Python Basics!

dictionaries, mutable arguments

CS101 Lecture #11

2016-11-02

Administrivia

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- Homework #5 is due Wed Nov. 9.
- Midterm #1 will be Monday Nov. 7, 7pm-9pm. (evening) in A-0414
  No lecture on Nov. 7 Monday but the instructor is available for office hour during the lecture time in Office 410 Arts and Science Building.

Midterm Instructions

- 30 multiple-choice questions
- 120 minutes (you typically can finish the exam within 60 minutes)
- Exams are unique—omitting the exam code will dock one letter grade (10%).
- Will cover all material except dictionaries and file operations. Practice midterm is a good guide.

Library Functions

import

- Python has built-in functions:
  - `abs`, `type`, `len`
- There are also specialized libraries:
  - `math`, `string`, `itertools`

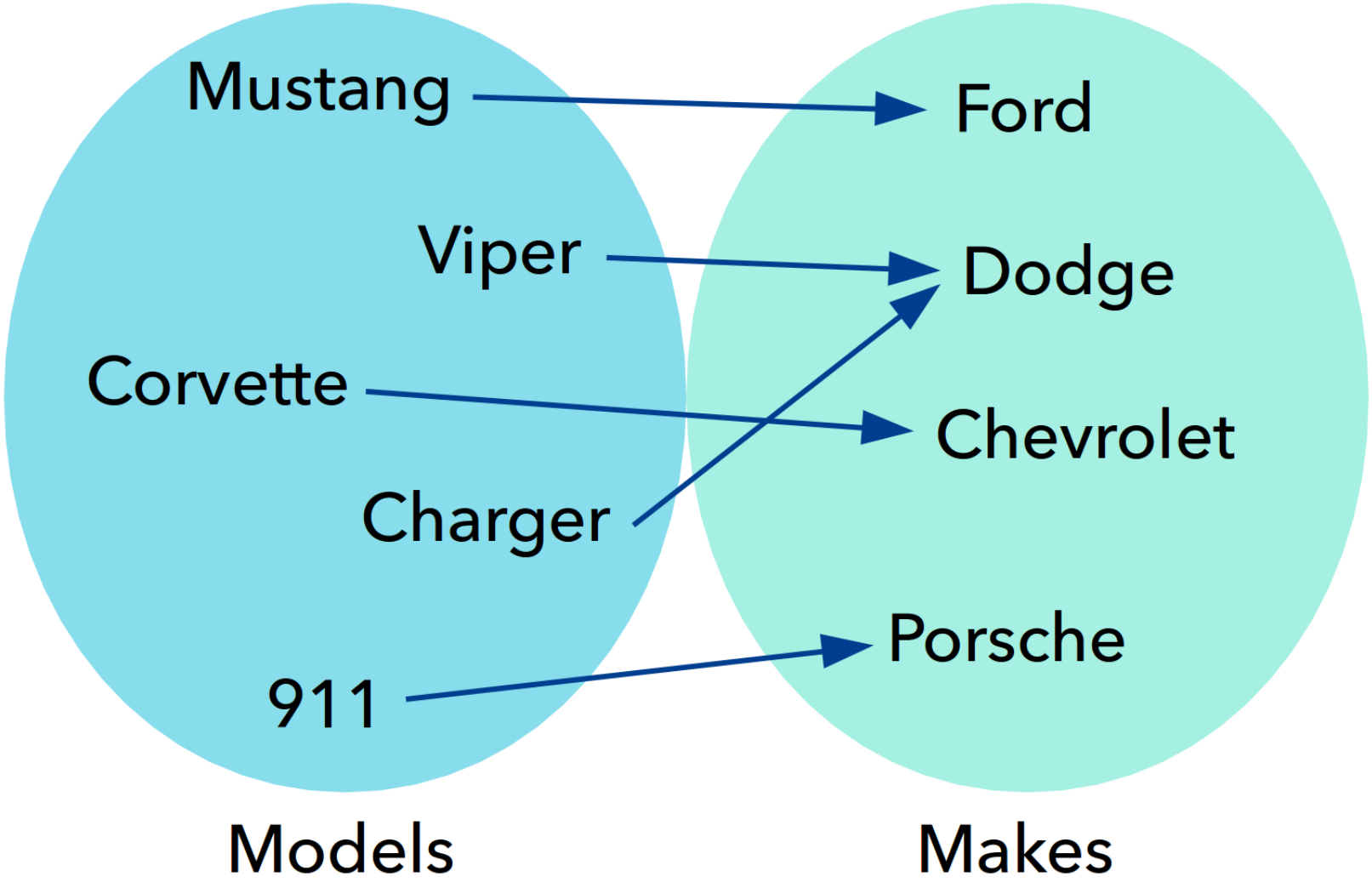
```
# These are basically equivalent:
import math
math.sin( 5.4 * math.pi )

from math import sin, pi
sin( 5.4 * pi )
```

Dictionaries

`dict` data type

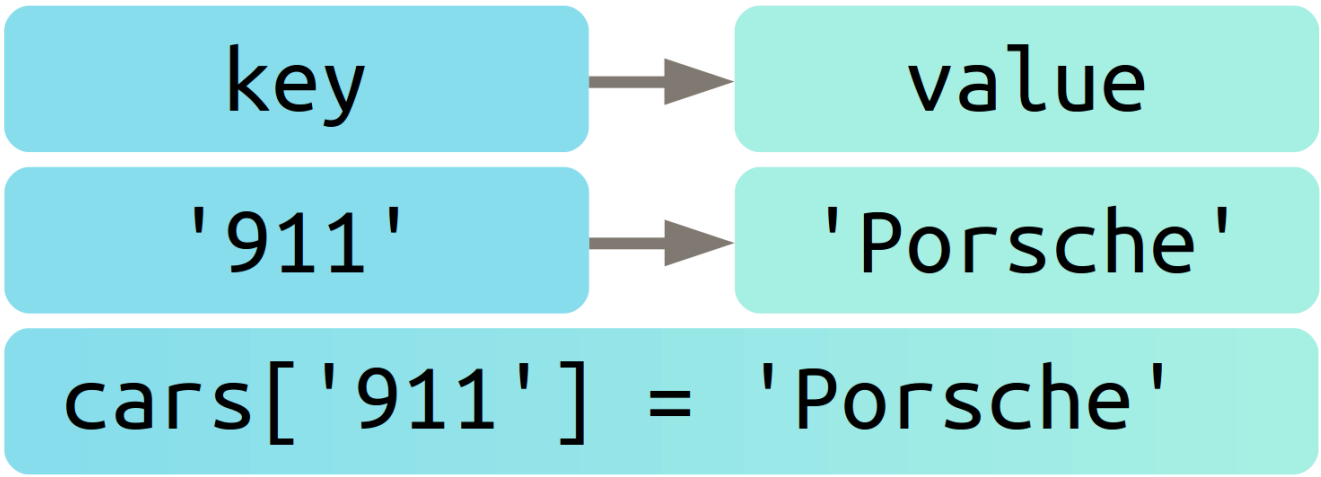
- How do we index a `list`?
- `lists` and `tuples` are *ordered*.
- What else may make sense—how else could you organize data?

Example


Mustang
Viper
Corvette
Charger
911
Ford
Dodge
Chevrolet
Porsche
Models
Makes

`dict` data type

- The `dict` indexes data by *any* value (*unordered*).
- Easy to think of as dictionary, but can use lots besides strings.
- This container maps *keys* to *values*.



dict data type

```
cars = {}
cars[ 'Mustang' ]  = 'Ford'
cars[ 'Viper' ]    = 'Dodge'
cars[ 'Corvette' ] = 'Chevrolet'
cars[ 'Charger' ]  = 'Dodge'
cars[ '911' ]      = 'Porsche'
```

`dict` literals

- We create a `dict` as follows:
  - opening brace `{`
  - `key : value` pairs, separated by commas
  - closing brace `}`

```
model = {
   'Civic': 'Honda',
   'Mustang': 'Ford',
   'Model S': 'Tesla',
   'Model T': 'Ford'
}
```

dict operations & methods

```
d = { 'one':1, 'two':2, 'three':3 }
print( d['one'] )
d[ 'four' ] = 4
del d[ 'four' ]
'five' in d
for key in d:  # no guarantee on order
    print( key, d[key] )
d.keys()
d.values()
```

Example

```
d = { 'a':2, 'c':3, 'b':1 }
x = d[ 'a' ] + d[ 'c' ]
```

What is the final value of `x`?

A `4`
B `'ac'`
C `'5'`
D `5`

Example

```
d = { }
words = [ 'red', 'orange', 'yellow' ]
for word in words:
    d[ word ] = words.index( word )
```

What is the final value of d?

A `{ 'red':3, 'orange':6, 'yellow':6 }`

B `{ 'red':0, 'orange':2, 'yellow':2 }`

C `None`

D `{'orange': 1, 'red': 0, 'yellow': 2}`

dict applications

- Dictionaries can encode/decode data, or translate from one representation to another.

```
x = 'ABCDEFGHIJKLMNOPQRSTUVWXYZ'
y = 'BCDEFGHIJKLMNOPQRSTUVWXYZA'
e = { }
for i in range( len(x) ):
    e[ x[i] ] = y[i]
encoded = ''
for c in 'HELLO':
    encoded += e[c]
```

- How would you reverse (decode) this?

dict applications

```
x = 'ABCDEFGHIJKLMNOPQRSTUVWXYZ'
y = 'BCDEFGHIJKLMNOPQRSTUVWXYZA'
d = { }
for i in range( len(x) ):
    d [y[i] ] = x[i]
decoded = ''
for c in encoded:
    decoded += d[c]
```

Exercise

- Encode all of the words in a file using a Caesar cipher (https://en.wikipedia.org/wiki/Caesar_cipher).
- Decode all of the words in the file.

`dict` applications

- Dictionaries can also function as accumulators.

```
x = 'ABBACAB'
d = { }
for c in x:
    if c not in d:
        d[c] = 0
    d[c] += 1
```

- How would you reverse (decode) this?

Exercise

- Count category frequencies in Jeopardy questions.
- Count bigram frequencies in Jeopardy clues.

dict applications

- We can link data based on a common field.

```
zipcode = { 'Bill': 60644,
            'Jill': 41073,
            'Tony': 63103 }
city = { 60644: 'Chicago',
         41073: 'Cincinnati',
         63103: 'St. Louis' }
for name in zipcode:
    print( name,city[ zipcode[ name ] ] )
```

Mutable Arguments

Exercise: mutability

```
x = [ 3,2,1 ]
y = x
y.sort()
x.append( 0 )
```

What is the final value of `x`?

A `[ 3,2,1 ]`
B `[ 1,2,3 ]`
C `[ 1,2,3,0 ]`
D `[ 0,1,2,3 ]`

Mutable arguments

- Mutability causes `lists` to work differently in functions.
- `lists` used as arguments *can be changed* by the function.
- This is very useful!

```
def fun(q):
    q.append(3)

a = [ ]
for i in range(3):
    fun(a)
print(a)
```

Mutable arguments

```
def readfile(fname,a):
    for line in open(fname):
        a.append(line)

all_lines = []
readfile( 'file1.txt', all_lines )
readfile( 'file2.txt', all_lines )
```

Mutable arguments

```
def readfile(fname,a):
    for line in open(fname):
        a.append(line)

all_lines = [ ]
for f in open( "filenames.txt" ):
    readfile( f,all_lines )
```

Copying mutable values

- What if we *want* a copy of a `list` (not an alias)?
- Slice everything!

```
x = [ 3,2,1 ]
y = x[ : ]
y.sort()
print( x )
```

Copying mutable values

```
x = [ 1,2,3 ]
y = x[ : ]
y.append( 4 )
print( x == y )
```

is tests identity

```
a = [ 1,2,3 ]
b = a
c = a[ : ]

b is a  # True
c is a  # False
```

Reminders

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