn = mysql_connect($dbhost, $dbuser, $dbpass);

   if(! $conn ) {
      die('Could not connect: ' . mysql_error());
   }

   $query_file = 'sql_query.txt';

   $fp = fopen($query_file, 'r');
   $sql = fread($fp, filesize($query_file));
   fclose($fp);
      mysql_select_db('test_db');
   $retval = mysql_query( $sql, $conn );

   if(! $retval ) {
      die('Could not create table: ' . mysql_error());
   }
   echo "Table employee created successfully\n";
   mysql_close($conn);
?>
```

PHP AND LDAP

LDAP is the Lightweight Directory Access Protocol, and is a protocol used to access "Directory Servers". The Directory is a special kind of database that holds information in a tree structure.

The concept is similar to your hard disk directory structure, except that in this context, the root directory is "The world" and the first level subdirectories are "countries". Lower levels of the directory structure contain entries for companies, organisations or places, while yet lower still we find directory entries for people, and perhaps equipment or documents.

To refer to a file in a subdirectory on your hard disk, you might use something like:

```
/usr/local/myapp/docs
```

The forwards slash marks each division in the reference, and the sequence is read from left to right.

The equivalent to the fully qualified file reference in LDAP is the "distinguished name", referred to simply as "dn". An example dn might be:

```
cn=John Smith,ou=Accounts,o=My Company,c=US
```

The comma marks each division in the reference, and the sequence is read from right to left. You would read this dn as:

```
country = US
organization = My Company
organizationalUnit = Accounts
commonName = John Smith
```

In the same way as there are no hard rules about how you organise the directory structure of a hard disk, a directory server manager can set up any structure that is meaningful for the purpose. However, there are some conventions that are used. The message is that you can not write code to access a directory server unless you know something about its structure, any more than you can use a database without some knowledge of what is available.

PHP Security Function

What is a Security?

Security is a measure put in place that protects an application from accidental or deliberate attacks.

The attacks can;

- **Corrupt data**
- **Allow unauthorized users gain access to sensitive data**
- **Lead to loss of important data**
- **Posting of unauthorized transactions i.e. in an accounting system**

Websites and web applications are hosted on public servers that are accessible from the internet.

Potential security threats

They are basically two groups of people that can attack your system

- **Hackers –** with the intent to gain access to unauthorized data or disrupt the application
- **Users** – they may innocently enter wrong parameters in forms which can have negative effects on a website or web application.

The following are the kinds of attacks that we need to look out for.

- **SQL Injection – This type of attack appends harmful code to SQL statements. This is done using either user input forms or URLs that use variables.**

  The appended code comments the condition in the WHERE clause of an SQL statement. The appended code can also;

  - insert a condition that will always be true

- delete data from a table
- update data in a table
- This type of attack is usually used to gain unauthorized access to an application.
- Cross-site scripting – this type of attack inserts harmful code usually JavaScript. This is done using user input forms such as contact us and comments forms. This is done to;
  - Retrieve sensitive information such as cookies data
  - Redirect the user to a different URL.
  - Other threats can include – PHP code injection, Shell Injection, Email Injection, Script Source Code Disclosure etc.

PHP Application Security Best Practices

Let's now look at some of the PHP Security best practices that we must consider when developing our applications.

PHP strip_tags

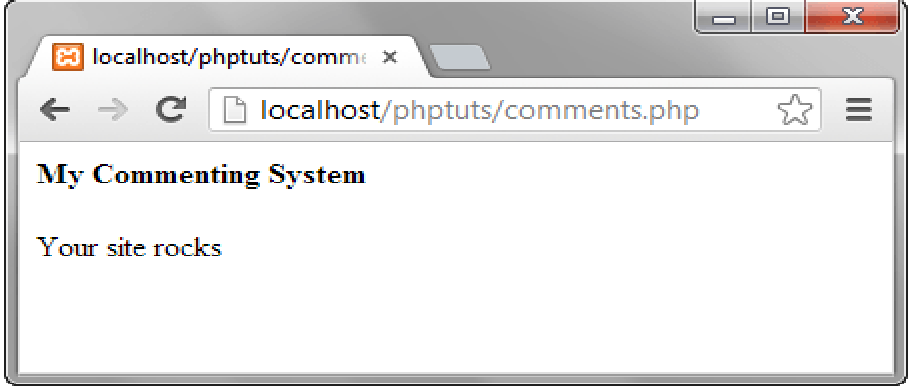
The strip_tags functions removes HTML, JavaScript or PHP tags from a string.

This function is useful when we have to protect our application against attacks such as cross site scripting.

Let's consider an application that accepts comments from users.

```
<?php

$user_input = "Your site rocks";

echo "<h4>My Commenting System</h4>";

echo $user_input;

?>
```

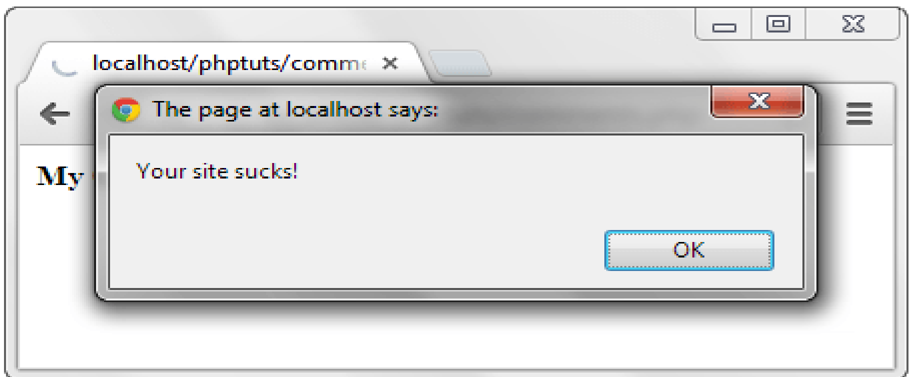
Assuming you have saved comments.php in the phptuts folder, browse to the URL**http://localhost/phptuts/comments.php**



Let's assume you receive the following as the user input <script>alert('Your site sucks!');</script>

```
<?php

$user_input = "<script>alert('Your site sucks!');</script>";

echo "<h4>My Commenting System</h4>";

echo $user_input;

?>
```

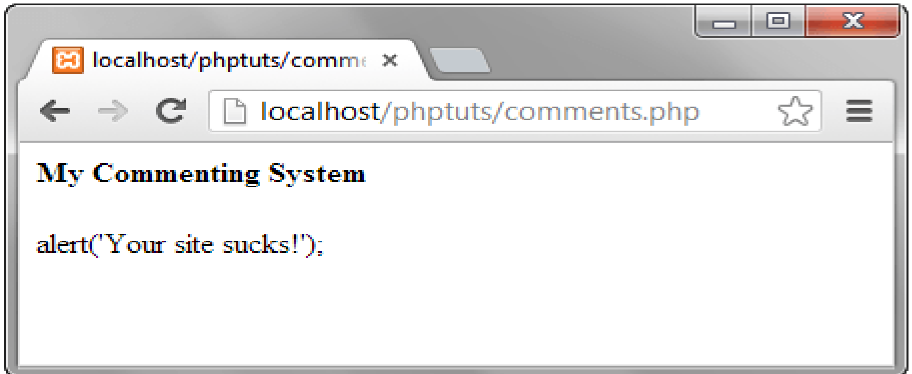
Browse to the URL **http://localhost/phptuts/comments.php**



Let's now secure our application from such attacks using strip_tags function.

```
<?php

$user_input = "<script>alert('Your site sucks!');</script>";

echo strip_tags($user_input);


?>
```

Browse to the URL **http://localhost/phptuts/comments.php**



PHP filter_var function

The filter_var function is used to validate and sanitize data.

Validation checks if the data is of the right type. A numeric validation check on a string returns a false result.

Sanitization is removing illegal characters from a string.

The code is for the commenting system.

It uses the filter_var function and FILTER_SANITIZE_STRIPPED constant to strip tags.

```
<?php

$user_input = "<script>alert('Your site sucks!');</script>";

echo filter_var($user_input, FILTER_SANITIZE_STRIPPED); ?>
```

Mysql_real_escape_string function This function is used to protect an application against SQL injection.

Let's suppose that we have the following SQL statement for validating the user id and password.

```
<?php

SELECT uid,pwd,role FROM users WHERE uid = 'admin' AND password = 'pass'; ?>
```

A malicious user can enter the following code in the user id text box. ' OR 1 = 1 -- And 1234 in the password text box Let's code the authentication module

```
<?php

$uid = "' OR 1 = 1 -- ";

$pwd = "1234";

$sql = "SELECT uid,pwd,role FROM users WHERE uid = '$uid' AND password = '$pwd';";
```

```
echo $sql;
?>
```

The end result will be

```
<?php
SELECT uid,pwd,role FROM users WHERE uid = '' OR 1 = 1 -- ' AND password = '1234';
?>
```

HERE,

- “SELECT * FROM users WHERE user_id = ''” tests for an empty user id
- “' OR 1 = 1 “ is a condition that will always be true
- “--" comments that part that tests for the password.

The above query will return all the users Let’s now use mysql_real_escape_string function to secure our login module.

```
<?php
$uid = mysql_real_escape_string("' OR 1 = 1 -- ");
$pwd = mysql_real_escape_string("1234");
$sql = "SELECT uid,pwd,role FROM users WHERE uid = '$uid' AND password = '$pwd';";
echo $sql;
?>
```

The above code will output

```
<?php
SELECT uid,pwd,role FROM users WHERE uid = '\' OR 1 = 1 -- ' AND password = '1234';
?>
```

Note the second single quote has been escaped for us, it will be treated as part of the user id and the password won’t be commented.

PHP Md5 and PHP sha1

Md5 is the acronym for Message Digest 5 and sha1 is the acronym for Secure Hash Algorithm 1.

They are both used to encrypt strings.

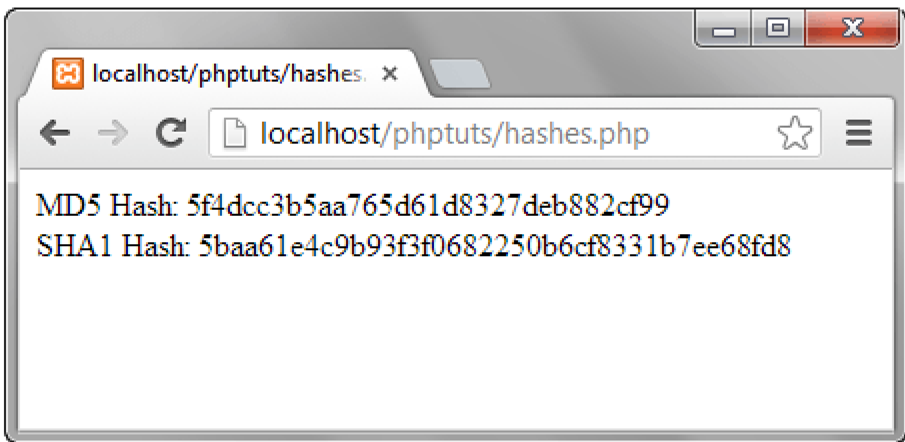
Once a string has been encrypted, it is tedious to decrypt it.

Md5 and sha1 are very useful when storing passwords in the database.

The code below shows the implementation of md5 and sha1

```
<?php
echo "MD5 Hash: " . md5("password");
echo "SHA1 Hash: " . sha1("password");
?>
```

Assuming you have saved the file hashes.php in phptuts folder, browse to the URL



As you can see from the above hashes, if an attacker gained access to your database, they still wouldn't know the passwords for them to login.

Summary

- Security refers to measures put in place to protect an application from accidental and malicious attacks.
- strip_tags function is used to remove tags such as <script></script> from input data
- filter_var function validates and php sanitize input data
- mysql_real_escape_string is used to sanitize SQL statement. It removes malicious characters from the statements
- both MD5 and SHA1 are used to encrypt password.

TEMPLATE

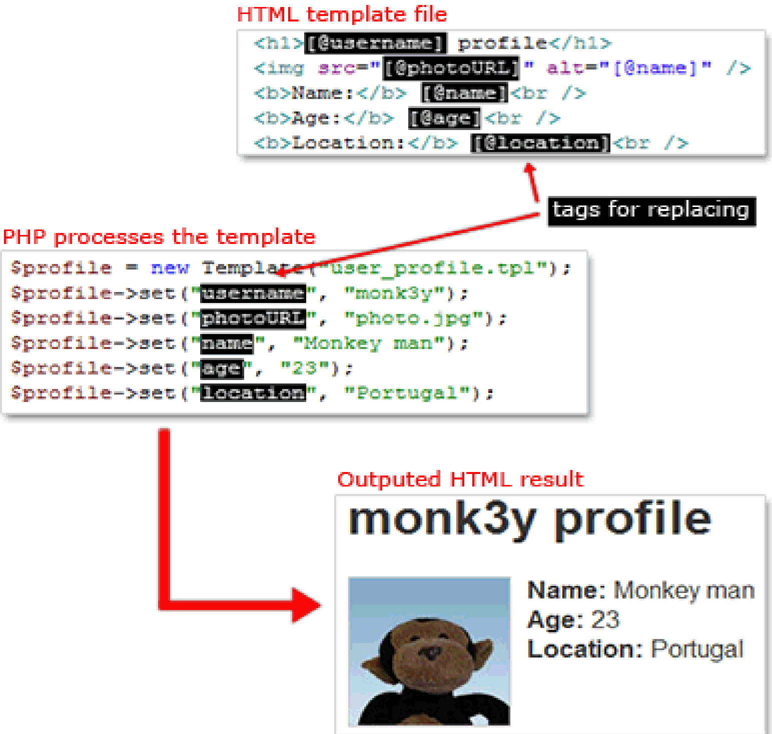
A template engine is used to separate the presentation from the business logic. A good developer knows this is very important - not only it allows for delegating responsibilities (the designer works on the presentation layer while the programmer works on the business logic), but it also provides a more easier maintenance.

There are a lot of template engines for PHP. A very popular example is **Smarty**. Most of these template engines have a lot of advanced options and require the user to learn a new syntax for building the template files.

What if you just want some easy to understand and simple to use template engine? Why not build your own? In this tutorial we'll do just that - we'll create a very simple template engine in PHP that anyone can use without having to spend time reading manuals.

Our template files will be written in pure HTML with some extra tags for easy replacement. We'll put the tags where we want our content to be - the engine will basically act as a replacement feature, but it could be updated for more advanced operations.

In the next picture I provide an overview of the working of this simple PHP template engine.



A simple HTML template

First, let's start with our HTML template file. We must define the tags' format we're going to use. Most templates use curly brackets surrounding the tags, e.g. {tag}, but I like to use a different syntax: [@tag]. Feel free to define your own conventions.

Imagine a typical case of building a user's profile page. Let's assume we need to display the user's photo, username, real name, age and location. An example HTML is provided below.

```
<h1>[@username] profile</h1>

<img src="[@photoURL]" class="photo" alt="[@name]" />

<b>Name:</b> [@name]<br />

<b>Age:</b> [@age]<br />

<b>Location:</b> [@location]<br />
```

Create your template file and save it. I like to use the tpl extension. In this case, let's call this template file user_profile.tpl.

Now we just need to load it in our PHP script and replace those tags with real values.

Template engine class

For easier use and portability we'll need a class - it will be called Template. This class will only need two member variables - one for storing the filename of the template and the other to store the values that will be used for replacing the tags in the template.

Let's start with this. We'll define our class and its constructor. I provide the code for this bellow.

```
class Template {

    protected $file;
```

```
  protected $values = array();

    public function __construct($file) {

      $this->file = $file;

  }}
```

Putting the engine to use

Now we can finally test our first iteration of the template engine. We'll create a simple PHP file (named user_profile.php) which loads the template with test data and outputs its result.

We'll start by including the file with the definition for our Template class (I called mine template.class.php). We then make a new Template object and we define each value in the template. In the end we want to write its output.

```
include("template.class.php");

  $profile = new Template("user_profile.tpl");

$profile->set("username", "monk3y");

$profile->set("photoURL", "photo.jpg");

$profile->set("name", "Monkey man");

$profile->set("age", "23");

$profile->set("location", "Portugal");

  echo $profile->output();

    <tr>

      <td>[@username]</td>
```

```
        <td>[@location]</td>

    </tr>
```

Now we'll combine these two into one. Because each user/row will be represented by a different template we'll make a function that will allow us to merge these different templates. This is needed because this merged value will then be used to replace the users tag on the main template (list_users.tpl).

```
static public function merge($templates, $separator = "n") {

    $output = "";

    foreach ($templates as $template) {

        $content = (get_class($template) !== "Template")

            ? "Error, incorrect type - expected Template."

            : $template->output();

        $output .= $content . $separator;

    }

     return $output;

}
```

Python

Python is a high-level, interpreted, interactive and object-oriented scripting language. Python is designed to be highly readable. It uses English keywords frequently where as other languages use punctuation, and it has fewer syntactical constructions than other languages.

- **Python is Interpreted:** Python is processed at runtime by the interpreter. You do not need to compile your program before executing it. This is similar to PERL and PHP.
- **Python is Interactive:** You can actually sit at a Python prompt and interact with the interpreter directly to write your programs.
- **Python is Object-Oriented:** Python supports Object-Oriented style or technique of programming that encapsulates code within objects.
- **Python is a Beginner's Language:** Python is a great language for the beginner-level programmers and supports the development of a wide range of applications from simple text processing to WWW browsers to games.

History of Python

Python was developed by Guido van Rossum in the late eighties and early nineties at the National Research Institute for Mathematics and Computer Science in the Netherlands.

Python is derived from many other languages, including ABC, Modula-3, C, C++, Algol-68, SmallTalk, and Unix shell and other scripting languages.

Python is copyrighted. Like Perl, Python source code is now available under the GNU General Public License (GPL).

Python Features

Python's features include:

- **Easy-to-learn:** Python has few keywords, simple structure, and a clearly defined syntax. This allows the student to pick up the language quickly.
- **Easy-to-read:** Python code is more clearly defined and visible to the eyes.
- **Easy-to-maintain:** Python's source code is fairly easy-to-maintain.

- **A broad standard library:** Python's bulk of the library is very portable and cross-platform compatible on UNIX, Windows, and Macintosh.

- **Interactive Mode :**Python has support for an interactive mode which allows interactive testing and debugging of snippets of code.

- **Portable:** Python can run on a wide variety of hardware platforms and has the same interface on all platforms.

- **Extendable:** You can add low-level modules to the Python interpreter. These modules enable programmers to add to or customize their tools to be more efficient.

- **Databases:** Python provides interfaces to all major commercial databases.

- **GUI Programming:** Python supports GUI applications that can be created and ported to many system calls, libraries and windows systems, such as Windows MFC, Macintosh, and the X Window system of Unix.

- **Scalable:** Python provides a better structure and support for large programs than shell scripting.

Installing Python

Python distribution is available for a wide variety of platforms. You need to download only the binary code applicable for your platform and install Python.

If the binary code for your platform is not available, you need a C compiler to compile the source code manually. Compiling the source code offers more flexibility in terms of choice of features that you require in your installation.

Here is a quick overview of installing Python on various platforms −

Unix and Linux Installation

Here are the simple steps to install Python on Unix/Linux machine.

- Open a Web browser and go to https://www.python.org/downloads/.

- Follow the link to download zipped source code available for Unix/Linux.

- Download and extract files.

- Editing the *Modules/Setup* file if you want to customize some options.
- run ./configure script
- make
- make install

This installs Python at standard location */usr/local/bin* and its libraries at*/usr/local/lib/pythonXX* where XX is the version of Python.

Windows Installation

Here are the steps to install Python on Windows machine.

- Open a Web browser and go to https://www.python.org/downloads/.
- Follow the link for the Windows installer *python-XYZ.msi* file where XYZ is the version you need to install.
- To use this installer *python-XYZ.msi*, the Windows system must support Microsoft Installer 2.0. Save the installer file to your local machine and then run it to find out if your machine supports MSI.
- Run the downloaded file. This brings up the Python install wizard, which is really easy to use. Just accept the default settings, wait until the install is finished, and you are done.

Setting up PATH

Programs and other executable files can be in many directories, so operating systems provide a search path that lists the directories that the OS searches for executables.

The path is stored in an environment variable, which is a named string maintained by the operating system. This variable contains information available to the command shell and other programs.

The **path** variable is named as PATH in Unix or Path in Windows (Unix is casesensitive; Windows is not).

In Mac OS, the installer handles the path details. To invoke the Python interpreter from any particular directory, you must add the Python directory to your path.

Integrated Development Environment

You can run Python from a Graphical User Interface (GUI) environment as well, if you have a GUI application on your system that supports Python.

- **Unix** − IDLE is the very first Unix IDE for Python.
- **Windows** − PythonWin is the first Windows interface for Python and is an IDE with a GUI.
- **Macintosh** − The Macintosh version of Python along with the IDLE IDE is available from the main website, downloadable as either MacBinary or BinHex'd files.

If you are not able to set up the environment properly, then you can take help from your system admin. Make sure the Python environment is properly set up and working perfectly fine.

The Python language has many similarities to Perl, C, and Java. However, there are some definite differences between the languages.

First Python Program

Let us execute programs in different modes of programming.

Interactive Mode Programming

Invoking the interpreter without passing a script file as a parameter brings up the following prompt −

```
$ python
Python 2.4.3 (#1, Nov 11 2010, 13:34:43)
[GCC 4.1.2 20080704 (Red Hat 4.1.2-48)] on linux2
Type "help", "copyright", "credits" or "license" for more information.
>>>
```

Type the following text at the Python prompt and press the Enter:

```
>>> print "Hello, Python!"
```

If you are running new version of Python, then you would need to use print statement with parenthesis as in **print ("Hello, Python!");**. However in Python version 2.4.3, this produces the following result:

```
Hello, Python!
```

Script Mode Programming

Invoking the interpreter with a script parameter begins execution of the script and continues until the script is finished. When the script is finished, the interpreter is no longer active.

Let us write a simple Python program in a script. Python files have extension **.py**. Type the following source code in a test.py file:

```
print "Hello, Python!"
```

We assume that you have Python interpreter set in PATH variable. Now, try to run this program as follows −

```
$ python test.py
```

This produces the following result:

```
Hello, Python!
```

Let us try another way to execute a Python script. Here is the modified test.py file −

```
#!/usr/bin/python


print "Hello, Python!"
```

We assume that you have Python interpreter available in /usr/bin directory. Now, try to run this program as follows −

```
$ chmod +x test.py     # This is to make file executable
$./test.py
```

This produces the following result −

```
Hello, Python!
```

Python Identifiers

A Python identifier is a name used to identify a variable, function, class, module or other object. An identifier starts with a letter A to Z or a to z or an underscore (_) followed by zero or more letters, underscores and digits (0 to 9).

Python does not allow punctuation characters such as @, $, and % within identifiers. Python is a case sensitive programming language. Thus, **Manpower** and **manpower** are two different identifiers in Python.

Here are naming conventions for Python identifiers −

- Class names start with an uppercase letter. All other identifiers start with a lowercase letter.
- Starting an identifier with a single leading underscore indicates that the identifier is private.
- Starting an identifier with two leading underscores indicates a strongly private identifier.
- If the identifier also ends with two trailing underscores, the identifier is a language-defined special name.

Reserved Words

The following list shows the Python keywords. These are reserved words and you cannot use them as constant or variable or any other identifier names. All the Python keywords contain lowercase letters only.

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

Lines and Indentation

Python provides no braces to indicate blocks of code for class and function definitions or flow control. Blocks of code are denoted by line indentation, which is rigidly enforced.

The number of spaces in the indentation is variable, but all statements within the block must be indented the same amount. For example −

```
if True:
   print "True"
else:
  print "False"
```

However, the following block generates an error −

```
if True:
   print "Answer"
   print "True"
else:
   print "Answer"
  print "False"
```

Thus, in Python all the continuous lines indented with same number of spaces would form a block. The following example has various statement blocks −

Note: Do not try to understand the logic at this point of time. Just make sure you understood various blocks even if they are without braces.

```
#!/usr/bin/python

import sys

try:
  # open file stream
  file = open(file_name, "w")
except IOError:
  print "There was an error writing to", file_name
  sys.exit()
print "Enter '", file_finish,
print "' When finished"
while file_text != file_finish:
  file_text = raw_input("Enter text: ")
  if file_text == file_finish:
    # close the file
    file.close
    break
  file.write(file_text)
  file.write("\n")
file.close()
file_name = raw_input("Enter filename: ")
if len(file_name) == 0:
  print "Next time please enter something"
  sys.exit()
try:
  file = open(file_name, "r")
except IOError:
  print "There was an error reading file"
  sys.exit()
```

```
file_text = file.read()
file.close()
print file_text
```

Multi-Line Statements

Statements in Python typically end with a new line. Python does, however, allow the use of the line continuation character (\) to denote that the line should continue. For example −

```
total = item_one + \
        item_two + \
        item_three
```

Statements contained within the [], {}, or () brackets do not need to use the line continuation character. For example −

```
days = ['Monday', 'Tuesday', 'Wednesday',
        'Thursday', 'Friday']
```

Quotation in Python

Python accepts single ('), double (") and triple (''' or """) quotes to denote string literals, as long as the same type of quote starts and ends the string.

The triple quotes are used to span the string across multiple lines. For example, all the following are legal −

```
word = 'word'
sentence = "This is a sentence."
paragraph = """This is a paragraph. It is
made up of multiple lines and sentences."""
```

Comments in Python

A hash sign (#) that is not inside a string literal begins a comment. All characters after the # and up to the end of the physical line are part of the comment and the Python interpreter ignores them.

```
#!/usr/bin/python
```

```
# First comment
print "Hello, Python!" # second comment
```

This produces the following result −

```
Hello, Python!
```

You can type a comment on the same line after a statement or expression −

```
name = "Madisetti" # This is again comment
```

You can comment multiple lines as follows −

```
# This is a comment.
# This is a comment, too.
# This is a comment, too.
# I said that already.
```

Using Blank Lines

A line containing only whitespace, possibly with a comment, is known as a blank line and Python totally ignores it.

In an interactive interpreter session, you must enter an empty physical line to terminate a multiline statement.

Waiting for the User

The following line of the program displays the prompt, the statement saying “Press the enter key to exit”, and waits for the user to take action −

```
#!/usr/bin/python
raw_input("\n\nPress the enter key to exit.")
```

Here, "\n\n" is used to create two new lines before displaying the actual line. Once the user presses the key, the program ends. This is a nice trick to keep a console window open until the user is done with an application.

Multiple Statements on a Single Line

The semicolon (;) allows multiple statements on the single line given that neither statement starts a new code block. Here is a sample snip using the semicolon −

```
import sys; x = 'foo'; sys.stdout.write(x + '\n')
```

Multiple Statement Groups as Suites

A group of individual statements, which make a single code block are called **suites** in Python. Compound or complex statements, such as if, while, def, and class require a header line and a suite.

Header lines begin the statement (with the keyword) and terminate with a colon (:) and are followed by one or more lines which make up the suite. For example −

```
if expression :
   suite
elif expression :
   suite
else :
   suite
```

Command Line Arguments

Many programs can be run to provide you with some basic information about how they should be run. Python enables you to do this with -h −

```
$ python -h
usage: python [option] ... [-c cmd | -m mod | file | -] [arg] ...
Options and arguments (and corresponding environment variables):
-c cmd : program passed in as string (terminates option list)
-d     : debug output from parser (also PYTHONDEBUG=x)
-E     : ignore environment variables (such as PYTHONPATH)
-h     : print this help message and exit

[ etc. ]
```

Standard Data Types

The data stored in memory can be of many types. For example, a person's age is stored as a numeric value and his or her address is stored as alphanumeric characters. Python has various standard data types that are used to define the operations possible on them and the storage method for each of them.

Python has five standard data types −

- Numbers
- String
- List
- Tuple
- Dictionary

Python Numbers

Number data types store numeric values. Number objects are created when you assign a value to them. For example −

```
var1 = 1
var2 = 10
```

You can also delete the reference to a number object by using the del statement. The syntax of the del statement is −

```
del var1[,var2[,var3[....,varN]]]]
```

You can delete a single object or multiple objects by using the del statement. For example −

```
del var
del var_a, var_b
```

Python supports four different numerical types −

- int (signed integers)
- long (long integers, they can also be represented in octal and hexadecimal)

- float (floating point real values)
- complex (complex numbers)

Examples

Here are some examples of numbers −

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

- Python allows you to use a lowercase l with long, but it is recommended that you use only an uppercase L to avoid confusion with the number 1. Python displays long integers with an uppercase L.
- A complex number consists of an ordered pair of real floating-point numbers denoted by x + yj, where x and y are the real numbers and j is the imaginary unit.

Python Strings

Strings in Python are identified as a contiguous set of characters represented in the quotation marks. Python allows for either pairs of single or double quotes. Subsets of strings can be taken using the slice operator ([ ] and [:]) with indexes starting at 0 in the beginning of the string and working their way from -1 at the end.

The plus (+) sign is the string concatenation operator and the asterisk (*) is the repetition operator. For example −

```
#!/usr/bin/python


str = 'Hello World!'


print str          # Prints complete string
print str[0]       # Prints first character of the string
print str[2:5]     # Prints characters starting from 3rd to 5th
print str[2:]      # Prints string starting from 3rd character
print str * 2      # Prints string two times
print str + "TEST" # Prints concatenated string
```

This will produce the following result −

```
Hello World!
H
llo
llo World!
Hello World!Hello World!
Hello World!TEST
```

Python Lists

Lists are the most versatile of Python's compound data types. A list contains items separated by commas and enclosed within square brackets ([]). To some extent, lists are similar to arrays in C. One difference between them is that all the items belonging to a list can be of different data type.

The values stored in a list can be accessed using the slice operator ([ ] and [:]) with indexes starting at 0 in the beginning of the list and working their way to end -1. The plus (+) sign is the list concatenation operator, and the asterisk (*) is the repetition operator. For example −

```
#!/usr/bin/python

list = [ 'abcd', 786 , 2.23, 'john', 70.2 ]
tinylist = [123, 'john']

print list          # Prints complete list
print list[0]       # Prints first element of the list
print list[1:3]     # Prints elements starting from 2nd till 3rd
print list[2:]      # Prints elements starting from 3rd element
print tinylist * 2  # Prints list two times
print list + tinylist # Prints concatenated lists
```

This produce the following result −

```
['abcd', 786, 2.23, 'john', 70.200000000000003]
abcd
[786, 2.23]
[2.23, 'john', 70.200000000000003]
[123, 'john', 123, 'john']
['abcd', 786, 2.23, 'john', 70.200000000000003, 123, 'john']
```

Python Tuples

A tuple is another sequence data type that is similar to the list. A tuple consists of a number of values separated by commas. Unlike lists, however, tuples are enclosed within parentheses.

The main differences between lists and tuples are: Lists are enclosed in brackets ([ ]) and their elements and size can be changed, while tuples are enclosed in parentheses (( )) and cannot be updated. Tuples can be thought of as **read-only** lists. For example −

```
#!/usr/bin/python

tuple = ( 'abcd', 786 , 2.23, 'john', 70.2  )
tinytuple = (123, 'john')
print tuple           # Prints complete list
print tuple[0]        # Prints first element of the list
```

```
print tuple[1:3]      # Prints elements starting from 2nd till 3rd
print tuple[2:]       # Prints elements starting from 3rd element
print tinytuple * 2   # Prints list two times
print tuple + tinytuple # Prints concatenated lists
```

This produce the following result −

```
('abcd', 786, 2.23, 'john', 70.200000000000003)
abcd
(786, 2.23)
(2.23, 'john', 70.200000000000003)
(123, 'john', 123, 'john')
('abcd', 786, 2.23, 'john', 70.200000000000003, 123, 'john')
```

The following code is invalid with tuple, because we attempted to update a tuple, which is not allowed. Similar case is possible with lists −

```
#!/usr/bin/python


tuple = ( 'abcd', 786 , 2.23, 'john', 70.2  )
list = [ 'abcd', 786 , 2.23, 'john', 70.2  ]
tuple[2] = 1000    # Invalid syntax with tuple
list[2] = 1000     # Valid syntax with list
```

Python Dictionary

Python's dictionaries are kind of hash table type. They work like associative arrays or hashes found in Perl and consist of key-value pairs. A dictionary key can be almost any Python type, but are usually numbers or strings. Values, on the other hand, can be any arbitrary Python object.

Dictionaries are enclosed by curly braces ({ }) and values can be assigned and accessed using square braces ([]). For example −

```
#!/usr/bin/python
dict = {}
dict['one'] = "This is one"
dict[2]     = "This is two"
```

```
tinydict = {'name': 'john','code':6734, 'dept': 'sales'}
print dict['one']       # Prints value for 'one' key
print dict[2]           # Prints value for 2 key
print tinydict          # Prints complete dictionary
print tinydict.keys()   # Prints all the keys
print tinydict.values() # Prints all the values
```

This produce the following result −

```
This is one
This is two
{'dept': 'sales', 'code': 6734, 'name': 'john'}
['dept', 'code', 'name']
['sales', 6734, 'john']
```

Dictionaries have no concept of order among elements. It is incorrect to say that the elements are "out of order"; they are simply unordered.

Data Type Conversion

Sometimes, you may need to perform conversions between the built-in types. To convert between types, you simply use the type name as a function.

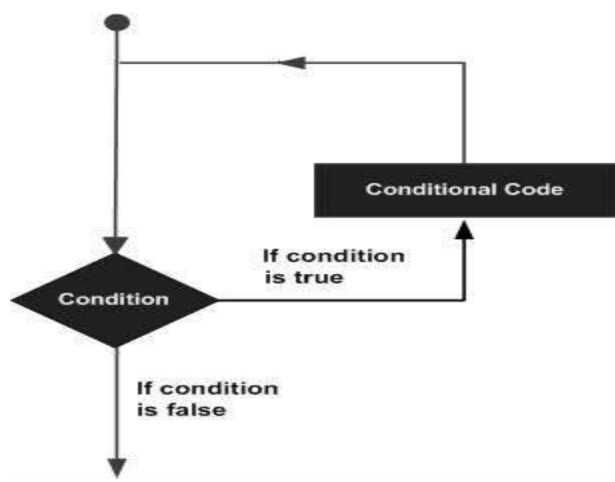
There are several built-in functions to perform conversion from one data type to another. These functions return a new object representing the converted value.

Function	Description
int(x [,base])	Converts x to an integer. base specifies the base if x is a string.
long(x [,base])	Converts x to a long integer. base specifies the base if x is a string.
float(x)	Converts x to a floating-point number.
complex(real [,imag])	Creates a complex number.

str(x)	Converts object x to a string representation.
repr(x)	Converts object x to an expression string.
eval(str)	Evaluates a string and returns an object.
tuple(s)	Converts s to a tuple.
list(s)	Converts s to a list.
set(s)	Converts s to a set.
dict(d)	Creates a dictionary. d must be a sequence of (key,value) tuples.
frozenset(s)	Converts s to a frozen set.
chr(x)	Converts an integer to a character.
unichr(x)	Converts an integer to a Unicode character.
ord(x)	Converts a single character to its integer value.
hex(x)	Converts an integer to a hexadecimal string.
oct(x)	Converts an integer to an octal string.

Conditional Loops

A loop statement allows us to execute a statement or group of statements multiple times. The following diagram illustrates a loop statement −



Python programming language provides following types of loops to handle looping requirements.

Loop Type	Description
while loop	Repeats a statement or group of statements while a given condition is TRUE. It tests the condition before executing the loop body.
for loop	Executes a sequence of statements multiple times and abbreviates the code that manages the loop variable.
nested loops	You can use one or more loop inside any another while, for or do..while loop.

while loop

A **while** loop statement in Python programming language repeatedly executes a target statement as long as a given condition is true.

Syntax

The syntax of a **while** loop in Python programming language is −

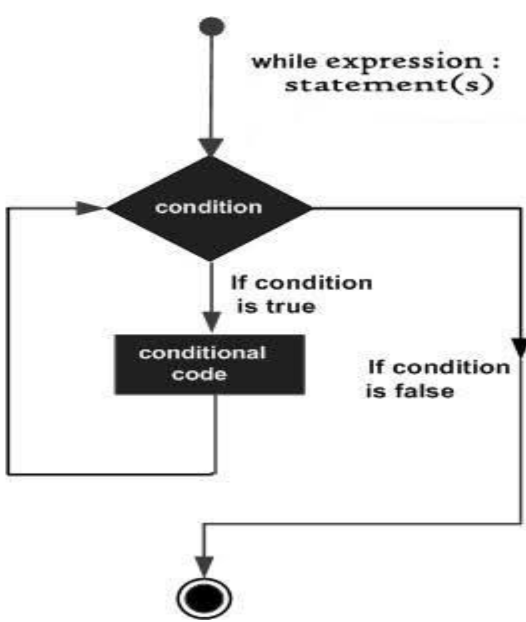
```
while expression:
   statement(s)
```

Here, **statement(s)** may be a single statement or a block of statements. The **condition** may be any expression, and true is any non-zero value. The loop iterates while the condition is true.

When the condition becomes false, program control passes to the line immediately following the loop.

In Python, all the statements indented by the same number of character spaces after a programming construct are considered to be part of a single block of code. Python uses indentation as its method of grouping statements.

Flow Diagram



Here, key point of the while loop is that the loop might not ever run. When the condition is tested and the result is false, the loop body will be skipped and the first statement after the while loop will be executed.

Example

```
#!/usr/bin/python
count = 0
while (count < 9):
   print 'The count is:', count
   count = count + 1
print "Good bye!"
```

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

```
The count is: 0
The count is: 1
The count is: 2
The count is: 3
The count is: 4
The count is: 5
The count is: 6
The count is: 7
The count is: 8
Good bye!
```

The block here, consisting of the print and increment statements, is executed repeatedly until count is no longer less than 9. With each iteration, the current value of the index count is displayed and then increased by 1.

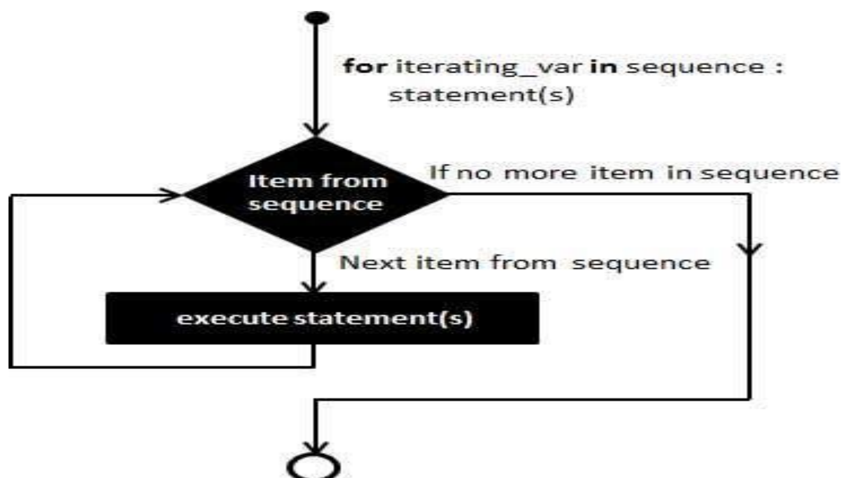
FOR LOOP

It has the ability to iterate over the items of any sequence, such as a list or a string.

Syntax

```
for iterating_var in sequence:
  statements(s)
```

If a sequence contains an expression list, it is evaluated first. Then, the first item in the sequence is assigned to the iterating variable *iterating_var*. Next, the statements block is executed. Each item in the list is assigned to *iterating_var*, and the statement(s) block is executed until the entire sequence is exhausted.Flow Diagram



Example

```
#!/usr/bin/python

for letter in 'Python':     # First Example
   print 'Current Letter :', letter

fruits = ['banana', 'apple',  'mango']
for fruit in fruits:        # Second Example
   print 'Current fruit :', fruit

print "Good bye!"
```

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

```
Current Letter : P
Current Letter : y
Current Letter : t
Current Letter : h
Current Letter : o
Current Letter : n
Current fruit : banana
Current fruit : apple
Current fruit : mango
Good bye!
```

NESTED LOOPS

Python programming language allows to use one loop inside another loop. Following section shows few examples to illustrate the concept.

Syntax

```
for iterating_var in sequence:
   for iterating_var in sequence:
      statements(s)
   statements(s)
```

The syntax for a **nested while loop** statement in Python programming language is as follows −

```
while expression:
  while expression:
    statement(s)
  statement(s)
```

A final note on loop nesting is that you can put any type of loop inside of any other type of loop. For example a for loop can be inside a while loop or vice versa.

Files I/O

Printing to the Screen

The simplest way to produce output is using the *print* statement where you can pass zero or more expressions separated by commas. This function converts the expressions you pass into a string and writes the result to standard output as follows −

```
#!/usr/bin/python
print "Python is really a great language,", "isn't it?"
```

This produces the following result on your standard screen −

```
Python is really a great language, isn't it?
```

Reading Keyboard Input

Python provides two built-in functions to read a line of text from standard input, which by default comes from the keyboard. These functions are −

- raw_input
- input

The *raw_input* Function

The *raw_input([prompt])* function reads one line from standard input and returns it as a string (removing the trailing newline).

```
#!/usr/bin/python
str = raw_input("Enter your input: ");
print "Received input is : ", str
```

This prompts you to enter any string and it would display same string on the screen. When I typed "Hello Python!", its output is like this −

```
Enter your input: Hello Python
Received input is :  Hello Python
```

The *input* Function

The *input([prompt])* function is equivalent to raw_input, except that it assumes the input is a valid Python expression and returns the evaluated result to you.

```
#!/usr/bin/python
str = input("Enter your input: ");
print "Received input is : ", str
```

This would produce the following result against the entered input −

```
Enter your input: [x*5 for x in range(2,10,2)]
Recieved input is :  [10, 20, 30, 40]
```

Opening and Closing Files

Until now, you have been reading and writing to the standard input and output. Now, we will see how to use actual data files.

Python provides basic functions and methods necessary to manipulate files by default. You can do most of the file manipulation using a **file** object.

The *open* Function

Before you can read or write a file, you have to open it using Python's built-in *open()* function. This function creates a **file** object, which would be utilized to call other support methods associated with it.

Syntax

```
file object = open(file_name [, access_mode][, buffering])
```

Here are parameter details:

- **file_name:** The file_name argument is a string value that contains the name of the file that you want to access.
- **access_mode:** The access_mode determines the mode in which the file has to be opened, i.e., read, write, append, etc. A complete list of possible values is given below in the table. This is optional parameter and the default file access mode is read (r).
- **buffering:** If the buffering value is set to 0, no buffering takes place. If the buffering value is 1, line buffering is performed while accessing a file. If you specify the buffering value as an integer greater than 1, then buffering action is performed with the indicated buffer size. If negative, the buffer size is the system default(default behavior).

Here is a list of the different modes of opening a file −

Modes	**Description**
r	Opens a file for reading only. The file pointer is placed at the beginning of the file. This is the default mode.
rb	Opens a file for reading only in binary format. The file pointer is placed at the beginning of the file. This is the default mode.
r+	Opens a file for both reading and writing. The file pointer placed at the beginning of the file.
rb+	Opens a file for both reading and writing in binary format. The file pointer placed at the beginning of the file.
w	Opens a file for writing only. Overwrites the file if the file exists. If the file does not exist, creates a new file for writing.
wb	Opens a file for writing only in binary format. Overwrites the file if the file exists. If the file does not exist, creates a new file for writing.

w+	Opens a file for both writing and reading. Overwrites the existing file if the file exists. If the file does not exist, creates a new file for reading and writing.
wb+	Opens a file for both writing and reading in binary format. Overwrites the existing file if the file exists. If the file does not exist, creates a new file for reading and writing.
a	Opens a file for appending. The file pointer is at the end of the file if the file exists. That is, the file is in the append mode. If the file does not exist, it creates a new file for writing.
ab	Opens a file for appending in binary format. The file pointer is at the end of the file if the file exists. That is, the file is in the append mode. If the file does not exist, it creates a new file for writing.
a+	Opens a file for both appending and reading. The file pointer is at the end of the file if the file exists. The file opens in the append mode. If the file does not exist, it creates a new file for reading and writing.
ab+	Opens a file for both appending and reading in binary format. The file pointer is at the end of the file if the file exists. The file opens in the append mode. If the file does not exist, it creates a new file for reading and writing.

The *file* Object Attributes

Once a file is opened and you have one *file* object, you can get various information related to that file.

Here is a list of all attributes related to file object:

Attribute	Description
file.closed	Returns true if file is closed, false otherwise.
file.mode	Returns access mode with which file was opened.

file.name	Returns name of the file.
file.softspace	Returns false if space explicitly required with print, true otherwise.

Example

```
#!/usr/bin/python


# Open a file
fo = open("foo.txt", "wb")
print "Name of the file: ", fo.name
print "Closed or not : ", fo.closed
print "Opening mode : ", fo.mode
print "Softspace flag : ", fo.softspace
```

This produces the following result −

```
Name of the file:  foo.txt
Closed or not :  False
Opening mode :  wb
Softspace flag :  0
```

The *close()* Method

The close() method of a *file* object flushes any unwritten information and closes the file object, after which no more writing can be done.

Python automatically closes a file when the reference object of a file is reassigned to another file. It is a good practice to use the close() method to close a file.

Syntax

```
fileObject.close();
```

Example

```
#!/usr/bin/python


# Open a file
```

```
fo = open("foo.txt", "wb")
print "Name of the file: ", fo.name

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

This produces the following result −

```
Name of the file:  foo.txt
```

Reading and Writing Files

The *file* object provides a set of access methods to make our lives easier. We would see how to use *read()* and *write()* methods to read and write files.

The *write()* Method

The *write()* method writes any string to an open file. It is important to note that Python strings can have binary data and not just text.

The write() method does not add a newline character ('\n') to the end of the string −

Syntax

```
fileObject.write(string);
```

Here, passed parameter is the content to be written into the opened file.

Example

```
#!/usr/bin/python

# Open a file
fo = open("foo.txt", "wb")
fo.write( "Python is a great language.\nYeah its great!!\n");

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

The above method would create *foo.txt* file and would write given content in that file and finally it would close that file. If you would open this file, it would have following content.

```
Python is a great language.
Yeah its great!!
```

The *read()* Method

The *read()* method reads a string from an open file. It is important to note that Python strings can have binary data. apart from text data.

Syntax

```
fileObject.read([count]);
```

Here, passed parameter is the number of bytes to be read from the opened file. This method starts reading from the beginning of the file and if *count* is missing, then it tries to read as much as possible, maybe until the end of file.

Example

Let's take a file *foo.txt*, which we created above.

```
#!/usr/bin/python


# Open a file
fo = open("foo.txt", "r+")
str = fo.read(10);
print "Read String is : ", str
# Close opend file
fo.close()
```

This produces the following result −

```
Read String is :  Python is
```

File Positions

The *tell()* method tells you the current position within the file; in other words, the next read or write will occur at that many bytes from the beginning of the file.

The *seek(offset[, from])* method changes the current file position. The *offset* argument indicates the number of bytes to be moved. The *from* argument specifies the reference position from where the bytes are to be moved.

If *from* is set to 0, it means use the beginning of the file as the reference position and 1 means use the current position as the reference position and if it is set to 2 then the end of the file would be taken as the reference position.

Example

Let us take a file *foo.txt*, which we created above.

```
#!/usr/bin/python
# Open a file
fo = open("foo.txt", "r+")
str = fo.read(10);
print "Read String is : ", str
# Check current position
position = fo.tell();
print "Current file position : ", position
# Reposition pointer at the beginning once again
position = fo.seek(0, 0);
str = fo.read(10);
print "Again read String is : ", str
# Close opend file
fo.close()
```

This produces the following result −

```
Read String is :  Python is
Current file position :  10
```

```
Again read String is :  Python is
```

Renaming and Deleting Files

Python **os** module provides methods that help you perform file-processing operations, such as renaming and deleting files.

To use this module you need to import it first and then you can call any related functions.

The rename() Method

The *rename()* method takes two arguments, the current filename and the new filename.

Syntax

```
os.rename(current_file_name, new_file_name)
```

Example

Following is the example to rename an existing file *test1.txt*:

```
#!/usr/bin/python
import os
# Rename a file from test1.txt to test2.txt
os.rename( "test1.txt", "test2.txt" )
```

The *remove()* Method

You can use the *remove()* method to delete files by supplying the name of the file to be deleted as the argument.

Syntax

```
os.remove(file_name)
```

Example

Following is the example to delete an existing file *test2.txt* −

```
#!/usr/bin/python
import os
# Delete file test2.txt
os.remove("text2.txt")
```

Directories in Python

All files are contained within various directories, and Python has no problem handling these too. The **os** module has several methods that help you create, remove, and change directories.

The *mkdir()* Method

You can use the *mkdir()* method of the **os** module to create directories in the current directory. You need to supply an argument to this method which contains the name of the directory to be created.

Syntax

```
os.mkdir("newdir")
```

Example

Following is the example to create a directory *test* in the current directory −

```
#!/usr/bin/python
import os
# Create a directory "test"
os.mkdir("test")
```

The *chdir()* Method

You can use the *chdir()* method to change the current directory. The chdir() method takes an argument, which is the name of the directory that you want to make the current directory.

Syntax

```
os.chdir("newdir")
```

Example

Following is the example to go into "/home/newdir" directory −

```
#!/usr/bin/python
import os
# Changing a directory to "/home/newdir"
os.chdir("/home/newdir")
```

Errors - Exceptions Handling

Python provides two very important features to handle any unexpected error in your Python programs and to add debugging capabilities in them −

- **Exception Handling:** This would be covered in this tutorial. Here is a list standard Exceptions available in Python: Standard Exceptions.
- **Assertions:** This would be covered in Assertions in Python tutorial.

List of Standard Exceptions −

EXCEPTION NAME	**DESCRIPTION**
Exception	Base class for all exceptions
StopIteration	Raised when the next() method of an iterator does not point to any object.
SystemExit	Raised by the sys.exit() function.
StandardError	Base class for all built-in exceptions except StopIteration and SystemExit.
ArithmeticError	Base class for all errors that occur for numeric calculation.
OverflowError	Raised when a calculation exceeds maximum limit for a numeric type.
FloatingPointError	Raised when a floating point calculation fails.
ZeroDivisonError	Raised when division or modulo by zero takes place for all numeric types.

What is Exception?

An exception is an event, which occurs during the execution of a program that disrupts the normal flow of the program's instructions. In general, when a Python script encounters a situation that it cannot cope with, it raises an exception. An exception is a Python object that represents an error.

When a Python script raises an exception, it must either handle the exception immediately otherwise it terminates and quits.

Handling an exception

If you have some *suspicious* code that may raise an exception, you can defend your program by placing the suspicious code in a **try:** block. After the try: block, include an **except:** statement, followed by a block of code which handles the problem as elegantly as possible.

Syntax

Here is simple syntax of *try....except...else* blocks −

```
try:
   You do your operations here;
   ......................
except ExceptionI:
   If there is ExceptionI, then execute this block.
except ExceptionII:
   If there is ExceptionII, then execute this block.
   ......................
else:
   If there is no exception then execute this block.
```

Here are few important points about the above-mentioned syntax −

- A single try statement can have multiple except statements. This is useful when the try block contains statements that may throw different types of exceptions.
- You can also provide a generic except clause, which handles any exception.
- After the except clause(s), you can include an else-clause. The code in the else-block executes if the code in the try: block does not raise an exception.

- The else-block is a good place for code that does not need the try: block's protection.

Example

This example opens a file, writes content in the, file and comes out gracefully because there is no problem at all −

```
#!/usr/bin/python
try:
   fh = open("testfile", "w")
   fh.write("This is my test file for exception handling!!")
except IOError:
   print "Error: can\'t find file or read data"
else:
   print "Written content in the file successfully"
   fh.close()
```

This produces the following result −

```
Written content in the file successfully
```

The *except* Clause with No Exceptions

You can also use the except statement with no exceptions defined as follows −

```
try:
   You do your operations here;
   ......................
except:
   If there is any exception, then execute this block.
   ......................
else:
   If there is no exception then execute this block.
```

This kind of a **try-except** statement catches all the exceptions that occur. Using this kind of try-except statement is not considered a good programming practice though, because it catches all

exceptions but does not make the programmer identify the root cause of the problem that may occur.

The *except* Clause with Multiple Exceptions

You can also use the same *except* statement to handle multiple exceptions as follows −

```
try:
   You do your operations here;
   ......................
except(Exception1[, Exception2[,...ExceptionN]]]):
   If there is any exception from the given exception list,
   then execute this block.
   ......................
else:
   If there is no exception then execute this block.
```

The try-finally Clause

You can use a **finally:** block along with a **try:** block. The finally block is a place to put any code that must execute, whether the try-block raised an exception or not. The syntax of the try-finally statement is this −

```
try:
   You do your operations here;
   ......................
   Due to any exception, this may be skipped.
finally:
   This would always be executed.
   ......................
```

You cannot use *else* clause as well along with a finally clause.

Example

```
#!/usr/bin/python
```

```
try:
  fh = open("testfile", "w")
  fh.write("This is my test file for exception handling!!")
finally:
  print "Error: can\'t find file or read data"
```

If you do not have permission to open the file in writing mode, then this will produce the following result:

```
Error: can't find file or read data
```

Same example can be written more cleanly as follows −

```
#!/usr/bin/python

try:
  fh = open("testfile", "w")
  try:
    fh.write("This is my test file for exception handling!!")
  finally:
    print "Going to close the file"
    fh.close()
except IOError:
  print "Error: can\'t find file or read data"
```

When an exception is thrown in the *try* block, the execution immediately passes to the *finally* block.

Raising an Exceptions

You can raise exceptions in several ways by using the raise statement. The general syntax for the **raise** statement is as follows.

Syntax

```
raise [Exception [, args [, traceback]]]
```

Here, *Exception* is the type of exception (for example, NameError) and *argument* is a value for the exception argument. The argument is optional; if not supplied, the exception argument is None.

The final argument, traceback, is also optional (and rarely used in practice), and if present, is the traceback object used for the exception.

Example

An exception can be a string, a class or an object. Most of the exceptions that the Python core raises are classes, with an argument that is an instance of the class. Defining new exceptions is quite easy and can be done as follows −

```
def functionName( level ):
  if level < 1:
    raise "Invalid level!", level
    # The code below to this would not be executed
    # if we raise the exception
```

Note: In order to catch an exception, an "except" clause must refer to the same exception thrown either class object or simple string. For example, to capture above exception, we must write the except clause as follows −

```
try:
  Business Logic here...
except "Invalid level!":
  Exception handling here...
else:
  Rest of the code here...
```

User-Defined Exceptions

Python also allows you to create your own exceptions by deriving classes from the standard built-in exceptions.

Here is an example related to *RuntimeError*. Here, a class is created that is subclassed from *RuntimeError*. This is useful when you need to display more specific information when an exception is caught.

In the try block, the user-defined exception is raised and caught in the except block. The variable e is used to create an instance of the class *Networkerror*.

```
class Networkerror(RuntimeError):
  def __init__(self, arg):
    self.args = arg
```

So once you defined above class, you can raise the exception as follows −

```
try:
  raise Networkerror("Bad hostname")
except Networkerror,e:
  print e.args
```

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.

As you already know, Python gives you many built-in functions like print(), etc. but you can also create your own functions. These functions are called *user-defined functions.*

Defining a Function

You can define functions to provide the required functionality. Here are simple rules to define a function in Python.

- Function blocks begin with the keyword **def** followed by the function name and parentheses (( )).
- Any input parameters or arguments should be placed within these parentheses. You can also define parameters inside these parentheses.
- The first statement of a function can be an optional statement - the documentation string of the function or *docstring*.
- The code block within every function starts with a colon (:) and is indented.
- The statement return [expression] exits a function, optionally passing back an expression to the caller. A return statement with no arguments is the same as return None.

Syntax

```
def functionname( parameters ):
   "function_docstring"
   function_suite
   return [expression]
```

By default, parameters have a positional behavior and you need to inform them in the same order that they were defined.

Example

The following function takes a string as input parameter and prints it on standard screen.

```
def printme( str ):
   "This prints a passed string into this function"
   print str
   return
```

Calling a Function

Defining a function only gives it a name, specifies the parameters that are to be included in the function and structures the blocks of code.

Once the basic structure of a function is finalized, you can execute it by calling it from another function or directly from the Python prompt. Following is the example to call printme() function –

```
#!/usr/bin/python

# Function definition is here
def printme( str ):
   "This prints a passed string into this function"
   print str
   return;

# Now you can call printme function
```

```
printme("I'm first call to user defined function!")
printme("Again second call to the same function")
```

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

```
I'm first call to user defined function!
Again second call to the same function
```

Pass by reference vs value

All parameters (arguments) in the Python language are passed by reference. It means if you change what a parameter refers to within a function, the change also reflects back in the calling function. For example −

```
#!/usr/bin/python
# Function definition is here
def changeme( mylist ):
   "This changes a passed list into this function"
   mylist.append([1,2,3,4]);
   print "Values inside the function: ", mylist
   return

# Now you can call changeme function
mylist = [10,20,30];
changeme( mylist );
print "Values outside the function: ", mylist
```

Here, we are maintaining reference of the passed object and appending values in the same object. So, this would produce the following result −

```
Values inside the function:  [10, 20, 30, [1, 2, 3, 4]]
Values outside the function:  [10, 20, 30, [1, 2, 3, 4]]
Values inside the function:  [1, 2, 3, 4]
```

Function Arguments

You can call a function by using the following types of formal arguments:

- Required arguments
- Keyword arguments
- Default arguments
- Variable-length arguments

Required arguments

Required arguments are the arguments passed to a function in correct positional order. Here, the number of arguments in the function call should match exactly with the function definition.

To call the function *printme()*, you definitely need to pass one argument, otherwise it gives a syntax error as follows −

```
#!/usr/bin/python

# Function definition is here
def printme( str ):
  "This prints a passed string into this function"
  print str
  return;

# Now you can call printme function
printme()
```

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

```
Traceback (most recent call last):
  File "test.py", line 11, in <module>
    printme();
TypeError: printme() takes exactly 1 argument (0 given)
```

Keyword arguments

Keyword arguments are related to the function calls. When you use keyword arguments in a function call, the caller identifies the arguments by the parameter name.

This allows you to skip arguments or place them out of order because the Python interpreter is able to use the keywords provided to match the values with parameters. You can also make keyword calls to the *printme()* function in the following ways −

```
#!/usr/bin/python


# Function definition is here
def printme( str ):
   "This prints a passed string into this function"
   print str
   return;


# Now you can call printme function
printme( str = "My string")
```

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

```
My string
```

The following example gives more clear picture. Note that the order of parameters does not matter.

```
#!/usr/bin/python
# Function definition is here
def printinfo( name, age ):
   "This prints a passed info into this function"
   print "Name: ", name
   print "Age ", age
   return;
```

```
# Now you can call printinfo function
printinfo( age=50, name="miki" )
```

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

```
Name:  miki
Age  50
```

Default arguments

A default argument is an argument that assumes a default value if a value is not provided in the function call for that argument. The following example gives an idea on default arguments, it prints default age if it is not passed −

```
#!/usr/bin/python

# Function definition is here
def printinfo( name, age = 35 ):
   "This prints a passed info into this function"
   print "Name: ", name
   print "Age ", age
   return;

# Now you can call printinfo function
printinfo( age=50, name="miki" )
printinfo( name="miki" )
```

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

```
Name:  miki
Age  50
Name:  miki
Age  35
```

Variable-length arguments

You may need to process a function for more arguments than you specified while defining the function. These arguments are called *variable-length* arguments and are not named in the function definition, unlike required and default arguments.

Syntax for a function with non-keyword variable arguments is this −

```
def functionname([formal_args,] *var_args_tuple ):
  "function_docstring"
  function_suite
  return [expression]
```

An asterisk (*) is placed before the variable name that holds the values of all nonkeyword variable arguments. This tuple remains empty if no additional arguments are specified during the function call. Following is a simple example −

```
#!/usr/bin/python

# Function definition is here
def printinfo( arg1, *vartuple ):
  "This prints a variable passed arguments"
  print "Output is: "
  print arg1
  for var in vartuple:
    print var
  return;

# Now you can call printinfo function
printinfo( 10 )
printinfo( 70, 60, 50 )
```

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

```
Output is:
```

```
10
Output is:
70
60
50
```

The *Anonymous* Functions

These functions are called anonymous because they are not declared in the standard manner by using the *def* keyword. You can use the *lambda* keyword to create small anonymous functions.

- Lambda forms can take any number of arguments but return just one value in the form of an expression. They cannot contain commands or multiple expressions.
- An anonymous function cannot be a direct call to print because lambda requires an expression
- Lambda functions have their own local namespace and cannot access variables other than those in their parameter list and those in the global namespace.
- Although it appears that lambda's are a one-line version of a function, they are not equivalent to inline statements in C or C++, whose purpose is by passing function stack allocation during invocation for performance reasons.

Syntax

The syntax of *lambda* functions contains only a single statement, which is as follows −

```
lambda [arg1 [,arg2,.....argn]]:expression
```

Following is the example to show how *lambda* form of function works −

```
#!/usr/bin/python

# Function definition is here
sum = lambda arg1, arg2: arg1 + arg2;
```

```
# Now you can call sum as a function
print "Value of total : ", sum( 10, 20 )
print "Value of total : ", sum( 20, 20 )
```

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

```
Value of total :  30
Value of total :  40
```

The *return* Statement

The statement return [expression] exits a function, optionally passing back an expression to the caller. A return statement with no arguments is the same as return None.

All the above examples are not returning any value. You can return a value from a function as follows −

```
#!/usr/bin/python

# Function definition is here
def sum( arg1, arg2 ):
   # Add both the parameters and return them."
   total = arg1 + arg2
   print "Inside the function : ", total
   return total;
# Now you can call sum function
total = sum( 10, 20 );
print "Outside the function : ", total
```

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

```
Inside the function :  30
Outside the function :  30
```

Scope of Variables

All variables in a program may not be accessible at all locations in that program. This depends on where you have declared a variable.

The scope of a variable determines the portion of the program where you can access a particular identifier. There are two basic scopes of variables in Python −

- Global variables
- Local variables

Global vs. Local variables

Variables that are defined inside a function body have a local scope, and those defined outside have a global scope.

Modules

A module allows you to logically organize your Python code. Grouping related code into a module makes the code easier to understand and use. A module is a Python object with arbitrarily named attributes that you can bind and reference.

Simply, a module is a file consisting of Python code. A module can define functions, classes and variables. A module can also include runnable code.

Example

The Python code for a module named *aname* normally resides in a file named *aname.py*. Here's an example of a simple module, support.py

```
def print_func( par ):
  print "Hello : ", par
  return
```

The *import* Statement

You can use any Python source file as a module by executing an import statement in some other Python source file. The *import* has the following syntax:

```
import module1[, module2[,... moduleN]
```

When the interpreter encounters an import statement, it imports the module if the module is present in the search path. A search path is a list of directories that the interpreter searches before importing a module. For example, to import the module hello.py, you need to put the following command at the top of the script −

```
#!/usr/bin/python
# Import module support
import support
# Now you can call defined function that module as follows
support.print_func("Zara")
```

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

```
Hello : Zara
```

A module is loaded only once, regardless of the number of times it is imported. This prevents the module execution from happening over and over again if multiple imports occur.

The *from...import* Statement

Python's *from* statement lets you import specific attributes from a module into the current namespace. The *from...import* has the following syntax −

```
from modname import name1[, name2[, ... nameN]]
```

For example, to import the function fibonacci from the module fib, use the following statement −

```
from fib import fibonacci
```

This statement does not import the entire module fib into the current namespace; it just introduces the item fibonacci from the module fib into the global symbol table of the importing module.

The *from...import* * Statement:

It is also possible to import all names from a module into the current namespace by using the following import statement −

```
from modname import *
```

This provides an easy way to import all the items from a module into the current namespace; however, this statement should be used sparingly.

Locating Modules

When you import a module, the Python interpreter searches for the module in the following sequences −

- The current directory.
- If the module isn't found, Python then searches each directory in the shell variable PYTHONPATH.
- If all else fails, Python checks the default path. On UNIX, this default path is normally /usr/local/lib/python/.

Namespaces and Scoping

Variables are names (identifiers) that map to objects. A *namespace* is a dictionary of variable names (keys) and their corresponding objects (values).

A Python statement can access variables in a *local namespace* and in the *global namespace*. If a local and a global variable have the same name, the local variable shadows the global variable.

The dir( ) Function

The dir() built-in function returns a sorted list of strings containing the names defined by a module.

The list contains the names of all the modules, variables and functions that are defined in a module. Following is a simple example −

```
#!/usr/bin/python
# Import built-in module math
import math
content = dir(math)
print content
```

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

```
['__doc__', '__file__', '__name__', 'acos', 'asin', 'atan',
'atan2', 'ceil', 'cos', 'cosh', 'degrees', 'e', 'exp',
'fabs', 'floor', 'fmod', 'frexp', 'hypot', 'ldexp', 'log',
'log10', 'modf', 'pi', 'pow', 'radians', 'sin', 'sinh',
'sqrt', 'tan', 'tanh']
```

Here, the special string variable *__name__* is the module's name, and *__file__* is the filename from which the module was loaded.

The *globals()* and *locals()* Functions −

The *globals()* and *locals()* functions can be used to return the names in the global and local namespaces depending on the location from where they are called.

If locals() is called from within a function, it will return all the names that can be accessed locally from that function.

If globals() is called from within a function, it will return all the names that can be accessed globally from that function.

The return type of both these functions is dictionary. Therefore, names can be extracted using the keys() function.

The *reload()* Function

When the module is imported into a script, the code in the top-level portion of a module is executed only once.

Therefore, if you want to reexecute the top-level code in a module, you can use the *reload()* function. The reload() function imports a previously imported module again. The syntax of the reload() function is this −

```
reload(module_name)
```

Here, *module_name* is the name of the module you want to reload and not the string containing the module name. For example, to reload *hello* module, do the following −

```
reload(hello)
```

CLASSES AND OOP

Python has been an object-oriented language since it existed. Because of this, creating and using classes and objects are downright easy. However, here is small introduction of Object-Oriented Programming (OOP) to bring you at speed −

Overview of OOP Terminology

- **Class:** A user-defined prototype for an object that defines a set of attributes that characterize any object of the class. The attributes are data members (class variables and instance variables) and methods, accessed via dot notation.
- **Class variable:** A variable that is shared by all instances of a class. Class variables are defined within a class but outside any of the class's methods. Class variables are not used as frequently as instance variables are.
- **Data member:** A class variable or instance variable that holds data associated with a class and its objects.
- **Function overloading:** The assignment of more than one behavior to a particular function. The operation performed varies by the types of objects or arguments involved.
- **Instance variable:** A variable that is defined inside a method and belongs only to the current instance of a class.
- **Inheritance:** The transfer of the characteristics of a class to other classes that are derived from it.
- **Instance:** An individual object of a certain class. An object obj that belongs to a class Circle, for example, is an instance of the class Circle.
- **Instantiation:** The creation of an instance of a class.
- **Method :** A special kind of function that is defined in a class definition.
- **Object:** A unique instance of a data structure that's defined by its class. An object comprises both data members (class variables and instance variables) and methods.
- **Operator overloading:** The assignment of more than one function to a particular operator.

Creating Classes

The *class* statement creates a new class definition. The name of the class immediately follows the keyword *class* followed by a colon as follows −

```
class ClassName:
   'Optional class documentation string'
   class_suite
```

- The class has a documentation string, which can be accessed via *ClassName.__doc__*.
- The *class_suite* consists of all the component statements defining class members, data attributes and functions.

Example

Following is the example of a simple Python class −

```
class Employee:
   'Common base class for all employees'
   empCount = 0

   def __init__(self, name, salary):
      self.name = name
      self.salary = salary
      Employee.empCount += 1

   def displayCount(self):
     print "Total Employee %d" % Employee.empCount

   def displayEmployee(self):
      print "Name : ", self.name,  ", Salary: ", self.salary
```

- The variable *empCount* is a class variable whose value is shared among all instances of a this class. This can be accessed as *Employee.empCount* from inside the class or outside the class.

- The first method *__init__()* is a special method, which is called class constructor or initialization method that Python calls when you create a new instance of this class.

- You declare other class methods like normal functions with the exception that the first argument to each method is *self*. Python adds the *self* argument to the list for you; you do not need to include it when you call the methods.

Creating Instance Objects

To create instances of a class, you call the class using class name and pass in whatever arguments its *__init__* method accepts.

```
"This would create first object of Employee class"
emp1 = Employee("Zara", 2000)
"This would create second object of Employee class"
emp2 = Employee("Manni", 5000)
```

Accessing Attributes

You access the object's attributes using the dot operator with object. Class variable would be accessed using class name as follows −

```
emp1.displayEmployee()
emp2.displayEmployee()
print "Total Employee %d" % Employee.empCount
```

Now, putting all the concepts together −

```
#!/usr/bin/python

class Employee:
   'Common base class for all employees'
   empCount = 0

   def __init__(self, name, salary):
      self.name = name
      self.salary = salary
```

```
    Employee.empCount += 1

  def displayCount(self):
    print "Total Employee %d" % Employee.empCount

  def displayEmployee(self):
    print "Name : ", self.name,  ", Salary: ", self.salary

"This would create first object of Employee class"
emp1 = Employee("Zara", 2000)
"This would create second object of Employee class"
emp2 = Employee("Manni", 5000)
emp1.displayEmployee()
emp2.displayEmployee()
print "Total Employee %d" % Employee.empCount
```

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

```
Name :  Zara ,Salary:  2000
Name :  Manni ,Salary:  5000
Total Employee 2
```

You can add, remove, or modify attributes of classes and objects at any time −

```
emp1.age = 7  # Add an 'age' attribute.
emp1.age = 8  # Modify 'age' attribute.
del emp1.age  # Delete 'age' attribute.
```

Instead of using the normal statements to access attributes, you can use the following functions −

- The **getattr(obj, name[, default])** : to access the attribute of object.
- The **hasattr(obj,name)** : to check if an attribute exists or not.

- The **setattr(obj,name,value)** : to set an attribute. If attribute does not exist, then it would be created.
- The **delattr(obj, name)** : to delete an attribute.

```
hasattr(emp1, 'age')    # Returns true if 'age' attribute exists
getattr(emp1, 'age')    # Returns value of 'age' attribute
setattr(emp1, 'age', 8) # Set attribute 'age' at 8
delattr(empl, 'age')    # Delete attribute 'age'
```

Built-In Class Attributes

Every Python class keeps following built-in attributes and they can be accessed using dot operator like any other attribute −

- **__dict__:** Dictionary containing the class's namespace.
- **__doc__:** Class documentation string or none, if undefined.
- **__name__:** Class name.
- **__module__:** Module name in which the class is defined. This attribute is "__main__" in interactive mode.
- **__bases__:** A possibly empty tuple containing the base classes, in the order of their occurrence in the base class list.

For the above class let us try to access all these attributes −

```
#!/usr/bin/python

class Employee:
   'Common base class for all employees'
   empCount = 0

   def __init__(self, name, salary):
      self.name = name
      self.salary = salary
```

```
      Employee.empCount += 1

   def displayCount(self):
     print "Total Employee %d" % Employee.empCount

   def displayEmployee(self):
      print "Name : ", self.name,  ", Salary: ", self.salary

print "Employee.__doc__:", Employee.__doc__
print "Employee.__name__:", Employee.__name__
print "Employee.__module__:", Employee.__module__
print "Employee.__bases__:", Employee.__bases__
print "Employee.__dict__:", Employee.__dict__
```

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

```
Employee.__doc__: Common base class for all employees
Employee.__name__: Employee
Employee.__module__: __main__
Employee.__bases__: ()
Employee.__dict__: {'__module__': '__main__', 'displayCount':
<function displayCount at 0xb7c84994>, 'empCount': 2,
'displayEmployee': <function displayEmployee at 0xb7c8441c>,
'__doc__': 'Common base class for all employees',
'__init__': <function __init__ at 0xb7c846bc>}
```

Destroying Objects (Garbage Collection)

Python deletes unneeded objects (built-in types or class instances) automatically to free the memory space. The process by which Python periodically reclaims blocks of memory that no longer are in use is termed Garbage Collection.

Python's garbage collector runs during program execution and is triggered when an object's reference count reaches zero. An object's reference count changes as the number of aliases that point to it changes.

Class Inheritance

Instead of starting from scratch, you can create a class by deriving it from a preexisting class by listing the parent class in parentheses after the new class name.

The child class inherits the attributes of its parent class, and you can use those attributes as if they were defined in the child class. A child class can also override data members and methods from the parent.

Syntax

Derived classes are declared much like their parent class; however, a list of base classes to inherit from is given after the class name −

```
class SubClassName (ParentClass1[, ParentClass2, ...]):
  'Optional class documentation string'
  class_suite
```

Example

```
#!/usr/bin/python

class Parent:        # define parent class
  parentAttr = 100
  def __init__(self):
    print "Calling parent constructor"

  def parentMethod(self):
    print 'Calling parent method'

  def setAttr(self, attr):
    Parent.parentAttr = attr

  def getAttr(self):
    print "Parent attribute :", Parent.parentAttr
```

```
class Child(Parent): # define child class
  def __init__(self):
    print "Calling child constructor"

  def childMethod(self):
    print 'Calling child method'

c = Child()          # instance of child
c.childMethod()      # child calls its method
c.parentMethod()     # calls parent's method
c.setAttr(200)       # again call parent's method
c.getAttr()          # again call parent's method
```

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

```
Calling child constructor
Calling child method
Calling parent method
Parent attribute : 200
```

Similar way, you can drive a class from multiple parent classes as follows −

```
class A:        # define your class A
.....

class B:         # define your class B
.....

class C(A, B):   # subclass of A and B
.....
```

You can use issubclass() or isinstance() functions to check a relationships of two classes and instances.

- The **issubclass(sub, sup)** boolean function returns true if the given subclass **sub** is indeed a subclass of the superclass **sup**.

- The **isinstance(obj, Class)** boolean function returns true if *obj* is an instance of class *Class* or is an instance of a subclass of Class

Overriding Methods

You can always override your parent class methods. One reason for overriding parent's methods is because you may want special or different functionality in your subclass.

Example

```
#!/usr/bin/python


class Parent:        # define parent class
   def myMethod(self):
      print 'Calling parent method'


class Child(Parent): # define child class
   def myMethod(self):
      print 'Calling child method'


c = Child()          # instance of child
c.myMethod()         # child calls overridden method
```

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

```
Calling child method
```

Data Hiding

An object's attributes may or may not be visible outside the class definition. You need to name attributes with a double underscore prefix, and those attributes then are not be directly visible to outsiders.