[301] Lists

Tyler Caraza-Harter

Learning Objectives Today

List syntax

- creation, indexing, for loop

Chapter 10 of Think Python

Comparison to strings

- similarity: len, slicing, concatenation, in, multiply
- differences: flexible types, mutability

Modifying lists

- update, append, pop, sort

Switching between strings and lists

- split, join

Today's Outline

List Syntax

Similarities with Strings

Difference 1: Flexibility of Types

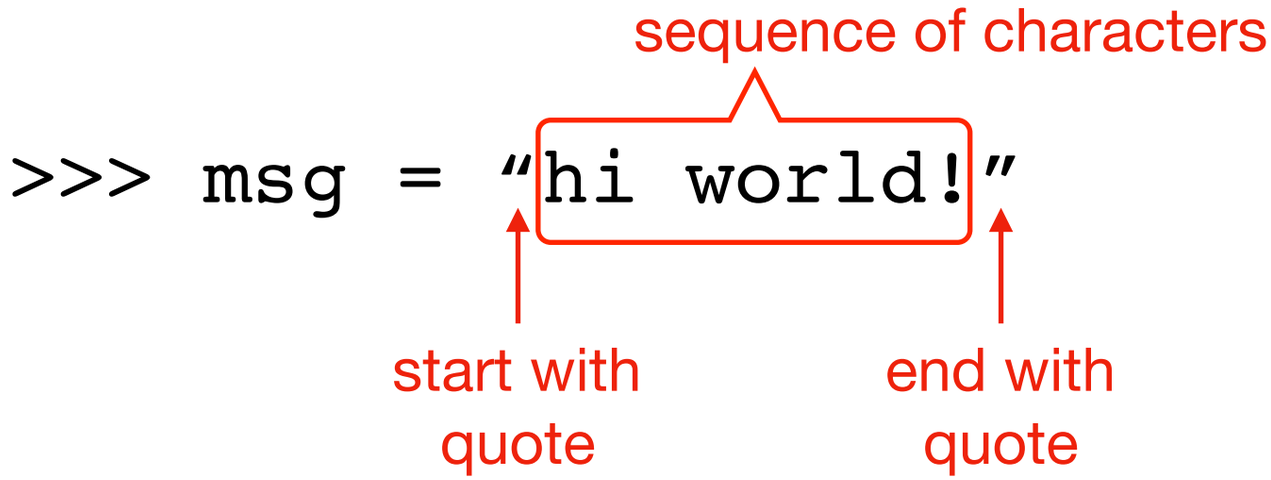
Difference 2: Mutability

Transforming between Strings and Lists

A string is a **sequence** of characters

```
>>> msg = “hi world!”
```

A string is a **sequence** of characters



A string is a **sequence** of characters

```
>>> msg = “hi world!”
```

Things we can do with sequences

- index
- slice
- for loop

A string is a **sequence** of characters

```
>>> msg = “hi world!”
>>> msg[1]
‘i’
```

Things we can do with sequences

- **index**
- slice
- for loop

A string is a **sequence** of characters

```
>>> msg = “hi world!”
>>> msg[1]
‘i’
>>> msg[3]
‘w’
```

Things we can do with sequences

- **index**
- slice
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A string is a **sequence** of characters

```
>>> msg = “hi world!”
>>> msg[3:]
‘world!’
```

Things we can do with sequences

- index
- **slice**
- for loop

A string is a **sequence** of characters

```
>>> msg = “hi world!”
>>> msg[3:]
‘world!’
>>> msg[3:-1]
‘world’
```

Things we can do with sequences

- index
- **slice**
- for loop

A string is a **sequence** of characters

```
>>> msg = “hi world!”
>>> for c in msg:
...   print(c)
```

Things we can do with sequences

- index
- slice
- **for loop**

A string is a **sequence** of characters

```
>>> msg = “hi world!”
>>> for c in msg:
...     print(c)
...
h
i

w
o
r
l
d
!
```

Things we can do with sequences

- index
- slice
- **for loop**

A string is a **sequence** of characters

```
>>> msg = “hi world!”
```

What if we want a sequence, of something other than characters?

Use a Python list, with any items we want!

A list is a **sequence** of values (could be integers, or anything else)

```
>>> msg = “hi world!”
>>> nums = [22, 11, 33]
```

What if we want a sequence, of something other than characters?

Use a Python list, with any items we want!

A list is a **sequence** of values (could be integers, or anything else)

```
>>> msg = “hi world!”
>>> nums = [22, 11, 33]
```

square bracket instead of quote

sequence of values, comma separated

square bracket instead of quote

What if we want a sequence, of something other than characters?

Use a Python list, with any items we want!

A list is a **sequence** of values (could be integers, or anything else)

```
>>> msg = “hi world!”
>>> nums = [22, 11, 33]
```

Things we can do with sequences

- index
- slice
- for loop

A list is a **sequence** of values (could be integers, or anything else)

```
>>> msg = “hi world!”
>>> nums = [22, 11, 33]
>>> nums[0]
22
```

Things we can do with sequences

- **index**
- slice
- for loop

A list is a **sequence** of values (could be integers, or anything else)

```
>>> msg = “hi world!”
>>> nums = [22, 11, 33]
>>> nums[0]
22
>>> nums[-1]
33
```

Things we can do with sequences

- **index**
- slice
- for loop

A list is a **sequence** of values (could be integers, or anything else)

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>>> msg = “hi world!”
>>> nums = [22, 11, 33]
>>> nums[1:]
[11, 33]
```

Things we can do with sequences

- index
- **slice**
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A list is a **sequence** of values (could be integers, or anything else)

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>>> msg = “hi world!”
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[11, 33]
>>> nums[3:]
[ ]
```

Things we can do with sequences

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- for loop

A list is a **sequence** of values (could be integers, or anything else)

```
>>> msg = “hi world!”
>>> nums = [22, 11, 33]
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Things we can do with sequences

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A list is a **sequence** of values (could be integers, or anything else)

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>>> msg = “hi world!”
>>> nums = [22, 11, 33]
>>> for x in nums:
...    print(x)
...
22
11
33
```

Things we can do with sequences

- index
- slice
- **for loop**

Demo: Finding a Sum

Goal: write a function to add a list of numbers

Input:

- Python list containing floats

Output:

- Sum of the numbers

Example:

```
>>> nums = [1, 2, 3]
>>> add_nums(nums)
6
>>> add_nums([20, 30])
50
```

Demo: Finding a Sum

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```

Note: I did it the hard way as an example, but these are handy:
min(lst), max(lst), sum(lst), len(lst)

Today's Outline

List Syntax

Similarities with Strings

Difference 1: Flexibility of Types

Difference 2: Mutability

Transforming between Strings and Lists

Things we can do with strings and lists

1. len

2. slicing

3. concatenation

4. in

5 multiply by an int

1. len(sequence)

string

```
>>> msg = “321go”
```

list

```
>>> items = [99,11,77,55]
```

1. len(sequence)

string

```
>>> msg = “321go”
>>> len(msg)
5
```

list

```
>>> items = [99,11,77,55]
>>> len(items)
4
```

2. slicing

string

```
>>> msg = “321go”
>>> msg[3:]
‘go’
```

list

```
>>> items = [99,11,77,55]
>>> items[1:3]
[11,77]
```

3. concatenation

string

```
>>> msg = “321go”
>>> msg + “!!!”
‘321go!!!’
```

list

```
>>> items = [99,11,77,55]
>>> items + [1,2,3]
[99,11,77,55,1,2,3]
```

4. in

string

```
>>> msg = “321go”
>>> ‘g’ in msg
True
```

list

```
>>> items = [99,11,77,55]
>>> 11 in items
True
```

4. in

string

```
>>> msg = “321go”
>>> ‘g’ in msg
True
>>> ‘z’ in msg
False
```

list

```
>>> items = [99,11,77,55]
>>> 11 in items
True
>>> 10 in items
False
```

5. multiply by int

string

```
>>> msg = “321go”
>>> msg * 2
‘321go321go’
```

list

```
>>> items = [99,11,77,55]
>>> items * 2
[99,11,77,55,99,11,77,55]
```

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Items can be any types

string, bool, int, float

even other lists!

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even other lists!

Code example (run in terminal):

```
l = [True, False, 3, "hey", [1, 2]]
for item in l:
  print(type(l))
```

Items can be any types

string, bool, int, float

even other lists!

Code example (run in terminal):

```
l = [True, False, 3, "hey", [1, 2]]
for item in l:
  print(type(l))
```

What to type if we want to get 2 (last item of last item)?

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List Syntax

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Mutability

Definition

- a type is **mutable** if values can be changed
- a type is **immutable** if values cannot be changed

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```
s += “oooo”
```

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this works! because we aren’t changing the string “hello”. We’re reassigning a new string “hellooooo” to the variable s

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```
nums = [3,2,1]

nums[0] = 300
```

Mutability

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```

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```
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```

this works! because we aren’t changing the string “hello”. We’re reassigning a new string “hellooooo” to the variable s

```
nums = [3,2,1]

nums[0] = 300
# nums is [300,2,1]
```

Mutability

Definition

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- a type is **immutable** if values cannot be changed

```
s = “hello”
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```

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```
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```

this works! because we aren’t changing the string “hello”. We’re reassigning a new string “hellooooo” to the variable s

```
nums = [3,2,1]

nums[0] = 300
# nums is [300,2,1]
nums += [9,8]
```

Mutability

Definition

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```
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```

fails! because strings are immutable

```
s += “oooo”
```

this works! because we aren’t changing the string “hello”. We’re reassigning a new string “hellooooo” to the variable s

```
nums = [3,2,1]

nums[0] = 300
# nums is [300,2,1]
nums += [9,8]
# nums is [300,2,1,9,8]
```

Mutability

Definition

- a type is **mutable** if values can be changed
- a type is **immutable** if values cannot be changed

```
s = “hello”
s[0] = “j”
```

fails! because strings are immutable

```
s += “oooo”

nums = [3,2,1]

nums[0] = 300
# nums is [300,2,1]
nums += [9,8]
# nums is [300,2,1,9,8]
```

this works! because we aren’t changing the string “hello”. We’re reassigning a new string “hellooooo” to the variable s

both work, because lists are mutable

Ways to mutate a list

Common Modifications

- L[index] = new_value
- L.append(new_value)
- L.pop(index)
- L.sort()

Example code:

```
L = [3,2,1]
L.append(0)
L[1] = -1
L.sort()
L.pop(0)
```

Demo these in interactive mode

Demo: Finding a Median

Goal: write a function to find the median of a list of numbers

Input:

- Python list containing floats

Output:

- The median

Example:

```
>>> nums = [1,5,2,9,8]
>>> median(nums)
5
>>> median([1, 20, 30, 100])
25
```

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List Syntax

Similarities with Strings

Difference 1: Flexibility of Types

Difference 2: Mutability

Transforming between Strings and Lists

split method

Turns a string into a list

- operates on a string
- takes a separator
- returns a list

```
>>> S = “this is a test”
>>> L = S.split(“ “)
>>> L
[“this”, “is”, “a”, “test”]
```

join method

Turns a list into a string

- operates on a separator
- takes a list
- returns a string

```
>>> L = [“i”, “don’t”, “know”]
>>> sep = “...“
>>> sep.join(L)
i...don't...know
```

Demo: Censoring Profanity

Goal: write a function to replace curse words with start

Input:

- A profane string

Output:

- A sanitized string

Example:

>>> censor(“OMG this class is so fun”)
‘*** this class is so fun’
>>> censor(“the midterm was darn tough”)
‘the ******* was **** tough’

Demo: Censoring Profanity

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Input:

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Example:

```
>>> censor(“OMG this class is so fun”)
‘*** this class is so fun’
>>> censor(“the midterm was darn tough”)
‘the ******* was **** tough’
```

replaces offensive words like “darn” and “midterm” with stars