Discussion 06

Mutability, Iterators, Generators

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Slides available at `teaching.aditbala.com`

Announcements 📣

- Homework 4 is due Thursday 10/6.

Mutability

List Mutation Functions

- append(elem)
  - box `elem` in list and add to end of lst (can lead to nested lists)
  - only adds one element!
- extend(elem)
  - unbox `elem` and add to end (have to use an iterable)
- insert(index, elem)
  - insert `elem` at `index` (don't replace existing elem)
- remove(elem)
  - remove first appearance of `elem` in list (error if not found)
- pop(index)
  - removes and `return` elem at `index` (default arg is end of list)

Mutating Lists

- List Mutation Functions modify **existing** list
- Slicing creates a **new** list
- `a = a + b` creates a **new** list
- `a += b` mutates **existing** list (basically `extend`)
- Indexing into list and changing values modifies **existing** list
  - `a = [1, 2, 3]`
  - `a[0] = 7`

Indentity vs Equality

- `is`
  - Check if two objects are the same (point to same reference in memory)
- `==`
  - Check to see if content is the same
- Demo

```
>>> a = [7,6,4]
>>> b = [7,6,4]
>>> a is b
False
>>> a == b
True
```

Shallow Copy and Deep Copy

- Shallow Copy
  - What Python does most of the time
  - Copy top level of list
  - Point to same objects with nested list
- Deep Copy
  - Make completely new copy of list
  - Difficult to do this
- Whenever we copy a sequence, we are using a shallow copy

Worksheet

Iterators

- What are they?
  - An object that iterates over **iterables**, anything you can loop over
- Why use them?
  - Lazy evaluation
  - this

Iterator Functions

- `next([iterator])`
  - get next element in iterator
  - When there are no more elements, return `StopIteration` Exception
- `iter([iterator])`
  - calling `iter` on an `[iterator]` will return the same iterator

Iterator Example

```
>>> next(lst)              # Calling next on an iterable
TypeError: 'list' object is not an iterator
>>> list_iter = iter(lst) # Creates an iterator for the list
>>> next(list_iter)        # Calling next on an iterator
1
>>> next(iter(list_iter)) # Calling iter on an iterator returns itself
2
>>> for e in list_iter:   # Exhausts remainder of list_iter
...     print(e)
3
>>> next(list_iter)        # No elements left!
StopIteration
>>> lst                    # Original iterable is unaffected
[1, 2, 3]
```

WWPD

Generators

- What are they?
  - functions that return a custom iterator
  - When called, they return generator objects
- How do they work?
  - When you call `next` on the generator object, you evaluate all the code until the `yield` statement
  - At the `yield`, you stop and return to that line when next is called again

Generator Function

```
def countdown(n):
    print("Beginning countdown!")
    while n >= 0:
        yield n
        n -= 1
    print("Blastoff!")

>>> c1, c2 = countdown(2), countdown(2)
>>> c1 is iter(c1)  # a generator is an iterator
True
>>> c1 is c2
False
>>> next(c1)
Beginning countdown!
2
>>> next(c2)
Beginning countdown!
2
```

`yield from`

- `yield from iterable`

```
for i in iterable:
    yield i
```

Worksheet

Thank you

Mid-Semester Survey -> `http://go.cs61a.org/mid-sem-survey`

Anon Feedback -> https://tinyurl.com/adit-anon