CS 61A Lecture 9

Friday, September 14

The Sequence Abstraction

red, orange, yellow, green, blue, indigo, violet.

0 , 1 , 2 , 3 , 4 , 5 , 6 .

There isn't just one sequence type (in Python or in general)

This abstraction is a collection of behaviors:

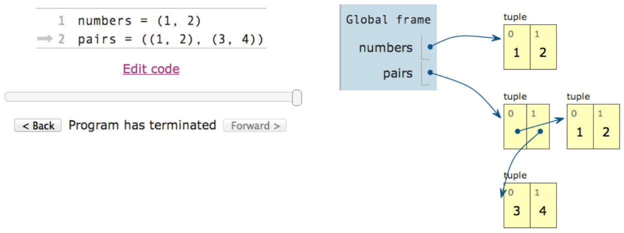
> **Length.** A sequence has a finite length.
>
> **Element selection.** A sequence has an element corresponding to any non-negative integer index less than its length, starting at 0 for the first element.

The sequence abstraction is shared among several types.

Tuples are Sequences

(Demo)

Box-and-Pointer Notation



```
numbers = (1, 2)
pairs = ((1, 2), (3, 4))
```

The Closure Property of Data Types

- A method for combining data values satisfies the *closure property* if:
- The result of combination can itself be combined using the same method.
- Closure is the key to power in any means of combination because it permits us to create hierarchical structures.
- Hierarchical structures are made up of parts, which themselves are made up of parts, and so on.

Tuples can contain tuples as elements

Recursive Lists

Constructor:

```
def rlist(first, rest):
    """Return a recursive list from its first element and the rest."""
```

Selectors:

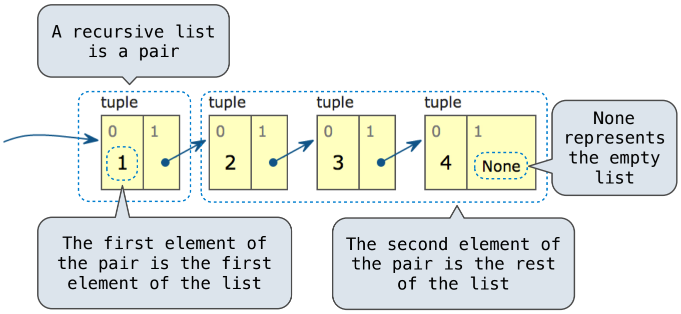
```
def first(s):
    """Return the first element of a recursive list s."""


def rest(s):
    """Return the rest of the elements of a recursive list s."""
```

Behavior condition(s):

> If a recursive list s is constructed from a first element f and a recursive list r, then
>
> - first(s) returns f, and
> - rest(s) returns r, which is a recursive list.

Implementing Recursive Lists with Pairs

1 , 2 , 3 , 4


A recursive list is a pair
tuple
0
1
1
2
3
4
None
None represents the empty list
The first element of the pair is the first element of the list
The second element of the pair is the rest of the list

(Demo)

Implementing the Sequence Abstraction

```
def len_rlist(s):
    """Return the length of recursive list s."""
    length = 0
    while s != empty_rlist:
        s, length = rest(s), length + 1
    return length
```

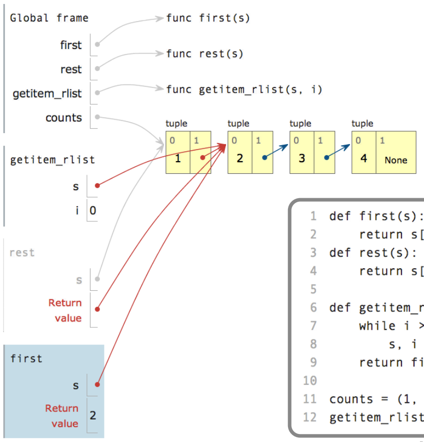
(Demo)

```
def getitem_rlist(s, i):
    """Return the element at index i of recursive list s."""
    while i > 0:
        s, i = rest(s), i - 1
    return first(s)
```

Length. A sequence has a finite length.

Element selection. A sequence has an element corresponding to any non-negative integer index less than its length, starting at 0 for the first element.

Environment Diagram for getitem_rlist



```
def first(s):
    return s[0]
def rest(s):
    return s[1]

def getitem_rlist(s, i):
    while i > 0:
        s, i = rest(s), i - 1
    return first(s)

counts = (1, (2, (3, (4, None))))
getitem_rlist(counts, 1)
```

Sequence Iteration

Not on Midterm 1

(Demo)

```
def count(s, value):
    total = 0
    for elem in s:
```

Name bound in the first frame of the current environment

```
        if elem == value:
            total = total + 1
    return total
```

For Statement Execution Procedure

Not on Midterm 1

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

1. Evaluate the header <expression>, which must yield an iterable value.

2. For each element in that sequence, in order:

   A. Bind <name> to that element in the local environment.

   B. Execute the <suite>.

Sequence Unpacking in For Statements

Not on Midterm 1

A sequence of fixed-length sequences

```
>>> pairs = ((1, 2), (2, 2), (2, 3), (4, 4))
>>> same_count = 0
```

A name for each element in a fixed-length sequence

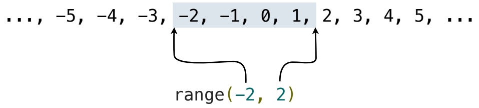
Each name is bound to a value, as in multiple assignment

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

>>> same_count
2
```

The Range Type

Not on Midterm 1

A range is a sequence of consecutive integers.*



```
..., -5, -4, -3, -2, -1, 0, 1, 2, 3, 4, 5, ...

range(-2, 2)
```

Length: ending value - starting value

(Demo)

Element selection: starting value + index

```
>>> tuple(range(-2, 2))
(-2, -1, 0, 1)
```

Tuple construction

```
>>> tuple(range(4))
(0, 1, 2, 3)
```

With a 0 starting value

* Ranges can actually represent more general integer sequences.

Membership & Slicing

Not on Midterm 1

The Python sequence abstraction has two more behaviors!

Membership.

```
>>> digits = (1, 8, 2, 8)
>>> 2 in digits
True
>>> 1828 not in digits
True
```

Slicing.

```
>>> digits[0:2]
(1, 8)
>>> digits[1:]
(8, 2, 8)
```