[220] Lists

Meena Syamkumar
Mike Doescher

Cheaters caught: 0

Learning Objectives Today

Lists, the mutable sequence that can hold ANYTHING!

Sequence stuff

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

Chapter 10 of Think Python

Mutating!

- update, append, pop, sort

Switching between strings and lists

- split, join

Today's Outline

From Strings to Lists

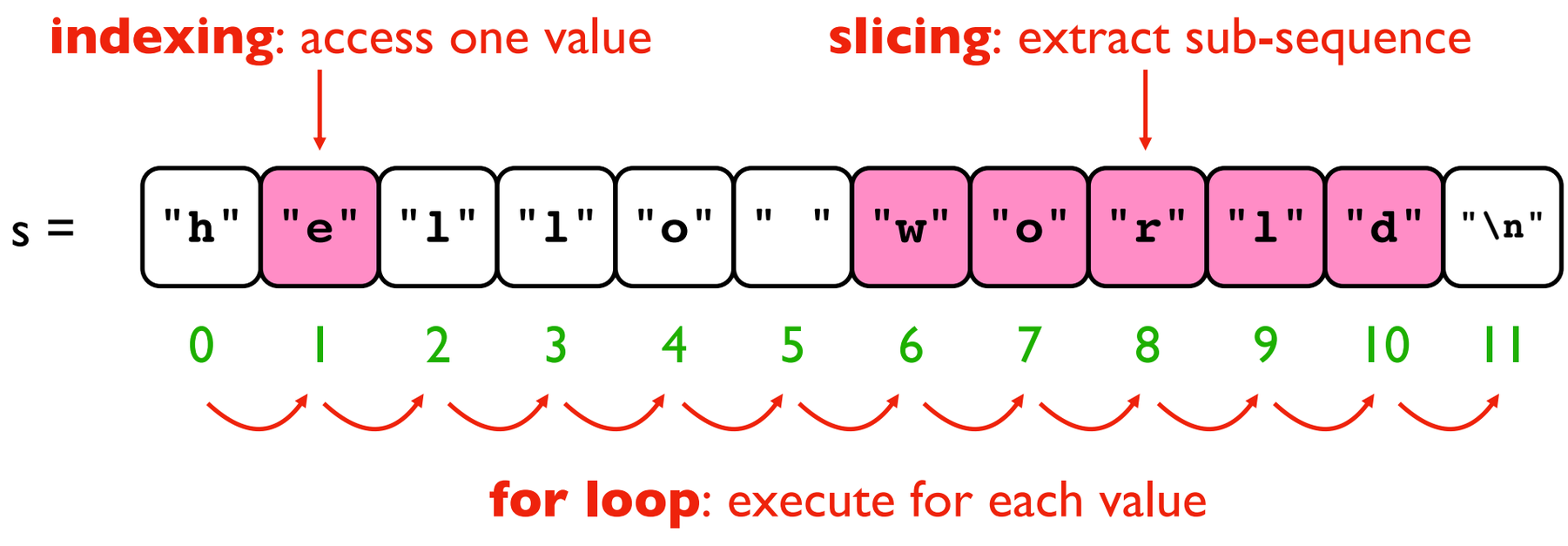
More Sequence Capabilities

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!”
>>> 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!’
>>> msg[3:-1]
‘world’
```

Things we can do with sequences

- indexing
- **slicing**
- for loop

A string is a **sequence** of characters

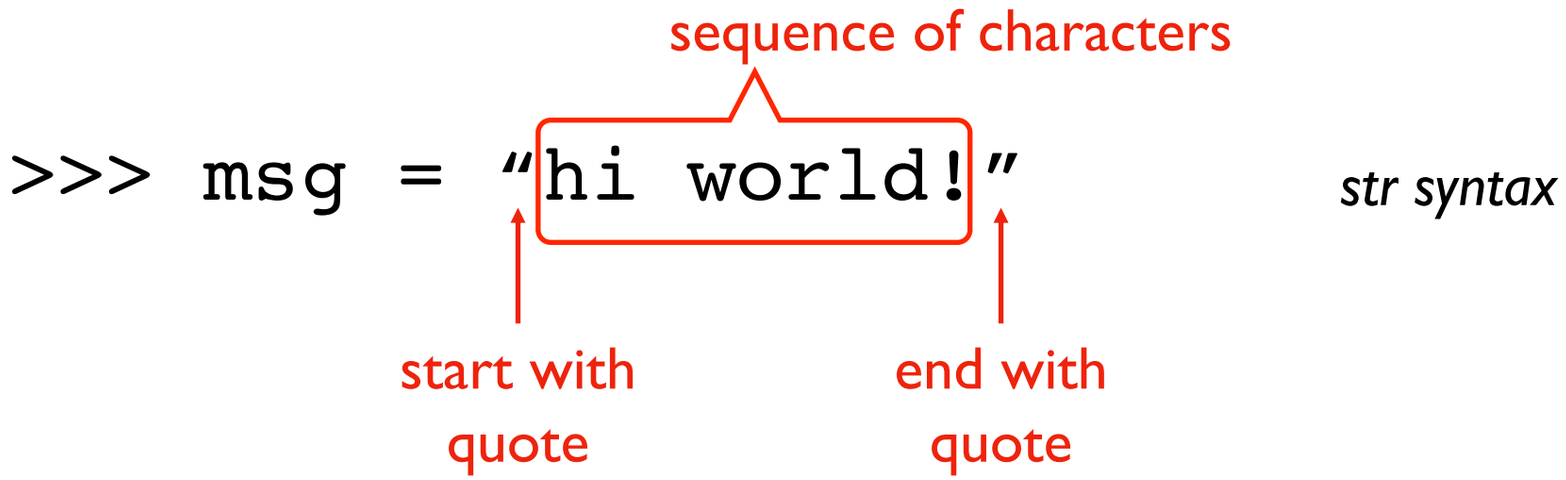
```
>>> msg = “hi world!”
>>> for c in msg:
...     print(c)
...
h
i

w
o
r
l
d
!
```

Things we can do with sequences

- indexing
- slicing
- **for loop**

A string is a **sequence** of characters



str syntax

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*

```
>>> 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*

```
>>> 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*

```
>>> 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*

```
>>> 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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Cool stuff we can do with ~~strings and lists~~ *any sequence*

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

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
>>> ‘z’ in msg
False
```

list

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

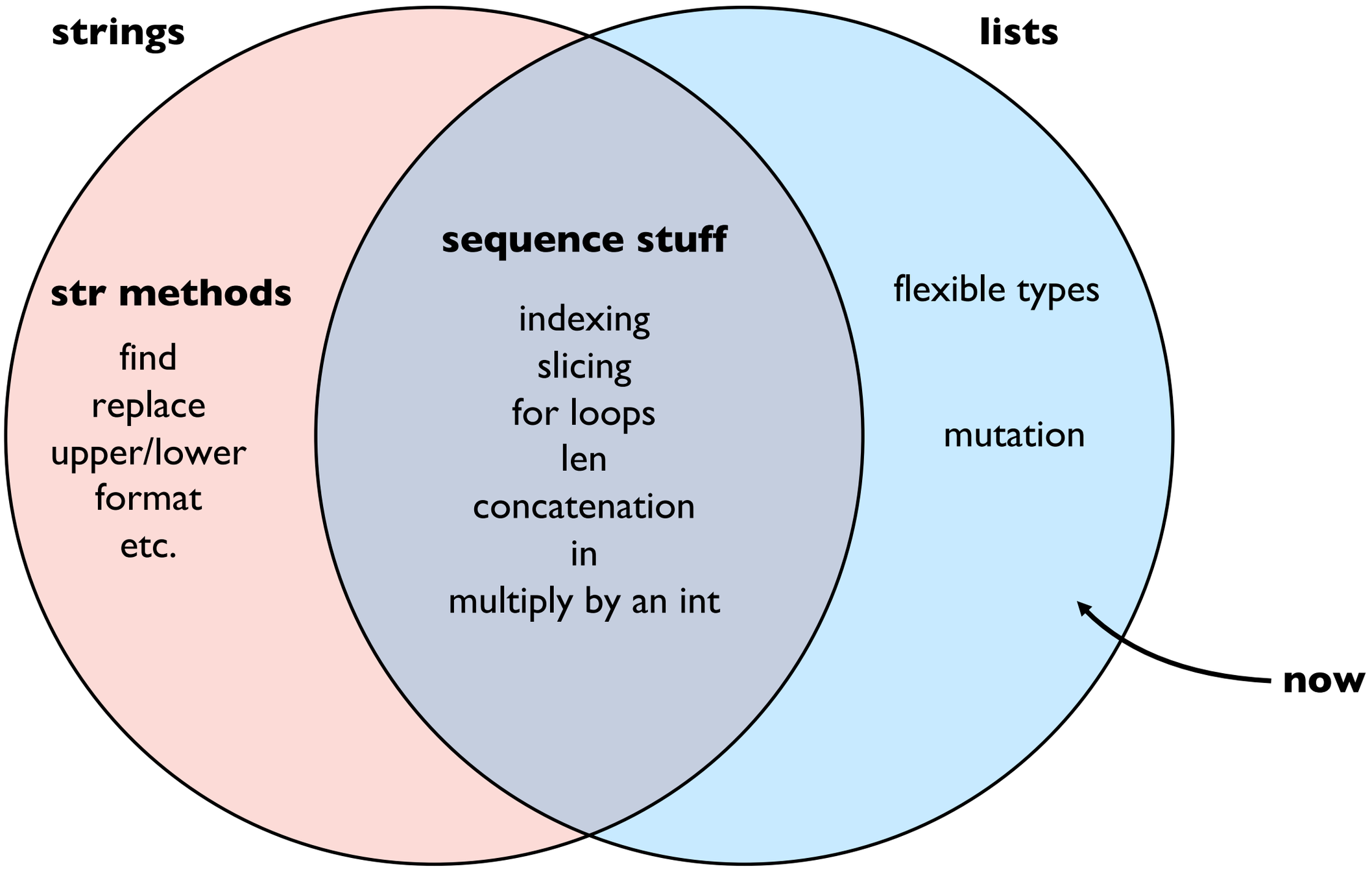
7. multiply by int

string

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

list

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


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

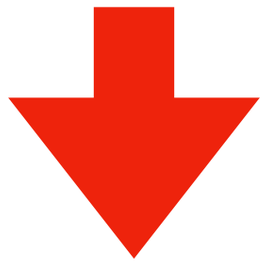
coding demo:

```
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?

Example game map with list of lists

```
[
  [".", ".", ".", ".", ".", "S"],
  [".", "S", "S", "S", ".", "S"],
  [".", ".", ".", ".", ".", "S"],
  [".", ".", ".", ".", ".", "."],
  [".", ".", ".", ".", "S", "."],
  [".", ".", ".", ".", "S", "."]
]
```



```
.....S
.SSS.S
.....S
......
....S.
....S.
```

rows and columns of data are useful for more than games...

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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*
(variables can ALWAYS be changed)

	set variable to new value	change existing value
list (mutable)	`nums = [1,2]` `nums = [3,4]` ✓	`nums = [2,2,9]` `nums[2] = 0` ✓

str (immutable)	`s = "AB"`
	`s = "CD"`
	`s += "E"` ✓
		`s = "229"`
		`s[2] = "0"` ✗

Ways to mutate a list

Common Modifications

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

Example code:

```
L = [3,2,1]
L.append(0)
L.extend([9, 8])
L[1] = -1
L.sort()
L.pop(0)
```

Demo these in PythonTutor

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(" ")
```

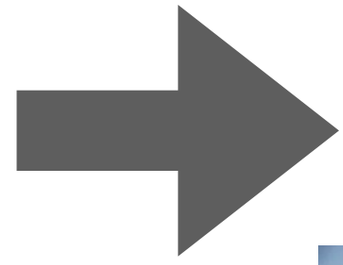
separator

join method

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

separator

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



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http://www.city-data.com/picfilesc/picc25424.php

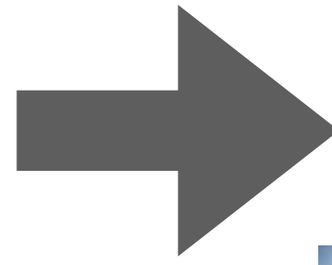
join method

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

separator

what if removed?

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



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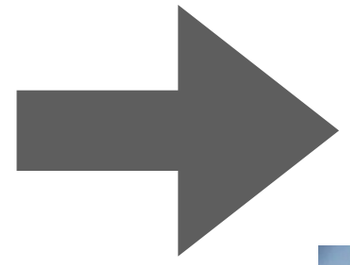
http://www.city-data.com/picfilesc/picc25424.php

join method

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

separator

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



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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 was darn tough")
'the ******* was **** tough'

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 was darn tough")
'the ******* was **** tough'

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

Bonus Topics (time permitting)...

1. Command line arguments, as a list

```
import sys
arg1 = sys.argv[1]
arg2 = sys.argv[2]
```

2. Random values, from a list

```
import random
random.choice(["rock", "paper", "scissors"])
```