CSCI 134 Fall 2021: Lists and Loops

September 24, 2021

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Announcements & Logistics

- **Homework 3** is out on GLOW, due Monday 10 pm
- **Lab 1** graded feedback was released on Wed
    - Any problems?
- **Lab 3** will be released today at noon
    - Watch pre-lab video with your herd and discuss before lab
    - Lab 3 is a collection of word puzzles: can use our newly acquired knowledge of strings, functions and loops to solve them

Do You Have Any Questions?

Last Time

- Started discussing *sequences* in Python
  - Focused on **strings** (sequences of characters)
  - Discussed *slicing* and *indexing* of strings
  - Learned about `in` operator to test membership:
    - Note: there is also a `not in` operator
  - Also learned about string methods `.lower()` and `.upper()`
    - There are also string methods `.islower()` and `.isupper()` that return True if string is in lowercase/uppercase, else False
- (Briefly) Introduced **for loops** as a mechanism to iterate over sequences

Today’s Plan

- Discuss for loops in more detail
- Introduce a new sequence: **Lists**
    - Apply indexing, slicing, `in` operator to lists
- Build a collection of functions that iterate over lists and strings
- Build a module for working with sequences

Recap: Iterating with `for` Loops

- The **loop variable** (char and var in the examples below) takes on the value of each of the elements of the sequence one by one

```
for var in seq:
    # loop body
    (do something)
```

```
# simple example of for loop

word = "Williams"

for char in word:
    print(char)
```

```
W
i
l
l
i
a
m
s
```

Recap: count Vowels

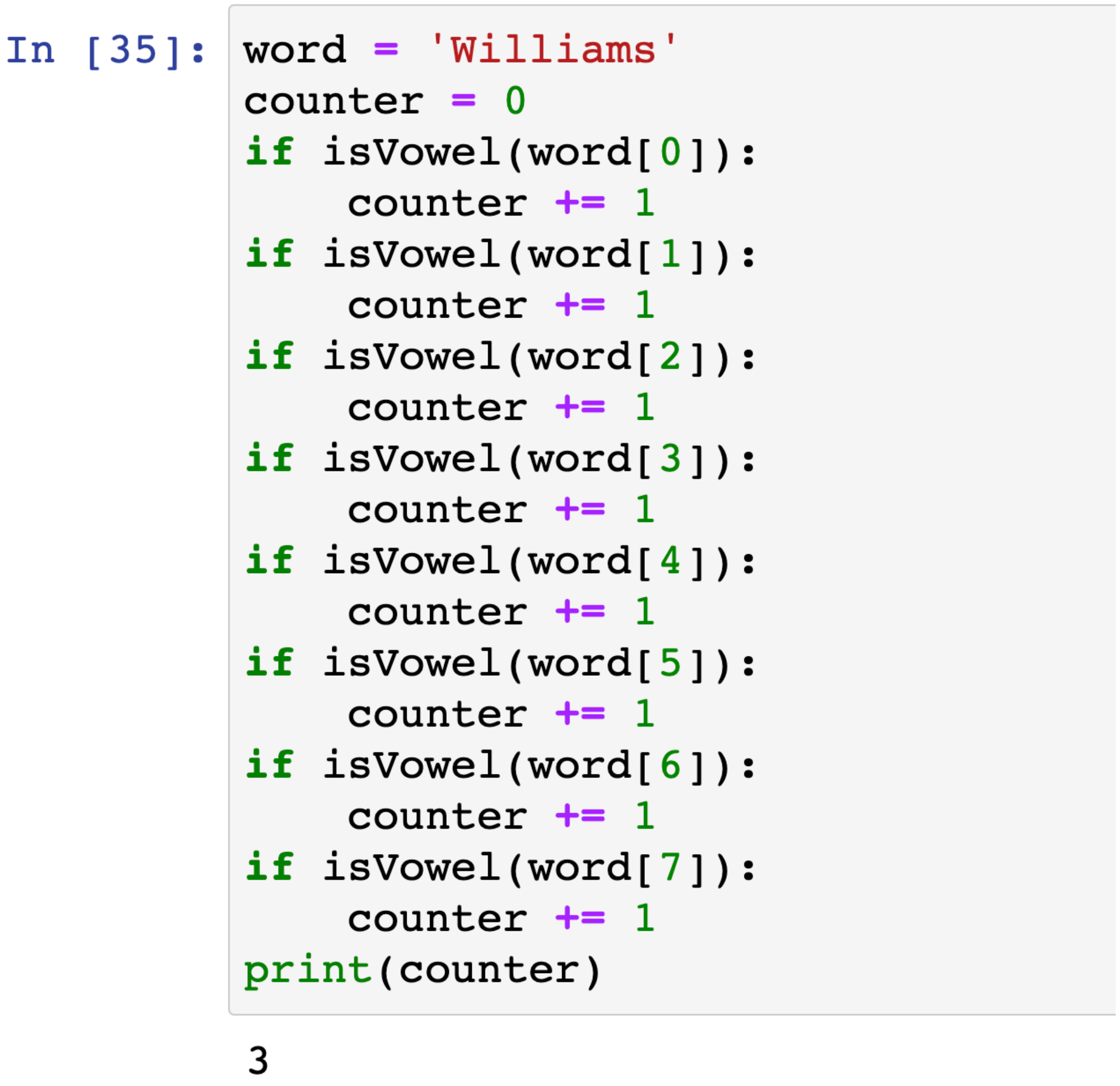
- **Problem:** Write a function `countVowels()` that takes a string `word` as input, counts and returns the number of vowels in the string.

```
def countVowels(word):
    '''Returns number of vowels in the word'''
    pass
```

```
>>> countVowels('Williamstown')
4
>>> countVowels('Ephelia')
4
```

(Bad) Attempt with Conditionals

- Using conditionals as shown is repetitive and does not generalize to arbitrary length words
- Note that `val += 1` is shorthand for `val = val + 1`



```
In [35]: word = 'Williams'
         counter = 0
         if isVowel(word[0]):
             counter += 1
         if isVowel(word[1]):
             counter += 1
         if isVowel(word[2]):
             counter += 1
         if isVowel(word[3]):
             counter += 1
         if isVowel(word[4]):
             counter += 1
         if isVowel(word[5]):
             counter += 1
         if isVowel(word[6]):
             counter += 1
         if isVowel(word[7]):
             counter += 1
         print(counter)

         3
```

Counting Vowels Revisited

- Let's use a for loop to finish implementing our `countVowels()` function correctly

```
def countVowels(word):
    '''Takes a string as input and returns
    the number of vowels in it'''

    count = 0 # initialize the counter

    # iterate over the word one character at a time
    for char in word:
        if isVowel(char): # call helper function
            count += 1
    return count
```

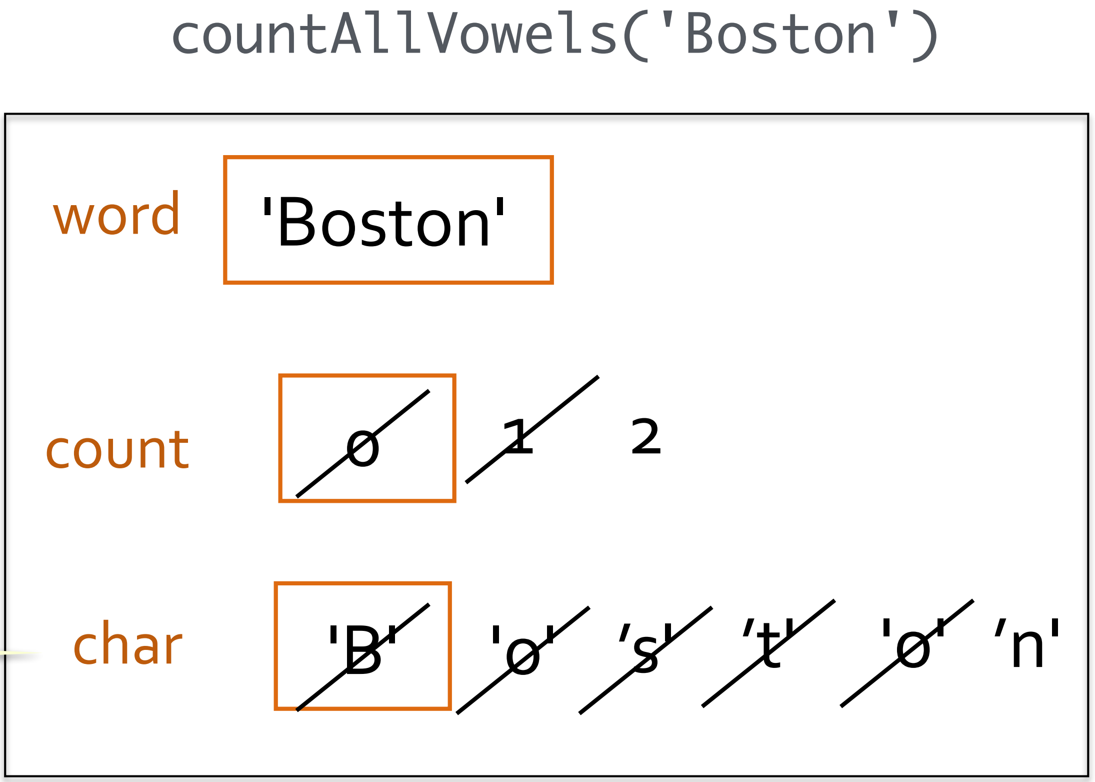
Count is an **accumulator** variable, since we accumulate the value as we go through the loop.

Counting Vowels: Tracing the Loop

- How are the local variables updated as the loop runs?

```
def countVowels(word):
     '''Takes a string as input and returns the number
      of vowels in it'''
     count = 0
     for char in word:
          if isVowel(char):
               count += 1
     return count
```

Loop variable



Exercise: vowelSeq

- Define a function `vowelSeq()` that takes a string `word` as input and returns a string containing all the vowels in word in the same order as they appear. (Hint: we can use isVowel() from last class)

```
def vowelSeq(word):
    '''returns the vowel subsequence in word'''
     pass
>>> vowelSeq("Chicago")
"iao"
>>> vowelSeq("protein")
"oei"
>>> vowelSeq("rhythm")
""
```

Exercise: vowelSeq

- Define a function `vowelSeq()` that takes a string `word` as input and returns a string containing all the vowels in word in the same order as they appear. (Hint: we can use isVowel() from last class)

```
def vowelSeq(word):
    '''returns the vowel subsequence in word'''
    vowels = ""  # accumulation variable
    for char in word:



    return vowels
```

Exercise: vowelSeq

- Define a function **`vowelSeq()`** that takes a string **`word`** as input and returns a string containing all the vowels in word in the same order as they appear. (Hint: we can use isVowel() from last class)

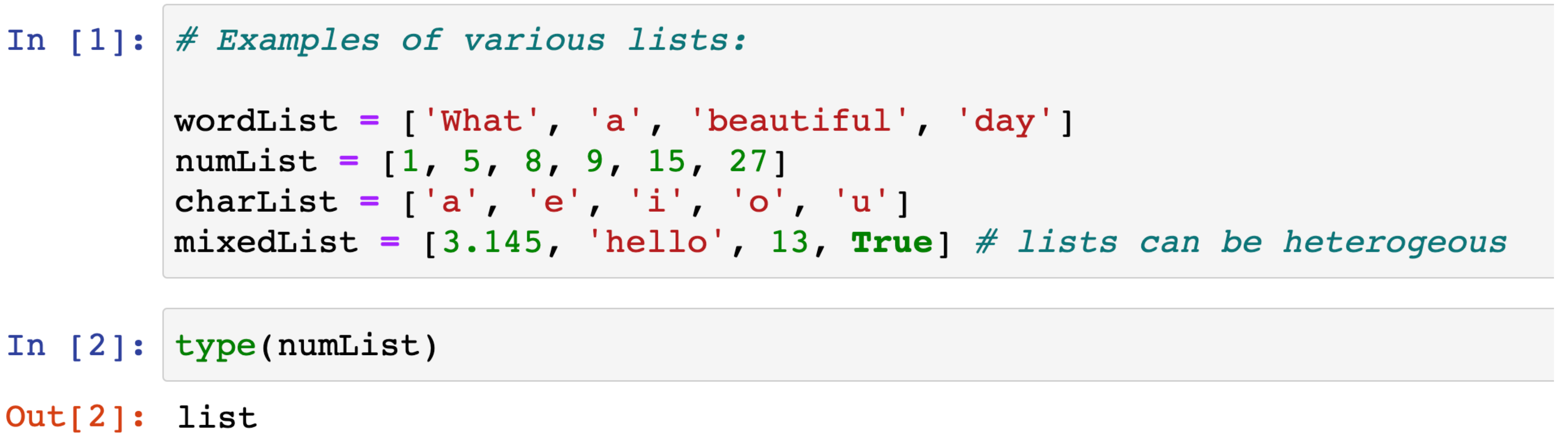
```python
def vowelSeq(word):
    '''returns the vowel subsequence in word'''
    vowels = ""  # accumulation variable
    for char in word:
        if isVowel(char): # if vowel
            vowels += char # accumulate characters
    return vowels
```

Moving on: Lists

- **Lists** are another type of **sequence** in Python
- Definition: A list is a comma separated sequence of values
- Unlike strings, which can *only contain characters*, lists can be collections of **heterogenous** objects (strings, ints, floats, etc)
- Today we'll focus on **iterating** over lists (i.e., looking at the elements sequentially) using for loops
- Next week we'll focus on manipulating and using lists to store dynamic sequences of objects

Lists

- Lists are:
  - **Comma separated sequences** of values
  - **Heterogenous** collections of objects
  - **Mutable** (or "changeable") objects in Pythons. In contrast, strings are immutable (they cannot be changed).
    - We will discuss mutability in more detail soon!

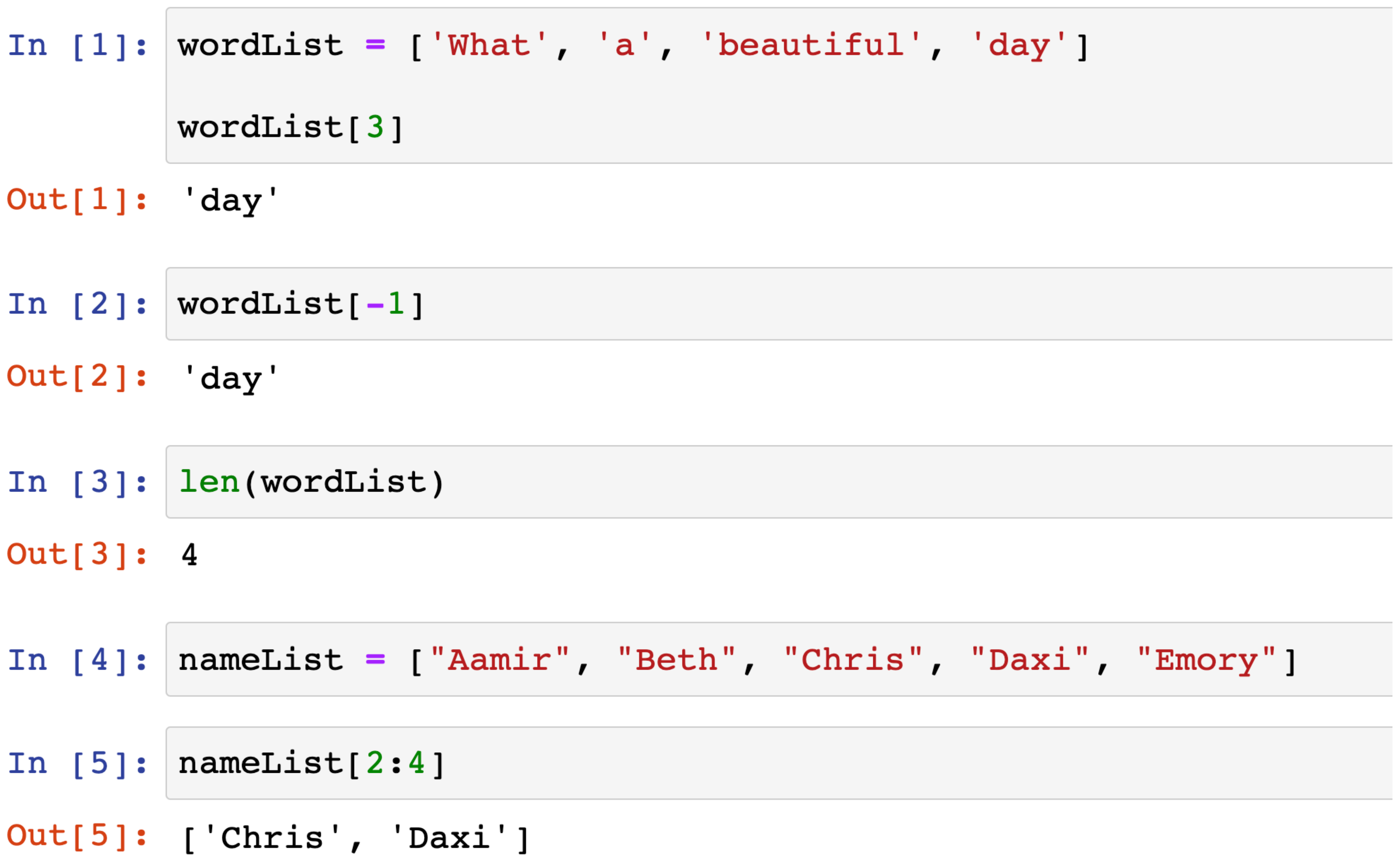


```
In [1]: # Examples of various lists:

        wordList = ['What', 'a', 'beautiful', 'day']
        numList = [1, 5, 8, 9, 15, 27]
        charList = ['a', 'e', 'i', 'o', 'u']
        mixedList = [3.145, 'hello', 13, True] # lists can be heterogeous

In [2]: type(numList)

Out[2]: list
```

Operations on Sequences

- We already saw several string operators and functions last time
- Most of these apply to lists as well
- We can do the following on lists:
    - Indexing elements of lists using `[]`
    - Using `len()` function to find length
    - Slicing lists using `[:]`
    - Testing membership using `in`/`not in` operators
    - Concatenation using `+`

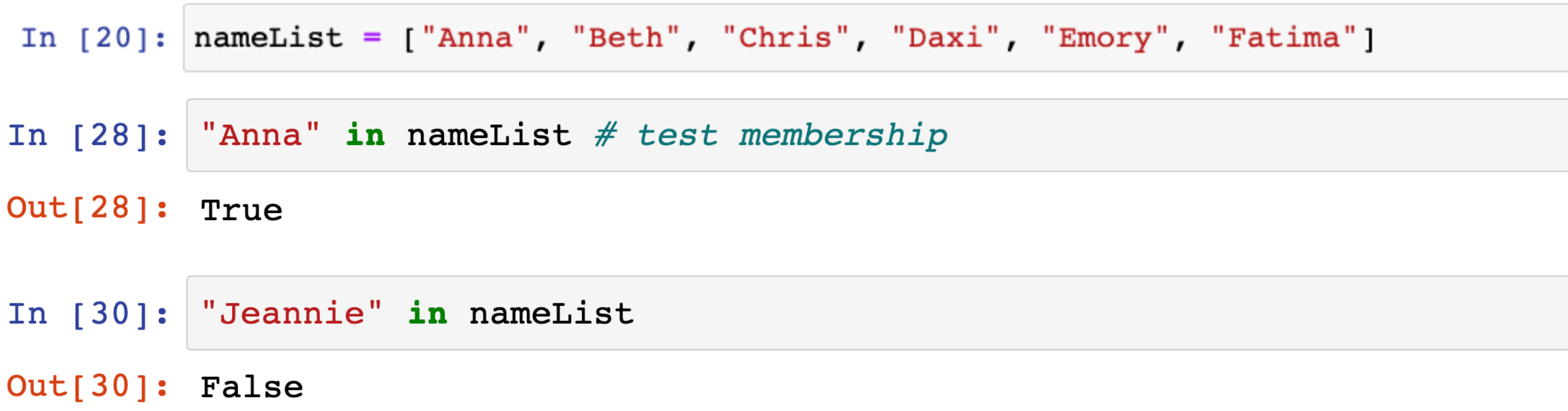
Operations on Sequences



```
In [1]: wordList = ['What', 'a', 'beautiful', 'day']

        wordList[3]
Out[1]: 'day'

In [2]: wordList[-1]
Out[2]: 'day'

In [3]: len(wordList)
Out[3]: 4

In [4]: nameList = ["Aamir", "Beth", "Chris", "Daxi", "Emory"]

In [5]: nameList[2:4]
Out[5]: ['Chris', 'Daxi']
```

Membership in Sequences

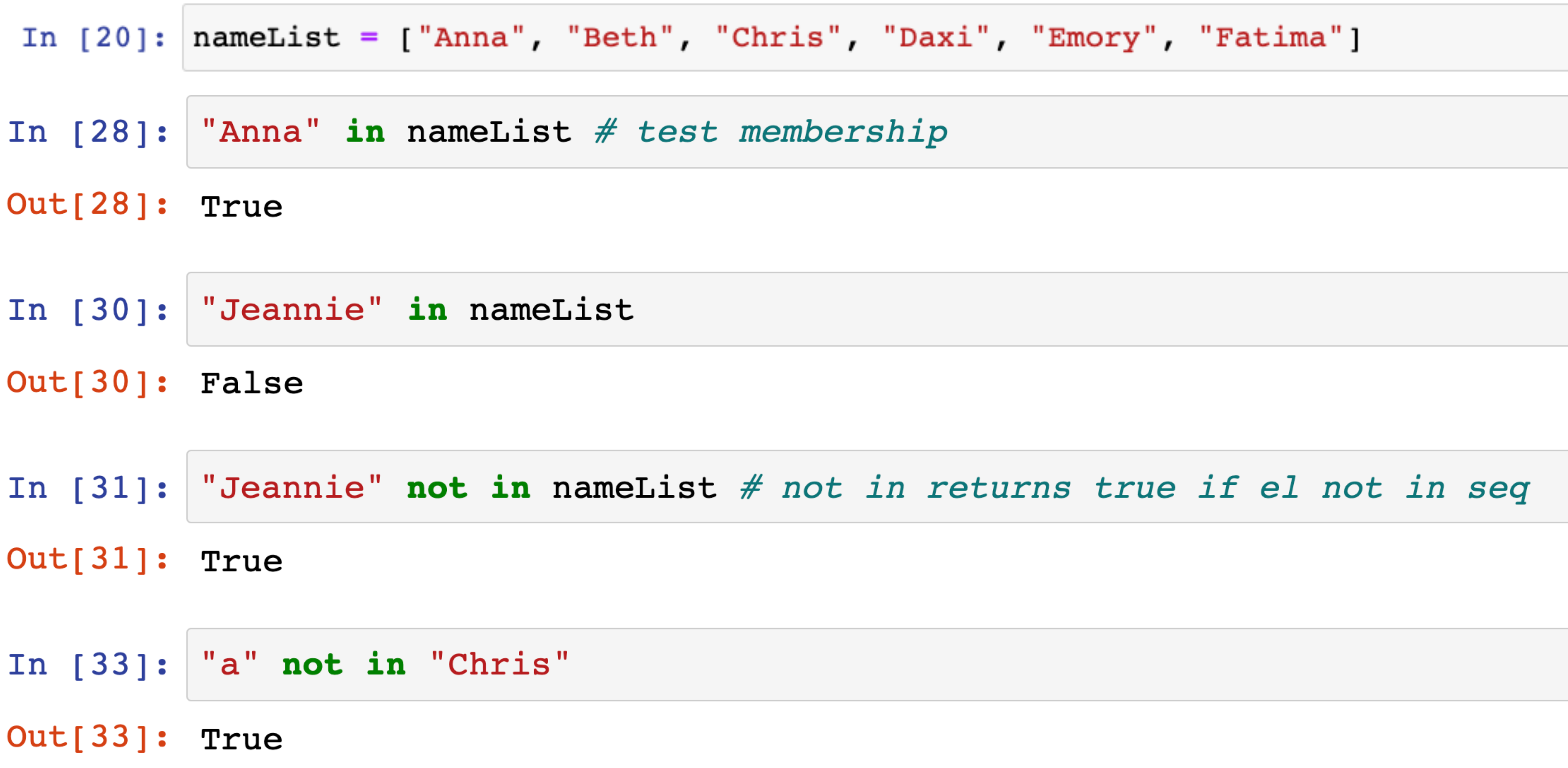
- Recall: The `in` operator in Python is used to test if a given sequence is a subsequence of another sequence; returns True or False



```
In [20]: nameList = ["Anna", "Beth", "Chris", "Daxi", "Emory", "Fatima"]

In [28]: "Anna" in nameList # test membership
Out[28]: True

In [30]: "Jeannie" in nameList
Out[30]: False
```

Sequences: `not in` operator

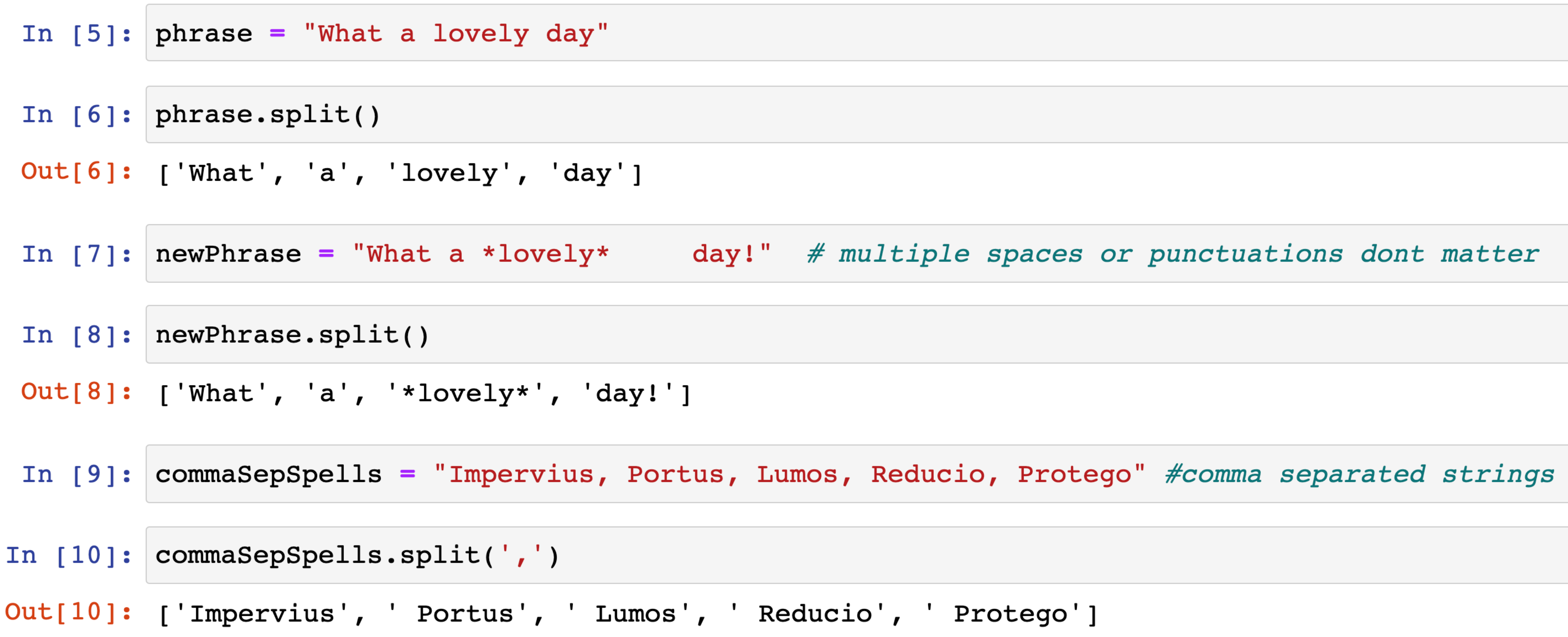
- The **`not in`** operator in Python returns True if and only if the given element is **not** in the sequence



```
In [20]: nameList = ["Anna", "Beth", "Chris", "Daxi", "Emory", "Fatima"]

In [28]: "Anna" in nameList # test membership

Out[28]: True

In [30]: "Jeannie" in nameList

Out[30]: False

In [31]: "Jeannie" not in nameList # not in returns true if el not in seq

Out[31]: True

In [33]: "a" not in "Chris"

Out[33]: True
```

Strings to Lists: `split()`

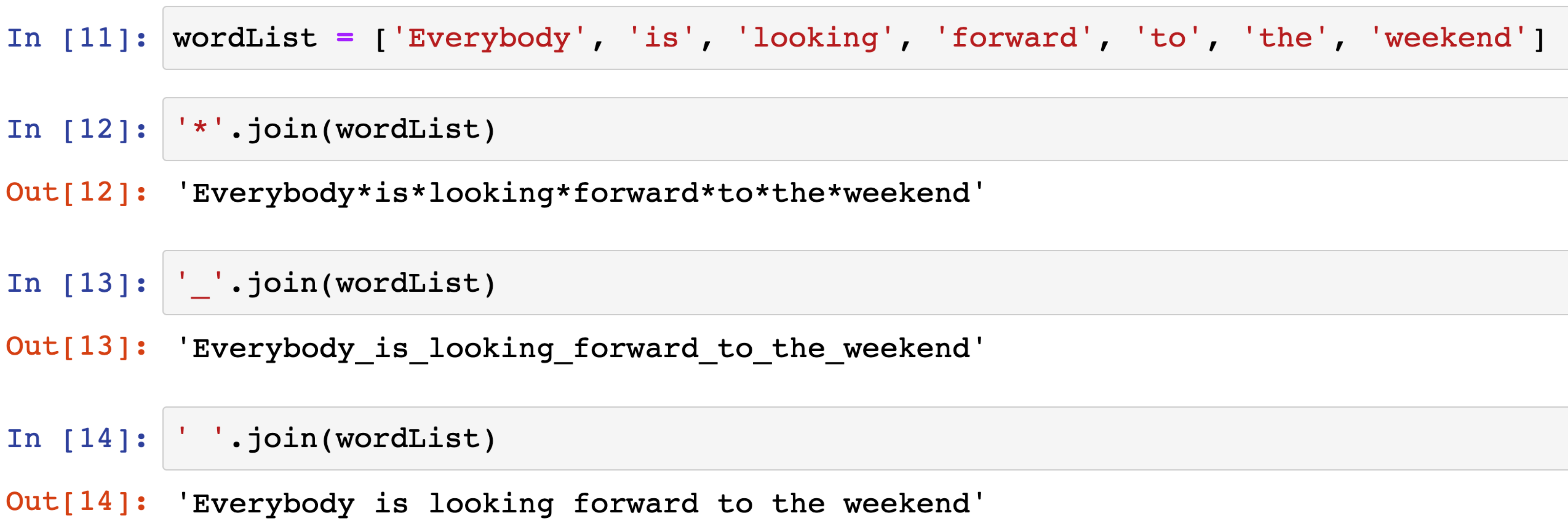
- It is often useful to be able to convert strings to lists, and lists to strings.
- The **`split()`** method splits strings at "spaces"(the default separator) and returns a list of (sub)strings
- Can optionally specify other **delimiters** as well



```
In [5]:  phrase = "What a lovely day"

In [6]:  phrase.split()
Out[6]:  ['What', 'a', 'lovely', 'day']

In [7]:  newPhrase = "What a *lovely*     day!"   # multiple spaces or punctuations dont matter

In [8]:  newPhrase.split()
Out[8]:  ['What', 'a', '*lovely*', 'day!']

In [9]:  commaSepSpells = "Impervius, Portus, Lumos, Reducio, Protego" #comma separated strings

In [10]: commaSepSpells.split(',')
Out[10]: ['Impervius', ' Portus', ' Lumos', ' Reducio', ' Protego']
```

List to Strings: `join()`

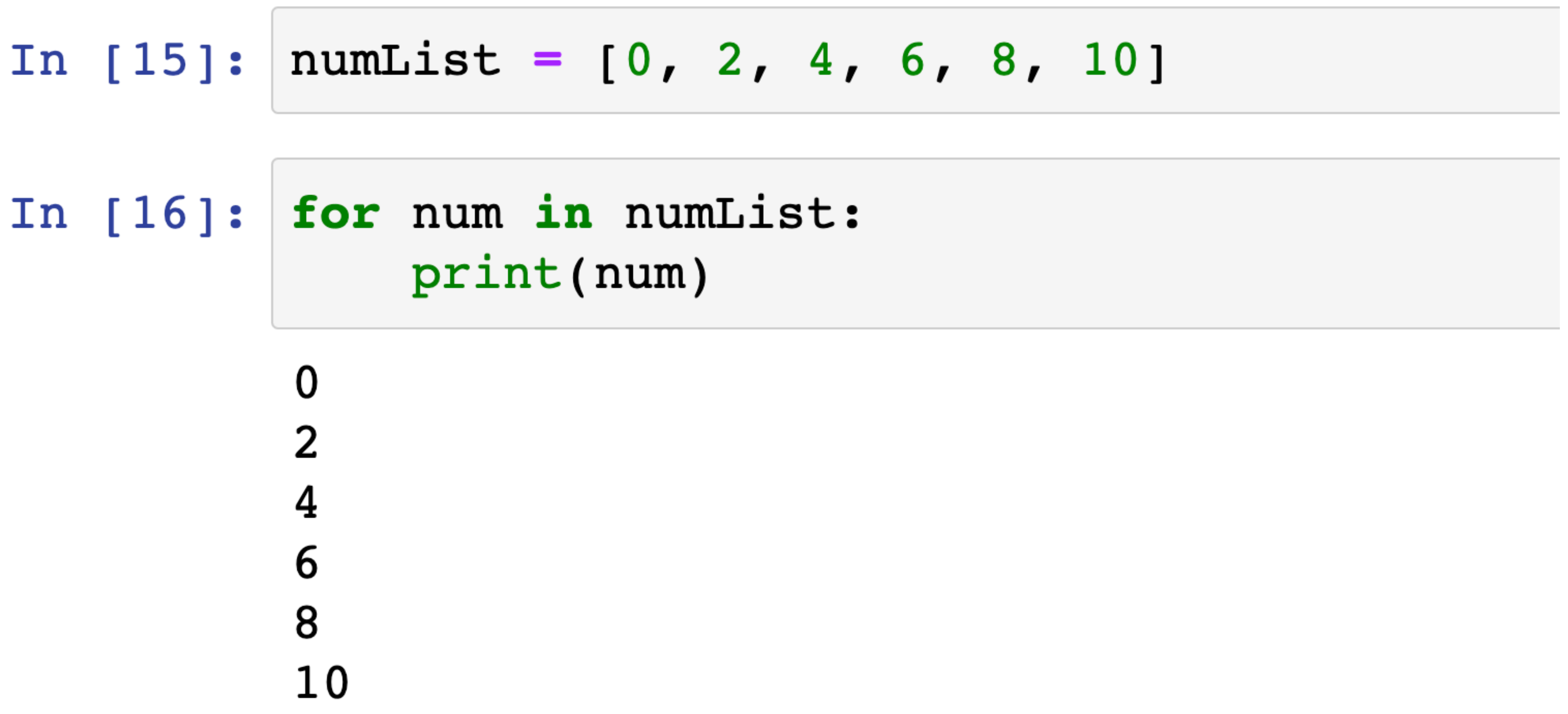
- Given a list of strings, the `join()` string method, when applied to a character `char`, concatenates the strings together with the character `char` between them



```
In [11]: wordList = ['Everybody', 'is', 'looking', 'forward', 'to', 'the', 'weekend']

In [12]: '*'.join(wordList)

Out[12]: 'Everybody*is*looking*forward*to*the*weekend'

In [13]: '_'.join(wordList)

Out[13]: 'Everybody_is_looking_forward_to_the_weekend'

In [14]: ' '.join(wordList)

Out[14]: 'Everybody is looking forward to the weekend'
```

Looping over Lists

- We can loop over lists the same way we loop over strings
- As before, the **loop variable** iteratively takes on the values of each item in the list, starting with the 0th item, then 1st, until the last item
- The following loop iterates over the list, printing each item in it



```
In [15]: numList = [0, 2, 4, 6, 8, 10]

In [16]: for num in numList:
             print(num)

         0
         2
         4
         6
         8
         10
```

Exercise: `countItem`

- Let's write a function `countItem()` that takes as input a sequence `seq` (can be a string or a list), and an element `el`, and returns the number of times `el` appears in the sequence `seq`.

```python
def countItem(seq, el):
    """Takes seq as input, and returns the number of times
    el appears in seq"""
    pass
```

Exercise: `countItem`

- Let's write a function `countItem()` that takes as input a sequence `seq` (can be a string or a list), and an element `el`, and returns the number of times `el` appears in the sequence `seq`.

```python
def countItem(seq, el):
    """Takes seq as input, and returns the number of times
    el appears in seq"""
    count = 0 # initialize counter

    for item in seq:
        if item == el: # if this item matches el
            count += 1 # increment counter
        # else do nothing, go to next item
    return count
```

Another accumulator variable!

Exercise: `wordStartEnd`

- Write a function that iterates over a given list of words `wordList`, returns a (new) list containing all the words in `wordList` that start and end with the same letter (ignoring case).

```python
def wordStartEnd(wordList):
    '''Takes a list of words wordList and returns a list
    of all words in wordList that start and end with the same letter'''
    pass
```

```
>>> wordStartEnd(['Anna', 'banana', 'salad', 'Rigor', 'tacit', 'hope'])
['Anna', 'Rigor', 'tacit']
>>> wordStartEnd(['New York', 'Tokyo', 'Paris'])
[]
>>> wordStartEnd(['*Hello*', '', 'nope'])
['*Hello*']
```

Exercise: `wordStartEnd`

- **Step by step approach (organize your work)**:
  - Go through every word in wordList
  - Check **if word starts and ends at same letter**
  - If true, we need to "collect" this word (remember it for later!)
    - Else, just go on to next word
  - Takeaway: need a new list to **accumulate** desirable words

- **Break down bigger steps (decomposition!)**
  - If word starts and ends at same letter:
    - Can do this using string **indexing**
  - Think about **corner cases:** what if string is empty? what about case?

Exercise: `wordStartEnd`

- Write a function that iterates over a given list of words `wordList`, returns a (new) list containing all the words in `wordList` that start and end with the same letter (ignoring case).

```python
def wordStartEnd(wordList):
    '''Takes a list of words and returns a list of words in it
    that start and end with the same letter'''
    # initialize accumulation variable (of type list)
    result = []
    for word in wordList: # iterate over list

        #check for empty strings before indexing
        if len(word) != 0:
            if word[0].lower() == word[-1].lower():
                result += [word] # concatenate to resulting list
    return result # notice the indentation of return
```