Python programming — introduction to Python

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First a case
Python programming — introduction

Downloading a Web page

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

```python
# 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)
```

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Output from the print function

"Brussels Sunshine", http://blog.brusselssunshine.eu/feeds/posts/default
"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 ...

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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/feed ...
['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']
...

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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>
Reading feeds

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

```python
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

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

All tags for all posts in one particular feed:

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

```python
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

```python
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

```python
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

\[(W, H) = \text{nmf}(M)\]

...And then display the results:

```python
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`

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

Executing the script as a standard (UNIX) program

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

Or execute it from within Python

```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
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 formatting

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 indentation
        except: pass  # One-liner!
    print(formatresult(res))
Print

The print function can print almost anything:

```python
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:

```python
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), 1.00000000000000000000000000000001 == 1

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

Long: 1231980985476123891320918203981230123, 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'

...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)
# Python programming — introduction

## Indexing with and function for sequences

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

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']

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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 . . .

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

What happens here? What is `b`?

```python
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:

```python
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:

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

Is there a problem?
And with an list of lists:

```python
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:

```python
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:

```python
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

```python
>>> 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

```python
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:

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

The function (reference) can be copied:

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

The original deleted and the “copy” still there:

```python
>>> del myadd
>>> myadd2(2,3)
```
...Functions...

With default input argument:

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

And with named arguments:

```python
>>> def mydivide(denominator, nominator):
...     return denominator / nominator
... >>> mydivide(1.0, 3.0)  # 0.33333333333333331
>>> mydivide(nominator=3.0, denominator=1.0)  # 0.33333333333333331
>>> mydivide(nominator=3.0, denominator=1.0)  # Error!
>>> mydivide(3.0, nominator=1.0)  # 3
```
Functions

Function call with a variable number of input arguments:

```python
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:

```python
>>> 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:

```python
([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:

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

Reading a file:

```python
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:

```python
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:

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

Another solution — on one line:

```python
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('Success')

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:

```python
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

```python
>>> 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 \texttt{math} module:

\begin{verbatim}
from math import *
sin(2.0)
cos(2.0)
\end{verbatim}

Renaming a loaded function:

\begin{verbatim}
from math import sin as mysin
mysin(2.0)
\end{verbatim}

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

\begin{verbatim}
reload(mymodule)
\end{verbatim}
Library loading example

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

```python
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:

![HTML page from `pydoc` output](image)
Testing

Using nose with mymodule.py containing

```python
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:

```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:

```python
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 $X$:

$$
\begin{pmatrix}
1 & 2 \\
3 & 4
\end{pmatrix}
$$

Read and compute $Y = 2 \times X$
A problem

Consider a file with the following matrix $X$:

\[
egin{pmatrix}
1 & 2 \\
3 & 4
\end{pmatrix}
\]

Read and compute $Y = 2 \times X$

\[
x = \left[ \left[ \text{int}(s) \text{ for } s \text{ in } \text{line}.\text{split()} \right] \text{ for } \text{line} \text{ in } \text{open('tmp.txt')} \right]
\]
\[
y = []
\]
for xrow in x:
\[
yrow = []
\]
for element in xrow:
\[
yrow.\text{append}(2*\text{element})
\]
y.\text{append}(yrow)
A problem

Consider a file with the following matrix $X$:

\[
\begin{pmatrix}
1 & 2 \\
3 & 4 \\
\end{pmatrix}
\]

Read and compute $Y = 2 \times X$

Or with numpy

```python
from numpy import *

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

References


