Introduction to Python

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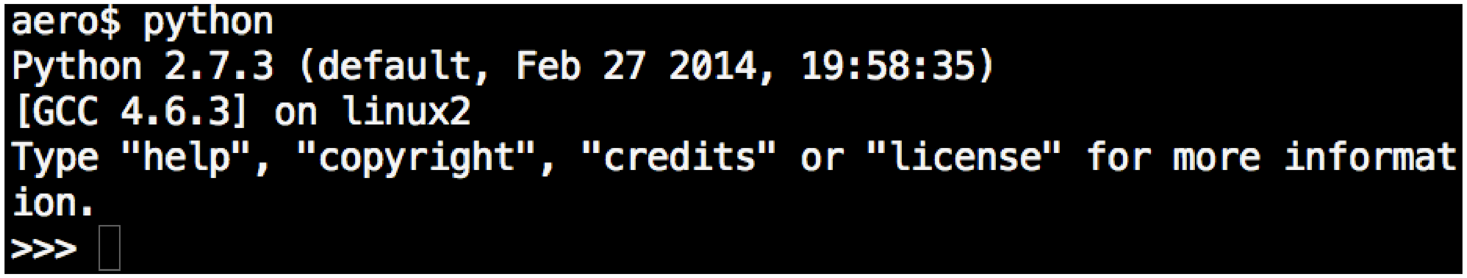
What is Python?

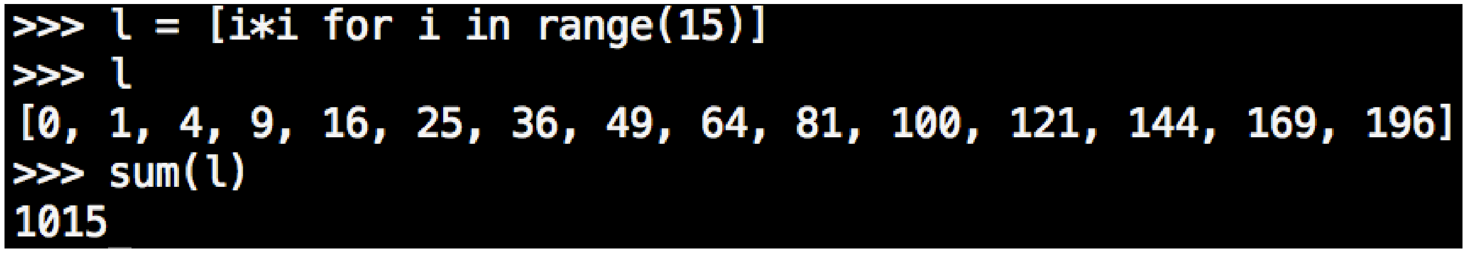
- Designed by Guido van Rossum, in 1990s
- Dynamic, interpreted language
  - does not declare types of variables or parameters
  - short and flexible code
  - no compile-time type checking
- Good for fast prototyping

Python Interpreter

- Installed on every cs machine



```
aero$ python
Python 2.7.3 (default, Feb 27 2014, 19:58:35)
[GCC 4.6.3] on linux2
Type "help", "copyright", "credits" or "license" for more informat
ion.
>>> 
```



```
>>> l = [i*i for i in range(15)]
>>> l
[0, 1, 4, 9, 16, 25, 36, 49, 64, 81, 100, 121, 144, 169, 196]
>>> sum(l)
1015
```

- ctrl-D to exit or use exit()

Python Scripts

- Python scripts suffix with .py
- In general,
  - $python ./helloworld.py
- Create executable scripts
  - in the first line of the script, add

```
#! /lusr/bin/python
```

  - make the file executable, type in the terminal

```
$chmod a+x helloword.py
```

  - type the name of the script to execute

```
$./helloword.py
```

Syntax

- Much of Python syntax is similar to C
- Missing operators: ++, --
- Code blocks denoted by line indentation
  - class and function definitions, control flow
  - same amount of indentation within the same block

```
if True:
   print 'true'
print 'answer'
```

```
if True:
   print 'true'
   print 'answer'
```

```
if True:
   print 'true'
else:
 print 'false'
```

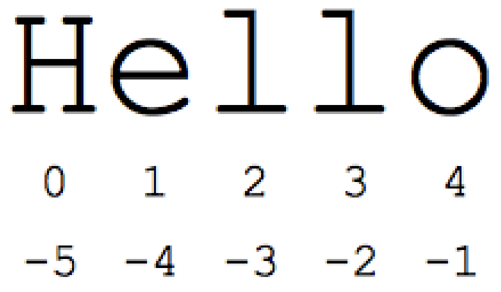
- Hash sign (#) begins a comment

Built-in Types

- Numerical types
  - integer, float, complex
  - bitwise operations on integer types are the same as in C
- Sequence types
  - string, list, tuple, bytearray, xrange, buffer, …
- Mapping type – dictionary
  - dict = {'Name': 'Zara', 'Age': 7, 'Class': 'First'};
  - dict['Name'] = ?   dict['Age'] = ?

String Methods

- Concatenation
  - “hello” + “world”   “helloworld”
- Repetition
  - “hello”*3   “hellohellohello”
- Length
  - len(“hello”)   5
- Indexing
  - “hello”[2], “hello”[-1]
- Slice
  - “hello”[1:3], “hello”[-2:]
  - “hello”[:], “hello”[1:10]



String Methods (Cont.)

s = “hello+world”

s.find(“world”)	6
s.split(“+”)	[“hello”,“world”]
“+”.join([“hello”,“world”])	“hello+world”
“lo” in s (“lo” not in s)	True
s.upper() (s.lower())	“HELLO+WORLD”
str(3.14)	“3.14”

List Methods

- A compound data type
  - [1,"hello", True, 3.2]
- Same operators as for strings
  - a+b, a*3, a[-1], a[1:], len(a)

items = [1,"hello", 9.2, True]

- Append an element
  - items.append("world") [1,"hello",9.2,True,"world"]
- Extend the list
  - items.extend(["world"]) [1,"hello",9.2,True,"world"]

Lists Methods (Cont.)

items = [1,“hello”, 9.2, True]

- Insert an element
  - items.insert(2, “world”) [1,“hello”,“world”, 9.2,True]
- Remove an element
  - items.remove(“hello”) [1,9.2,True]
  - items.pop() [1,“hello”,9.2]
- Reverse the order of the list
  - items.reverse() [True, 9.2, “hello”, 1]
- Generate a list
  - range(5) [0,1,2,3,4]
  - [i*i for i in range(5)] [0,1,4,9,16]

Control Flow - if/elif/else

```
if a == 0:
    print "zero!"
elif a < 0:
    print "negative!"
else:
    print "positive!"
```

- blocks identified by indentation
- colon (:) used at end of lines containing control flow keywords

Control Flow - for loop

```
for x in list:
    do something...
```

Example:

```
a = [3, 1, 4, 1, 5, 9]
for x in a:
    print x
```

Functions

- Defining functions

```
def inc(x):
    y = x+1
    return y
```

❖ begins with keyword def, function name, and parentheses

❖ parameters are placed within parentheses

❖ code block starts with colon and indented

- Calling functions

```
print inc(3)
```

- Functions must be defined before they are called

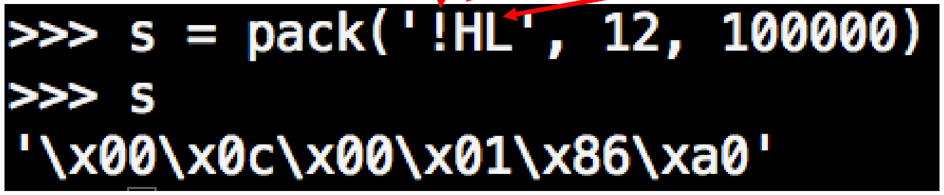
Modules

- files containing Python definitions and statements
  - ❖ code reuse, easier maintenance
- Importing modules

```
from socket import *
socket(AF_INET, SOCK_STREAM)
import random
random.randint(1, 10)
```

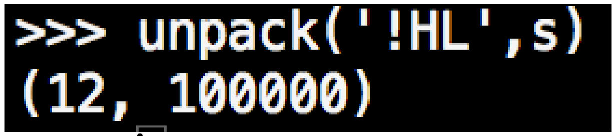
Packing Datagrams

- struct module
  - ❖ from struct import *
- A message has two fields. field 1 has 2 bytes, field 2 has 4 bytes
  - ❖ sender side



```
>>> s = pack('!HL', 12, 100000)
>>> s
'\x00\x0c\x00\x01\x86\xa0'
```

  - ❖ receiver side



```
>>> unpack('!HL',s)
(12, 100000)
```

- Details in Python documentation

When You Need Help…

- Google search
  - 'python list', 'python string uppercase', …
- Official Python docs site – docs.python.org
- Many questions (answers) can be found on StackOverflow
- Use help() inside the Python interpreter
  - help(len), help(list), …

Example: TCP client in Python

```
from socket import *
serverName = 'servername'
serverPort = 12000
clientSocket = socket(AF_INET,
                      SOCK_STREAM)
clientSocket.connect((serverName,serverPort))
sentence = raw_input('Input lowercase sentence:')
clientSocket.send(sentence)
modifiedSentence = clientSocket.recv(1024)
print 'From Server:', modifiedSentence
clientSocket.close()
```

include Python's socket library

create TCP socket

No need to attach server name, port

Example: TCP server in Python

```
from socket import *
serverPort = 12000
serverSocket = socket(AF_INET,
                              SOCK_STREAM)
serverSocket.bind(('',serverPort))
serverSocket.listen(1)
print 'The server is ready to receive'
while 1:
    connectionSocket, addr = serverSocket.accept()
    sentence = connectionSocket.recv(1024)
    capitalizedSentence = sentence.upper()
    connectionSocket.send(capitalizedSentence)
    connectionSocket.close()
```

create TCP welcoming socket

server begins listening for incoming TCP requests

server waits on accept() for incoming requests, new socket created on return

read bytes from connection socket

close connection to this client (but *not* welcoming socket)

Example: UDP client in Python

```
from socket import *
serverName = 'hostname'
serverPort = 12000
clientSocket = socket(AF_INET,
                      SOCK_DGRAM)
message = raw_input('Input lowercase sentence:')

clientSocket.sendto(message,(serverName, serverPort))
modifiedMessage, serverAddress =
                      clientSocket.recvfrom(2048)
print modifiedMessage
clientSocket.close()
```

create UDP socket for server

Attach server name, port to message; send into socket

read reply characters from socket into string

print out received string and close socket

Example: UDP server in Python

```
from socket import *
serverPort = 12000
serverSocket = socket(AF_INET,
                              SOCK_DGRAM)
serverSocket.bind(('', serverPort))
print "The server is ready to receive"
while 1:

  message, clientAddress = serverSocket.recvfrom(2048)
  modifiedMessage = message.upper()
  serverSocket.sendto(modifiedMessage, clientAddress)
```

create UDP socket

bind socket to local port number 12000

Read from UDP socket into message, getting client's address (client IP and port)

send upper case string back to this client