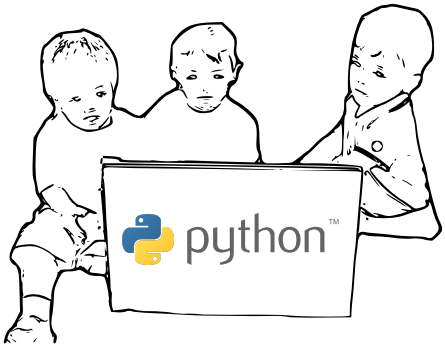
Python for you and me 0.2

Python for you and me

A book to learn Python in a quick way (work in progress)

Edition 2



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Abstract

This book is for the python newbies

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Preface

1. Document Conventions

This manual uses several conventions to highlight certain words and phrases and draw attention to specific pieces of information.

In PDF and paper editions, this manual uses typefaces drawn from the Liberation Fonts set. The Liberation Fonts set is also used in HTML editions if the set is installed on your system. If not, alternative but equivalent typefaces are displayed. Note: Red Hat Enterprise Linux 5 and later includes the Liberation Fonts set by default.

1.1. Typographic Conventions

Four typographic conventions are used to call attention to specific words and phrases. These conventions, and the circumstances they apply to, are as follows.

`Mono-spaced Bold`

Used to highlight system input, including shell commands, file names and paths. Also used to highlight keys and key combinations. For example:

> To see the contents of the file **`my_next_bestselling_novel`** in your current working directory, enter the **`cat my_next_bestselling_novel`** command at the shell prompt and press **`Enter`** to execute the command.

The above includes a file name, a shell command and a key, all presented in mono-spaced bold and all distinguishable thanks to context.

Key combinations can be distinguished from an individual key by the plus sign that connects each part of a key combination. For example:

> Press **`Enter`** to execute the command.
>
> Press **`Ctrl`**+**`Alt`**+**`F2`** to switch to a virtual terminal.

The first example highlights a particular key to press. The second example highlights a key combination: a set of three keys pressed simultaneously.

If source code is discussed, class names, methods, functions, variable names and returned values mentioned within a paragraph will be presented as above, in **`mono-spaced bold`**. For example:

> File-related classes include **`filesystem`** for file systems, **`file`** for files, and **`dir`** for directories. Each class has its own associated set of permissions.

Proportional Bold

This denotes words or phrases encountered on a system, including application names; dialog box text; labeled buttons; check-box and radio button labels; menu titles and sub-menu titles. For example:

> Choose **System** → **Preferences** → **Mouse** from the main menu bar to launch **Mouse Preferences**. In the **Buttons** tab, click the **Left-handed mouse** check box and click **Close** to switch the primary mouse button from the left to the right (making the mouse suitable for use in the left hand).
>
> To insert a special character into a **gedit** file, choose **Applications** → **Accessories** → **Character Map** from the main menu bar. Next, choose **Search** → **Find...** from the

> **Character Map** menu bar, type the name of the character in the **Search** field and click **Next**. The character you sought will be highlighted in the **Character Table**. Double-click this highlighted character to place it in the **Text to copy** field and then click the **Copy** button. Now switch back to your document and choose **Edit** → **Paste** from the **gedit** menu bar.

The above text includes application names; system-wide menu names and items; application-specific menu names; and buttons and text found within a GUI interface, all presented in proportional bold and all distinguishable by context.

Mono-spaced Bold Italic or ***Proportional Bold Italic***

Whether mono-spaced bold or proportional bold, the addition of italics indicates replaceable or variable text. Italics denotes text you do not input literally or displayed text that changes depending on circumstance. For example:

> To connect to a remote machine using ssh, type **ssh *username*@*domain.name*** at a shell prompt. If the remote machine is **example.com** and your username on that machine is john, type **ssh john@example.com**.
>
> The **mount -o remount *file-system*** command remounts the named file system. For example, to remount the **/home** file system, the command is **mount -o remount /home**.
>
> To see the version of a currently installed package, use the **rpm -q *package*** command. It will return a result as follows: ***package-version-release***.

Note the words in bold italics above — username, domain.name, file-system, package, version and release. Each word is a placeholder, either for text you enter when issuing a command or for text displayed by the system.

Aside from standard usage for presenting the title of a work, italics denotes the first use of a new and important term. For example:

> Publican is a *DocBook* publishing system.

1.2. Pull-quote Conventions

Terminal output and source code listings are set off visually from the surrounding text.

Output sent to a terminal is set in **mono-spaced roman** and presented thus:

```
books        Desktop   documentation  drafts  mss    photos   stuff  svn
books_tests  Desktop1  downloads      images  notes  scripts  svgs
```

Source-code listings are also set in **mono-spaced roman** but add syntax highlighting as follows:

```
package org.jboss.book.jca.ex1;

import javax.naming.InitialContext;

public class ExClient
{
   public static void main(String args[])
       throws Exception
   {
      InitialContext iniCtx = new InitialContext();
      Object         ref    = iniCtx.lookup("EchoBean");
      EchoHome       home   = (EchoHome) ref;
      Echo           echo   = home.create();

      System.out.println("Created Echo");

      System.out.println("Echo.echo('Hello') = " + echo.echo("Hello"));
   }
}
```

1.3. Notes and Warnings

Finally, we use three visual styles to draw attention to information that might otherwise be overlooked.

Note

Notes are tips, shortcuts or alternative approaches to the task at hand. Ignoring a note should have no negative consequences, but you might miss out on a trick that makes your life easier.

Important

Important boxes detail things that are easily missed: configuration changes that only apply to the current session, or services that need restarting before an update will apply. Ignoring a box labeled 'Important' will not cause data loss but may cause irritation and frustration.

Warning

Warnings should not be ignored. Ignoring warnings will most likely cause data loss.

2. We Need Feedback!

You should over ride this by creating your own local Feedback.xml file.

Chapter 1. Installation

In this chapter you will learn how to install python

1.1. On Windows

You have to download the latest Windows(TM) installer from the python site http://www.python.org/ftp/python/2.7.3/python-2.7.3.msi . Install it just as any other Windows software.

1.2. On GNU/Linux

Generally all GNU/Linux distributions come with Python, so no need to worry about that :) If you don't have it then you can install it by either downloading from the python website or from your distribution's repository.

For Fedora

```
[user@host]$ sudo yum install python
```

For Debian

```
[user@host]$ sudo apt-get install python
```

Chapter 2. The Beginning

So we are going to look at our first code. As python is an interpreted language , you can directly write the code into the python interpreter or write in a file and then run the file. First we are going to do that using the interpreter, to start type python in the command prompt (shell or terminal).

```
[kd@kdlappy ~]$ python
Python 2.5.1 (r251:54863, Oct 30 2007, 13:54:11)
[GCC 4.1.2 20070925 (Red Hat 4.1.2-33)] on linux2
Type "help", "copyright", "credits" or "license" for more information.
>>>
```

In our first code we are going to print "Hello World!" , so do it as below,

```
>>> print "Hello World!"
Hello World!
```

2.1. helloworld.py

Now as a serious programmer you may want to write the above code into a source file. We will create a helloworld.py. Use any text editor you like to create the file. I used vi, you can even use GUI based tools like Kate, gedit too.

```
#!/usr/bin/env python
print "Hello World!"
```

To run the code first you have to make the file executable, in GNU/Linux you can do that by giving the command in a shell or terminal

```
$ chmod +x helloworld.py
```

Then

```
$ ./helloworld.py
Hello World!
```

On the first line you can *#!* , we call it sha-bang. Using this we are telling that use python interpreter to run this code. In the next line we are printing a text message. In python we call all the line of texts as strings.

2.2. Whitespaces and indentation

In Python whitespace is an important thing. We divide different identifiers using spaces.Whitespace in the beginning of the line is known as indentation, but if you give wrong indentation it will throw an error. Examples are given below:

```
>>> a = 12
>>>  a = 12
  File "<stdin>", line 1
      a = 12
          ^
          IndentationError: unexpected indent
```

Warning

There is an extra space in the beginning of the second line which is causing the error, so always look for the proper indentation.
You can even get into this indentation errors if you mix up tabs and spaces. Like if you use spaces and only use spaces for indentation, don't use tabs in that case. For you it may look same, but the code will give you error if you try to run it.

So we can have few basic rules ready for spaces and indentation.

- Use 4 spaces for indentation.
- Never mix tab and spaces.
- One blank line between functions.
- Two blank lines between classes.

There are more places where you should be following same type of rules of whitespace, they are like

- Add a space after "," in dicts, lists, typles, and argument lists and after ":" in dicts.
- Spaces around assignments and comparisons (except in argument list)
- No spaces just inside parentheses.

2.3. Comments

Comments are some piece of English text which explains what this code does, we write comments in the code so that is easier for others to understand. A comment line starts with # , everything after that is ignored as comment, that means they don't effect on the program.

```
>>> #this is a comment
>>> #the next line will add two numbers
>>> a = 12 + 34
>>> print c #this is a comment too :)
```

Comments are mainly for the people will *develop* or *maintain* the codebase, so it means if you have some complex code somewhere you should write enough comments inside so that anyone else can understand the code by reading the comments. You can also use some standard comments like

```
#FIXME -- fix these code later
#TODO -- in future you have to do this
```

2.4. Modules

Modules are python files which contain different function definitions , variables which we can reuse, it should always end with a .py extension.. Python itself is having a vast module library with the default installation. We are going to use some of them. To use a module you have to import it first.

```
>>> import math
>>> print math.e
2.71828182846
```

We are going to learn more about modules on the Modules chapter.

Chapter 3. Variables and Datatypes

Every programming language is having own grammar rules just like the other languages we speak.

3.1. Keywords and Identifiers

Python codes can be divided into identifiers. Identifiers (also referred to as names) are described by the following lexical definitions:

```
identifier ::= (letter|"_") (letter | digit | "_")*
letter ::= lowercase | uppercase
lowercase ::= "a"..."z"
uppercase ::= "A"..."Z"
digit ::= "0"..."9"
```

This means *_abcd* is a valid identifier where as *1sd* is not. The following identifiers are used as reserved words, or keywords of the language, and cannot be used as ordinary identifiers. They must be spelled exactly as written here:

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

In Python we don't specify what kind of data we are going to put in a variable. So you can directly write abc = 1 and abc will become an integer datatype. If you write abc = 1.0 abc will become of floating type. Here is a small program to add two given numbers

```
>>> a = 13
>>> b = 23
>>> a + b
36
```

From the above example you can understand that to declare a variable in python , what you need is just to type the name and the value. Python can also manipulate strings They can be enclosed in single quotes or double quotes like

```
>>> 'India'
'India'
>>> 'India\'s best'
"India's best"
>>> "Hello World!"
'Hello World!'
```

3.2. Reading input from the Keyboard

Generally the real life python codes do not need to read input from the keyboard. In python we use raw_input function to do input. *raw_input("String to show")* , this will return a string as output. Let us write

a program to read a number from the keyboard and check if it is less than 100 or not. Name of the program is testhundred.py

```
#!/usr/bin/env python
number = int(raw_input("Enter an integer: "))
if number < 100:
    print "Your number is smaller than 100"
else:
    print "Your number is greater than 100"
```

The output

```
$ ./testhundred.py
Enter an integer: 13
Your number is smaller than 100
$ ./testhundred.py
Enter an integer: 123
Your number is greater than 100
```

In the next program we are going to calculate investments.

```
#!/usr/bin/env python
amount = float(raw_input("Enter amount: "))
inrate = float(raw_input("Enter Interest rate: "))
period = int(raw_input("Enter period: "))
value = 0
year = 1
while year <= period:
    value = amount + (inrate * amount)
    print "Year %d Rs. %.2f" %(year, value)
    amount = value
    year = year + 1
```

The output

```
$ ./investment.py
Enter amount: 10000
Enter Interest rate: 0.14
Enter period: 5
Year 1 Rs. 11400.00
Year 2 Rs. 12996.00
Year 3 Rs. 14815.44
Year 4 Rs. 16889.60
Year 5 Rs. 19254.15
```

3.3. Some Examples

Some examples of variables and datatypes:

3.3.1. Average of N numbers

In the next program we will do an average of N numbers.

```
#!/usr/bin/env python
N = 10
sum = 0
count = 0
while count < N:
    number = float(raw_input(""))
    sum = sum + number
    count = count + 1
average = float(sum)/N
print "N = %d , Sum = %f" % (N, sum)
print "Average = %f" % average
```

The output

```
$ ./averagen.py
1
2.3
4.67
1.42
7
3.67
4.08
2.2
4.25
8.21
N = 10 , Sum = 38.800000
Average = 3.880000
```

3.3.2. Temperature conversion

In this program we will convert the given temperature to Celsius from Fahrenheit by using the formula C=(F-32)/1.8

```
#!/usr/bin/env python
fahrenhite = 0.0
print "Fahrenheit Celsius"
while fahrenheit <= 250:
    celsius = ( fahrenheit - 32.0 ) / 1.8 #Here we calculate the fahrenhite
value
    print "%5.1f %7.2f" % (fahrenheit , celsius)
    fahrenheit = fahrenheit + 25
```

The output

```
[kd@kdlappy book]$ ./temperature.py
Fahrenheit Celsius
  0.0  -17.78
 25.0   -3.89
 50.0   10.00
 75.0   23.89
100.0   37.78
125.0   51.67
150.0   65.56
175.0   79.44
200.0   93.33
225.0  107.22
250.0  121.11
```

3.4. Multiple assignments in a single line

You can even assign values to multiple variables in a single line, like

```
>>> a , b = 45, 54
>>> a
45
>>> b
54
```

Using this swapping two numbers becomes very easy

```
>>> a, b = b , a
>>> a
54
>>> b
45
```

To understand how this works, you will have to learn about a data type called *tuple*. We use *comma* to create tuple. In the right hand side we create the tuple (we call this as tuple packing) and in the left hand side we do tuple unpacking into a new tuple.

Below we have another example of tuple unpacking.

```
>>> data = ("Kushal Das", "India", "Python")
>>> name, country, language = data
>>> name
'Kushal Das'
>>> country
'India'
>>> language
'Python'
```

Chapter 4. Operators and expressions

In python most of the lines you will write will be expressions. Expressions are made of operators and operands. An expression is like *2 + 3* .

4.1. Operators

Operators are the symbols which tells the python interpreter to do some mathematical or logical operation. Few basic examples of mathematical operators are given below:

```
>>> 2 + 3
5
>>> 23 - 3
20
>>> 22.0 / 12
1.8333333333333333
```

To get floating result you need to the division using any of operand as floating number. To do modulo operation use % operator

```
>>> 14 % 3
2
```

4.2. Example of integer arithmetic

The code

```
#!/usr/bin/env python
days = int(raw_input("Enter days: "))
months = days / 30
days = days % 30
print "Months = %d Days = %d" % (months, days)
```

The output

```
$ ./integer.py
Enter days: 265
Months = 8 Days = 25
```

In the first line I am taking the input of days, then getting the months and days and at last printing them. You can do it in a easy way

```
#!/usr/bin/env python
days = int(raw_input("Enter days: "))
print "Months = %d Days = %d" % (divmod(days, 30))
```

The divmod(num1, num2) function returns two values , first is the division of num1 and num2 and in second the modulo of num1 and num2.

4.3. Relational Operators

You can use the following operators as relational operators

Relational Operators
Operator: <
Meaning: Is less than
Operator: <=
Meaning: Is less than or equal to
Operator: >
Meaning: Is greater than
Operator: >=
Meaning: Is greater than or equal to
Operator: ==
Meaning: Is equal to
Operator: !=
Meaning: Is not equal to

Some examples

```
>>> 1 < 2
True
>>> 3 > 34
False
>>> 23 == 45
False
>>> 34 != 323
True
```

// operator gives the floor division result

```
>>> 4.0 // 3
1.0
>>> 4.0 / 3
1.3333333333333333
```

4.4. Logical Operators

To do logical AND , OR we use *and* , *or* keywords. *x and y* returns *False* if *x* is *False* else it returns evaluation of *y*. If *x* is *True*, it returns *True*.

```
>>> 1 and 4
4
>>> 1 or 4
1
>>> -1 or 4
-1
>>> 0 or 4
4
```

4.5. Shorthand Operator

x op = expression is the syntax for shorthand operators. It will be evaluated like *x = x op expression* , Few examples are

```
>>> a = 12
>>> a += 13
>>> a
25
>>> a /= 3
>>> a
8
>>> a += (26* 32)
>>> a
840
```

shorthand.py example

```
#!/usr/bin/env python
N = 100
a = 2
while a < N:
    print "%d" % a
    a *= a
```

The output

```
$ ./shorthand.py
2
4
16
```

4.6. Expressions

Generally while writing expressions we put spaces before and after every operator so that the code becomes clearer to read, like

```
a = 234 * (45 - 56.0 / 34)
```

One example code used to show expressions

```
#!/usr/bin/env python
a = 9
b = 12
c = 3
x = a -b / 3 + c * 2 -1
y = a -b / (3 + c) * (2 -1)
z = a - (b / (3 +c) * 2) -1
print "X = ", x
print "Y = ", y
print "Z = ", z
```

The output

```
$ ./evaluationexp.py
X =  10
Y =  7
Z =  4
```

At first *x* is being calculated. The steps are like this

```
9 - 12 / 3 + 3 * 2 -1
9 - 4 + 3 * 2 - 1
9 - 4 + 6 - 1
5 + 6 -1
11 - 1
10
```

Now for *y* and *z* we have parentheses, so the expressions evaluated in different way. Do the calculation yourself to check them.

4.7. Type Conversions

We have to do the type conversions manually. Like

```
float(string) -> float value
int(string) -> integer value
str(integer) or str(float) -> string representation
>>> a = 8.126768
>>> str(a)
'8.126768'
```

4.8. evaluateequ.py

This is a program to evaluate 1/x+1/(x+1)+1/(x+2)+ ... +1/n series upto n, in our case x = 1 and n =10

```
#!/usr/bin/env python
sum = 0.0
for i in range(1, 11):
    sum += 1.0 / i
    print "%2d %6.4f" % (i , sum)
```

The output

```
$ ./evaluateequ.py
 1 1.0000
 2 1.5000
 3 1.8333
 4 2.0833
 5 2.2833
 6 2.4500
 7 2.5929
 8 2.7179
 9 2.8290
10 2.9290
```

In the line *sum += 1.0 / i* what is actually happening is *sum = sum + 1.0 / i*.

4.9. quadraticequation.py

This is a program to evaluate the quadratic equation

```
#!/usr/bin/env python
import math
a = int(raw_input("Enter value of a: "))
b = int(raw_input("Enter value of b: "))
c = int(raw_input("Enter value of c: "))
d = b * b - 4 * a * c
if d < 0:
    print "ROOTS are imaginary"
else:
    root1 = (-b + math.sqrt(d)) / (2.0 * a)
    root2 = (-b - math.sqrt(d)) / (2.0 * a)
print "Root 1 = ", root1
print "Root 2 = ", root2
```

4.10. salesmansalary.py

In this example we are going to calculate the salary of a camera salesman. His basic salary is 1500, for every camera he will sell he will get 200 and the commission on the month's sale is 2 %. The input will be number of cameras sold and total price of the cameras.

```
#!/usr/bin/env python
basic_salary = 1500
bonus_rate = 200
commision_rate = 0.02
numberofcamera = int(raw_input("Enter the number of inputs sold: "))
price = float(raw_input("Enter the total prices: "))
bonus = (bonus_rate * numberofcamera)
commision = (commision_rate * numberofcamera * price)

print "Bonus        = %6.2f" % bonus
print "Commision    = %6.2f" % commision
print "Gross salary = %6.2f" % ( basic_salary + bonus + commision)
```

The output

```
$ ./salesmansalary.py
Enter the number of inputs sold: 5
Enter the total prices: 20450
Bonus        = 1000.00
Commision    = 2045.00
Gross salary = 4545.00
```

Chapter 5. If-else , the control flow

While working on real life of problems we have to make decisions. Decisions like which camera to buy or which cricket bat is better. At the time of writing a computer program we do the same. We make the decisions using if-else statements, we change the flow of control in the program by using them.

5.1. If statement

The syntax looks like

```
if expression:
    do this
```

If the value of *expression* is true (anything other than zero), do the what is written below under indentation. Please remember to give proper indentation, all the lines indented will be evaluated on the True value of the expression. One simple example is to take some number as input and check if the number is less than 100 or not.

```
#!/usr/bin/env python
number = int(raw_input("Enter a number: "))
if number < 100:
    print "The number is less than 100"
```

Then we run it

```
$ ./number100.py
Enter a number: 12
The number is less than 100
```

5.2. Else statement

Now in the above example we want to print "Greater than" if the number is greater than 100. For that we have to use the *else* statement. This works when the *if*statement is not fulfilled.

```
#!/usr/bin/env python
number = int(raw_input("Enter a number: "))
if number < 100:
    print "The number is less than 100"
else:
    print "The number is greater than 100"
```

The output

```
$ ./number100.py
Enter a number: 345
The number is greater than 100
```

Another very basic example

```
>>> x = int(raw_input("Please enter an integer: "))
>>> if x < 0:
...      x = 0
...      print 'Negative changed to zero'
... elif x == 0:
...      print 'Zero'
... elif x == 1:
...      print 'Single'
... else:
...      print 'More'
```

5.3. Truth value testing

The elegant way to test Truth values is like

```
if x:
    pass
```

Don't do this

```
if x == True:
    pass
```

Chapter 6. Looping

In the examples we used before , sometimes it was required to do the same work couple of times. We use a counter to check how many times the code needs to be executed. This technique is known as looping. First we are going to look into while statement for looping.

6.1. While loop

The syntax for *while* statement is like

```
while condition:
    statement1
    statement2
```

The code we want to reuse must be indented properly under the while statement. They will be executed if the *condition* is true. Again like in *if-else* statement any non zero value is true. Let us write a simple code to print numbers 0 to 10

```
>>> n = 0
>>> while n < 11:
...     print n
...     n += 1
...
0
1
2
3
4
5
6
7
8
9
10
```

In the first line we are setting *n = 0*, then in the while statement the condition is *n < 11* , that means what ever line indented below that will execute until n becomes same or greater than 11. Inside the loop we are just printing the value of n and then increasing it by one.

6.2. Fibonacci Series

Let us try to solve *Fibonacci* series. In this series we get the next number by adding the previous two numbers. So the series looks like *1,1,2,3,5,8,13 .....*

```
#!/usr/bin/env python
a, b = 0, 1
while b < 100:
    print b
    a, b = b, a + b
```

The output

```
$ ./fibonacci1.py
1
1
2
3
5
8
13
21
34
55
89
```

In the first line of the code we are initializing *a* and *b*, then looping while b's value is less than 100. Inside the loop first we are printing the value of *b* and then in the next line putting the value of *b* to *a* and *a* + *b* to *b* in the same line.

If you put a trailing comma in the *print* statement , then it will print in the same line

```
#!/usr/bin/env python
a, b = 0, 1
while b < 100:
    print b,
    a, b = b, a + b
```

The output

```
$ ./fibonacci2.py
1 1 2 3 5 8 13 21 34 55 89
```

6.3. Power Series

Let us write a program to evaluate the power series. The series looks like e**x =1+x+x**2/2! +x**3/3! +....+ x**n/n! where 0 < x < 1

```
#!/usr/bin/env python
x = float(raw_input("Enter the value of x: "))
n = term = num = 1
sum = 1.0
while n <= 100:
    term *= x / n
    sum += term
    n += 1
    if term < 0.0001:
        break
print "No of Times= %d and Sum= %f" % (n, sum)
```

The output

```
$ ./powerseries.py
Enter the value of x: 0
No of Times= 2 and Sum= 1.000000
$ ./powerseries.py
Enter the value of x: 0.1
No of Times= 5 and Sum= 1.105171
$ ./powerseries.py
Enter the value of x: 0.5
No of Times= 7 and Sum= 1.648720
```

In this program we introduced a new keyword called *break*. What break does is stop the innermost loop. In this example we are using *break* under the *if* statement

```
if term < 0.0001:
        break
```

This means if the value of *term* is less than *0.0001* then get out of the loop.

6.4. Multiplication Table

In this example we are going to print the multiplication table up to 10.

```
#!/usr/bin/env python
i = 1
print "-" * 50
while i < 11:
    n = 1
    while n <= 10:
        print "%4d" % (i * n),
        n += 1
    print ""
    i += 1
print "-" * 50
```

The output

```
$ ./multiplication.py
--------------------------------------------------
   1    2    3    4    5    6    7    8    9   10
   2    4    6    8   10   12   14   16   18   20
   3    6    9   12   15   18   21   24   27   30
   4    8   12   16   20   24   28   32   36   40
   5   10   15   20   25   30   35   40   45   50
   6   12   18   24   30   36   42   48   54   60
   7   14   21   28   35   42   49   56   63   70
   8   16   24   32   40   48   56   64   72   80
   9   18   27   36   45   54   63   72   81   90
  10   20   30   40   50   60   70   80   90  100
--------------------------------------------------
```

Here we used one while loop inside another loop, this is known as nested looping. You can also see one interesting statement here

```
print "-" * 50
```

In a *print* statement if we multiply the string with an integer *n* , the string will be printed *n*many times. Some examples

```
>>> print "*" * 10
**********
>>> print "#" * 20
####################
>>> print "--" * 20
----------------------------------------
>>> print "-" * 40
----------------------------------------
```

6.5. Some printing * examples

Here are some examples which you can find very often in college lab reports

Design 1

```
#!/usr/bin/env python
row = int(raw_input("Enter the number of rows: "))
n = row
while n >= 0:
    x =  "*" * n
    print x
    n -= 1
```

The output

```
$ ./design1.py
Enter the number of rows: 5
*****
****
***
**
*
```

Design 2

```
#!/usr/bin/env python
n = int(raw_input("Enter the number of rows: "))
i = 1
while i <= n:
    print "*" * i
    i += 1
```

The output

```
$ ./design2.py
Enter the number of rows: 5
*
**
***
****
*****
```

Design 3

```
#!/usr/bin/env python
row = int(raw_input("Enter the number of rows: "))
n = row
while n >= 0:
    x =  "*" * n
    y = " " * (row - n)
    print y + x
    n -= 1
```

The output

```
$ ./design3.py
Enter the number of rows: 5
*****
 ****
  ***
   **
    *
```

6.6. Lists

We are going to learn a data structure called list before we go ahead to learn more on looping. Lists an be written as a list of comma-separated values (items) between square brackets.

```
>>> a = [ 1 , 342, 2233423, 'India', 'Fedora']
>>> a
[1, 342, 2233423, 'India', 'Fedora']
```

Lists can keep any other data inside it. It works as a sequence too, that means

```
>>> a[0]
1
>>> a[4]
'Fedora'
```

You can even slice it into different pieces, examples are given below

```
>>> a[4]
'Fedora'
>>> a[-1]
'Fedora'
>>> a[-2]
'India'
>>> a[0:-1]
[1, 342, 2233423, 'India']
>>> a[2:-2]
[2233423]
>>> a[:-2]
[1, 342, 2233423]
>>> a[0::2]
[1, 2233423, 'Fedora']
```

In the last example we used two :(s) , the last value inside the third brackets indicates step. *s[i:j:k]* means slice of *s* from *i* to *j* with step *k*.

To check if any value exists within the list or not you can do

```
>>> a = ['Fedora', 'is', 'cool']
>>> 'cool' in a
True
>>> 'Linux' in a
False
```

That means we can use the above statement as *if* clause expression. The built-in function *len()* can tell the length of a list.

```
>>> len(a)
3
```

Note

If you want to test if the list is empty or not, do it like this

```
if list_name: #This means the list is not empty
    pass
else: #This means the list is empty
    pass
```

6.7. For loop

There is another to loop by using *for* statement. In python the *for* statement is different from the way it works in *C*. Here for statement iterates over the items of any sequence (a list or a string). Example given below

```
>>> a = ['Fedora', 'is', 'powerfull']
>>> for x in a:
...     print x,
...
Fedora is powerfull
```

We can also do things like

```
>>> a = [1, 2, 3, 4, 5, 6, 7, 8, 9, 10]
>>> for x in a[::2]:
...     print x
...
1
3
5
7
9
```

6.8. range() function

range() is a buitin function. From the help document

```
range(...)
    range([start,] stop[, step]) -> list of integers
    Return a list containing an arithmetic progression of integers.
    range(i, j) returns [i, i+1, i+2, ..., j-1]; start (!) defaults to 0.
    When step is given, it specifies the increment (or decrement).
    For example, range(4) returns [0, 1, 2, 3].  The end point is omitted!
    These are exactly the valid indices for a list of 4 elements.
```

Now if you want to see this help message on your system type *help(range)* in the python interpreter. *help(s)* will return help message on the object *s*. Examples of *range* function

```
>>> range(1,5)
[1, 2, 3, 4]
>>> range(1,15,3)
[1, 4, 7, 10, 13]
>>> range(10)
[0, 1, 2, 3, 4, 5, 6, 7, 8, 9]
```

6.9. Continue statement

Just like *break* we have another statement, *continue*, which skips the execution of the code after itself and goes back to the start of the loop. That means it will help you to skip a part of the loop. In the below example we will ask the user to input an integer, if the input is negative then we will ask again, if positive then we will square the number. To get out of the infinite loop user must input 0.

```
#!/usr/bin/env python
while True:
    n = int(raw_input("Please enter an Integer: "))
    if n < 0:
        continue #this will take the execution back to the starting of the loop
    elif n == 0:
        break
    print "Square is ", n ** 2
print "Goodbye"
```

The output

```
$ ./continue.py
Please enter an Integer: 34
Square is 1156
Please enter an Integer: 4
Square is 16
Please enter an Integer: -9
Please enter an Integer: 0
Goodbye
```

6.10. Else loop

We can have an optional *else* statement after any loop. It will be executed after the loop unless a *break* statement stopped the loop.

```
>>> for i in range(0,5):
...     print i
... else:
...     print "Bye bye"
...
0
1
2
3
4
Bye bye
```

We will see more example of *break* and *continue* later in the book.

6.11. Game of sticks

This is a very simple game of sticks. There are 21 sticks, first the user picks number of sticks between 1-4, then the computer picks sticks(1-4). Who ever will pick the last stick will loose. Can you find out the case when the user will win ?

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

sticks = 21

print "There are 21 sticks, you can take 1-4 number of sticks at a time."
print "Whoever will take the last stick will loose"

while True:
    print "Sticks left: " , sticks
    sticks_taken = int(raw_input("Take sticks(1-4):"))
    if sticks == 1:
        print "You took the last stick, you loose"
        break
    if sticks_taken >=5 or sticks_taken <=0:
        print "Wrong choice"
        continue
    print "Computer took: " , (5 - sticks_taken) , "\n\n"
    sticks -= 5
```

Chapter 7. Data Structures

Python is having a few built-in data structure. If you are still wondering what is a data structure, then it is nothing a but a way to store data and the having particular methods to retrieve or manipulate it. We already saw lists before, now we will go in depth.

7.1. Lists

```
>>> a = [23, 45, 1, -3434, 43624356, 234]
>>> a.append(45)
>>> a
[23, 45, 1, -3434, 43624356, 234, 45]
```

At first we created a list *a*. Then to add *45* at the end of the list we call *a.append(45)* method. You can see that *45* added at the end of the list. Sometimes it may require to insert data at any place within the list, for that we have *insert()* method.

```
>>> a.insert(0, 1) # 1 added at the 0th position of the list
>>> a
[1, 23, 45, 1, -3434, 43624356, 234, 45]
>>> a.insert(0, 111)
>>> a
[111, 1, 23, 45, 1, -3434, 43624356, 234, 45]
```

count(s) will return you number of times *s* is in the list. Here we are going to check how many times *45* is there in the list.

```
>>> a.count(45)
2
```

If you want to any particular value from the list you have to use *remove()* method.

```
>>> a.remove(234)
>>> a
[111, 1, 23, 45, 1, -3434, 43624356, 45]
```

Now to reverse the whole list

```
>>> a.reverse()
>>> a
[45, 43624356, -3434, 1, 45, 23, 1, 111]
```

We can store anything in the list, so first we are going to add another list *b* in *a* , then we will learn how to add the values of *b* into *a* .

```
>>> b = [45, 56, 90]
>>> a.append(b)
>>> a
[45, 43624356, -3434, 1, 45, 23, 1, 111, [45, 56, 90]]
>>> a[-1]
[45, 56, 90]
>>> a.extend(b) #To add the values of b not the b itself
>>> a
[45, 43624356, -3434, 1, 45, 23, 1, 111, [45, 56, 90], 45, 56, 90]
>>> a[-1]
90
```

Above you can see how we used *a.extend()* method to extend the list. To sort any list we have *sort()* method.

```
>>> a.sort()
>>> a
[-3434, 1, 1, 23, 45, 45, 45, 56, 90, 111, 43624356, [45, 56, 90]]
```

You can also delete element at any particular position of the list using the del keyword.

```
>>> del a[-1]
>>> a
[-3434, 1, 1, 23, 45, 45, 45, 56, 90, 111, 43624356]
```

7.2. Using lists as stack and queue

Stacks are often known as LIFO (Last In First Out) structure. It means the data will enter into it at the end , and the last data will come out first. The easiest example can be of couple of marbles in an one side closed pipe. So if you want to take the marbles out of it you have to do that from the end where you entered the last marble. To achieve the same in code

```
>>> a
[1, 2, 3, 4, 5, 6]
>>> a.pop()
6
>>> a.pop()
5
>>> a.pop()
4
>>> a.pop()
3
>>> a
[1, 2]
>>> a.append(34)
>>> a
[1, 2, 34)
```

We learned a new method above *pop()*. *pop(i)* will take out the ith data from the list.

In our daily life we have to encounter queues many times, like in ticket counters or in library or in the billing section of any supermarket. Queue is the data structure where you can append more data at the end and take out data from the beginning. That is why it is known as FIFO (First In First Out).

```
>>> a = [1, 2, 3, 4, 5]
>>> a.append(1)
>>> a
[1, 2, 3, 4, 5, 1]
>>> a.pop(0)
1
>>> a.pop(0)
2
>>> a
[3, 4, 5, 1]
```

To take out the first element of the list we are using *a.pop(0)*.

7.3. List Comprehensions

List comprehensions provide a concise way to create lists. Each list comprehension consists of an expression followed by a for clause, then zero or more for or if clauses. The result will be a list resulting from evaluating the expression in the context of the for and if clauses which follow it.

For example if we want to make a list out of the square values of another list, then

```
>>> a = [1, 2, 3]
>>> [x ** 2 for x in a]
[1, 4, 9]
>>> z = [x + 1 for x in [x ** 2 for x in a]]
>>> z
[2, 5, 10]
```

Above in the second case we used two list comprehensions in a same line.

7.4. Tuples

Tuples are data separated by comma.

```
>>> a = 'Fedora', 'Debian', 'Kubuntu', 'Pardus'
>>> a
('Fedora', 'Debian', 'Kubuntu', 'Pardus')
>>> a[1]
'Debian'
>>> for x in a:
...     print x,
...
Fedora Debian Kubuntu Pardus
```

You can also unpack values of any tuple in to variables, like

```
>>> divmod(15,2)
(7, 1)
>>> x, y = divmod(15,2)
>>> x
7
>>> y
1
```

Tuples are immutable, that means you can not del/add/edit any value inside the tuple. Here is another example

```
>>> a = (1, 2, 3, 4)
>>> del a[0]
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
TypeError: 'tuple' object doesn't support item deletion
```

Above you can see python is giving error when we are trying to delete a value in the tuple.

To create a tuple which contains only one value you have to type a trailing comma.

```
>>> a = (123)
>>> a
123
>>> type(a)
<type 'int'>
>>> a = (123, ) #Look at the trailing comma
>>> a
(123,)
>>> type(a)
<type 'tuple'>
```

Using the buitin function *type()* you can know the data type of any variable. Remember the *len()* function we used to find the length of any sequence ?

```
>>> type(len)
<type 'bulletin_function_or_method'>
```

7.5. Sets

Sets are another type of data structure with no duplicate items. We can also mathematical set operations on sets.

```
>>> a = set('abcthabcjwethddda')
>>> a
set(['a', 'c', 'b', 'e', 'd', 'h', 'j', 't', 'w'])
```

And some examples of the set operations

```
>>> a = set('abracadabra')
>>> b = set('alacazam')
>>> a                                  # unique letters in a
set(['a', 'r', 'b', 'c', 'd'])
>>> a - b                              # letters in a but not in b
set(['r', 'd', 'b'])
>>> a | b                              # letters in either a or b
set(['a', 'c', 'r', 'd', 'b', 'm', 'z', 'l'])
>>> a & b                              # letters in both a and b
set(['a', 'c'])
>>> a ^ b                              # letters in a or b but not both
set(['r', 'd', 'b', 'm', 'z', 'l'])
```

To add or pop values from a set

```
>>> a
set(['a', 'c', 'b', 'e', 'd', 'h', 'j', 'q', 't', 'w'])
>>> a.add('p')
>>> a
set(['a', 'c', 'b', 'e', 'd', 'h', 'j', 'q', 'p', 't', 'w'])
```

7.6. Dictionaries

Dictionaries are unordered set of *key: value* pairs where keys are unique. We declare dictionaries using {} braces. We use dictionaries to store data for any particular key and then retrieve them.

```
>>> data = {'kushal':'Fedora', 'kart_':'Debian', 'Jace':'Mac'}
>>> data
{'kushal': 'Fedora', 'Jace': 'Mac', 'kart_': 'Debian'}
>>> data['kart_']
'Debian'
```

We can add more data to it by simply

```
>>> data['parthan'] = 'Ubuntu'
>>> data
{'kushal': 'Fedora', 'Jace': 'Mac', 'kart_': 'Debian', 'parthan': 'Ubuntu'}
```

To delete any particular *key:value* pair

```
>>> del data['kushal']
>>> data
{'Jace': 'Mac', 'kart_': 'Debian', 'parthan': 'Ubuntu'
```

To check if any *key* is there in the dictionary or not you can use *in* keyword.

```
>>> 'Soumya' in data
False
```

You must remember that no mutable object can be a *key*, that means you can not use a *list* as a *key*.

dict() can create dictionaries from tuples of *key,value* pair.

```
>>> dict((('Indian','Delhi'),('Bangladesh','Dhaka')))
{'Indian': 'Delhi', 'Bangladesh': 'Dhaka'}
```

If you want to loop through a dict use *iteritems()* method.

```
>>> data
{'Kushal': 'Fedora', 'Jace': 'Mac', 'kart_': 'Debian', 'parthan': 'Ubuntu'}
>>> for x, y in data.iteritems():
...     print "%s uses %s" % (x, y)
...
Kushal uses Fedora
Jace uses Mac
kart_ uses Debian
parthan uses Ubuntu
```

Many times it happens that we want to add more data to a value in a dictionary and if the key does not exists then we add some default value. You can do this efficiently using *dict.setdefault(key, default)*.

```
>>> data = {}
>>> data.setdefault('names', []).append('Ruby')
>>> data
{'names': ['Ruby']}
>>> data.setdefault('names', []).append('Python')
>>> data
{'names': ['Ruby', 'Python']}
>>> data.setdefault('names', []).append('C')
>>> data
{'names': ['Ruby', 'Python', 'C']}
```

When we try to get value for a key which does not exists we get *KeyError*. We can use *dict.get(key, default)* to get a default value when they key does not exists before.

```
>>> data['foo']
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
KeyError: 'foo'
>>> data.get('foo', 0)
0
```

If you want to loop through a list (or any sequence) and get iteration number at the same time you have to use *enumerate()*.

```
>>> for i, j in enumerate(['a', 'b', 'c']):
...     print i, j
...
0 a
1 b
2 c
```

You may also need to iterate through two sequences same time, for that use *zip()* function.

```
>>> a = ['Pradeepto', 'Kushal']
>>> b = ['OpenSUSE', 'Fedora']
>>> for x, y in zip(a, b):
...     print "%s uses %s" % (x, y)
...
Pradeepto uses OpenSUSE
Kushal uses Fedora
```

7.7. students.py

In this example , you have to take number of students as input , then ask marks for three subjects as 'Physics', 'Maths', 'History', if the total number for any student is less 120 then print he failed, or else say passed.

```
#!/usr/bin/env python
n = int(raw_input("Enter the number of students:"))
data = {} # here we will store the data
languages = ('Physics', 'Maths', 'History') #all languages
for i in range(0, n): #for the n number of students
    name = raw_input('Enter the name of the student %d: ' % (i + 1)) #Get the
name of the student
    marks = []
    for x in languages:
        marks.append(int(raw_input('Enter marks of %s: ' % x))) #Get the marks
for  languages
    data[name] = marks
for x, y in data.iteritems():
    total =  sum(y)
    print "%s 's  total marks %d" % (x, total)
    if total < 120:
        print "%s failed :(" % x
    else:
        print "%s passed :)" % y
```

The output

```
[kd@kdlappy book]$ ./students.py
Enter the number of students:2
Enter the name of the student 1: Babai
Enter marks of Physics: 12
Enter marks of Maths: 45
Enter marks of History: 40
Enter the name of the student 2: Tesla
Enter marks of Physics: 99
Enter marks of Maths: 98
Enter marks of History: 99
Babai 's  total marks 97
Babai failed :(
Tesla 's  total marks 296
Tesla passed :)
```

7.8. matrixmul.py

In this example we will multiply two matrix's. First we will take input the number of rows/columns in the

matrix (here we assume we are using n x n matrix). Then values of the matrix's.

```
#!/usr/bin/env python
n = int(raw_input("Enter the value of n: "))
print "Enter values for the Matrix A"
a = []
for i in range(0, n):
    a.append([int(x) for x in raw_input("").split(" ")])
print "Enter values for the Matrix B"
b = []
for i in range(0, n):
    b.append([int(x) for x in raw_input("").split(" ")])
c = []
for i in range(0, n):
    c.append([a[i][j] * b[j][i] for j in range(0,n)])
print "After matrix multiplication"
print "-" * 10 * n
for x in c:
    for y in x:
        print "%5d" % y,
    print ""
print "-" * 10 * n
```

The output

```
[kd@kdlappy book]$ ./matrixmul.py
Enter the value of n: 3
Enter values for the Matrix A
1 2 3
4 5 6
7 8 9
Enter values for the Matrix B
9 8 7
6 5 4
3 2 1
After matrix multiplication
------------------------------
    9    12     9
   32    25    12
   49    32     9
------------------------------
```

Here we have used list comprehensions couple of times. *[int(x) for x in raw_input("").split(" ")]* here first it takes the input as string by *raw_input()*, then split the result by " ", then for each value create one int. We are also using *[a[i][j] * b[j][i] for j in range(0,n)]* to get the resultant row in a single line.

Chapter 8. Strings

Strings are nothing but simple text. In python we declare strings in between "" or '' or ''' ''' or """ """. The examples below will help you to understand sting in a better way.

```
 >>> s = "I am Indian"
>>> s
'I am Indian'
>>> s = 'I am Indian'
>>> s = "Here is a line \
... splitted in two lines"
>>> s
'Here is a line splitted in two lines'
>>> s = "Here is a line \n splitted in two lines"
>>> s
'Here is a line \n splitted in two lines'
>>> print s
Here is a line
 splitted in two lines
```

Now if you want to multiline strings you have to use triple single/double quotes.

```
>>> s = """ This is a
... multiline string, so you can
... write many lines"""
>>> print s
 This is a
multiline string, so you can
write many lines
```

8.1. Different methods available for Strings

Every string object is having couple of buildin methods available, we already saw some of them like *s.split(" ")*.

```
>>> s = "kushal das"
>>> s.title()
'Kushal Das'
```

title() method returns a titlecased version of the string, words start with uppercase characters, all remaining cased characters are lowercase.

```
>>> z = s.upper()
>>> z
'KUSHAL DAS'
>>> z.lower()
'kushal das'
```

upper() returns a total uppercase version whereas *lower()* returns a lower case version of the string.

```
>>> s = "I am A pRoGraMMer"
>> s.swapcase()
'i AM a PrOgRAmmER'
```

swapcase() returns the string with case swapped :)

```
>>> s = "jdwb 2323bjb"
>>> s.isalnum()
False
>>> s = "jdwb2323bjb"
>>> s.isalnum()
True
```

Because of the space in the first line *isalnum()* returned *False* , it checks for all charecters are alpha numeric or not.

```
>>> s = "SankarshanSir"
>>> s.isalpha()
True
>>> s = "Sankarshan Sir"
>>> s.isalpha()
False
```

isalpha() checkes for only alphabets.

```
>>> s = "1234"
>>> s.isdigit() #To check if all the characters are digits or not
True
>>> s = "Fedora9 is coming"
>>> s.islower() # To check if all chracters are lower case or not
False
>>> s = "Fedora9 Is Coming"
>>> s.istitle() # To check if it is a title or not
True
>>> s = "INDIA"
>>> s.isupper() # To check if characters are in upper case or not
True
```

To split any string we have *split()*. It takes a string as an argument , depending on that it will split the main string and returns a list containing splitted strings.

```
>>> s = "We all love Python"
>>> s.split(" ")
['We', 'all', 'love', 'Python']
>>> x = "Nishant:is:waiting"
>>> x.split(':')
['Nishant', 'is', 'waiting']
```

The opposite method for *split()* is *join()*. It takes a list contains strings as input and join them.

```
>>> "-".join("GNU/Linux is great".split(" "))
'GNU/Linux-is-great'
```

In the above example first we are splitting the string "GNU/Linux is great" based on the white space, then joining them with "-".

8.2. Strip the strings

Strings do have few methods to do striping. The simplest one is *strip(chars)*. If you provide the chars argument then it will strip any combination of them. By default it strips only whitespace or newline characters.

```
>>> s = "  abc\n "
>>> s.strip()
'abc'
```

You can particularly strip from the left hand or right hand side also using *lstrip(chars)* or *rstrip(chars)*.

```
>>> s = "www.foss.in"
>>> s.lstrip("cwsd.")
'foss.in'
>>> s.rstrip("cnwdi.")
'www.foss'
```

8.3. Finding text

Stings have some methods which will help you in finding text/substring in a string. Examples are given below:

```
>>> s.find("for")
7
>>> s.find("fora")
-1
>>> s.startswith("fa") #To check if the string startswith fa or not
True
>>> s.endswith("reason") #
True
```

find() helps to find the first occurrence of the substring given, if not found it returns -1.

8.4. Palindrome checking

Palindrome are the kind of strings which are same from left or right whichever way you read them. Example "madam". In this example we will take the word as input from the user and say if it is palindrome or not.

```
#!/usr/bin/env python
s = raw_input("Please enter a string: ")
z = s[::-1]
if s == z
    print "The string is a palindrome"
else:
    print "The string is not a palindrome"
```

The output

```
[kd@kdlappy book]$ ./palindrome.py
Please enter a string: madam1
The string is not a palindrome
[kd@kdlappy book]$ ./palindrome.py
Please enter a string: madam
The string is a palindrome
```

8.5. Number of words

In this example we will count the number of words in a given line

```
#!/usr/bin/env python
s = raw_input("Enter a line: ")
print "The number of words in the line are %d" % (len(s.split(" ")))
```

The output

```
[kd@kdlappy book]$ ./countwords.py
Enter a line: Sayamindu is a great programmer
The number of words in the line are 5
```

Chapter 9. Functions

Reusing the same code is required many times within a same program. Functions help us to do so. We write the things we have to do repeatedly in a function then call it where ever required. We already saw build in functions like *len()*, *divmod()*.

9.1. Defining a function

We use *def* keyword to define a function. general syntax is like

```
def functionname(params):
    statement1
    statement2
```

Let us write a function which will take two integers as input and then return the sum.

```
>>> def sum(a, b):
...     return a + b
```

In the second line with the *return* keyword, we are sending back the value of *a* + *b* to the caller. You must call it like

```
>>> res = sum(234234, 34453546464)
>>> res
34453780698L
```

Remember the palindrome program we wrote in the last chapter. Let us write a function which will check if a given string is palindrome or not, then return *True* or *False*.

```
#!/usr/bin/env python
def palindrome(s):
    return s == s[::-1]

if __name__ = '__main__':
 s = raw_input("Enter a string: ")
 if palindrome(s):
     print "Yay a palindrome"
 else:
     print "Oh no, not a palindrome"
```

Now run the code :)

9.2. Local and global variables

To understand local and global variables we will go through two examples.

```
#!/usr/bin/env python
def change(b):
    a = 90
    print a
a = 9
print "Before the function call ", a
print "inside change function",
change(a)
print "After the function call ", a
```

The output

```
$ ./local.py
Before the function call  9
inside change function 90
After the function call  9
```

First we are assigning *9* to *a*, then calling change function, inside of that we are assigning *90* to *a* and printing *a*. After the function call we are again printing the value of *a*. When we are writing *a = 90* inside the function, it is actually creating a new variable called *a*, which is only available inside the function and will be destroyed after the function finished. So though the name is same for the variable *a* but they are different in and out side of the function.

```
#!/usr/bin/env python
def change(b):
    global a
    a = 90
    print a
a = 9
print "Before the function call ", a
print "inside change function",
change(a)
print "After the function call ", a
```

Here by using global keyword we are telling that *a* is globally defined, so when we are changing a's value inside the function it is actually changing for the *a* outside of the function also.

9.3. Default argument value

In a function variables may have default argument values, that means if we don't give any value for that particular variable it will assigned automatically.

```
>>> def test(a , b = -99):
...     if a > b:
...         return True
...     else:
...         return False
```

In the above example we have written *b = -99* in the function parameter list. That means of no value for *b* is given then b's value is *-99*. This is a very simple example of default arguments. You can test the code by

```
>>> test(12, 23)
False
>>> test(12)
True
```

Important

Remember that you can not have an argument without default argument if you already have one argument with default values before it. Like *f(a, b=90, c)* is illegal as *b* is having a default value but after that *c* is not having any default value.

Also remember that default value is evaluated only once, so if you have any mutable object like list it will

make a difference. See the next example

```
>>> def f(a, data=[]):
...     data.append(a)
...     return data
...
>>> print f(1)
[1]
>>> print f(2)
[1, 2]
>>> print f(3)
[1, 2, 3]
```

To avoid this you can write more idiomatic Python, like the following

```
>>> def f(a, data=None):
    if data is None:
        data = []
    data.append(a)
    return data

>>> print f(1)
[1]
>>> print f(2)
[2]
```

9.4. Keyword arguments

```
>>> def func(a, b=5, c=10):
...     print 'a is', a, 'and b is', b, 'and c is', c
...
>>> func(12, 24)
a is 12 and b is 24 and c is 10
>>> func(12, c = 24)
a is 12 and b is 5 and c is 24
>>> func(b=12, c = 24, a = -1)
a is -1 and b is 12 and c is 24
```

In the above example you can see we are calling the function with variable names, like *func(12, c = 24)*, by that we are assigning *24* to *c* and *b* is getting its default value. Also remember that you can not have without keyword based argument after a keyword based argument. like

```
>>> def func(a, b=13, v):
...     print a, b, v
...
  File "<stdin>", line 1
SyntaxError: non-default argument follows default argument
```

9.5. Docstrings

In Python we use docstrings to explain how to use the code, it will be useful in interactive mode and to create auto-documentation. Below we see an example of the docstring for a function called *longest_side*.

text

```
#!/usr/bin/env python
import math

def longest_side(a, b):
 """
 Function to find the length of the longest side of a right triangle.

 :arg a: Side a of the triangle
 :arg b: Side b of the triangle

 :return: Length of the longest side c as float
 """
 return math.sqrt(a*a + b*b)

if __name__ == '__main__':
 print longest_side(4, 5)
```

We will learn more on docstrings in reStructuredText chapter.

Chapter 10. File handling

A file is some information or data which stays in the computer storage devices. You already know about different kinds of file , like your music files, video files, text files. Python gives you easy ways to manipulate these files. Generally we divide files in two categories, text file and binary file. Text files are simple text where as the binary files contain binary data which is only readable by computer.

10.1. File opening

To open a file we use *open()* function. It requires two arguments, first the file path or file name, second which mode it should open. Modes are like

"r" -> open read only, you can read the file but can not edit / delete anything inside
"w" -> open with write power, means if the file exists then delete all content and open it to write
"a" -> open in append mode

The default mode is read only, ie if you do not provide any mode it will open the file as read only. Let us open a file

```
>>> f = open("love.txt")
>>> f
<open file 'love.txt', mode 'r' at 0xb7f2d968>
```

10.2. Closing a file

After opening a file one should always close the opened file. We use method *close()* for this.

```
>>> f = open("love.txt")
>>> f
<open file 'love.txt', mode 'r' at 0xb7f2d968>
>>> f.close()
```

Important

Always make sure you *explicitly* close each open file, once its job is done and you have no reason to keep it open. Because

- There is an upper limit to the number of files a program can open. If you exceed that limit, there is no reliable way of recovery, so the program could crash.
- Each open file consumes some main-memory for the data-structures associated with it, like file descriptor/handle or file locks etc. So you could essentially end-up wasting lots of memory if you have more files open that are not useful or usable.
- Open files always stand a chance of corruption and data loss.

10.3. Reading a file

To read the whole file at once use the *read()* method.

```
>>> f = open("sample.txt")
>>> f.read()
'I love Python\nPradeepto loves KDE\nSankarshan loves Openoffice\n'
```

If you call *read()* again it will return empty string as it already read the whole file. readline() can help you to read one line each time from the file.

```
>>> f = open("sample.txt")
>>> f.readline()
'I love Python\n'
>>> f.readline()
'Pradeepto loves KDE\n'
```

To read all the all the lines in a list we use *readlines()* method.

```
>>> f = open("sample.txt")
>>> f.readlines()
['I love Python\n', 'Pradeepto loves KDE\n', 'Sankarshan loves Openoffice\n']
```

You can even loop through the lines in a file object.

```
>>> f = open("sample.txt")
>>> for x in f:
...     print x,
...
I love Python
Pradeepto loves KDE
Sankarshan loves Openoffice
```

Let us write a program which will take the file name as the input from the user and show the content of the file in the console.

```
#!/usr/bin/env python
name = raw_input("Enter the file name: ")
f = open(name)
print f.read()
f.close()
```

In the last line you can see that we closed the file object with the help of close() method.

The output

```
$ ./showfile.py
Enter the filename: sample.txt
I love Python
Pradeepto loves KDE
Sankarshan loves Openoffice
```

10.4. Writing in a file

Let us open a file then we will write some random text into it by using the write() method.

```
>>> f = open("ircnicks.txt", 'w')
>>> f.write('powerpork\n')
>>> f.write('indrag\n')
>>> f.write('mishti\n')
>>> f.write('sankarshan')
>>> f.close()
```

Now read the file we just created

```
>>> f = open('ircnicks.txt')
>>> s = f.read()
>>> print s
powerpork
indrag
mishti
sankarshan
```

10.5. copyfile.py

In this example we will copy a given text file to another file.

```
#!/usr/bin/env python
import sys
if len(sys.argv) < 3:
    print "Wrong parameter"
    print "./copyfile.py file1 file2"
    sys.exit(1)
f1 = open(sys.argv[1])
s = f1.read()
f1.close()
f2 = open(sys.argv[2], 'w')
f2.write(s)
f2.close()
```

Note

This way of reading file is not always a good idea, a file can be very large to read and fit in the memory. It is always better to read a known size of the file and wirte that to the new file.

You can see we used a new module here *sys*. *sys.argv* contains all command line parameters. Remember *cp* command in shell, after *cp* we type first the file to be copied and then the new file name.

The first value in *sys.argv* is the name of the command itself.

```
#!/usr/bin/env python
import sys
print "First value", sys.argv[0]
print "All values"
for i, x  in enumerate(sys.argv):
    print i, x
```

The output

```
$ ./argvtest.py Hi there
First value ./argvtest.py
All values
0 ./argvtest.py
1 Hi
2 there
```

Here we used a new function *enumerate(iterableobject)*, which returns the index number and the value from the iterable object.

10.6. Random seeking in a file

You can also randomly move around inside a file using *seek()* method. It takes two arguments , offset and whence. To know more about it let us read what python help tells us

seek(...) seek(offset[, whence]) -> None. Move to new file position. Argument offset is a byte count. Optional argument whence defaults to 0 (offset from start of file, offset should be >= 0); other values are 1 (move relative to current position, positive or negative), and 2 (move relative to end of file, usually negative, although many platforms allow seeking beyond the end of a file). If the file is opened in text mode, only offsets returned by tell() are legal. Use of other offsets causes undefined behavior. Note that not all file objects are speakable.

Let us see one example

```
>>> f = open('/tmp/tempfile', 'w')
>>> f.write('0123456789abcdef')
>>> f.close()
>>> f = open('/tmp/tempfile')
>>> f.tell()    #tell us the offset position
0L
>>> f.seek(5) # Goto 5th byte
>>> f.tell()
5L
>>> f.read(1) #Read 1 byte
'5'
>>> f.seek(-3, 2) # goto 3rd byte from the end
>>> f.read() #Read till the end of the file
'def'
```

10.7. Count spaces, tabs and new lines in a file

Let us try to write an application which will count the spaces , tabs, and lines in any given file.

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

import os
import sys


def parse_file(path):
    """
    Parses the text file in the given path and returns space, tab & new line
    details.

    :arg path: Path of the text file to parse

    :return: A tuple with count of spacaes, tabs and lines.
    """
    fd = open(path)
    i = 0
    spaces = 0
    tabs = 0
    for i,line in enumerate(fd):
        spaces += line.count(' ')
        tabs += line.count('\t')
    #Now close the open file
    fd.close()

    #Return the result as a tuple
    return spaces, tabs, i + 1

def main(path):
    """
    Function which prints counts of spaces, tabs and lines in a file.

    :arg path: Path of the text file to parse
    :return: True if the file exits or False.
    """
    if os.path.exists(path):
        spaces, tabs, lines = parse_file(path)
        print "Spaces %d. tabs %d. lines %d" % (spaces, tabs, lines)
        return True
    else:
        return False


if __name__ == '__main__':
    if len(sys.argv) > 1:
        main(sys.argv[1])
    else:
        sys.exit(-1)
    sys.exit(0)
```

You can see that we have two functions in the program , *main* and *parse_file* where the second one actually parses the file and returns the result and we print the result in *main* function. By splitting up the code in smaller units (functions) helps us to organize the codebase and also it will be easier to write test cases for the functions.

Chapter 11. Class

11.1. Your first class

Before writing your first class, you should know the syntax. We define a class in the following way..

```
class nameoftheclass:
    statement1
    statement2
    statement3
```

in the statements you can write any python statement, you can define functions (which we call methods of a class).

```
>>> class MyClass:
...     a = 90
...     b = 88
...
>>> p = MyClass()
>>> p
<__main__.MyClass instance at 0xb7c8aa6c>
```

In the above example you can see first we are declaring a class called MyClass, writing some random statements inside that class. After the class definition, we are creating an *object* p of the *class* MyClass.If you do a dir on that...

```
>>> dir(p)
['__doc__', '__module__', 'a', 'b']
```

You can see the variables *a* and *b* inside it.

11.2. __init__ method

__init__ is a special method in python classes, it is the constructor method for a class. In the following example you can see how to use it

```
class Student(object):
    """
    Returns a ```Student``` object with the given name, branch and year.

    """
    def __init__(self, name, branch, year):
            self.name = name
            self.branch = branch
            self.year = year
            print "A student object is created"

    def set_name(self, name):
        """
        Sets the name of the student.

        :arg name: new name ofthe student.

        """
        self.name = name

    def get_name(self):
        """
        Returns the name of the student.

        :return: a string contain the student's name

        """
        return self.name
```

__init__ is called when ever an object of the class is constructed.That means when ever we will create a student object we will see the message "Creating a new student" in the prompt. You can see the first argument to the method is *self*. It is a special variable which points to the current object (like `this` in C++). The object is passed implicitly to every method available in it , but we have to get it explicitly in every method while writing the methods. Example shown below.

```
>>> std1 = Student()
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
TypeError: __init__() takes exactly 4 arguments (1 given)
>>> std1 = Student('Kushal','CSE','2005')
A student object is created
```

In this example at first we tried to create a Student object with passing any argument and python interpreter complained that it takes exactly 4 arguments but received only one (self). Then we created an object with proper argument values and from the message printed, one can easily understand that *__init__* method was called as the constructor method.

Now we are going to call *getName()* and *setName()* methods.

```
>>> std1.get_name()
'Kushal'
>>> std1.set_name()
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
TypeError: set_name() takes exactly 2 arguments (1 given)
>>> std1.set_name('Shreyank Gupta')
>>> std1.get_name()
'Shreyank Gupta'
```

First we called getName on the object we created, then tried to call setName without any arguments and we got an error. Next we again called setName with argument 'Shreyank Gupta'. Now calling getName gives 'Shreyank Gupta' as the output.

11.3. Inheritance

In general we human beings always know about inheritance. In programming it is almost the same. When a class inherits another class it inherits all features(like variables and methods) of the parent class. This helps in reusing codes.

In the next example we first create a class called Person and create two sub-classes Student and Teacher. As both of the classes are inherited from Person class they will have all methods of Person and will have new methods and variables for their own purpose.

11.4. student_teacher.py

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

class Person(object):
    """
    Returns a ```Person``` object with given name.

    """
    def __init__(self,name):
        self.name = name

    def get_details(self):
        "Returns a string containing name of the person"
        return self.name


class Student(Person):
    """
    Returns a ```Student``` object, takes 3 arguments, name, branch, year.

    """
    def __init__(self,name,branch,year):
        Person.__init__(self,name)
        self.branch = branch
        self.year = year

    def get_details(self):
        "Returns a string containing student's details."
        return "%s studies %s and is in %s year." % (self.name, self.branch,
self.year)


class Teacher(Person):
    """
    Returns a ```Teacher``` object, takes a list of strings (list of papers) as
    argument.
    """
    def __init__(self, name, papers):
        Person.__init__(self, name)
        self.papers = papers

    def get_details(self):
        return "%s teaches %s" % (self.name, ','.join(self.papers))


person1 = Person('Sachin')
student1 = Student('Kushal', 'CSE', 2005)
teacher1 = Teacher('Prashad', ['C', 'C++'])

print person1.get_details()
print student1.get_details()
print teacher1.get_details()
```

The output:

```
$ ./student_teacher.py
Sachin
Kushal studies CSE and is in 2005 year.
Prashad teaches C,C++
```

In this example you can see how we called the __init__ method of the class Person in both Student and Teacher classes' __init__ method. We also reimplemented *get_details()* method of Person class in both Student and Teacher class. So, when we are calling *get_details()* method on the teacher1 object it returns based on the object itself (which is of teacher class) and when we call *get_details()* on the student1 or person1 object it returns based on *get_details()* method implemented in it's own class.

11.5. Multiple Inheritance

One class can inherit more than one classes. It gets access to all methods and variables of the parent classes. The general syntax is:

```
class MyClass(Parentclass1, Parentclass2,...):
    def __init__(self):
        Parentclass1.__init__(self)
        Parentclass2.__init__(self)
        ...
        ...
```

11.6. Deleting an object

As we already know how to create an object , now we are going to see how to delete an python object. We use *del* for this.

```
>>> s = "I love you"
>>> del s
>>> s
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
NameError: name 's' is not defined
```

del actually decreases reference count by one. When the reference count of an object becomes zero the garbage collector will delete that object.

Chapter 12. Iterators, generators and decorators

In this chapter we will learn about iterators, generators and decorators.

12.1. Iterators

Python iterator objects required to support two methods while following the iterator protocol.

__iter__ returns the iterator object itself. This is used in *for* and *in* statements.

next method returns the next value from the iterator. If there is no more items to return then it should raise *StopIteration* exception.

```
class Counter(object):
    def __init__(self, low, high):
        self.current = low
        self.high = high

    def __iter__(self):
        'Returns itself as an iterator object'
        return self

    def next(self):
        'Returns the next value till current is lower than high'
        if self.current > self.high:
            raise StopIteration
        else:
            self.current += 1
            return self.current - 1
```

Now we can use this iterator in our code.

```
>>> c = Counter(5,10)
>>> for i in c:
...   print i,
...
5 6 7 8 9 10
```

Remember that an iterator object can be used only once. It means after it raises *StopIteration* once, it will keep raising the same exception.

```
>>> c = Counter(5,6)
>>> next(c)
5
>>> next(c)
6
>>> next(c)
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
  File "<stdin>", line 11, in next
StopIteration
>>> next(c)
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
  File "<stdin>", line 11, in next
StopIteration
```

Using the iterator in for loop example we saw, the following example tries to show the code behind the

scenes.

```
>>> iterator = iter(c)
>>> while True:
...     try:
...         x = iterator.next()
...         print x,
...     except StopIteration as e:
...         break
...
5 6 7 8 9 10
```

12.2. Generators

In this section we learn about Python generators. They were introduced in Python 2.3. It is an easier way to create iterators using a keyword *yield* from a function.

```
>>> def my_generator():
...     print "Inside my generator"
...     yield 'a'
...     yield 'b'
...     yield 'c'
...
>>> my_generator()
<generator object my_generator at 0x7fbcfa0a6aa0>
```

In the above example we create a simple generator using the yield statements. We can use it in a for loop just like we use any other iterators.

```
>>> for char in my_generator():
...     print char
...
Inside my generator
a
b
c
```

In the next example we will create the same Counter class using a generator function and use it in a for loop.

```
>>> def counter_generator(low, high):
...     while low <= high:
...         yield low
...         low += 1
...
>>> for i in counter_generator(5,10):
...     print i,
...
5 6 7 8 9 10
```

Inside the while loop when it reaches to the *yield* statement, the value of low is returned and the generator state is suspended. During the second *next* call the generator resumed where it freeze-ed before and then the value of *low* is increased by one. It continues with the while loop and comes to the *yield* statement again.

When you call an generator function it returns a *generator* object. If you call *dir* on this object you will find that it contains *__iter__* and *next* methods among the other methods.

```
>>> c = counter_generator(5,10)
>>> dir(c)
['__class__', '__delattr__', '__doc__', '__format__', '__getattribute__',
'__hash__', '__init__', '__iter__', '__name__', '__new__', '__reduce__',
'__reduce_ex__', '__repr__', '__setattr__', '__sizeof__', '__str__',
'__subclasshook__', 'close', 'gi_code', 'gi_frame', 'gi_running', 'next',
'send', 'throw']
```

We mostly use generators for laze evaluations. This way generators become a good approach to work with lots of data. If you don't want to load all the data in the memory, you can use a generator which will pass you each piece of data at a time.

One of the biggest example of such example is *os.path.walk()* function which uses a callback function and current *os.walk* generator. Using the generator implementation saves memory.

We can have generators which produces infinite values. The following is a one such example.

```
>>> def infinite_generator(start=0):
...     while True:
...         yield start
...         start += 1
...
>>> for num in infinite_generator(4):
...     print num,
...     if num > 20:
...         break
...
4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21
```

If we go back to the example of *my_generator* we will find one feature of generators. They are not re-usable.

```
>>> g = my_generator()
>>> for c in g:
...     print c
...
Inside my generator
a
b
c
>>> for c in g:
...     print c
...
```

One way to create a reusable generator is Object based generators which does not hold any state. Any class with a *__iter__* method which yields data can be used as a object generator. In the following example we will recreate out counter generator.

```
>>> class Counter(object):
...     def __init__(self, low, high):
...         self.low = low
...         self.high = high
...     def __iter__(self):
...          counter = self.low
...          while self.high >= counter:
...              yield counter
...              counter += 1
...
>>> gobj = Counter(5, 10)
>>> for num in gobj:
...     print num,
...
5 6 7 8 9 10
>>> for num in gobj:
...     print num,
...
5 6 7 8 9 10
```

12.3. Generator expressions

In this section we will learn about generator expressions which is a high performance, memory efficient generalization of list comprehensions and generators.

For example we will try to sum the squares of all numbers from 1 to 99.

```
>>> sum([x*x for x in range(1,10)])
```

The example actually first creates a list of the square values in memory and then it iterates over it and finally after sum it frees the memory. You can understand the memory usage in case of a big list.

We can save memory usage by using a generator expression.

```
sum(x*x for x in range(1,10))
```

The syntax of generator expression says that always needs to be directly inside a set of parentheses and cannot have a comma on either side. Which basically means both the examples below are valid generator expression usage example.

```
>>> sum(x*x for x in range(1,10))
285
>>> g = (x*x for x in range(1,10))
>>> g
<generator object <genexpr> at 0x7fc559516b90>
```

We can have chaining of generators or generator expressions. In the following example we will read the file */var/log/cron* and will find if any particular job (in the example we are searching for anacron) is running successfully or not.

We can do the same using a shell command *tail -f /var/log/cron |grep anacron*

```
>>> jobtext = 'anacron'
>>> all = (line for line in open('/var/log/cron', 'r') )
>>> job = ( line for line in all if line.find(jobtext) != -1)
>>> text = next(job)
>>> text
"May  6 12:17:15 dhcp193-104 anacron[23052]: Job `cron.daily' terminated\n"
>>> text = next(job)
>>> text
'May  6 12:17:15 dhcp193-104 anacron[23052]: Normal exit (1 job run)\n'
>>> text = next(job)
>>> text
'May  6 13:01:01 dhcp193-104 run-parts(/etc/cron.hourly)[25907]: starting
0anacron\n'
```

You can write a for loop to the lines.

12.4. Clousers

Clousers are nothing function which got returned by another function. We use clousers to remove code duplications. In the following example we create a simple clouser for adding numbers.

```
>>> def add_number(num):
...     def adder(number):
...         'adder is a clouser'
...         return num + number
...     return adder
...
>>> a_10 = add_number(10)
>>> a_10(21)
31
>>> a_10(34)
44
>>> a_5 = add_number(5)
>>> a_5(3)
8
```

adder is a clouser which adds a given number to a pre-defined one.

Chapter 13. Modules

In this chapter we are going to learn about Python modules.

13.1. Introduction

Still now when ever we wrote code in the python interpreter, after we came out of it, the code was lost. But in when one writes a larger program, people breaks their codes into different files and reuse then as required. In python we do this by *modules*. Modules are nothing files with Python definitions and statements. The module name is same as the file name without the .py extension.

You can find the name of the module by accessing the __*name*__ variable. It is a global variable.

Now we are going to see how modules work. Create a file called bars.py. Content of the file is given bellow.

```
"""
Bars Module
============

This is an example module with provide different ways to print bars.

"""

def starbar(num):
    """
    Prints a bar with *

    :arg num: Length of the bar

    """
    print '*' * num

def hashbar(num):
    """
    Prints a bar with #

    :arg num: Length of the bar

    """
    print '#' * num

def simplebar(num):
    """
    Prints a bar with -

    :arg num: Length of the bar

    """
    print '-' * num
```

Now we are going to start the python interpreter and import our module.

```
>>> import bars
>>>
```

This will import the module bars. We have to use the module name to access functions inside the module.

```
>>> bars.hashbar(10)
##########
>>> bars.simplebar(10)
----------
>>> bars.starbar(10)
**********
```

13.2. Importing modules

There are different ways to import modules. We already saw one way to do this. You can even import selected functions from modules. To do so:

```
>>> from bars import simplebar, starbar
>>> simplebar(20)
--------------------
```

13.3. Default modules

Now your Python installation comes with different modules installed, you can use them as required and install new modules for any other special purposes. In the following few examples we are going to see many examples on the same.

```
>>> help()

Welcome to Python 2.6!  This is the online help utility.

If this is your first time using Python, you should definitely check out
the tutorial on the Internet at http://docs.python.org/tutorial/.

Enter the name of any module, keyword, or topic to get help on writing
Python programs and using Python modules.  To quit this help utility and
return to the interpreter, just type "quit".

To get a list of available modules, keywords, or topics, type "modules",
"keywords", or "topics".  Each module also comes with a one-line summary
of what it does; to list the modules whose summaries contain a given word
such as "spam", type "modules spam".

help> modules
```

The above example shows how to get the list of all installed modules in your system. I am not pasting them here as it is a big list in my system :)

You can also use *help()* function in the interpeter to find documentation about any module/classes. Say you want to know all available methods in strings, you can use the following method

```
>>> help(str)
```

13.4. Submodules

We can many submodules inside a module. A directory with a *__init__.py* can also be used a module and all *.py* files inside it become submodules.

```
$ tree mymodule
mymodule
|-- bars.py
|-- __init__.py
`-- utils.py
```

In this example *mymodule* is the module name and *bars* and *utils* are two submodules in it. You can create an empty *__init__.py* using touch command.

```
$ touch mymodule/__init__.py
```

13.5. Module os

os module provides operating system dependent functionality. You can import it using the following import statement.

```
>>> import os
```

getuid() function returns the current process's effective user's id.

```
>>> os.getuid()
500
```

getpid() returns the current process's id. *getppid()* returns the parent process's id.

```
>>> os.getpid()
16150
>>> os.getppid()
14847
```

uname() returns different information identifying the operating system, in Linux it returns details you can get from the *uname* command. The returned object is a tuple, *(sysname, nodename, release, version, machine)*

```
>>> os.uname()
('Linux', 'd80', '2.6.34.7-56.fc13.i686.PAE', '#1 SMP Wed Sep 15 03:27:15 UTC
2010', 'i686')
```

*getcwd()*returns the current working directory. *chdir(path)* changes the current working directory to path. In the example we first see the current directory which is my home directory and change the current directory to */tmp* and then again checking the current directory.

```
>>> os.getcwd()
'/home/kushal'
>>> os.chdir('/tmp')
>>> os.getcwd()
'/tmp'
```

So let us use another function provided by the os module and create our own function to list all files and

directories in any given directory.

```
def view_dir(path='.'):
    """
    This function prints all files and directories in the given directory.

    :args path: Path to the directory, default is current directory
    """
    names = os.listdir(path)
    names.sort()
    for name in names:
        print name,
```

```
>>> view_dir('/')
.readahead bin boot dev etc home junk lib lib64 lost+found media mnt opt proc
root run sbin srv sys tmp usr var
```

Chapter 14. Collections module

In this chapter we will learn about a module called *Collections*. In this module we some nice data structures which will help you to solve various real life problems.

```
>>> import collections
```

This is how you can import the module, now we will see the available classes which you can use.

14.1. Counter

Counter is a *dict* subclass which helps to count hashable objects. Inside it elements are stored as dictionary keys and counts are stored as values which can be zero or negative.

Below we will see one example where we will find occurrences of words in the Python LICENSE file.

Example 14.1. Counter example

```
>>> from collections import Counter
>>> import re
>>> path = '/usr/share/doc/python-2.7.3/LICENSE'
>>> words = re.findall('\w+', open(path).read().lower())
>>> Counter(words).most_common(10)
[('2', 97), ('the', 80), ('or', 78), ('1', 76), ('of', 61), ('to', 50),
('and', 47), ('python', 46), ('psf', 44), ('in', 38)]
```

Counter objects has an method called *elements* which returns an iterator over elements repeating each as many times as its count. Elements are returned in arbitrary order.

```
>>> c = Counter(a=4, b=2, c=0, d=-2)
>>> list(c.elements())
['a', 'a', 'a', 'a', 'b', 'b']
```

most_common is a method which returns most common elements abd their counts from the most common to the least.

```
>>> Counter('abracadabra').most_common(3)
[('a', 5), ('r', 2), ('b', 2)]
```

14.2. defaultdict

defaultdict is a dictionary like object which provides all methods provided by dictionary but takes first argument (default_factory) as default data type for the dictionary. Using defaultdict is faster than doing the same using *dict.set_default* method.

Example 14.2. defaultdict example

```
>>> s = [('yellow', 1), ('blue', 2), ('yellow', 3), ('blue', 4), ('red', 1)]
>>> d = defaultdict(list)
>>> for k, v in s:
...     d[k].append(v)
...
>>> d.items()
[('blue', [2, 4]), ('red', [1]), ('yellow', [1, 3])]
```

In the example you can see even if the key is not there in the defaultdict object, it automatically creates an empty list. *list.append* then helps to append the value to the list.

14.3. namedtuple

Named tuples helps to have meaning of each position in a tuple and allow us to code with better readability and self-documenting code. You can use them in any place where you are using *tuples*. In the example we will create a namedtuple to show hold information for points.

Example 14.3. Named tuple

```
>>> from collections import namedtuple
>>> Point = namedtuple('Point', ['x', 'y'])  #Defining the namedtuple
>>> p = Point(10, y=20)  #Creating an object
>>> p
Point(x=10, y=20)
>>> p.x + p.y
30
>>> p[0] + p[1]  #Accessing the values in normal way
30
>>> x, y = p      #Unpacking the tuple
>>> x
10
>>> y
20
```

Chapter 15. Virtualenv

Virtual Python Environment builder or virtualenv is a tool which will help you to install different versions of python modules in a local directory using which you can develop and test your code without requiring to install everything systemwide.

15.1. Installation

You can install virtualenv ewither from distro provided package or through pip.

```
[user@host]$ sudo yum install python-virtualenv
```

Or

```
$ sudo pip install virtualenv
```

15.2. Usage

We will create a directory call *virtual* inside which we will have two different virtual environment.

The following commands will the create an env called virt1.

```
[user@host]$ cd virtual
[user@host]$ virtualenv virt1
New python executable in virt1/bin/python
Installing setuptools.....done.
Installing pip.....done.
```

Now we can virt1 environment.

```
[user@host]$ source virt1/bin/activate
(virt1)[user@host]$
```

The firt part of the prompt is now name of the virtual environment, it will help you to understand which environment you are in when you will have many environments.

To deactivate the environment use *deactivate* command.

```
(virt1)[user@host]$ deactivate
[user@host]$
```

So, now we will install a python module called redis.

```
(virt1)[user@host]$ pip install redis
Downloading/unpacking redis
  Downloading redis-2.6.2.tar.gz
  Running setup.py egg_info for package redis

Installing collected packages: redis
  Running setup.py install for redis

Successfully installed redis
Cleaning up...
```

Same way we can install a project called yolk, which can tell us which all modules are installed.

```
(virt1)[user@host]$ pip install yolk
(virt1)[user@host]$ yolk -l
Python          - 2.7.3        - active development (/usr/lib64/python2.7/lib-
dynload)
pip             - 1.1          - active
redis           - 2.6.2        - active
setuptools      - 0.6c11       - active
wsgiref         - 0.1.2        - active development (/usr/lib64/python2.7)
yolk            - 0.4.3        - active
```

Now we will create another virtual environment *virt2* where we will install same redis module but an old 2.4 version.

```
[user@host]$ virtualenv virt2
New python executable in virt1/bin/python
Installing setuptools............done.
Installing pip...............done.
[user@host]$ source virt2/bin/activate
(virt2[user@host]$
(virt2)[user@host]$ pip install redis==2.4
Downloading/unpacking redis
  Downloading redis-2.4.0.tar.gz
  Running setup.py egg_info for package redis

Installing collected packages: redis
  Running setup.py install for redis

Successfully installed redis
Cleaning up...
(virt1)[user@host]$ pip install yolk
(virt1)[user@host]$ yolk -l
Python          - 2.7.3        - active development (/usr/lib64/python2.7/lib-
dynload)
pip             - 1.1          - active
redis           - 2.4.0        - active
setuptools      - 0.6c11       - active
wsgiref         - 0.1.2        - active development (/usr/lib64/python2.7)
yolk            - 0.4.3        - active
```

As you can see yolk says that in this envrionment we have redis 2.4 installed. This way you can have many different environments for your all development needs.

Chapter 16. Acknowledgment

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I am missing some names in the above list, will add them soon

I also took help from the following sites

- http://docs.python.org
- http://en.wikipedia.org

Few books or sites I would recommend to read

- *Byte of Python*
- *Dive into Python*
- *Python Tutorial*

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