Lecture 11: Sequences

hi, i’m sriya :)

Announcements

Lab 3 is due TONIGHT

Homework 3 is due tomorrow

Resources

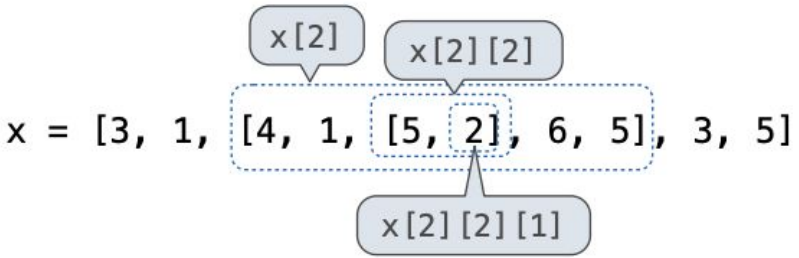
- Sign up for Quest Exam Support Meetings
- Sign up for an Exam Prep Tutoring Section on sections.cs61a.org
- OH today and tomorrow in Warren from 5-8 PM

Lists

```
digits = [8, 0, 8, 1]
Index              0  1  2  3
Index (negative)  -4 -3 -2 -1
```

```
>>> digits[2]
8

>>> digits[-1]
1
```



Write an expression to get the 2: `x[2][2][1]`

For Loops

demo!

Ranges

A range is a sequences of consecutive integers.*

…, -5, -4, -3, -2, -1, 0, 1, 2, 3, 4, 5, …

`range(-2, 2)`

Interesting Properties:

- **Length**: ending value - starting value
- **Element Selection**: starting value + index

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

list constructor

range with a 0 starting value

* Ranges can be represent more general integer sequences.

List Comprehensions

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

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

Example: Evens

```
def evens(n: int) -> list[int]:
    """Return a list of the first n even numbers.

    >>> evens(0)
    []
    >>> evens(3)
    [0, 2, 4]
    """
    return ____________________________
```

Example: Evens

```
def evens(n: int) -> list[int]:
    """Return a list of the first n even numbers.

    >>> evens(0)
    []
    >>> evens(3)
    [0, 2, 4]
    """
    return [2 * x for x in range(n)]
```

Example: Two Lists

Given these two related lists of the same length:

```
xs = list(range(-10, 11))
ys = [x*x - 2*x + 1 for x in xs]
```

Write a list comprehension that evaluates to: A list of all the x values (from `xs`) for which the corresponding y (from `ys`) is below 10.

```
>>> list(xs)
[-10, -9, -8, -7, -6, -5, -4, -3, -2, -1, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9,
10]
>>> ys
[121, 100, 81, 64, 49, 36, 25, 16, 9, 4, 1, 0, 1, 4, 9, 16, 25, 36, 49,
64, 81]
>>> xs_where_y_is_below_10
[-2, -1, 0, 1, 2, 3, 4]
```

Example: Promoted

Implement `promoted`, which takes a sequence `s` and a one-argument function `f`. It returns a list with the same elements as `s`, but with all elements `e` for which `f(e)` is a true value ordered first. Among those placed first and those placed after, the order stays the same.

```
def promoted(s, f):
    """Return a list with the same elements as s, but with all
    elements e for which f(e) is a true value placed first.

    >>> promoted(range(10), odd)  # odds in front
    [1, 3, 5, 7, 9, 0, 2, 4, 6, 8]
    """
    return _____
```

Example: Promoted

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    """Return a list with the same elements as s, but with all
    elements e for which f(e) is a true value placed first.

    >>> promoted(range(10), odd)  # odds in front
    [1, 3, 5, 7, 9, 0, 2, 4, 6, 8]
    """
    return [e for e in s if f(e)] + [e for e in s if not f(e)]
```

List, Slices, & Recursion

For any list `s`, the expression `s[1:]` is called a slice from index 1 to the end (or 1 onward)

- The value of `s[1:]` is a list whose length is one less than the length of `s`
- It contains all of the elements of `s` except `s[0]`
- Slicing `s` doesn't affect `s`

```
>>> s = [2, 3, 6, 4]
>>> s[1:]
[3, 6, 4]
>>> s
[2, 3, 6, 4]
```

In a list `s`, the first element is `s[0]` and the rest of the elements are `s[1:]`.

Example: Reverse

```
def reverse(s):
    """Return s in reverse order.

    >>> reverse([4, 6, 2])
    [2, 6, 4]
    """
    if not s:
        return []
    return _____
```

there are multiple ways to do this!

Example: Reverse

```
def reverse(s):
    """Return s in reverse order.

    >>> reverse([4, 6, 2])
    [2, 6, 4]
    """
    if not s:
        return []
    return reverse(s[1:]) + [s[0]]
```

there are multiple ways to do this!

More Examples!

```
def multiplication_table(n):
    """
    Return a 2D list (a list of lists) representing a multiplication
    table for digits 1 through n.
    >>> multiplication_table(3)
    [[1, 2, 3], [2, 4, 6], [3, 6, 9]]
    """
    # YOUR CODE HERE
```

it helps to write the list in a different way!

```
[[1,  2,  3],   row 1
 [2,  4,  6],   row 2
 [3,  6,  9]]   row 3

col 1  col 2  col 3
```

More Examples!

```
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    """
    Return a 2D list (a list of lists) representing a multiplication
    table for digits 1 through n.
    >>> multiplication_table(3)
    [[1, 2, 3], [2, 4, 6], [3, 6, 9]]
    """
    my_table = [[0] * n for _ in range(n)]
    for i in range(n):          ← outer loop
        for j in range(n):      ← inner loop
            my_table[i][j] = (i + 1) * (j + 1)
    return my_table
```

```
think of it like this:
my_table = [[0] * n for _ in range(n)]
for row in range(rows):
    for col in range(columns):
        my_table[row][col] = row * col
return my_table
```

there are multiple ways to do this! can you think of another?

More Examples!

```
def multiplication_table(n):
    """
    Return a 2D list (a list of lists) representing a multiplication
    table for digits 1 through n.
    >>> multiplication_table(3)
    [[1, 2, 3], [2, 4, 6], [3, 6, 9]]
    """
    return ____________________________________________________________
```

More Examples!

```
def multiplication_table(n):
    """
    Return a 2D list (a list of lists) representing a multiplication
    table for digits 1 through n.
    >>> multiplication_table(3)
    [[1, 2, 3], [2, 4, 6], [3, 6, 9]]
    """
    return [[i * j for j in range(1, n + 1)] for i in range(1, n + 1)]
```

More Examples!

```
def shuffle(deck1, deck2):
    """
    Interleave two decks of any length together.
    >>> odds = [1, 3, 5]
    >>> evens = [2, 4, 6, 8]
    >>> shuffle(odds, evens)
    [1, 2, 3, 4, 5, 6, 8]
    """
    # YOUR CODE HERE
```

how do we solve this with a for loop?

what do we need to consider?

1) deck1 is longer
2) deck2 is longer
3) both decks are the same length

More Examples!

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    >>> evens = [2, 4, 6, 8]
    >>> shuffle(odds, evens)
    [1, 2, 3, 4, 5, 6, 8]
    """
    shuffled_deck = []
    min_len = min(len(deck1), len(deck2))
    for i in range(min_len):
        shuffled_deck += [deck1[i], deck2[i]]
    shuffled_deck += deck1[min_len:]
    shuffled_deck += deck2[min_len:]
    return shuffled_deck
```

← why do we need to use min?

More Examples!

```
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    Interleave two decks of any length together.
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    >>> shuffle(odds, evens)
    [1, 2, 3, 4, 5, 6, 8]
    """
    # YOUR CODE HERE
```

now can we solve this with recursion?

what do we need to consider?

1) deck1 is longer
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More Examples!

```
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    """
    Interleave two decks of any length together.
    >>> odds = [1, 3, 5]
    >>> evens = [2, 4, 6, 8]
    >>> shuffle(odds, evens)
    [1, 2, 3, 4, 5, 6, 8]
    """
    # base cases
    if not deck1:
        return deck2
    if not deck2:
        return deck1
    # recursive call
    return [deck1[0], deck2[0]] + shuffle(deck1[1:], deck2[1:])
```

shuffle([], [3, 4]) → [3, 4]

shuffle([1, 2], []) → [1, 2]

now can we solve this with recursion?

what do we need to consider?

1) deck1 is longer
2) deck2 is longer
3) both decks are the same length

Feedback :)

go.cs61a.org/sriya-lecture