Mutability, Nonlocal, Exceptions

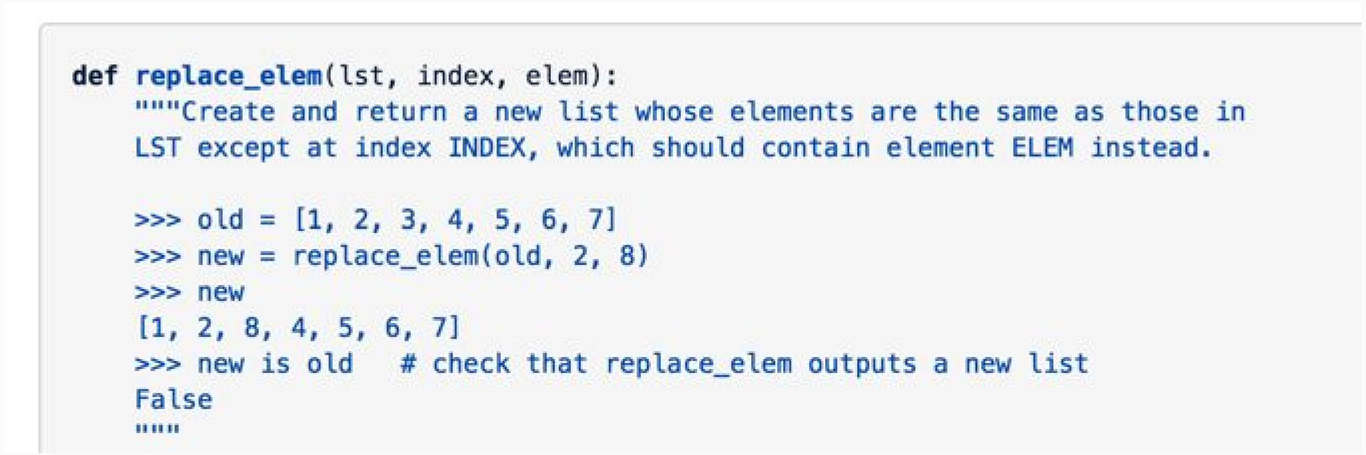
10/14/16

What is mutation?

- Mutation is the changing of values
- Certain data types in Python are mutable
  - Lists
- Other data types in Python are immutable
  - Tuples
  - Strings
- Dictionary keys must be immutable
- Dictionary values can be mutable or immutable

Brief Intro to Mutability in HW 4

- Instead of returning a new list, we could have modified lst, which would be an example of mutation



```
def replace_elem(lst, index, elem):
    """Create and return a new list whose elements are the same as those in
    LST except at index INDEX, which should contain element ELEM instead.

    >>> old = [1, 2, 3, 4, 5, 6, 7]
    >>> new = replace_elem(old, 2, 8)
    >>> new
    [1, 2, 8, 4, 5, 6, 7]
    >>> new is old   # check that replace_elem outputs a new list
    False
    """
```

Examples of Immutable Data Types

```
>>> x = (1, 2, 3)
>>> x[0] = 10               # What will this do?

>>> d = {}
>>> key = [1, 2]
>>> value = [3, 4]
>>> d[key] = value          # What about this?
```

Mutability is Tricky

- Mutability can often lead to unexpected behavior when writing programs
- http://tinyurl.com/zexl7he

- Both variables refer to the same list in the above example
- It’s easy to mistake x and y as being two different lists

Examples of Mutable Data Types

- List creation: http://tinyurl.com/j4jc5gg
- Appending to a list: http://tinyurl.com/jnteyar
- Nested lists: http://tinyurl.com/j57szgu

- These sorts of scenarios can often lead to buggy code
- Understanding the basics of mutability really helps in debugging your code

Is vs. ==

- == only compares values, “is” compares whether two variables actually point to the same list

```
>>> x = [1, 2, 3, 4]
>>> y1 = x
>>> y2 = list(x)
>>> y1 is x
True
>>> y2 is x
False
```

```
>>> y1 == x
True
>>> y2 == x
True
```

Administrivia

- We’re almost done grading midterms.
- Mid-semester survey to come out soon. We would really appreciate everyone’s feedback!
- Prof. Friedland will not be having office hours this and next week. He is still reachable by email.
- Clarification on slip day/late policy

- Any questions?

Mutability and Nonlocal

- Consider the following example:

```
def outer():
    x = 5
    def inner():
        x = 6      # Will this change the value of the outer x?
    return inner()
```

Mutability and Nonlocal

```
def outer():
    x = 5
    def inner():
        x = 6      # Will this change the value of the outer x?
    return inner()
```

- inner() does not modify the outer variable; it will create a new local variable
- http://tinyurl.com/jxxanzl
- However.... http://tinyurl.com/jluwmfg

Mutation and Nonlocal

- Mutable values can be changed inside inner()
- To change immutable values inside inner(), we must use the nonlocal keyword
- http://tinyurl.com/j42yu3w

- Nonlocal will not allow you to change global variables in this manner
- To do this, you must use the global keyword http://tinyurl.com/z766886

Exceptions

- Python raises an exception whenever an error occurs
    - ZeroDivisionError
    - ValueError

- Exceptions can be handled by the program, preventing a crash (next slide)
- Programs can also raise exceptions of their own (later in the course)

Handling Exceptions

- The following function won’t cause the program to crash, even if you try to divide by 0

```
def safe_divide(x, y):
    quotient = “Error”
    try:
        quotient = x/y
    except ZeroDivisionError:
        print(“Can’t divide by zero!”)
    return quotient
```