NLP Lab: Week 1

Introduction to Python

Computing Ngrams

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based on slides by Paul Prescod
Vancouver Python/Zope Users' Group
http://www.vanpyz.org

Outline

- Python 簡介
- 內建資料形態
- 流程控制
- 函式與模組
- 今天的實作題

What is Python?

- Python is an easy to learn, powerful programming language.
  - Efficient high-level data structures
    - lists, hash table (dictionary), sets
  - Elegant syntax and dynamic typing
  - Up-and-coming language in the open source world

Running python code

- Interactive interpreters
  - Type your code after the prompt ">>>"

```
>>> 5 + 3 * 4
17
```

- Python scripts
  - Make a .py file with your code in it
  - One step interpretation (no compile, link steps)

```
$ python foo.py
```

Python is dynamically typed

```
>>> width = 20
>>> print(width)
20
>>> height = 5 * 9
>>> print(height)
45
>>> print(width * height)
900
>>> width = "really wide"
>>> print(width)
really wide
```

Coding notes

- Continuing Statements
    - Continue one line with a backslash \

```
>>> a_long_variable_name = \
    a_long_function_name( param1, param2)
```

- Indentation (4 spaces, not tabs)

```
if this_function(that_variable):
    do_something()
else:
    do_something_else()
```

- Comment
    - Start comment with a number sign #

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Numeric Types

- **Int** : integral number , e.g. "x=5"
- **Float** : accuracy depends on platform , e.g. "x=3.14"
- **Bool** : True, False
- Convert from one type to another

```
>>> x=  int(“5”)
>>> y=  int(5.9)
```

Math Operations

- Basic operations

```
>>> 5+3
>>> 5*2+3
>>> 3+5*2
```

- Integer Division

```
>>> 5/2
2
>>> 5.0/2
2.5
>>> float(5) / 2
2.5
>>> 5.0//2
2
>>> 5.0 % 2
1.0
```

Strings

- Can be enclosed in single or double quotes:

```
>>>  print("spam eggs”)
spam eggs
>>>  #backslash escapes quotes
>>>  print(' "Isn\'t," she said.’)
"Isn't," she said.
```

- Basic string operations

```
>>>  myStr = "abc"                # assignment
>>>  myStr = myStr + "def"  # = "abcdef“
>>>  myStr = "abc"*3            # = "abcabcabc“
>>>  for char in myStr:         # iterate
             print(char)
>>>  myStr = str(5)               # = ‘5’
>>>  myStr = str([1,2])          # = ‘[1, 2]’
```

String methods

```
>>> s = "hello there"
>>> print(s.replace("h", “j"))        # jello tjere
>>> print(s.capitalize())             # Hello there
>>> print(s.title())                  #Hello There
>>> print(s.upper())                  #HELLO THERE
>>>  string = "positively python powered"
>>>  print(string.count("po"))         #2
>>>  print(string.startswith("abc")) #False
>>>  print(string.endswith("ed"))    #True
>>>  print(string.find("pow"))       #18
```

String Formatting

```
>>> print("(%s, %d, %4.2f)" % (str1, int1, real1))
(orange, 12, 3.5)
```

Unicode

- Unicode data type:

  normal string: “hello”
  unicode string: u“hello”

- Encode/ decode a string

```
>>> string = 'hello'
>>> string.decode('cp950')   # u'hello'
```

- Coding in different system

  Windows : cp950
  Linux/Unix : utf-8

Lists

```
>>> List1 = ["a", 5, 3.25]
>>> List2 = ["a",  ["3", "2"]]
>>> List3 = List1 + List2
>>> print List3
["a", 5, 3.25, "a",  ["3", "2"]]
>>> range(5)
[0, 1, 2, 3, 4]
>>> [ i*i for i in range(5)]
[0, 1, 4, 9, 16]
```

Splitting and Joining

```
>>> names = ["Peter", "Paul","Mary"]
>>> joined =  ' and '.join(names)
>>> joined   'Peter and Paul and Mary'
>>> joined.split(' and ')
['Peter', 'Paul', 'Mary']
>>> ' and '. joined.split()
['Peter',‘and',  'Paul',‘and',  'Mary']
```

Sequence Types

- Sequence types can be looped over, indexed, sliced ...
  - **Strings** “1a3”
  - **Lists** [1,"a",3]
  - **Tuples** (1,2,"b")
- Sequence operation
  - **Iteration**

    ```
    >>> for i in myList:
    >>>     print(i)
    ```

  - **Numeric indexing** `myList[3]`
  - **Slicing** `mylist[2:5]`

Sequences Operations

- Iterating over sequences

```
>>> strlist = ["abc", "def", "ghi"]
>>> for item in strlist:
        for char in item:
            print(char)
```

- Sequence Concatenation

```
>>> word = 'Help' + 'Me'              # == HelpMe
>>> list = ["Hello"] + ["World"]  # == ['Hello', 'World']
```

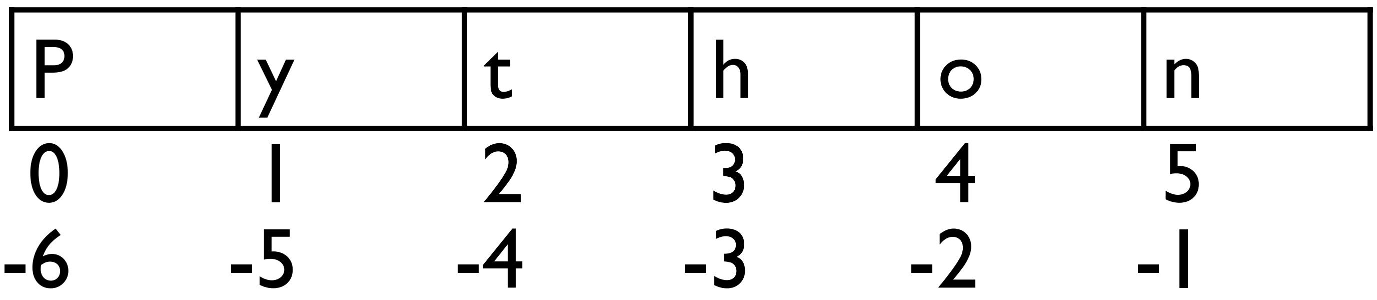
- Getting sequence length

```
>>> len( "abc" )                      # == 3
>>> len( ["abc","def"] )              # == 2
```

Sequence Indexing

```
>>> str="abc"
>>> print(str[0])     # a
>>> print(str[1])     # b
>>> print(str[-1])    # c
```

- Negative indices
  - Counting forward: 0,   1, 2, ..., n-1
  - Counting backward: -1, -2, -3, ...,   -1



P	y	t	h	o	n
0	1	2	3	4	5
-6	-5	-4	-3	-2	-1

Sequence Slicing

- Basic slice form sequence[x:y]

```
>>> word = "Python"
>>> word[1]          # y
>>> word[0:2]        # Py
>>> word[:2]         # Py
>>> word[2:4]        # th
>>> word[-1]         # n
>>> word[0:-1]       # Pytho
>>> word[0:-2]       # Pyth
>>> word[2:-2]       # th
>>> word[–2:]        # on
```

List Comprehension

```
>>> word = 'generataed'
>>> splits = [(word[:i], word[i:]) for i in range(len(word)+1)]
>>> splits
[('', 'generataed'),('g, 'enerataed'),
   ('ge', 'nerataed'),('gen', 'erataed'),
   ('gene', 'rataed'),('gener', 'ataed'),
   ('genera', 'taed'),('generat', 'aed'),
   ('generata', 'ed'),('generatae', 'd'),
   ('generataed', '')]
>>> deletes = [a + b[1:] for a, b in splits if b]
>>> deletes
['enerataed','gnerataed','genrataed',
   'geneataed','genertaed','generaaed',
   'generated','generatad','generatae']
```

List Comprehension

```
>>> word = 'generataed'
>>> splits = [(word[:i], word[i:]) for i in range(len(word)+1)]
>>> splits
[ ('', 'generataed'),('g, 'enerataed'),
   ('ge', 'nerataed'),('gen', 'erataed'),
   ('gene', 'rataed'),('gener', 'ataed'),
   ('genera', 'taed'),('generat', 'aed'),
   ('generata', 'ed'),('generatae', 'd'),
   ('generataed', '')]
>>> deletes = [a + b[1:] for a, b in splits if b]
>>> deletes
[ 'enerataed','gnerataed','genrataed',
   'geneataed','genertaed','generaaed',
   'generated','generatad','generatae']
```

Sorting List

Sorting -- generating new value data vs. sorting *in place*

```
>>> sorted([5, 2, 3, 1, 4])
[1, 2, 3, 4, 5]

>>> a = [5, 2, 3, 1, 4]
>>> a.sort()
>>> a
[1, 2, 3, 4, 5]
```

sorting *in place*

```
>>> students = [
        ('john', 'A', 15),
        ('dave', 'B', 10),
        ('jane', 'B', 12) ]
>>> students.sort(key=lambda x: x[2], reverse=True)# sort by age
>>> students
[('john', 'A', 15), ('jane', 'B', 12), ('dave', 'B', 10)]
```

Bindings

- When we assign a variable, we establish another reference or “binding” to the original value.

  ```
  >>>  a=b    # the same object
  ```

  If you change a, you change b!

-
  ```
  >>>  a= (b)    # the same object
  ```

  - No binding

Mutability

Lists Are Mutable

- Lists can be changed "in-place"

```
>>> a = ['spam', 'eggs', 100, 1234]
>>> b = a
>>>  print(b)
['spam', 'eggs', 100, 1234]
>>>  a[2] = 5.5
>>>  print(a)
['spam', 'eggs', 5.5, 1234]
>>>  print(b)
['spam', 'eggs', 5.5, 1234]
```

- Strings are not mutable

```
>>> a = "abcdefgh"; a[3]="k"
** TypeError
```

Tuples Are Not Mutable

- Immutable list-like objects are called **tuples**

```
>>> tup = (“a”, 1, 5.3, 4)
>>> a[3]="k"
Traceback (innermost last):
File "<stdin>", line 1, in ?
TypeError: object doesn't have assignment
```

- Use tuples not lists as key for **dictionary**

Working With Tuples (1)

- Tuples can be returned from functions.
- Easy to return multiple values without defining object and class.

```
>>> import time

>>> (year, month, day, hr, min, sec, wday, ydays, saving) = time.localtime()
>>> print y year, month, day, hr, min, sec, wday, ydays, saving
2012 9 17 13 25 25 0 261 0
```

Working With Tuples (2)

- Tuples can be used to pass parameters

```
>>> def foo(a, b, c):
        return a+b+c
>>> x = (1, 2, 3)
>>> foo(x)
TypeError: foo() takes exactly 3 arguments (1 given)
>>> x = (1, 2, 3)
>>> foo(*x)
6
```

Tuple Shortcut

- We can usually leave out the parens:

```
>>> j=1,2
>>> j=(1,2)       # same as above
>>> a,b = 1,2
>>> a,b = b,a
>>> j=[1,2]
>>> a,b=j
>>> x,y = getXYCoords()
```

Dictionaries

- Serve as a lookup table
- Maps "keys" to "values".
- Keys can be of any **immutable** type
- Assignment adds or changes members
- keys() method returns keys

Dictionaries

```
>>> mydict={"a":"alpha", "b":"bravo","c":"charlie"}
>>> mydict["abc"]=10
>>> mydict[5]="def"
>>> mydict[2.52]=6.71
>>> print(mydict)
{2.52: 6.71, 5: 'def', 'abc': 10, 'b': 'bravo', 'c': 'charlie', 'a': 'alpha'}
```

Constructing Dictionaries

- Dictionaries can be constructed directly or by using “dict”

```
>>> list_of_tuples = [("a", "alpha"), ("b", "bravo"), ("c", "charlie")]

    or

    >>> mydic = {}

    >>> mydic[ "a" ] =  "alpha"

    >>> mydic[ "b" ],  mydic[ "c" ] =  "bravo", "charlie"

>>> mydict = dict(list_of_tuples)

>>> print(mydict)

{'a': 'alpha', 'c': 'charlie', 'b': 'bravo'}
```

Dictionary Methods

```
>>> mydict={"a":"alpha", "b":"bravo", "c":"charlie"}
>>> mydict.keys()
['a', 'c', 'b']
>>> mydict.values()
['alpha', 'charlie', 'bravo']
>>> mydict.items()
[('a', 'alpha'), ('c', 'charlie'), ('b', 'bravo')]
>>> mydict.clear()
>>> print(dict)
{}
```

Dictionary for word counts

```
>>> model = {}
>>> if 'generataed'  in  model:
. . .    model [ 'generataed'] += 1
. . . else:
. . .    model [ 'generataed'] = 1
```

Put the code in function ‘count’

```
>>> def count(word):
. . .    if word  in  model:
. . .       model [ word ] += 1
. . .   else:
. . .        model [ word ] = 1
```

Calling count

```
>>> count('generataed')
```

File Objects

- File objects represent opened files:

```
>>> infile = open( "catalog.txt", "r" )
>>> data = infile.read()
>>> infile.close()
>>> outfile = open( "catalog2.txt", "w" )
>>> data = data+ "more data"
>>> outfile.write( data )
>>> outfile.close()
```

- You may sometimes see the name “open” used to create files. That is an older name.

System Enviroment

```
import sys
print sys.argv
```

sys_ex.py

```
>>> python sys_ex.py 1 2 3
['sysex.py', '1', '2', '3']
```

Working With Lines of Files

- Process your file line by line

```
>>> infile = open( "catalog2.txt", "r")
>>> for line in infile:
        print line

>>> infile.close()
>>> infile = open( "catalog2.txt", "r")
>>> lines = infile.readlines()
>>> lines = list(infile)
```

Working With Lines of Files

- Process really big files
    - read and process one line at a time

```
fh = open( "catalog2.txt", "r")
while True:
    line = fh.readline()
    if line = ‘’:
        break
    <handle line>
fh.close()
```

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Basic Flow Control

- if / elif / else (test condition)
- while (loop until condition changes)
- for (iterate over iteraterable object)

if Statement

```
if j=="Hello":
    doSomething()
elif j=="World":
    doSomethingElse()
else:
    doTheRightThing()
```

while Statement

```
str= ""
while str!="quit":
        str=raw_input()
        print str
print("Done")
```

Breaking Out

- break statement allows you to jump out of the middle of a loop

```
while str!="quit":
    str=raw_input()
    if str=="exit":
        break
    print(str)
print("Done")
```

Continue Statement

- The continue statement is a short-cut way of jumping to the top of the loop.

```
string = ""
while string!="quit":
    string = raw_input()
    if string=="wait":
        continue
    print("String was not wait", string)
```

for Statement

-
  ```
  myList = ["a", "b", "c", "d", "e"]
  for item in myList:
      print(item)
  for i in range( 10 ):
      print(i)
  for i in range( len( myList ) ):
      if myList[i]=="c":
          myList[i]=None
  for i, item in enumerate( myList ):
      print(i, item)
  ```

Function Definitions

- Encapsulate bits of code.
- Can take a fixed or variable number of arguments.
- Arguments can have default values.

Function Definition

```
def double( a ):
  return a*2

def quadruple( a ):
  return double( double( a ) )

print quadruple( 8 )
```

Return Values

- The return statement returns a value.
- If no return statement is executed the function returns the value None.
- These are the same:

```
def display( a ):
    print(a)
    return None
```

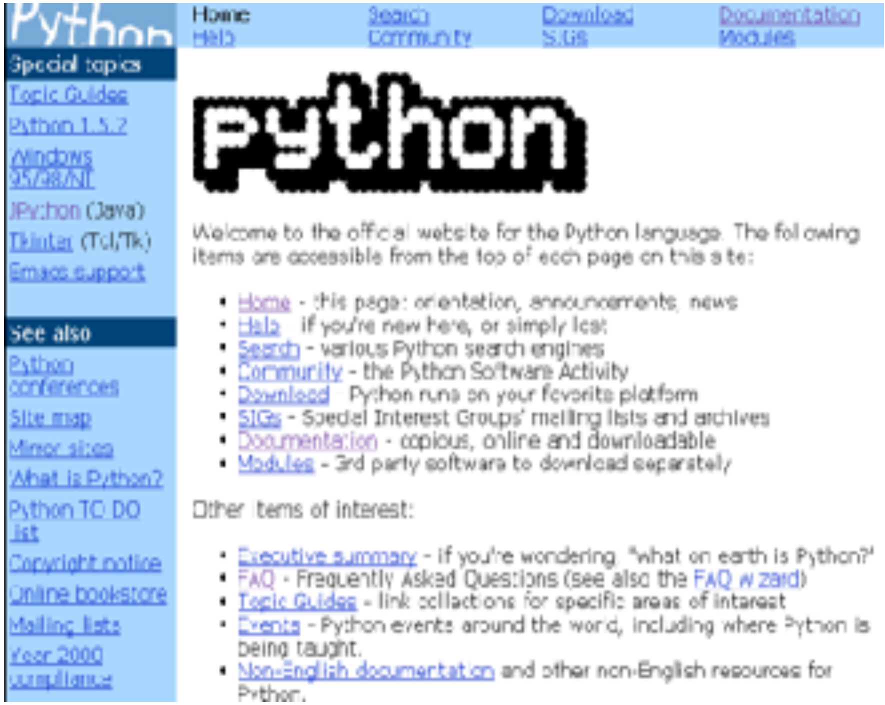
```
def display( a ):
    print(a)
```

Python Resources

The Python website

- Run by the PSF
- FAQ (Frequently Asked Questions)
- Downloads
- Standard Documentation Set
- Search engines
- PyPi

www.python.org



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Special topics

Topic Guides
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Welcome to the official website for the Python language. The following items are accessible from the top of each page on this site:

- Home - this page: orientation, announcements, news
- Help - if you're new here, or simply lost
- Search - various Python search engines
- Community - the Python Software Activity
- Download - Python runs on your favorite platform
- SIGs - Special Interest Groups' mailing lists and archives
- Documentation - copious, online and downloadable
- Modules - 3rd party software to download separately

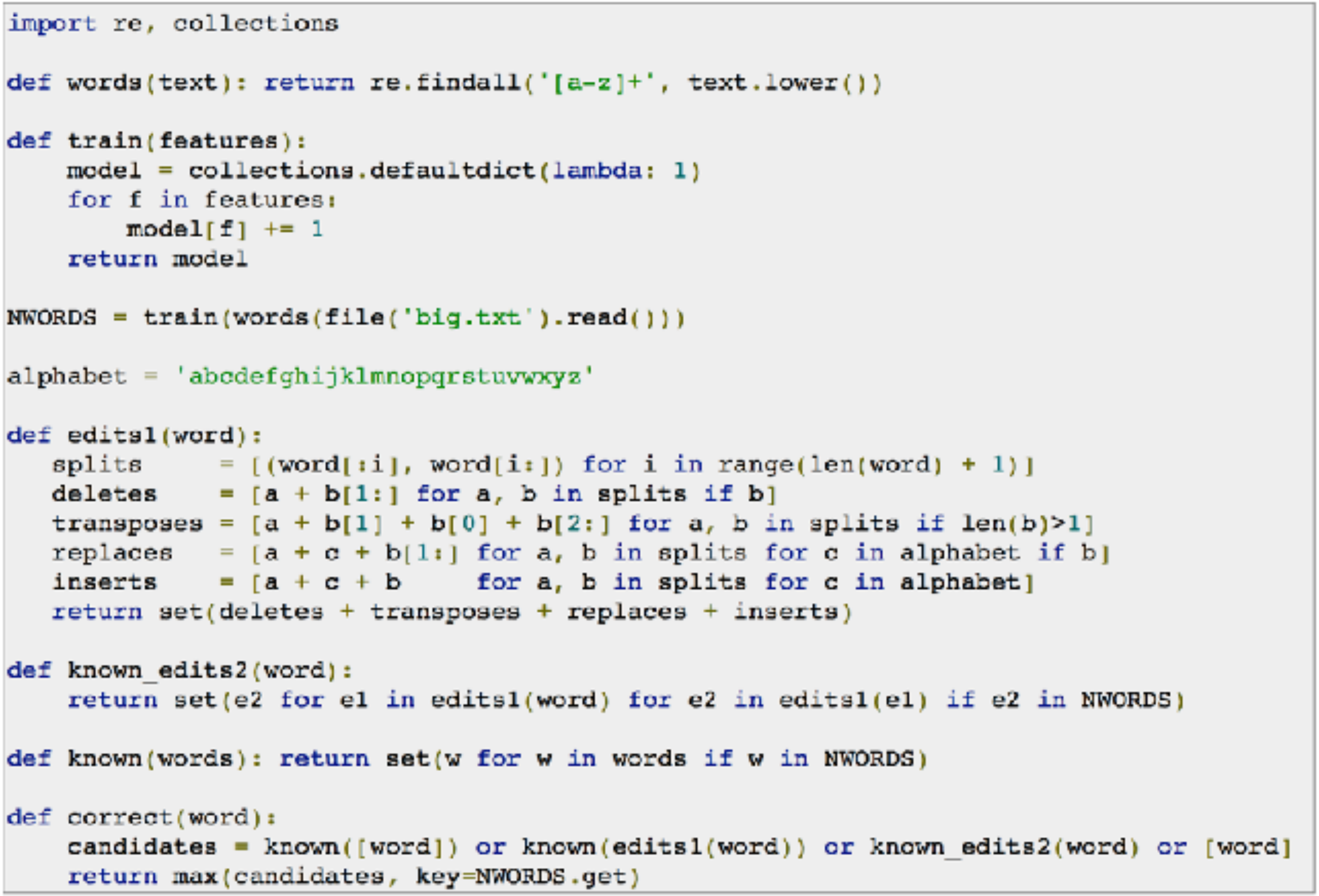
Other items of interest:

- Executive summary - if you're wondering "what on earth is Python?"
- FAQ - Frequently Asked Questions (see also the FAQ wizard)
- Topic Guides - link collections for specific areas of interest
- Events - Python events around the world, including where Python is being taught.
- Non-English documentation and other non-English resources for Python.

Assignment

Expand the program in http://norvig.com/spell-correct.html to deal with the follow types of spelling error:

- Fusion errors (e.g. “taketo” → “take to”)
- Multi-token errors (e.g. “mor efun” → “more fun”)
- Fusion errors (e.g. “with out” → “without”)



```python
import re, collections

def words(text): return re.findall('[a-z]+', text.lower())

def train(features):
    model = collections.defaultdict(lambda: 1)
    for f in features:
        model[f] += 1
    return model

NWORDS = train(words(file('big.txt').read()))

alphabet = 'abcdefghijklmnopqrstuvwxyz'

def edits1(word):
   splits     = [(word[:i], word[i:]) for i in range(len(word) + 1)]
   deletes    = [a + b[1:] for a, b in splits if b]
   transposes = [a + b[1] + b[0] + b[2:] for a, b in splits if len(b)>1]
   replaces   = [a + c + b[1:] for a, b in splits for c in alphabet if b]
   inserts    = [a + c + b     for a, b in splits for c in alphabet]
   return set(deletes + transposes + replaces + inserts)

def known_edits2(word):
    return set(e2 for e1 in edits1(word) for e2 in edits1(e1) if e2 in NWORDS)

def known(words): return set(w for w in words if w in NWORDS)

def correct(word):
    candidates = known([word]) or known(edits1(word)) or known_edits2(word) or [word]
    return max(candidates, key=NWORDS.get)
```

Downloadable Python Books

- *How to think like a Computer Scientist -* introductory programming book that comes in Python and Java version. by Downey, Elkner, and Meyers
- *Dive Into Python* - free Python book for experienced programmers. By Mark Pilgrim
- *Thinking In Python -* for intermediate Python programmers. By Bruce Eckel
- *Python Text Processing with NLTK 2.0 Cookbook*. By Jacob Perkins