Python programming — introduction to Python

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August 28, 2009

First a case

Downloading a Web page

Read information from the Web (Martelli et al., 2005, p. 489)

```
# Import the 'urllib' library for Web page retrieval
from urllib import urlopen

url = 'http://neuro.imm.dtu.dk/tmp/w/index.php/' + \
      'Special:Ask/-5B-5Bfeed::+-5D-5D/-3FFeed/' + \
      'sort=/order=ASC/format=csv/sep=,/limit=100'

help('urllib')

# Get and read the web page
doc = urlopen(url).read()  # Read is built-in

print(doc)
```

Output from the print function

```
"Autoblog Green",http://feeds.autoblog.com/weblogsinc/autoblog
"Brussels Sunshine",http://blog.brusselssunshine.eu/feeds/posts/default
"Capital Eye",http://www.opensecrets.org/news/atom.xml
Causecast,http://feeds.feedburner.com/causecast/latest_news.rss
"Clean Fuels Blog",http://feeds.feedburner.com/CFDC?format=xml
"Close Concerns Weblog",http://closeconcerns.typepad.com/close_ ...
"Corporate Eye Corporate social responsibility",http://feeds. ...
"Corporate social responsibility (guardian)",http://www.guardian. ...
"Corpwatch Blog",http://www.corpwatch.org/rss.php
"Crane and Matten blog",http://craneandmatten.blogspot.com/feeds ...
"Dax Mahoney (blog)",http://daxmahoney.blogspot.com/feeds/posts/default
...
```

Reading the comma separated values

```
# Import a CSV reader/writer library.
import csv

web = urlopen(url)
# 'web' is now a file-like handle

blogs = csv.reader(web, delimiter=',', quotechar='"')
# 'blogs' is now an object that can be iterated over

# Iterate over 'blogs'
for blog in blogs:
    print(blog)
```

Outout from the print function

```
['Autoblog Green', 'http://feeds.autoblog.com/weblogsinc/autoblog']
['Brussels Sunshine', 'http://blog.brusselssunshine.eu/fe ...
['Capital Eye', 'http://www.opensecrets.org/news/atom.xml']
['Causecast', 'http://feeds.feedburner.com/causecast/latest_ ...
['Clean Fuels Blog', 'http://feeds.feedburner.com/CFDC?format=xml']
['Close Concerns Weblog', 'http://closeconcerns.typepad. ...
['Corporate Eye Corporate social responsibility', 'http:// ...
['Corporate social responsibility (guardian)', 'http://www ...
['Corpwatch Blog', 'http://www.corpwatch.org/rss.php']
['Crane and Matten blog', 'http://craneandmatten.blogspot.c ...
['Dax Mahoney (blog)', 'http://daxmahoney.blogspot.com/feed ...
['Dgoodr', 'http://feeds.feedburner.com/dgoodr?format=xml']
...
```

Adding the URLs to a Python list

```
# Each row is of a Python 'list' type
isinstance(blog, list)   # or type(blog)

blogs = csv.reader(urlopen(url), delimiter=',', quotechar='"')

# Create empty list
urls = []

for blog in blogs:
    # Python indexes from 0: '1' is the second column
    feed = blog[1]
    if len(feed):
        urls.append(feed)
```

The feeds

```
>>> urls[0]
'http://feeds.autoblog.com/weblogsinc/autoblog'

>>> doc = urlopen(urls[0]).read()
>>> print(doc[0:600])
<?xml version="1.0" encoding="UTF-8"?>
<?xml-stylesheet type="text/xsl" media="screen" href="/~d/ ...
<channel>
<title>Autoblog</title>
<link>http://www.autoblog.com</link>
<description>Autoblog</description>
<image>
<url>http://www.blogsmithmedia.com/www.autoblog.com/media/feedlogo.
```

Reading feeds

Reading feeds from, e.g., blogs (Segaran, 2007, p. 229)

```
import feedparser

f = feedparser.parse(urls[0])
# Now 'f' is a kind of Python dictionary

>>> f.keys()
['feed', 'status', 'updated', 'version', 'encoding', 'bozo',
'headers', 'etag', 'href', 'namespaces', 'entries']

>>> f['entries'][0].keys()
['summary_detail', 'author', 'links', 'title', 'feedburner_origlink',
'tags', 'updated', 'comments', 'summary', 'guidislink',
'title_detail', 'link', 'id', 'updated_parsed']
```

Examining the feeds

The 7th tag of the 1st entry in the downloaded feed

```
>>> f['entries'][0]['tags'][6]['term']
u'obama administration'
```

All tags for all posts in one particular feed:

```
tags = [];
for e in f['entries']:
    for t in e['tags']:
        tags.append(t['term']);
```

Getting all feeds

```
from BeautifulSoup import BeautifulSoup          # HTML reading library
fs = [];
for url in urls:
 fs.append(feedparser.parse(url))
 fs[-1]['wordlist'] = []
 for e in fs[-1]['entries']:
  if e.has_key('summary'):
   fs[-1]['wordlist'].extend(''.join(BeautifulSoup( \
    e.summary).findAll(text=True)).split());
 print(url)

allwords = [word for f in fs for word in f['wordlist']]
```

Some statistics

```
float(len(allwords))/len(set(allwords))

wordcount = dict([ [t, allwords.count(t)] for t in set(allwords) ])

wordcount = {}
for term in allwords:
    wordcount[term] = wordcount.get(term, 1) + 1

items = [(v, k) for k, v in wordcount.items()]
items.sort()
items.reverse()

for n in range(0,2000):
    print('%3d: %4d %s' % (n+1, items[n][0], items[n][1]))
```

```
  1: 5205 the
  2: 3211 to
  3: 2922 of
```

Determine “interesting” words

Reading a stopword list

```
stopwords = [ line.strip() for line in open('stop_english1.txt', 'r') ]

wordcount = {}
for term in allwords:
    if term.lower() not in stopwords:
        wordcount[term] = wordcount.get(term, 1) + 1

items = [(v, k) for k, v in wordcount.items()]  # 'Inverting' the dict
items.sort()
items.reverse()

terms = []
for n in range(0,500):
    terms.append(items[n][1])
    print('%3d: %4d %s' % (n+1, items[n][0], items[n][1]))
```

Making a matrix

To make numerical processing in Python import the `numpy` module and then initialize the elements

```
import numpy                    # Import of the numerical module

M = numpy.matrix(numpy.zeros([len(fs), len(terms)]))
for n in range(len(fs)):
    for m in range(len(terms)):
        M[n,m] = fs[n]['wordlist'].count(terms[m])
```

The `M` matrix has the size feeds-by-terms and each element is set to the number of times a term (i.e., a word) occurs in a feed.

Multivariate analysis algorithm:

```
def nmf(M, components=5, iterations=5000):
    import random
    W = numpy.matrix(numpy.zeros([M.shape[0], components]))
    H = numpy.matrix(numpy.zeros([components, M.shape[1]]))
    for n in range(M.shape[0]):
        for m in range(components):
            W[n,m] = random.random()
    for n in range(components):
        for m in range(M.shape[1]):
            H[n,m] = random.random()
    for n in range(0, iterations):
        H = numpy.multiply(H, (W.T * M) / (W.T * W * H + 0.001))
        W = numpy.multiply(W, (M * H.T) / (W * (H * H.T) + 0.001))
        print "%d/%d" % (n, iterations)
    return (W, H)
```

Using the algorithm on the matrix

```
(W, H) = nmf(M)
```

. . . And then display the results:

```
for n in range(4):
    print n, "-----"
    w = []; h = []
    for m in range(W.shape[0]):
        w.append((W[m,n], fs[m]))
    for m in range(H.shape[1]):
        h.append((H[n,m], terms[m]))
    h.sort()
    h.reverse()
    w.sort()
    w.reverse()
    for n in range(0,20):
      print "%5.3f %10s %s" % (h[n][0], h[n][1], w[n][1]['feed']['title'])
```

Python introduction: Back to the basics

Invoking python . . .

From the command line with no argument and interactive:

```
$ python
>>> 1+1
```

With the file `mypythonscript.py` with the following content

```
print(1+1)
```

From the command line with a python function:

```
$ python mypythonscript.py
```

From the command line with a python function:

```
$ python
>>> import mypythonscript
```

. . . Invoking python . . .

With a shell-like program `myscript`

```
#!/usr/bin/python
print(1+1)
```

Executing the script as a standard (UNIX) program

```
$ chmod u+x myscript
$ ./myscript
```

Or execute it from within Python

```
>>> import os
>>> os.system('myscript')
```

. . . Invoking python . . .

Construct a string with the Python code for execution

```
s = 'a = 1+1; print(a)'
exec(s)
```

and evaluation

```
s = '1+1'
a = eval(s)
print(a)
```

or a script

```
execfile('myscript.py')
```

. . . Invoking python

`mymodule.py` with the following content

```
def myfunction():
    print(1+1)
def myotherfunction():
    print(2+2)
```

Load the library and call the functions in the library:

```
$ python
>>> import mymodule
>>> mymodule.myfunction()
>>> mymodule.myotherfunction()
```

Invoking python: IPython

"An Enhanced Interactive Python" with automatic completion and some more help.

```
$ ipython

In [1]: a = 1 + 1

In [2]: ?a
Type:           int
Base Class:     <type 'int'>
String Form:    2
Namespace:      Interactive
Docstring:
    int(x[, base]) -> integer
```

A python program

```
import math, sys                    #  Importing modules.

def formatresult(res):              # Define function. Remember colon!
    """This is the documentation for a function."""
    return "The result is %f" % res  # Percentage for formating

if len(sys.argv) < 3:                # Conditionals should be indended
    print("Too few input argument")
elif len(sys.argv) > 10:   # Not 'elsif' or 'elseif'
    print("Too many input argument")
else:
    res = 0;         # Semicolon not necessary. Considered bad style
    for n in range(1, len(sys.argv)):    # Not first element in loop
        try: res += float(sys.argv[n])   # One-liner: no identation
        except: pass  # One-liner!
    print(formatresult(res))
```

Print

The `print` function can print almost anything:

```
print(math)                          # An imported module
print(sys.argv)                      # Some variable from a module
print(range(1, len(sys.argv)))       # A result from a call
print("""
Here goes
some text
""")
```

It is possible to call `print` as a statement:

```
print math
print "Hello"
```

However, in Python 3.0 it is no longer allowed.

Examining the Python program

What does the `len()` function returns?

What does the `range()` function returns?

What is in `sys.argv`?

Data types: Simple types

None: `None==None` is true, `None==False` is false, `not(None)` is true!

Boolean (from Python 2.2.1): All true: `True`, `False==False`, `bool(42)`, `not(42==True)`, `(True or False) and not(False)`, `True==1`, `not(1.000001 == 1)`, `1.00000000000000000000000001 == 1`

Integer: `32`, `int('42')`, `1/3` (yes, still integer!), `int(True)`, `int(3.14)`

Long: `123198098547612389132091820398123012 3`, `long(1)`, `5L`

Float: `4.`, `4.0`, `float(42)`, `1.0/3`, `complex(1j).real`, `complex(1j).imag`, `4.2e3`, `4.2E+3`, `3**-1`, `float('nan')`, `float('inf')` (Python 2.4/2.5 issue)

Complex: `complex(3)`, `complex(1j)`, `complex('4+j')`, `complex(1,2)`, `1+1j`

Things that does NOT work...

```
double(3.14)
single(3.14)
int('3.14')
int(None)
import math; math.sqrt(-1)     # import cmath; cmath.sqrt(-1)
1+j                            # use 1+1j..
3+'4'
float(0)/float(0)              # Not 'not a number'

float(1/3)                     # is not 0.3333. float(1./3) is
```

...and a hack

```
from __future__ import division
1/3                            # result is a float
```

Data types: Sequences

String: `'A string'`, `"Another"`, `'<a href="http://dtu.dk">DTU</a>'`, `str(32)`, `str(True)`, `"Escape \" quotation"`, `'Wo' + 'rd'`, `'Hm' + 'm'*10`
`'''A ' is not necessary'''`, `"""Multiline string`
`A newline"""`, `'The results are %.02f and %d' % (3.14159, 5)`, `repr(42)`, `` `42` ``, `repr('42')`

List: `[1, 2, 3]`, `['heterogeneous', 3]`, `['w', 'o', 'r', 'd']`, `list("word")`, `[['list'], ['of', 'lists']]`, `list(('a', 1))`

Tuple: `(1, 2)`, `('a', 1)`, `('remember comma',)` `tuple(['a', 1])`

(xrange): `xrange(2)`, `xrange(2, 4)`, `xrange(0, 10, 2)`

Indexing with and function for sequences

```
# Python                 Result          Matlab
a = [5, 6, 7, 8]         #               a = [5 6 7 8]
a[0]                     # 5             a(1)              First element
a[2:4]                   # [7, 8]        a(3:4)            Third and fourth
a[-1]                    # 8             a(end)            Last element
a[-2]                    # 7             a(end-1)          Second last
a[2:]                    # [7, 8]        a(3:end)          From third element
a[::2]                   # [5, 7]        a(1:2:end)        Every second element
a[::-1]                  # [8, 7, 6, 5]  a(end:-1:1)       Reverse
len(a)                   # 4             length(a)         Length
[min(a), max(a)]         # [5, 8]        [min(a) max(a)]   Extreme elements
```

It also works for other sequences, such as

```
a = 'Der kom en soldat'[0:4]
a = (5, 6, 7, 8)
a = [{1: 2}, [3, 4], 5, 'Six']
```

Functions for lists and string

Some of the functions for lists (modifies `a`!):

```
a = [5, 6, 7, 8]
a.pop()                                  # a = [5, 6, 7]
a.append(2)                              # a = [5, 6, 7, 2]
a.sort()                                 # a = [2, 5, 6, 7]
a.reverse()                              # a = [7, 6, 5, 2]
```

Some of the functions for strings (leaves `a` unchanged):

```
a = 'Der kom en soldat'
a.split()                                # ['Der', 'kom', 'en', 'soldat']
a.upper()                                # 'DER KOM EN SOLDAT'
a.title()                                # 'Der Kom En Soldat'
import string
string.join(a.split(), '-')              # 'Der-kom-en-soldat'
```

Lists and copy . . .

```
a = [1, 2, 3]
b = a
a[1] = 2000
b
```

What happens here? What is `b`?

Lists and copy . . .

```
a = [1, 2, 3]
b = a
a[1] = 2000
b
```

What happens here? What is `b`?

```
b = [1, 2, 3]
b = [2000, 2, 3]
b = [1, 2000, 3]
```

How do we solve it?

. . . List and copy . . .

Google: Python + lists + copy

Multiple ways:

```
a = [1, 2, 3]

b = a[:]
b = list(a)
b = []; b.extend(a)
b = [];
for n in range(len(a)):
    b.append(a[n])
b = [ e for e in a ]

a[1] = 2000
b
```

And with an list of lists:

```
a = [1, 2, 3]
as = []
as.append(a)
a[1] = 2000
as.append(a)
```

Is there a problem?

And with an list of lists:

```
a = [1, 2, 3]
as = []
as.append(a)
a[1] = 2000
as.append(a)
```

Is there a problem? Yes. So how do we fix it?

And with an list of lists:

```
a = [1, 2, 3]
as = []
as.append(a)
a[1] = 2000
as.append(a)
```

Is there a problem? Yes. So how do we fix it? Same as before or:

```
a = [1, 2, 3]
as = []
as.append(a)
import copy
as = copy.deepcopy(as)
a[1] = 2000
as.append(a)
```

The problem with "range"

The following

```
for n in range(1000000000):
    print(n)
```

will MemoryError! in Python 2.4.4 due to memory allocation in the range function, but this code with xrange works ok:

```
for n in xrange(1000000000):
    print(n)
```

But xrange is "no longer exists" in Python 3.0!
(http://docs.python.org/dev/3.0/whatsnew/3.0.html)

Data types

Dictionary (Python hash): `{}`, `{ 'three': 3, 5: 'five'}`
`{'Danmark': 'Copenhagen', 'Botswana': 'Gaborone'}`,
`dict([['Danmark', 'Copenhagen' ], ['Botswana', 'Gaborone']])`

Set (distinct unordered): `set()`, `set([1, 2])`, `set([2, 1])`,
`set((2, 1))`, `set(range(0,5)) - set(range(4,10))`,
`set([1, 2]) | set([3, 4])`

Frozenset (immutable): `frozenset()`, `frozenset([1, 2])`
`frozenset([frozenset([1, 2]), frozenset([1, 2, 3])])`

Dictionaries

```
>>> d = {'Danmark': 'Copenhagen', 'Botswana': 'Gaborone'}

>>> d.keys()
['Danmark', 'Botswana']

>>> d.values()
['Copenhagen', 'Gaborone']

>>> for (k,v) in d.items():
>>>     print(k + ' has the capital ' + v)
Danmark has the capital Copenhagen
Botswana has the capital Gaborone
```

Control structures: `if`, `for` and `while`

```
xs = [ float(i)/64.0 for i in range(-150, 41) ]
ys = [ float(i)/16.0 for i in range(-25,26) ]
for y in ys:
    s = ''
    for x in xs:
        z = 0j; i = 0
        while i < 10:
            z = z**2 + x+y*1j
            if abs(z) > 2:
                break   # Get out of inner loop
            i += 1
        if abs(z) <= 2:
            s += '*'
        else:
            s += ' '
    print(s + '|')
```

Control structures: `if`, `for` and `while`

Other control flows: `for-continue`, `for-else`, `while-else`, `if-elif-else`

```
for i in range(-10,10):
    if i <= 0:
        continue
    print('Positive: ' + str(i))

a = 9
for i in range(-10,10):
    if i == a:
        print(str(a) + ' found!')
        break
else:
    print(str(a) + ' was not in the list')
```

Change the inner `while` to a `for` loop in the Mandelbrot program

Control structures: `if`, `for` and `while`

```
xs = [ float(i)/64.0 for i in range(-150, 41) ]
ys = [ float(i)/16.0 for i in range(-25, 26) ]
for y in ys:
    s = ''
    for x in xs:
        z = 0j
        for i in range(10):
            z = z**2 + x+y*1j
            if abs(z) > 2:
                s += ' ';
                break
        else:
            s += '*'
    print(s + '|')
```

Functions . . .

Defining and using a function in the interactive Python:

```
>>> def myadd(x,y):
...     return x+y
...
>>> myadd(1,2)
```

The function (reference) can be copied:

```
>>> myadd2 = myadd
>>> myadd2(2,3)
```

The original deleted and the “copy” still there:

```
>>> del myadd
>>> myadd2(2,3)
```

. . . Functions . . .

With default input argument:

```
>>> def myadd(x,y=2):
...     return x+y
...
>>> myadd(1)
```

And with named arguments:

```
>>> def mydivide(denominator, nominator):
...      return denominator/nominator
...
>>> mydivide(1.0, 3.0)                          # 0.3333333333333331
>>> mydivide(nominator=3.0, denominator=1.0)    # 0.3333333333333331
>>> mydivide(nominator=3.0, 1.0)                # Error!
>>> mydivide(3.0, nominator=1.0)                # 3
```

. . . Functions

Function call with a variable number of input arguments:

```
def myunion(x, *varargin):
    u = set(x)
    for y in varargin:
        u = u.union(set(y))
    return u
```

`myunion` may now be called with different number of input arguments:

```
>>> myunion([1])
set([1])
>>> myunion([1], [1, 2, 4], [3, 4])
set([1, 2, 3, 4])
```

In the latter case the variable `varargin` is a tuple:

```
([1, 2, 4], [3, 4])
```

Object-orientation with `class`: $2+2=5$

```
class myint(int):                          # Inheritance from 'int'
    def __init__(self, integer):
        print "I am the constructor"
        self.integer = integer
    def __add__(self, integer):            # Overloaded '+' operator
        if self.integer == 2 and integer == 2:
            return 5
        else:
            return self.integer + integer

>>> a = myint(2)
I am the constructor
>>> a+2
5
>>> 2+a
4
```

File processing ...

Writing to a file:

```
fid = open('test.txt', 'w')
fid.write('Hello\nWorld')
fid.close()
```

Reading a file:

```
fid = open('test.txt', 'r')
s = fid.read()                          # Read the entire file
fid.close()

fid = open('test.txt', 'r')
for line in fid:                        # Using file identifier as iterator
   print("Line: " + line.strip())

fid.close()
```

. . . File processing

Counting the number of lines in the following file:

`http://neuro.imm.dtu.dk/software/brede/code/brede/data/stop_english1.txt`

. . . File processing

Counting the number of lines in the following file:

`http://neuro.imm.dtu.dk/software/brede/code/brede/data/stop_english1.txt`

One solution:

```
fid = open('stop_english1.txt')
k = 0
for line in fid:
    k = k + 1
print(k)
```

. . . File processing

Counting the number of lines in the following file:

`http://neuro.imm.dtu.dk/software/brede/code/brede/data/stop_english1.txt`

One solution:

```
fid = open('stop_english1.txt')
k = 0
for line in fid:
    k = k + 1
print(k)
```

Another solution — on one line:

```
len([ line for line in open('stop_english1.txt')])
```

Exceptions

```
try:
    [ int(line) for line in open('stop_english1.txt') ]
except IOError, message:
    print('An IO error', message)
except ValueError, message:
    print('A value error', message)
else:
    print('Succes')
```

Exceptions can be 'raised' with `raise`:

```
raise RuntimeError, 'Another error'
```

New exception types can be defined by subclassing the `Exception` class.

Exceptions example

Definition of a function that catches an exception and returns NaN (Not a number) on zero division:

```
def mydivide(a, b):
    try:
        return float(a)/b
    except ZeroDivisionError:
        return float('nan')
    except Exception, e:
        print 'Error:', e

>>> 1./0
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
ZeroDivisionError: float division
>>> mydivide(1,0)
nan
```

Libraries . . .

Python library = "module"

"Package" = A set of "modules" in a directory tree

```
>>> sin(2.0)
```

leads to `NameError`: You need to load a module with `import`

```
import math
dir(math)       # look what is in the 'math' module
math.sin(2.0)
```

```
from math import sin
sin(2.0)
```

. . . Libraries . . .

Loading all functions in the `math` module:

```
from math import *
sin(2.0)
cos(2.0)
```

Renaming a loaded function:

```
from math import sin as mysin
mysin(2.0)
```

After changing in a module it is necessary to reload it:

```
reload(mymodule)
```

Library loading example

Loading a module may also be done ‘within’ the code, e.g., in exception statements:

```
try:
    import urllib3 as urllib     # There is nothing called urllib3
except:
    try:
        import urllib2 as urllib # urllib2 might be installed
    except:
        import urllib as urllib

urllib.urlopen('http://neuro.imm.dtu.dk/')
```

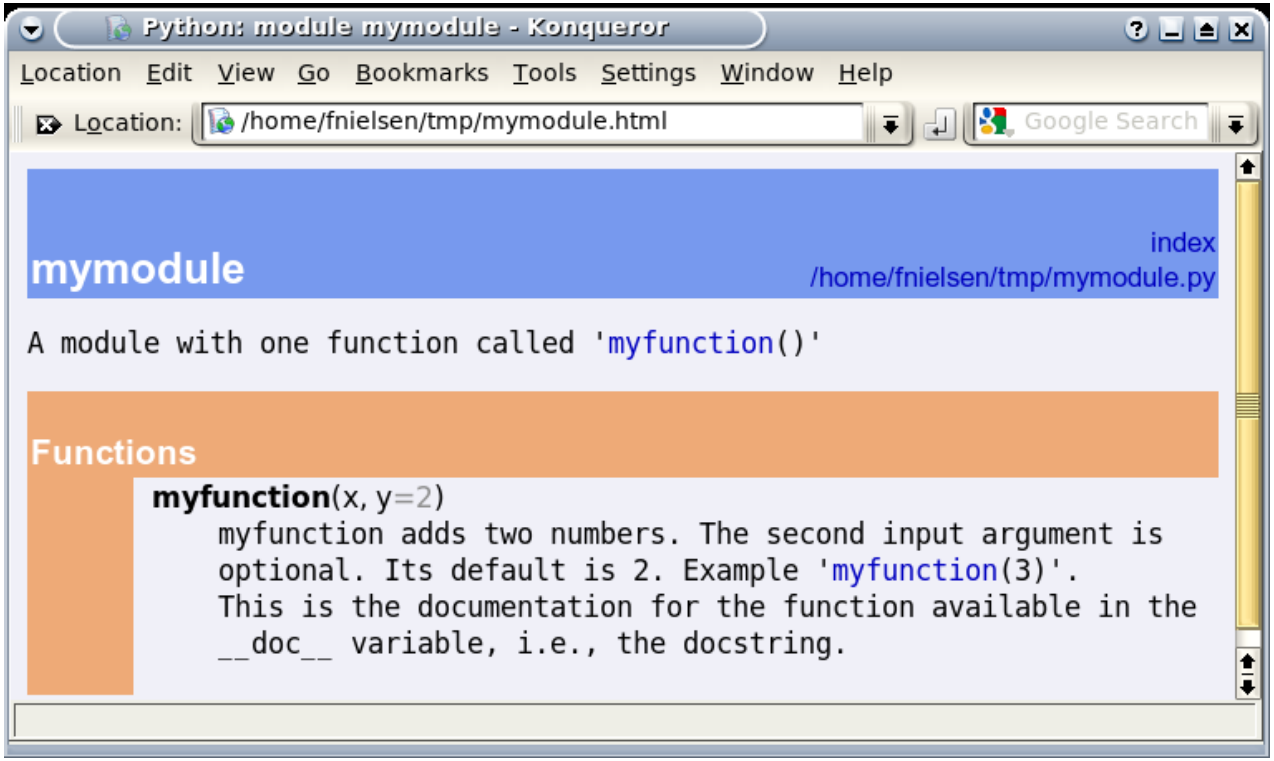
Documentation

```
"""A module with one function called 'myfunction()'"""

def myfunction(x, y=2):
    """
    myfunction adds two numbers. The second input argument is
    optional. Its default is 2. Example 'myfunction(3)':
    This is the documentation for the function available in the
    __doc__ variable, i.e., the docstring.
    """
    return x + y

print(myfunction.__doc__)
```

HappyDoc, *Epydoc*, *Pydoc*, *Docutils* tools (Langtangen, 2005, section B.2), e.g., `pydoc` included in the basic Python distribution:

```
$ pydoc -w ./mymodule.py
```

This call produces the following HTML page



Testing

Using `nose` with `mymodule.py` containing

```
def myfunction(x, y=2):
    return x+y

def test_myfunction():
    assert myfunction(1) == 3
    assert myfunction(1,3) == 4
```

Run the program `nosetests` (Campbell et al., 2009, p. 61–67)

```
$ nosetests mymodule.py
```

that discovers the `test_` functions. Or within Python:

```
>>> import nose, mymodule
>>> nose.run(mymodule)
```

doctest = documentation + testing ...

mymodule.py with myfunction with Python code in the docstring:

```
def myfunction(x, y=2):
    """
    This function will add two numbers, e.g.,
    >>> myfunction(1,7)
    8

    The second argument is optional
    >>> myfunction(2)
    4
    """
    return x+y

if __name__ == "__main__":
    import doctest
    doctest.testmod()
```

...doctest

```
$ python mymodule.py
```

The body of the following conditional gets executed if the function is called as the main program (`__main__`), — rather than imported as a module:

```
if __name__ == "__main__":
    import doctest
    doctest.testmod()
```

`doctest.testmod()` will extract the code and the execution result from the docstrings (indicated with >>>), execute the extracted code and compare its result to the extracted result: Literal testing!

This scheme also works for errors and their messages.

A problem

Consider a file with the following matrix $\mathbf{X}$:

```
1 2
3 4
```

Read and compute $\mathbf{Y} = 2 * \mathbf{X}$

A problem

Consider a file with the following matrix $\mathbf{X}$:

```
1 2
3 4
```

Read and compute $\mathbf{Y} = 2 * \mathbf{X}$

```
x = [ [ int(s) for s in line.split()] for line in open('tmp.txt') ]
y = []
for xrow in x:
  yrow = []
  for element in xrow:
      yrow.append(2*element)
  y.append(yrow)
```

A problem

Consider a file with the following matrix $\mathbf{X}$:

```
1 2
3 4
```

Read and compute $\mathbf{Y} = 2 * \mathbf{X}$

Or with numpy

```
from numpy import *

x = [ [ int(s) for s in line.split()] for line in open('tmp.txt') ]
y = 2*matrix(x)
```

Debian packages

python-beautifulsoup, python-feedparser, python-gnuplot, python-imaging, python-json, python-librdf, python-libsvm, python-matplotlib, python-nifti, python-numpy, python-nose, python-pysqlite2, python-rdflib, python-scipy, python-sparse, python-xml

References

Campbell, J., Gries, P., Montojo, J., and Wilson, G. (2009). *Practical Programming: An Introduction to Computer Science Using Python*. The Pragmatic Bookshelf, Raleigh.

Langtangen, H. P. (2005). *Python Scripting for Computational Science*, volume 3 of *Texts in Computational Science and Engineering*. Springer, second edition. ISBN 3540294155.

Martelli, A., Ravenscroft, A. M., and Ascher, D., editors (2005). *Python Cookbook*. O'Reilly, Sebastopol, California, 2nd edition.

Segaran, T. (2007). *Programming Collective Intelligence*. O'Reilly, Sebastopol, California.