Announcements

Lists

```
['Demo']
```

Working with Lists

```
>>> digits = [1, 8, 2, 8]
```

```
>>> digits = [2//2, 2+2+2+2, 2, 2*2*2]
```

The number of elements

```
>>> len(digits)
4
```

An element selected by its index

```
>>> digits[3]
8
```

```
>>> getitem(digits, 3)
8
```

Concatenation and repetition

```
>>> [2, 7] + digits * 2
[2, 7, 1, 8, 2, 8, 1, 8, 2, 8]
```

```
>>> add([2, 7], mul(digits, 2))
[2, 7, 1, 8, 2, 8, 1, 8, 2, 8]
```

Nested lists

```
>>> pairs = [[10, 20], [30, 40]]
>>> pairs[1]
[30, 40]
>>> pairs[1][0]
30
```

Containers

Containers

Built-in operators for testing whether an element appears in a compound value

```
>>> digits = [1, 8, 2, 8]
>>> 1 in digits
True
>>> 8 in digits
True
>>> 5 not in digits
True
>>> not(5 in digits)
True
```

in is an operator

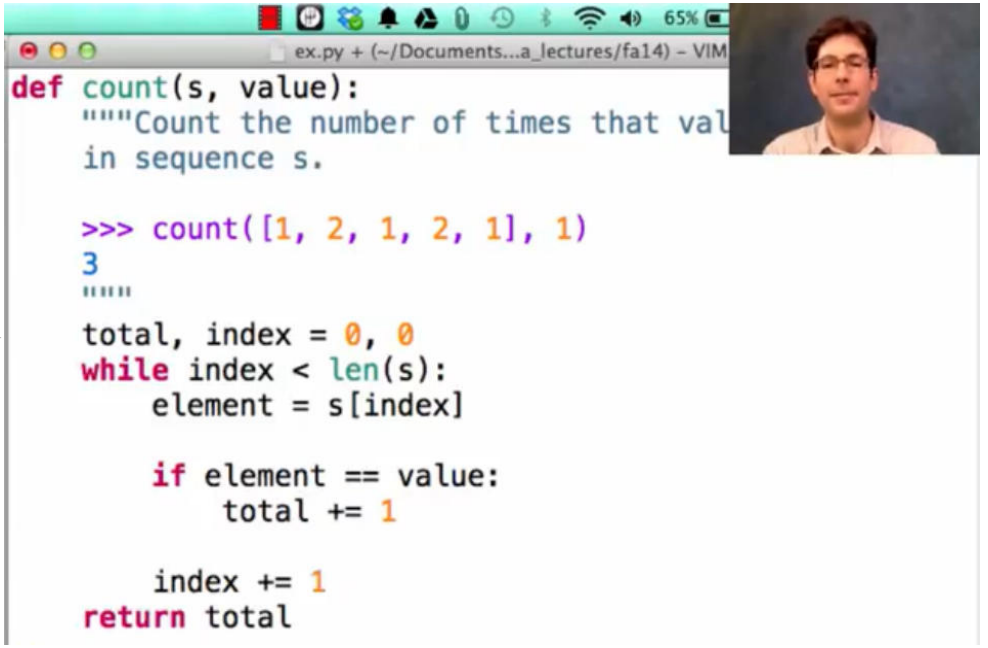
```
>>> '1' in digits
False
>>> [1, 8] in digits
False
>>> [1, 2] in [3, [1, 2], 4]
True
>>> [1, 2] in [3, [[1, 2]], 4]
False
```

(Demo)

For Statements

(Demo)

Sequence Iteration




```
def count(s, value):
    total = 0
    for element in s:
        if element == value:
            total = total + 1
    return total
```

Name bound in the first frame of the current environment (not a new frame)

For Statement Execution Procedure

```
for <name> in <expression>:
    <suite>
```

1. Evaluate the header <expression>, which must yield an iterable value (a sequence)
2. For each element in that sequence, in order:
   A. Bind <name> to that element in the current frame
   B. Execute the <suite>

Sequence Unpacking in For Statements

A sequence of fixed-length sequences

```
>>> pairs = [[1, 2], [2, 2], [3, 2], [4, 4]]
>>> same_count = 0
```

A name for each element in a fixed-length sequence

Each name is bound to a value, as in multiple assignment

```
>>> for x, y in pairs:
...     if x == y:
...         same_count = same_count + 1

>>> same_count
2
```

Ranges

usage of range:

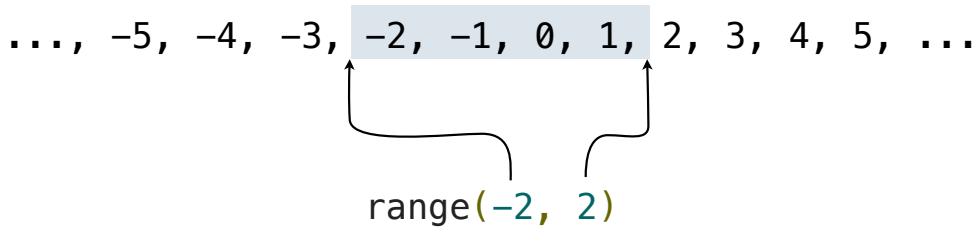
```
def sum_below(n):
    total = 0
    for i in range(n):
        total += i
    return total

def cheer():
    for _ in range(3):
        print('Go Bears!')
```

_ is a convention, meaning you won't use the variable

The Range Type

A range is a sequence of consecutive integers.*



Length: ending value – starting value

Element selection: starting value + index

(Demo)

```
>>> list(range(-2, 2))
[-2, -1, 0, 1]
```

List constructor

```
>>> list(range(4))
[0, 1, 2, 3]
```

Range with a 0 starting value

* Ranges can actually represent more general integer sequences.

List Comprehensions

```
>>> letters = ['a', 'b', 'c', 'd', 'e', 'f', 'm', 'n', 'o', 'p']
>>> [letters[i] for i in [3, 4, 6, 8]]
['d', 'e', 'm', 'o']
```

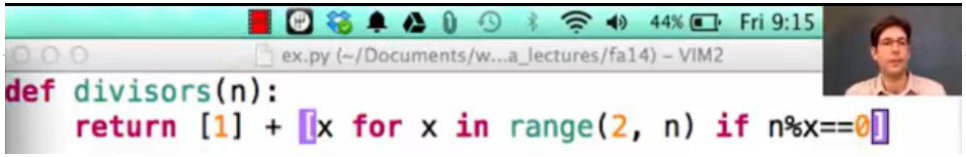
List Comprehensions

```
[<map exp> for <name> in <iter exp> if <filter exp>]
```

```
Short version: [<map exp> for <name> in <iter exp>]
```

A combined expression that evaluates to a list using this evaluation procedure:

1. Add a new frame with the current frame as its parent
2. Create an empty *result list* that is the value of the expression
3. For each element in the iterable value of <iter exp>:
   A. Bind <name> to that element in the new frame from step 1
   B. If <filter exp> evaluates to a true value, then add the value of <map exp> to the result list



Strings

Strings are an Abstraction

Representing data:

```
'200'      '1.2e-5'      'False'      '[1, 2]'
```

Representing language:

```
"""And, as imagination bodies forth
The forms of things unknown, the poet's pen
Turns them to shapes, and gives to airy nothing
A local habitation and a name.
"""
```

Representing programs:

```
'curry = lambda f: lambda x: lambda y: f(x, y)'
```

(Demo)

String Literals Have Three Forms

```
>>> 'I am string!'
'I am string!'

>>> "I've got an apostrophe"
"I've got an apostrophe"

>>> '您好'
'您好'


>>> """The Zen of Python
claims, Readability counts.
Read more: import this."""
'The Zen of Python\nclaims, Readability counts.\nRead more: import this.'
```

Single-quoted and double-quoted strings are equivalent

A backslash "escapes" the following character

"Line feed" character represents a new line

String are Sequences

Length and element selection are similar to all sequences

```
>>> city = 'Berkeley'
>>> len(city)
8
>>> city[3]
'k'
```

Careful: An element of a string is itself a string, but with only one element!

However, the "in" and "not in" operators match substrings

```
>>> 'here' in "Where's Waldo?"
True
>>> 234 in [1, 2, 3, 4, 5]
False
>>> [2, 3, 4] in [1, 2, 3, 4, 5]
False
```

In lists, operator in only searches for a single element

When working with strings, we usually care about whole words more than letters.

Dictionaries

```
{'Dem': 0}
```

Limitations on Dictionaries

Dictionaries are **unordered** collections of key-value pairs

Dictionary keys do have two restrictions:

- A key of a dictionary **cannot be** a list or a dictionary (or any *mutable type*)
- Two **keys cannot be equal;** There can be at most one value for a given key

This first restriction is tied to Python's underlying implementation of dictionaries

The second restriction is part of the dictionary abstraction

If you want to associate multiple values with a key, store them all in a sequence value

Limitations on Dictionaries

```
>>> numerals = {'I': 1, 'V': 5, 'X': 10}
>>> numerals
{'X': 10, 'V': 5, 'I': 1}
>>> numerals['X']
10
>>> numerals[10]
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
KeyError: 10
>>> numerals.keys()
dict_keys(['X', 'V', 'I'])
>>> numerals.values()
dict_values([10, 5, 1])
>>> numerals.items()
dict_items([('X', 10), ('V', 5), ('I', 1)])
>>> items = [('X', 10), ('V', 5), ('I', 1)]
>>> items
[('X', 10), ('V', 5), ('I', 1)]
>>> dict(items)
{'X': 10, 'V': 5, 'I': 1}
>>> dict(items)['X']
10
```

unordered

can only call keys

```
>>> 'X' in numerals
True
>>> 'X-ray' in numerals
False
>>> numerals.get('X', 0)
10
>>> numerals.get('X-ray', 0)
0
>>> {x:x*x for x in range(10)}
{0: 0, 1: 1, 2: 4, 3: 9, 4: 16, 5: 25, 6: 36, 7: 49, 8: 64, 9: 81}
>>> squares = {x:x*x for x in range(10)}
>>> squares[7]
49
>>> {1: 2, 1: 3}
{1: 3}
>>> {1: [2, 3]}
{1: [2, 3]}
>>> {[1]: 2}
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
TypeError: unhashable type: 'list'
```

set default of 0

dictionary comprehensive