Basic Python Syntax

Numbers and Strings

- like Java, Python has built-in (atomic) types
  - numbers (`int`, `float`), `bool`, `string`, `list`, etc.
  - numeric operators: `+ - * / ** %`

```
>>> a = 5
>>> b = 3
>>> type (5)
<type 'int'>
>>> a += 4
>>> a
9
```

no `i++` or `++i`

```
>>> c = 1.5
>>> 5/2
2
>>> 5/2.
2.5
>>> 5 ** 2
25
```

```
>>> s = “hey”
>>> s + “ guys”
'hey guys'
>>> len(s)
3
>>> s[0]
'h'
>>> s[-1]
'y'
```

```
>>> from __future__ import division
>>> 5/2
2.5
```

recommended!

Assignments and Comparisons

```
>>> a = b = 0
>>> a
0
>>> b
0

>>> a, b = 3, 5
>>> a + b
8
>>> (a, b) = (3, 5)
>>> a + b
>>> 8
>>> a, b = b, a
(swap)
```

```
>>> a = b = 0
>>> a == b
True
>>> type (3 == 5)
<type 'bool'>
>>> "my" == 'my'
True

>>> (1, 2) == (1, 2)
True

>>> 1, 2 == 1, 2
???
(1, False, 2)
```

for loops and range()

- for always iterates through a list or sequence

```
>>> sum = 0
>>> for i in range(10):
...     sum += i
...
>>> print sum
45

>>> for word in ["welcome", "to", "python"]:
...     print word,
...
welcome to python

>>> range(5), range(4,6), range(1,7,2)
([0, 1, 2, 3, 4], [4, 5], [1, 3, 5])
```

Java 1.5

```
foreach (String word : words)
    System.out.println(word)
```

`while` loops

- very similar to `while` in Java and C
  - but be careful
    - `in` behaves differently in `for` and `while`
  - `break` statement, same as in Java/C

```
>>> a, b = 0, 1
>>> while b <= 5:
...       print b
...       a, b = b, a+b
...
1
1
2
3
5
```

simultaneous assignment

fibonacci series

Conditionals

```
>>> if x < 10 and x >= 0:
...     print x, "is a digit"
...
>>> False and False or True
True
>>> not True
False
```

```
>>> if 4 > 5:
...     print "foo"
... else:
...     print "bar"
...
bar
```

```
>>> print “foo” if 4 > 5 else “bar”
...
>>> bar
```

conditional expr since Python 2.5

C/Java `printf( (4>5)? ”foo” : “bar”);`

if … elif … else

```
>>> a = "foo"
>>> if a in ["blue", "yellow", "red"]:
...     print a + " is a color"
... else:
...     if a in ["US", "China"]:
...             print a + " is a country"
...     else:
...             print "I don't know what”, a, “is!"
...
I don't know what foo is!
```

```
>>> if a in …:
...     print …
... elif a in …:
...     print …
... else:
...     print …
```

C/Java

```
switch (a) {
    case “blue”:
    case “yellow”:
    case “red”:
        print ...; break;
    case “US”:
    case “China”:
        print ...; break;
    else:
        print ...;
}
```

break, continue and else

- break and continue borrowed from C/Java
- special else in loops
  - when loop terminated *normally* (i.e., not by break)
  - very handy in testing a set of properties

```
>>> for n in range(2, 10):
...     for x in range(2, n):
...         if n % x == 0:
...             break
...     else:
...         print n,
...
```

prime numbers

```
                                 || func(n)
for (n=2; n<10; n++) {
    good = true;
    for (x=2; x<n; x++)
        if (n % x == 0) {
          good = false;
          break;
        }            if (x==n)
    if (good)
        printf("%d ", n);
}
```

C/Java

Defining a Function `def`

- no type declarations needed! wow!
  - Python will figure it out at run-time
    - you get a run-time error for type violation
      - well, Python does not have a compile-error at all

```
>>> def fact(n):
...     if n == 0:
...         return 1
...     else:
...         return n * fact(n-1)
...
>>> fact(4)
24
```

Fibonacci Revisited

```
>>> a, b = 0, 1
>>> while b <= 5:
...       print b
...       a, b = b, a+b
...
1
1
2
3
5
```

```
def fib(n):
   if n <= 1:
      return n
   else:
      return fib (n-1) + fib (n-2)
```

conceptually cleaner, but much slower!

```
>>> fib(5)
5
>>> fib(6)
8
```

Default Values

```
>>> def add(a, L=[]):
...     return L + [a]
...
>>> add(1)
[1]

>>> add(1,1)
error!

>>> add(add(1))
[[1]]

>>> add(add(1), add(1))
???
[1, [1]]
```

lists are heterogenous!

Approaches to Typing

- ✓ strongly typed: types are strictly enforced. no implicit type conversion
- weakly typed: not strictly enforced
- statically typed: type-checking done at compile-time
- ✓ dynamically typed: types are inferred at runtime

	weak	strong
static	C, C++	Java, Pascal
dynamic	Perl, VB	Python, OCaml

Lists

heterogeneous variable-sized array

```
a = [1,'python', [2,'4']]
```

Basic List Operations

- length, subscript, and slicing

```
>>> a = [1,'python', [2,'4']]
>>> len(a)
3
>>> a[2][1]
'4'
>>> a[3]
IndexError!
>>> a[-2]
'python'
>>> a[1:2]
['python']
```

```
>>> a[0:3:2]
[1, [2, '4']]

>>> a[:-1]
[1, 'python']

>>> a[0:3:]
[1, 'python', [2, '4']]

>>> a[0::2]
[1, [2, '4']]

>>> a[::]
[1, 'python', [2, '4']]

>>> a[:]
[1, 'python', [2, '4']]
```

+, extend, +=, append

- extend (+=) and append mutates the list!

```
>>> a = [1,'python', [2,'4']]
>>> a + [2]
[1, 'python', [2, '4'], 2]
>>> a.extend([2, 3])
>>> a
[1, 'python', [2, '4'], 2, 3]
```

same as `a += [2, 3]`

```
>>> a.append('5')
>>> a
[1, 'python', [2, '4'], 2, 3, '5']
>>> a[2].append('xtra')
>>> a
[1, 'python', [2, '4', 'xtra'], 2, 3, '5']
```

Comparison and Reference

- as in Java, comparing built-in types is by value
  - by contrast, comparing objects is by reference

```
>>> [1, '2'] == [1, '2']
True
>>> a = b = [1, '2']
>>> a == b
True
>>> a is b
True
>>> b [1] = 5
>>> a
[1, 5]
>>> a = 4
>>> b
[1, 5]
>>> a is b
>>> False
```

```
>>> c = b [:]
>>> c
[1, 5]
>>> c == b
True
>>> c is b
False
```

slicing gets a shallow copy

```
>>> b[:0] = [2]
>>> b
[2, 1, 5]
```

insertion

```
>>> b[1:3]=[]
>>> b
[2]
```

deletion

```
>>> a = b
>>> b += [1]
>>> a is b
True
```

`a += b` means `a.extend(b)` NOT `a = a + b` !!

List Comprehension

```
>>> a = [1, 5, 2, 3, 4 , 6]
>>> [x*2 for x in a]
[2, 10, 4, 6, 8, 12]

>>> [x for x in a if \
... len( [y for y in a if y < x] ) == 3 ]
[4]

>>> a = range(2,10)
>>> [x*x for x in a if \
... [y for y in a if y < x and (x % y == 0)] == [] ]
???
[4, 9, 25, 49]
```

4th smallest element

square of prime numbers

List Comprehensions

```
>>> vec = [2, 4, 6]
>>> [[x,x**2] for x in vec]
[[2, 4], [4, 16], [6, 36]]

>>> [x, x**2 for x in vec]
SyntaxError: invalid syntax

>>> [(x, x**2) for x in vec]
[(2, 4), (4, 16), (6, 36)]

>>> vec1 = [2, 4, 6]
>>> vec2 = [4, 3, -9]
>>> [x*y for x in vec1 for y in vec2]
[8, 6, -18, 16, 12, -36, 24, 18, -54]
```

(cross product)

```
>>> [x+y for x in vec1 for y in vec2]
[6, 5, -7, 8, 7, -5, 10, 9, -3]
```

should use zip instead!

```
>>> [vec1[i]*vec2[i] for i in range(len(vec1))]
[8, 12, -54]
```

(dot product)

Strings

sequence of characters

Basic String Operations

- join, split, strip
- upper(), lower()

```
>>> s = " this is  a  python course. \n"
>>> words = s.split()
>>> words
['this', 'is', 'a', 'python', 'course.']
>>> s.strip()
'this is  a  python course.'
>>> " ".join(words)
'this is a python course.'
>>> "; ".join(words).split("; ")
['this', 'is', 'a', 'python', 'course.']
>>> s.upper()
' THIS IS  A  PYTHON COURSE. \n'
```

http://docs.python.org/lib/string-methods.html

Basic Search/Replace in String

```
>>> "this is a course".find("is")
2
>>> "this is a course".find("is a")
5
>>> "this is a course".find("is at")
-1

>>> "this is a course".replace("is", "was")
'thwas was a course'
>>> "this is a course".replace(" is", " was")
'this was a course'
>>> "this is a course".replace("was", "were")
'this is a course'
```

these operations are much faster than regexps!

String Formatting

```
>>> print “%.2f%%” % 97.2363
97.24%

>>> s = '%s has %03d quote types.' % ("Python", 2)
>>> print s
Python has 002 quote types.
```