Genome Sciences 373
Genome Informatics

Quiz Section 2

April 7, 2015

Topics for today

Questions from lecture

Homework 1 due tomorrow 5pm
Homework 2 assigned tomorrow

Python overview: more data types

Questions about material from lecture

Can python lists have strings and numbers mixed together?

What are some ways of writing a newline to my program's output?

How do I decide what scores to put in my alignment scoring matrix?

More python for beginners: comments, sets, dictionaries

Commenting for beginners

Your homework MUST HAVE COMMENTS

It's OK to "over-comment"

Usually we put comments just above the part of the program we're referring to

In-class example

Today: data types, flow control

Dictionaries

Sets

If/elif/else statements

The importance of indenting!

Useful data type: sets

- Sets usually get introduced “later on” when learning to program
- But, they are VERY useful in bioinformatics! So we’re jumping ahead.
- A “set” in python implements the *mathematical* concept of a set [In-class example]

```
>>> my_list = [1, 1, 2, 2, 3, 3]
>>> my_set = set(my_list)
>>> my_list
[1, 1, 2, 2, 3, 3]
>>> my_set
set([1, 2, 3])
>>>
```

Working with sets

- len(s) – cardinality or size of set s.
- x in s – test x for membership in s.
- s.issubset(t) – test whether every element in s is in t.
- s.issuperset(t) – test whether every element in t is in s.
- s.update(t) – Update set by adding all elements in t.
- s.add(e) – Add e to set.
- s.remove(e) – Remove e from set (or KeyError) compare:
- s.discard(e) – Remove e from set if it exists.
- s.clear() – Remove all items.

Working with sets: part 2

- s | t – new set with elements from both s and t.
  (a.k.a. “UNION”)
- s & t – new set with elements common to s and t.
  (a.k.a. “INTERSECTION”)
- s - t – new set with elements in s but not in t
- s ^ t – new set with elements in either s or t but not both

```
0406 16:18 s020:~% python
Python 2.7.2 (default, Feb 28 2012, 08:29:13)
[GCC 4.4.6 20110731 (Red Hat 4.4.6-3)] on linux2
Type "help", "copyright", "credits" or "license" for more information.
>>> odds = set([1,3,5,7,9])
>>> evens = set([2,4,6,8,10])
>>> primes = set([2,3,5,7])
>>>
>>> print odds & primes
set([3, 5, 7])
>>> print evens & primes
set([2])
>>> print odds & evens
set([])
>>> print odds + evens
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
TypeError: unsupported operand type(s) for +: 'set' and 'set'
>>> print odds | evens
set([1, 2, 3, 4, 5, 6, 7, 8, 9, 10])
>>>
```

In class example:

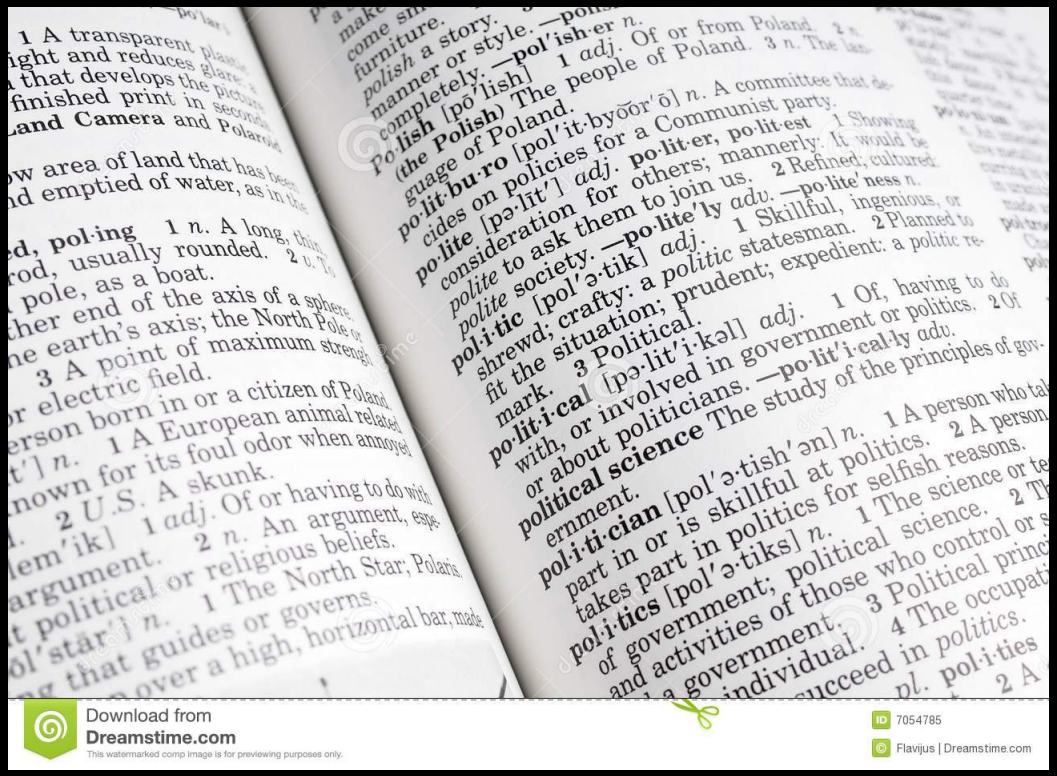
State names

Dictionaries: pretty much what it sounds like

Like a printed dictionary maps *words* to *definitions*,

Python dictionaries map *keys* to associated *values*

You can quickly “look up” the “value” associated with a “key”




```
>>> capitals = { }
>>> capitals[“WA”] = “Olympia”
>>> capitals[“ID”] = “Boise”
>>> capitals[“AK”] = “Juneau”
```

Working with dictionaries

```
0406 21:32 iris:~% python
Python 2.7.6 (default, Sep  9 2014, 15:04:36)
[GCC 4.2.1 Compatible Apple LLVM 6.0 (clang-600.0.39)] on darwin
Type "help", "copyright", "credits" or "license" for more information.
>>>
>>> capitals = { }
>>> capitals["WA"] = "Olympia"
>>> capitals["ID"] = "Boise"
>>> capitals["AK"] = "Juneau"
>>> capitals
{'AK': 'Juneau', 'ID': 'Boise', 'WA': 'Olympia'}
>>> capitals["ID"]
'Boise'
>>> capitals["IE"]
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
KeyError: 'IE'
>>> for state, city in capitals.items():
...     print "The capital of", state, "is", city
...
The capital of AK is Juneau
The capital of ID is Boise
The capital of WA is Olympia
>>>
```

note: “random” order

Working with dictionaries, part 2

my_dict.get(*k*, *default*) – returns the *value* associated with **k**,
or default if key **k** does not exist

my_dict.items() – returns all *key: value* pairs as an iterator

my_dict.keys() – returns all *keys* in the dictionary (in “random” order)

my_dict.values() – returns all *values* in the dictionary (“random”)

Values can be anything, even other dictionaries!

<In class example>

Python flow control: if / elif / else

```
num = int(sys.argv[1])

if num > 0:
    print “input is greater than zero”
elif num < 0:
    print “input is less than zero”
else:
    print “input must be zero!”
```

The order of these MUST be if → $elif_n$ → else

But you only *need* “if” – the others are optional

Python flow control: if / elif / else

```
num = int(sys.argv[1])

if num == 1:
    print “input is exactly 1”
elif num == 2:
    print “input is exactly 2”
elif num == 3:
    print “input is exactly 3”
elif num == 4: […]
else:
    print “input didn’t match anything I wanted!”
```

Doing more than one thing

```
num = int(sys.argv[1])

if num == 1:
    print “input is exactly 1”
    prime = False
    even = False
elif num == 2:
    print “input is exactly 2”
    prime = True
    even = True
else:
    print “didn’t get a 1 or a 2”
```

Doing more than one thing

```
num = int(sys.argv[1])

if num == 1:
    print “input is exactly 1”
    prime = False
    even = False
elif num == 2:
    print “input is exactly 2”
    prime = True
    even = True
else:
    print “didn’t get a 1 or a 2”
```

a “block” of code defined by having the same indenting

another block

For loops: iterating over groups of things

Often you want to do something to every element of a group:

- Check every number to see if it's less than some value
- Read the second column in every line of input
- Look at every *key: value* pair in a dictionary

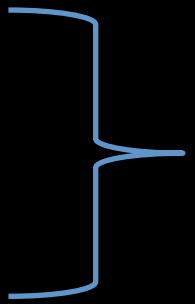
Lists

```
>>> my_list = [1, 2, 3, 4]
>>> for temporary_name in my_list:
...     print temporary_name * 2
...
2
4
6
8
>>>
>>> temporary_name
4
>>> for temporary_name in my_list:
...     print temporary_name * 2
...
2
4
6
8
>>>
```

Strings

```
>>> my_string = "ACGTA"
>>> for my_character in my_string:
...     print my_character.lower()
...
a
c
g
t
a
>>>
```

```
>>>
>>> my_dict = {'geneA': 4500, 'geneB': 5000, 'geneC': 2000}
>>> my_dict
{'geneA': 4500, 'geneB': 5000, 'geneC': 2000}
>>> current_max = 0
>>> top_gene_name = ""
>>> for g, v in my_dict.items():
...     if v > current_max:
...             current_max = v
...             top_gene_name = g
...
>>>
>>>
```



Note: three layers of indentation!

```
>>>
>>> my_dict = {'geneA': 4500, 'geneB': 5000, 'geneC': 2000}
>>> my_dict
{'geneA': 4500, 'geneB': 5000, 'geneC': 2000}
>>> current_max = 0
>>> top_gene_name = ""
>>> for g, v in my_dict.items():
...     if v > current_max:
...             current_max = v
...             top_gene_name = g
...
>>>
>>>
```

What is the value of current_max ?

What is the value of top_gene_name?

Comparison operators: comparing values

Boolean: **and**, **or**, **not**

Numeric: **< , > , ==, !=, >=, <=**

String: **in, not in**

< is less than
> is greater than
== is equal to
!= is NOT equal to
<= is less than or equal to
>= is greater than or equal to

Beware!
= vs. ==

Comparison operators: examples

```
>>> seq = 'CAGGT'
>>> if ('C' == seq[0]):
...  print 'C is first in', seq
C is first in CAGGT
>>> if ('CA' in seq):
...  print 'CA is found in', seq
CA is found in CAGGT
>>> if (('CA' in seq) and ('CG' in seq)):
...  print "Both there!“
>>>
```