[301] Lists

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Learning Objectives Today

Lists, the mutable sequence that can hold ANYTHING!

Sequence stuff

- indexing, slicing, for loops
- len, in, concatenation, multiplication

Mutating!

- update, append, pop, sort

Switching between strings and lists

- split, join

Chapter 10 of Think Python

Today's Outline

From Strings to Lists

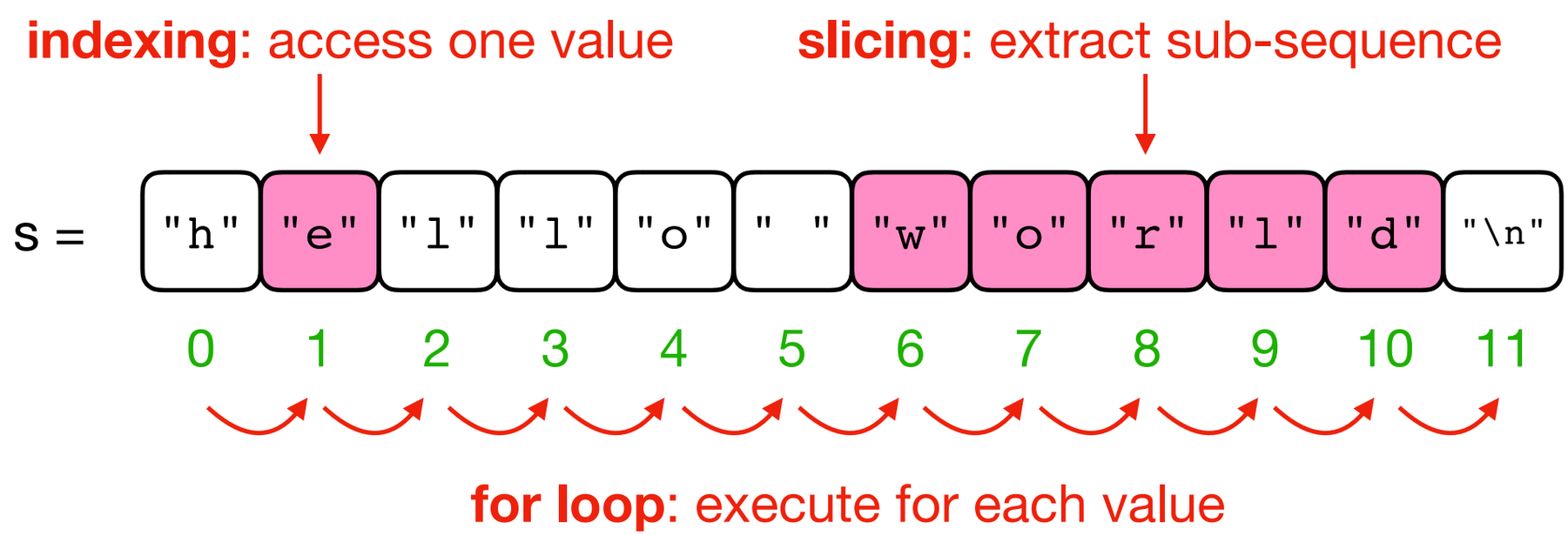
More Sequence Capabilities

Difference 1: Flexibility of Types

Difference 2: Mutability

Transforming between Strings and Lists

A string is a **sequence** of characters



Things we can do with sequences

- indexing
- slicing
- for loop

A string is a **sequence** of characters

```
>>> msg = “hi world!”
```

Things we can do with sequences

- indexing
- slicing
- for loop

A string is a **sequence** of characters

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

Things we can do with sequences

- **indexing**
- slicing
- for loop

A string is a **sequence** of characters

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

Things we can do with sequences

- **indexing**
- slicing
- for loop

A string is a **sequence** of characters

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

Things we can do with sequences

- indexing
- **slicing**
- 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

- indexing
- **slicing**
- for loop

A string is a **sequence** of characters

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

Things we can do with sequences

- indexing
- slicing
- **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

- indexing
- slicing
- **for loop**

A string is a **sequence** of characters

```
>>> msg = “hi world!”
```

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

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 string is a **sequence** of characters

sequence of characters

```
>>> msg = "hi world!"
```

str syntax

start with quote

end with 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 *anything*

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

str syntax

list syntax

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 *anything*

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

Things we can do with sequences

- indexing
- slicing
- for loop

A list is a **sequence** of *anything*

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

Things we can do with sequences

- **indexing**
- slicing
- for loop

A list is a **sequence** of *anything*

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

Things we can do with sequences

- **indexing**
- slicing
- for loop

A list is a **sequence** of *anything*

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

Things we can do with sequences

- **indexing**
- slicing
- for loop

A list is a **sequence** of *anything*

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

Things we can do with sequences

- **indexing**
- slicing
- for loop

A list is a **sequence** of *anything*

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

seeing brackets for both creating lists and indexing often confuses new coders!

Things we can do with sequences

- **indexing**
- slicing
- for loop

A list is a **sequence** of *anything*

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

Things we can do with sequences

- indexing
- **slicing**
- for loop

A list is a **sequence** of *anything*

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

Things we can do with sequences

- indexing
- **slicing**
- for loop

A list is a **sequence** of *anything*

```
>>> msg = “hi world!”
>>> nums = [22, 11, 33]
>>> nums[1:]
[11, 33]
>>> nums[3:]
```

Things we can do with sequences

- indexing
- **slicing**
- for loop

A list is a **sequence** of *anything*

```
>>> msg = “hi world!”
>>> nums = [22, 11, 33]
>>> nums[1:]
[11, 33]
>>> nums[3:]
[ ]
```

Things we can do with sequences

- indexing
- **slicing**
- for loop

A list is a **sequence** of *anything*

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

Things we can do with sequences

- indexing
- slicing
- **for loop**

A list is a **sequence** of *anything*

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

Things we can do with sequences

- indexing
- slicing
- **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, 3.5]
>>> add_nums(nums)
6.5
>>> add_nums([20, 30.1])
50.1
```

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More Sequence Capabilities

Difference 1: Flexibility of Types

Difference 2: Mutability

Transforming between Strings and Lists

Cool stuff we can do with strings and lists

1. indexing
2. slicing
3. for loops
4. len
5. concatenation
6. in
7. multiply by an int

4. len(sequence)

string

```
>>> msg = “321go”
```

list

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

4. len(sequence)

string

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

list

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

5. concatenation

string

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

list

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

6. in

string

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

list

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

6. 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
```

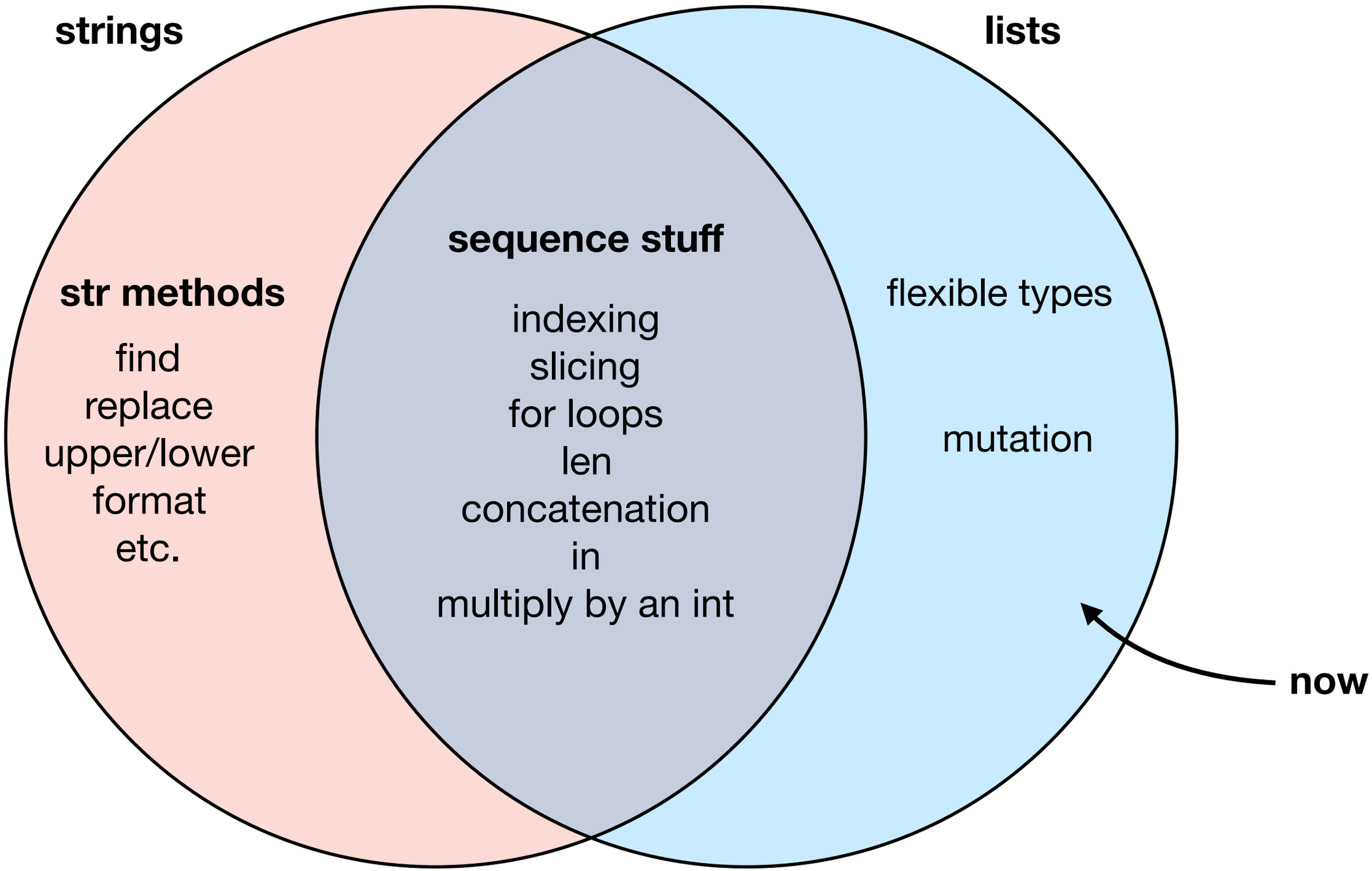
7. multiply by int

string

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

list

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


strings
lists
sequence stuff
indexing
slicing
for loops
len
concatenation
in
multiply by an int
str methods
find
replace
upper/lower
format
etc.
flexible types
mutation
now

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Difference 1: Flexibility of Types

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Transforming between Strings and Lists

Items can be any types

string, bool, int, float

even other lists!

Items can be any types

string, bool, int, float

even other lists!

coding demo:

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

bonus: how to extract the last item of the last item?

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Difference 1: Flexibility of Types

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Mutability

Definition

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

careful! this is is about values, not variables

Mutability

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	set variable to new value	**change existing value**
list (mutable)		
str (immutable)	`s = "AB"` `s += "C"` ✓	`s = "201"` `s[0] = "3"` ✗

Mutability

Definition

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

careful! this is is about values, not variables

	set variable to new value	**change existing value**
list (mutable)	`nums = [1,2]` `nums += [3]` ✓	`nums = [2,0,1]` `nums[0] = 3` ✓
str (immutable)	`s = "AB"` `s += "C"` ✓	`s = "201"` `s[0] = "3"` ✗

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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split method

```
S = "a quick brown fox"
L = S.split(" ")
```

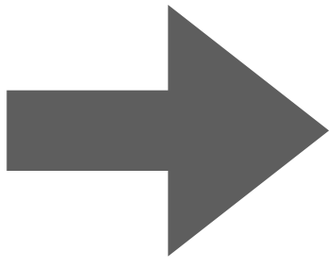
separator

join method

```
L = ["M", "SS", "SS", "PP", ""]
S = L.join("I")
```

separator

```
["M", "SS", "SS", "PP", ""]
```



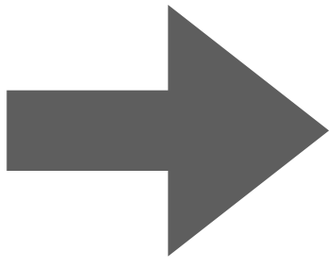
????

join method

```
L = ["M", "SS", "SS", "PP", ""]
S = L.join("I")
```

separator

```
["M", "SS", "SS", "PP", ""]
```



```
MISSISSIPPI
```

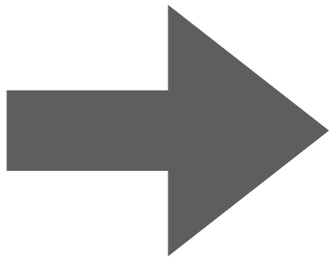
join method

```
L = ["M", "SS", "SS", "PP", ""]
S = L.join("I")
```

what if removed?

separator

```
["M", "SS", "SS", "PP", ""]
```



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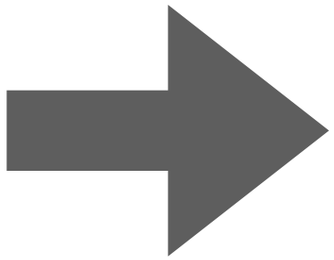
```

join method

```
L = ["M", "SS", "SS", "PP"]
S = L.join("I")
```

separator

```
["M", "SS", "SS", "PP", ""]
```



```
MISSISSIPP
```

Demo: Censoring Profanity

Goal: write a function to replace curse words with stars

Input:

- A profane string

Output:

- A sanitized string

Example:

```
>>> censor("OMG this class is so fun")
'*** this class is so fun'
>>> censor("the midterm is darn soon")
'the ******* was **** tough'
```

Demo: Censoring Profanity

Goal: write a function to replace curse words with stars

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Output:

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Example:

```
>>> censor("OMG this class is so fun")
'*** this class is so fun'
>>> censor("the midterm is darn soon")
'the ******* was **** tough'
```

replaces offensive words like "darn" and "midterm" with stars