# Mathython (=Math+Python)

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# Preface

Mathython as you guessed means Math + Python. This book guides you through how can you enrich your mathematical creativty with the master tool Python. This book requires neither any previous knowledge of Python nor any experience with programming. But some experience with middle school mathematics and eagerness to explore is expected. The format of this book is almost like story-telling although it covers some serious topics. I earnestly hope that you will enjoy it. If you find any error feel free to contact me or commit your fix at http://github.com/debdut/mathython . I will be very happy to recieve any comments or ideas about this book.

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# Contents

# Chapter 1

# Creating Mathython Environment

## 1.1 Introduction

In this chapter we will create the Mathython Environment. I have been using GNU/Linux environment while writing this book and will assume that you are also running some GNU/Linux distribution or atleast some Unix-type operating system. I hope that does not deter you from reading this book! Don't worry! this chapter includes instructions for setting up a GNU/Linux distribution. Or if you can import my instructions for use in windows, I won't mind. If you are in MacOS, feel happy because you are already in a Unix-type environment but still there will be some little differences.

Choose any GNU/Linux distribution based on Debian/Ubuntu, some of the preferred distributions for beginners are :

- GNU Trisquel

- Elementary OS (Mac-Like)

- Xubuntu

- Ubuntu

- Linux Mint (Windows-Like)

Out of this, I prefer Elementary OS[1] for beginners. Note The instructions in the whole book for all of this distributions is same. So you have two options:

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[1]I have some special instructions for Elementary OS here to make it the nicest workplace. Experiment with it and have some fun!

- Install GNU/Linux distribution in your harddisk.

- Install GNU/Linux distribution in a USB stick.

## 1.2  Starting Python

Open Terminal or console, type python followed by <Enter> and you will probably see this:

```
Python 2.7.3 (default, Apr 10 2013, 05:46:21)
[GCC 4.6.3] on linux2
Type "help", "copyright", "credits" or "license" for more information.
>>>
```

Did you see the same thing (without colors)? Yeppy! You are running python. If not, then probably your distribution does not have python installed. Go to Downloads and save the file. Change to dirctory of download and do the following to install python :

```
$tar -xvzf Python-2.7.9.tar.xz
$cd Python-2.7.9
$./configure
$make
$./python
$sudo make install
```

Ok, now you must be able to open python by typing python in terminal.

## 1.3  Installing Python Packages

# Chapter 2

# Python & Numbers

## 2.1 Basics

Lets get our hands dirty! We start with this Hello Numbers example :

```
# This program prints the counting numbers 1, 2, 3, 4 ... 10

print 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
```

Write or copy this code into file hellonum.py, save it and run it. You will probably get this :

```
1 2 3 4 5 6 7 8 9 10
```

Ok! lets understand what that program does. The command print takes numbers as arguments and prints them to the file stdout. This file is the Standard Output file, which in turn is printed on the screen before us. This print command can also print strings as shown in the following example :

```
#This program prints a string and numbers

print "My favorite number is", 7
```

Guess what this outputs,

```
My favorite number is 7
```

### 2.1.1 Numbers and Strings

**Numbers**

Python generally separates numbers in two ways :

- Integers $(\cdots -2, -1, 0, 1, 2, 3, \cdots)$ or plain integers as type int

- Floating point numbers, eg. $(1.0, 1.2, 1.3, 0.0, 1.3332)$ , as type float to represent decimals upto a certain precision.

int have the capability to handle numbers from $-2^{31}$ to $2^{31} - 1$ . For integers larger than that are handled by long type. For example, (100000000000000L, 1L). The letter L at the end denotes type. Operations involving long type numbers may output in long type even if they are in range of int type.

Python also has other types such as Decimal, Fraction, complex to handle other types of numbers. We will go through those later in this book.

**Strings and Characters**

On the other hand, python needs to handle characters and other things. Single characters, eg. (a, b, c, A, Z) are handled by char type in python.

But to handle sequence to characters, python has String or str type, eg. ("Hello Numbers", 'My favorite number is 7.0'). Strings are enclosed in either double quotes "" or single quotes ''. There are some special character such as :

- ' ' or space character

- \n or newline character

- \t or tab character

- \b or backspace character

- \v or vertical tab character

A program to understand special characters : After you copy this program, please make sure that you write the print command line is a single line, otherwise, you get a error. Here it is shown in many lines for convenience. Special strings known as Verbatim Strings with three quotes, "' "', support this feature. These are strings in which escape sequences (such as \n) won't be interpreted, line breaks will be preserved and quotation marks don't have to be masked. They are enclosed with triple double quotation marks. Possible indentations after a line break are part of the string as well.

```
#This program shows use of special characters

print "\t\t\b3.14159265358979323846264338279\n   502884197169
3993751058209749445923\n   07816406286208998628034825342117067\n
  9821    48086        5132       \n 823    06647       0
9384         \n46      09550       58223        \n17
 25359       4081        \n         2848       1117
    \n         4502      8410        \n         2701
    9385          \n        21105      55964         \n
   46229        48954        \n        9303        81964
     \n        4288       10975       \n        66593
     34461           \n     284756       48233        \n
    78678         31652       71\n    2019091        4564
85       66\n    9234603          486104543266480\n    2133936
       072024914127 \n    3724587          00660631558
\n    817488               152092096    Pi"
```

The ' ' or space character insert single blank in between other characters, while \t or tab character insert a tab, and with \n newline character we go to new line. The backspace character does not show the previous character.

```
        3.14159265358979323846264338327
      9502884197169399375105820974944592
     30781640628620899862803482534211706
  9821     48086         5132
 823       06647        09384
46         09550        58223
17         25359        4081
           2848         1117
           4502         8410
           2701         9385
           21105        55964
           46229        48954
           9303         81964
           4288         10975
           66593        34461
          284756        48233
          78678         31652        71
          2019091       456485       66
         9234603       486104543266480
         2133936        0726024914127
         3724587         00660631558
         817488           152092096   Pi
```

### 2.1.2  Booleans

You may or may not know that there is a lot math about booleans. In python, we call them
bool type. It have two values true and false . For mathematical purposes, we use 1 for true and
0 for . We will talk about them later.

## 2.2  Python as calculator

Open python console and follow me :

```
[GCC 4.6.3] on linux2
Type "help", "copyright", "credits" or "license" for more information.
>>> 2+2
4
>>>
```

After we write each line, we press <Enter> , get the result and continue. Some operations in python :

- \+ or addition operator; it is a binary operator, i.e, takes two inputs and gives single output.

- \* or multiplication operator; it is a binary operator, i.e, takes two inputs and gives single output.

- \- or subtraction operator; it is a binary operator, i.e, takes two inputs and gives single output.

- / or division operator; it is a binary operator, i.e, takes two inputs and gives single output.

- ** or exponentiation operator; it is a binary operator, i.e, takes two inputs and gives single output. (Simply, power operator, for eg. $2^2$ or 2 to the power 2)

- % or modulus operator; it is a binary operator, i.e, takes two inputs and gives single output. It is the remainder operator.

Note : All this operators other than last one work with int, long, Fraction, float and complex. The modulus character works with only int and long type. The + operation is also used for strings to conacatenate or merge. Other operators in the list do not work with strings. We will talk about this topic later.

### 2.2.1   Addition

```
>>> 107+24
131
>>> 1073741824+0
1073741824
>>> -2+2
0
>>> 2.333+2.334
4.667
>>> 1073741824+124
1073741948
```

Lets proceed to subtraction.

### 2.2.2   Subtraction

```
>>> 2-1
1
>>> 18998283-18399999938
-18381001655L
>>> 0-0
0
```

### 2.2.3   Multiplication

```
>>> 2*2
4
>>> 2*0
0
>>> 2*(3+4)
14
```

### 2.2.4   Division

```
>>> 2/1
2
>>> 10/4
2
>>> 10.0/4
2.5
>>> 1/0
Traceback (most recent call last):
   File "<stdin>", line 1, in <module>
ZeroDivisionError: integer division or modulo by zero
```

In the second example, we see that $10/4 = 2$. Actually it gives the quotient of 10 divided by 4. But $10.0/4 = 2.5$ since 10.0 is a float type, python performs a decimal type division. In the last example we see that we get a error message on dividing by 0 as it is not possible.

# Appendix A

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