

Companion Notes for Python Programming Tutorial at www.learnpython.org by Sheila Kannappan

These notes accompany the first 14 sections of the tutorial at <http://www.learnpython.org/>. However, we will not use the online Input/Output boxes. Rather, we will write code with emacs and run it locally under both python 2.7 and python 3. To get set up, use the linux command [*mkdir*](#) (“make directory”) to create a subdirectory called “python” in your “public” directory in afs. Then cd into it and start emacs as well as firefox with [*firefox &*](#).

Learn the Basics

1. Hello, World!
2. Variables and Types
3. Lists
4. Basic Operators
5. String Formatting
6. Basic String Operations
7. Conditions
8. Loops
9. Functions
10. Classes and Objects
11. Dictionaries
12. Modules and Packages

Advanced Tutorials

13. Generators
14. List Comprehensions

Why two versions of python?? Unfortunately, you are learning python at a time of transition. The creator of python decided to fix some issues with the language in python 3 in such a way that *it is not backwards compatible*. The changes were planned for a while, and the last version of the earlier family of python releases, python 2.7, is designed to make the changeover as painless as possible, but nonetheless two things are true:

- 1) all future development will follow the lineage and new syntax of python 3, as the previous lineage has been frozen at 2.7
- 2) many existing packages have not yet been converted to python 3 (even one we’ve provided, Fabric) and must be run under python 2.7

Fortunately, only a few changes will affect beginning users – chiefly, the syntax of the *print* command and the syntax for integer vs. floating point division. Visit the following webpages for all the gory details:

<http://wiki.python.org/moin/Python2orPython3>
<http://docs.python.org/3/whatsnew/3.0.html>
<http://python3porting.com/preparing.html>

Now please complete the tutorial sections sequentially, noting the clarifying comments/extra exercises given for selected sections below. Note: since white space has syntactical meaning in python, *never* use tabs in your python code!

1. [Hello, World!](#)

Create a file called hello2.py and another called hello3.py. ~~Paste the contents of the input box at learnpython.org into your hello2.py file and save it.~~ In the file hello2.py, type `print "Hello world!"` Notice the use of comments (**anything in your code that has a # in front of it**) that are not actually executed. Run the program by typing `python hello2.py` on the command line.

Now modify and copy the contents in file hello2.py using the new **python 3** print syntax in hello3.py. You'll have to refer to one of the python 2 vs. 3 web pages given above. Run the modified code by typing `python3 hello3.py`.

2. [Variables and Types](#)

If you don't know the phrase "object oriented" don't worry! It will become clearer later.

4. [Basic Operators](#)

Put the initial example calculation `number = 1 + 2 * 3 / 4.0` into a little program calcnum2.py for python 2 and add a print command to output the number. Do the same for python 3 (**using the proper print syntax**) in calcnum3.py.

Now change the 4.0 to 4 in both codes and rerun both codes to see how the output changes.

Finally, modify the division operator in calcnum3.py so that the output matches the output from calcnum2.py. (You'll have to refer to the python 2 vs. 3 web pages again.)

7. [Conditions](#)

The "is" operator gets at the idea of an "object" in object-oriented programming. The idea is that a particular variable has an identity (perhaps it would be helpful to imagine it at a specific location on a hard disk) which is independent of its value. The "id" function helps clarify matters, because in general any two variables a and b will return different id's, even if they have the same value, unless b was *defined* by b=a, in which case b has no identity independent of being the same as a. In python, a or b could even be functions, so "object" is a very general term for any defined entity in your program. A potential confusion arises because small integers from -5 to 256 are hardwired as objects in python before you ever use them in your code. Therefore we get:

```
>>> a = 256
>>> b = 256
>>> a is b
True          # both were linked to the hardwired object "256"
>>> a = 257
```

```
>>> b = 257
>>> a is b
False          # "257" was not an object, so a and b are distinct
To understand this weirdness, look at the id's:
```

```
>>> a = 256
>>> b = 256
>>> id(a)
9987148
>>> id(b)
9987148
>>> a = 257
>>> b = 257
>>> id(a)
11662816
>>> id(b)
11662828
```

Bottom line, if a “is” b, then `id(a) == id(b)`.

8. [Loops](#)

An iterator generator can only be used in a loop – it doesn’t make sense outside that context because it is designed to suspend execution until a “for” statement comes back and asks it for another number. To see the difference compared to a standard list, we’ll use python interactively. At the linux command line, simply type “python” (which is again python 2.7 by default). Now you can type python commands one by one and see the output. Type `print(range(0,7))` and then `print(xrange(0,7))` and compare the results. Now exit with Ctrl-D, and type “python3” to repeat the experiment under the newer python. Effectively, the old range behavior is gone in python 3, but you can recreate it by typing `print(list(range(0,7)))`.

12. [Modules and Packages](#)

A lot of the exercises in this section aren't meant to be ran, but instead are an outline of how modules would be utilized if you were running your own modules. Only a few of the examples near the bottom are actually expected to run, so be mindful of that.

The command written `>>> dir(urllib)` should say `print(dir(urllib))`.

The sentence "This file can be empty, and it indicates that the directory it contains is a Python package" should say "This file can be empty, and it indicates that the directory it is contained in is a Python package".

API = “applications programming interface” = functions the package provides for use by default

The exercise in this section is unclear – you are meant to actually look for a function in “re” that can help you perform the task.

Unlike the foo bar example, the “import re” statement at the top of the input window code involves no package/module information, it’s just a module as is. So any re functions must be called with the “re.” prefix unless you define a new term (e.g., “search = re.search”). **This tip isn't necessary to solve the last question, but is something you should know about using functions in any module (such as re).**

13. [Generators](#)

Note the generator doesn’t get looped over, just paused/suspended.

For now you should stop after tutorial #14. Obviously we’ve just scratched the surface. If you want to dig deeper on your own, besides finishing the online tutorial, you might look into any of these links:

Brief intro to scientific computing with the python packages provided on the REU machines:
www.physics.unc.edu/~sheila/emmettpythonpresentation.pdf

Google course on python:

<http://code.google.com/edu/languages/google-python-class/>

Downloadable pdf book on python for computational science, free with UNC credentials:

<http://search.lib.unc.edu/search?Ntt=python+scripting+for+computational+science&Ntk=Title&Nty=1&sugg=is>

Translation tables between common programming languages:

<http://mathesaurus.sourceforge.net/>

astronomy-specific resources:

<http://stsdas.stsci.edu/perry/pydatatut.pdf>

<http://www.cv.nrao.edu/~aleroy/pytut/pytut.html>