CSI 34 Lecture 7: Lists, Ranges and Loops

Announcements & Logistics

• Lab 3 was released Friday

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- Builds upon everything we've learned so far (including today's content):
 - Iterating over sequences (strings, lists, ranges) as well as conditionals
- More "moving pieces" than Lab 2
- Please come to help hours if you have questions (or to say hi!)
- **Prelab** due at the beginning of lab
- **HW 3** due tonight at 10 pm on Glow

Do You Have Any Questions?

LastTime

- Introduce iteration using **for loops** to iterate over **sequences**
- Discussed sequence indexing using [] and using the len() function
- Introduce a new data type (which is also a sequence):
 - list



- Learn more about sequences
 - in operator
 - sequence "slicing"
- Iterating over and "accumulating" using lists
- New sequence type: <u>range</u>

Sequences in Python: Strings

- Sequences in Python represent ordered collections of elements: e.g., strings, lists, ranges, etc.
- A **string** is an ordered sequences of individual characters
 - Example: word = "Hello"
- A list is a comma-separated, ordered sequence of values
 - Example: num_list = [1, 5, 8, 9, 15, 27]
- In CS, we use zero-indexing, so we say that 'H' is at index 0 of word, 8 is at index 2 of num_list, and so on
- We can access each character of a sequence using indices
 >> word[1] >>> num_list[4]

'e' 15

Slicing Sequences

- We can extract subsequences of a sequence using the slicing operator [:]
- For a given sequence **var**,

```
var[start:end]
```

returns a new sequence of the same type that contains the elements starting at index 'start' (*inclusive*) and ending at index 'end' (*exclusive*)

```
>>> vowels = 'aeiou'
>>> vowels[0:2]
'ae'
>>> numList = [2, 4, 8, 16]
>>> numList = [0:-1] # everything except last
[2, 4, 8]
```

Slicing Sequences

- We can extract subsequences of a sequence using the slicing operator [:]
- For a given sequence **var**,

var[start:end:step]

returns a new sequence of the same type that contains the elements starting at index 'start' (*inclusive*), ending at index 'end' (*exclusive*), and using an (optional) increment of 'step'

- By default (if not specified):
 - start defaults to 0 (the beginning of string)
 - end defaults to **len(var)** (end of string)
 - step defaults to +1

Examples

- >>> evens = [2, 4, 6, 8, 10, 12, 14, 16, 18, 20]
- >>> evens[0:5]
- [2, 4, 6, 8, 10]
- >>> evens[:8:2]
- [2, 6, 10, 14]
- >>> evens[::2]
- [2, 6, 10, 14, 18]
- Question. How would we reverse a sequence using slicing?
- >>> name = "Ephelia"
- >>> name[::-1]

'ailehpE

Testing Membership: in Operator

• The **in** operator in Python is used to test if a given sequence is a subsequence of another sequence; returns **True** or **False**

```
>>> "Williams" in "Williamstown"
True
```

>>> "w" in "Williams" # capitalization matters
False

```
>>> dog_list = ["Wally", "Velma", "Pixel", "Linus"]
>>> "Linus" in dog_list
True
>>> "Artie" in dog_list
False
```

Testing Membership: **not** in Operator

• The **not** in operator does the opposite of in



Summary: Sequence Operations

Operation	Result
seq[i]	The i 'th item of seq , when starting with 0
<pre>seq[si:ee]</pre>	slice of seq from si to ee
<pre>seq[si:ee:s]</pre>	slice of seq from si to ee with step s
<pre>len(seq)</pre>	length of seq
seq1 + seq2	The concatenation of seq1 and seq2
x in seq	True if x is contained within seq
x not in seq	False if x is contained within seq

All of these operators work on both strings and lists!

Exercise: palindromes

- A palindrome is a string that is the same forwards and backwards
- The following strings are all examples of palindromes:
 - "" (any string with length 0)
 - "x" (any string with length I)
 - ''aba''
 - "racecar"
- The following strings are not palindromes:
- ''aA'' (Case mismatch)
- "12321 " (Un-matched space "" at end of string)

Exercise: palindromes

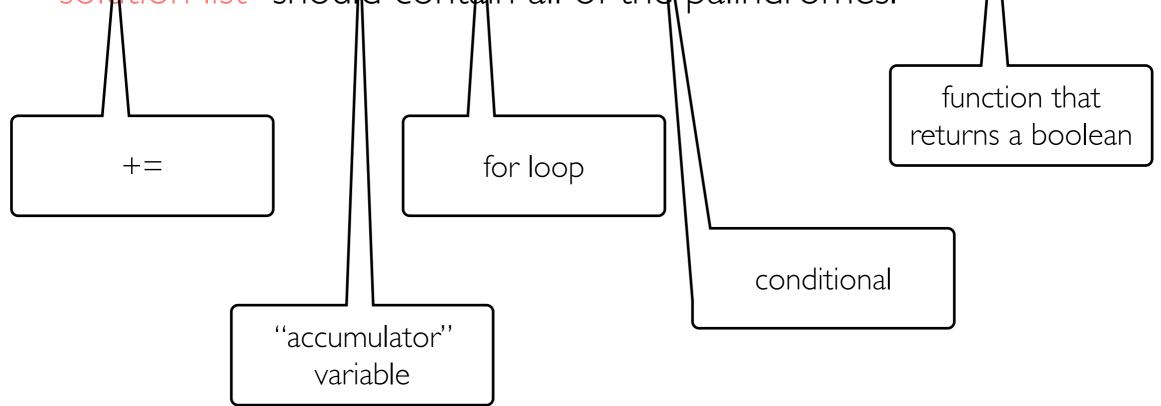
 Write a function that iterates over a given list of strings s_list, returns a (new) list containing all the strings in s_list that are the same forward and backwards (ignoring case).

```
>>> palindromes(["anna", "banana", "kayak", "rigor", "tacit", "hope"])
['anna', 'kayak']
>>> palindromes(["1313", "1110111", "0101"])
['1110111']
>>> palindromes(["level", "stick", "gag"])
['level', 'gag']
```

Exercise: palindromes

What is our high level algorithm, in words?

• Go through each word in s_list. If the word is a palindrome, append it to our "solution list". After reaching the end of our list, our "solution list" should contain all of the palindromes.



Solution: palindromes

```
def palindromes(s_list):
    '''Takes a list of string s_list and returns a new list
     containing strings from s_list that
     are the same forwards and backwards'''
    solution = [] # initialize the accumulation variable
    # iterate over each item in seq
                                               How do we implement
    for item in s_list:
                                             is palindrome (word)?
        # check if it's a palindrome
        if is_palindrome(item):
            # append to accumulation variable
            solution += [item]
    # return what we accumulated
    return solution
```

is_palindrome(word)

What is our high level algorithm, in words?

- Multiple correct algorithms exist!
 - Return true if word is equal to a reversed copy of word
 - return word == word[::-1]
 - Return true if the first character is equal to the last character AND the second character is equal to the second to last character AND the third character is equal to the third to last character AND ...
 - How do we write code that handles arbitrarily long strings?
 - We want a loop that runs len(word) // 2 times because we want to compare len(word) // 2 pairs of characters



Ranges (another sequence!)

- Python provides an easy way to iterate over numerical sequences using the **range** data type, which is **another sequence**
- When the range() function is given two integer arguments, it returns a range object of all integers starting at the first and up to, but not including, the second (note: default starting value is 0)
- To see the values included in the range, we can pass our range to the list() function which returns a list of them

>>> range(0, 10) range(0, 10)	<pre>>>> list(range(0, 10)) [0, 1, 2, 3, 4, 5, 6, 7, 8, 9]</pre>
<pre>>>> type(range(0, 10)) range</pre>	<pre>>>> list(range(10)) [0, 1, 2, 3, 4, 5, 6, 7, 8, 9]</pre>

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- To see the values included in the range, we can I To see elements in range, pass
 list() function which returns a list of them

>>> range(0, 10) >>> list(range(0, 10))
range(0, 10) [0, 1, 2, 3, 4, 5, 6, 7, 8, 9]

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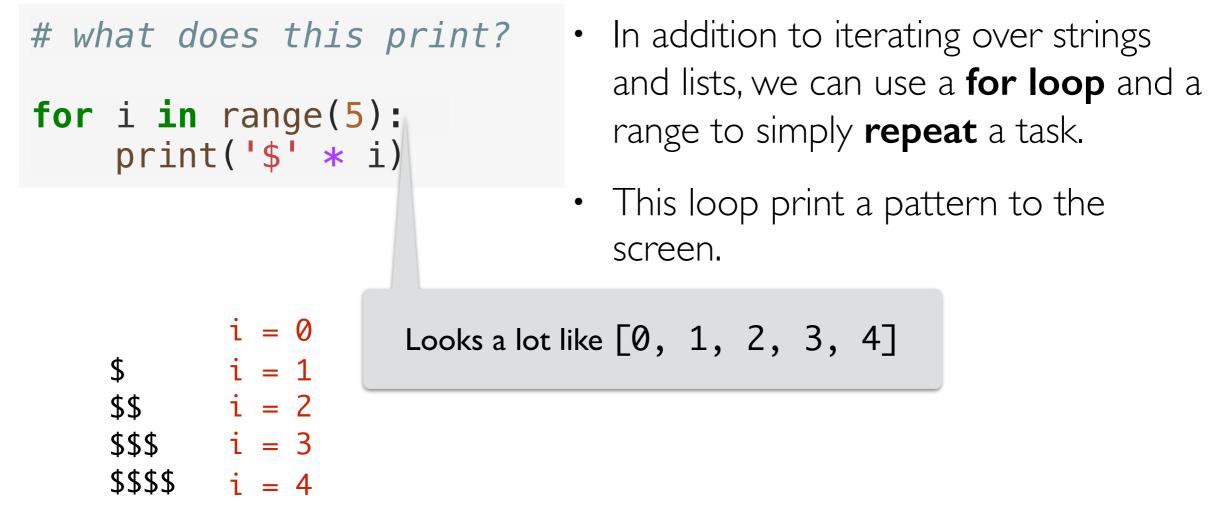
>>> type(range(0, 10)) >>> list(range(10))

range

A range is a **type** of sequence in Python (like string and list) 1, 2, 3, 4, 5, 6, 7, 8, 9]

First argument omitted, **defaults to 0**

Iterating Over Ranges



Using Range For Parallel Iteration

- This also a really convenient way for iterating over two lists in parallel
- Say we wanted to iterate over two lists
- chars = ['a', 'b', 'c'] and nums = [1, 2, 3]
- And form a new list ['a1', 'b2', 'c3']
- Here's how we'd do it

```
>>> char_nums
['a1', 'b2', 'c3']
```

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```
chars = ['a', 'b', 'c']
nums = [1, 2, 3]
char_nums = [] Loop Variable

for i in range(0, len(chars)):
    cnum = chars[i] + str(nums[i])
    char_nums += [cnum]
    Accumulator Variable
```

```
>>> char_nums
['a1', 'b2', 'c3']
```

Using range to check palindromes

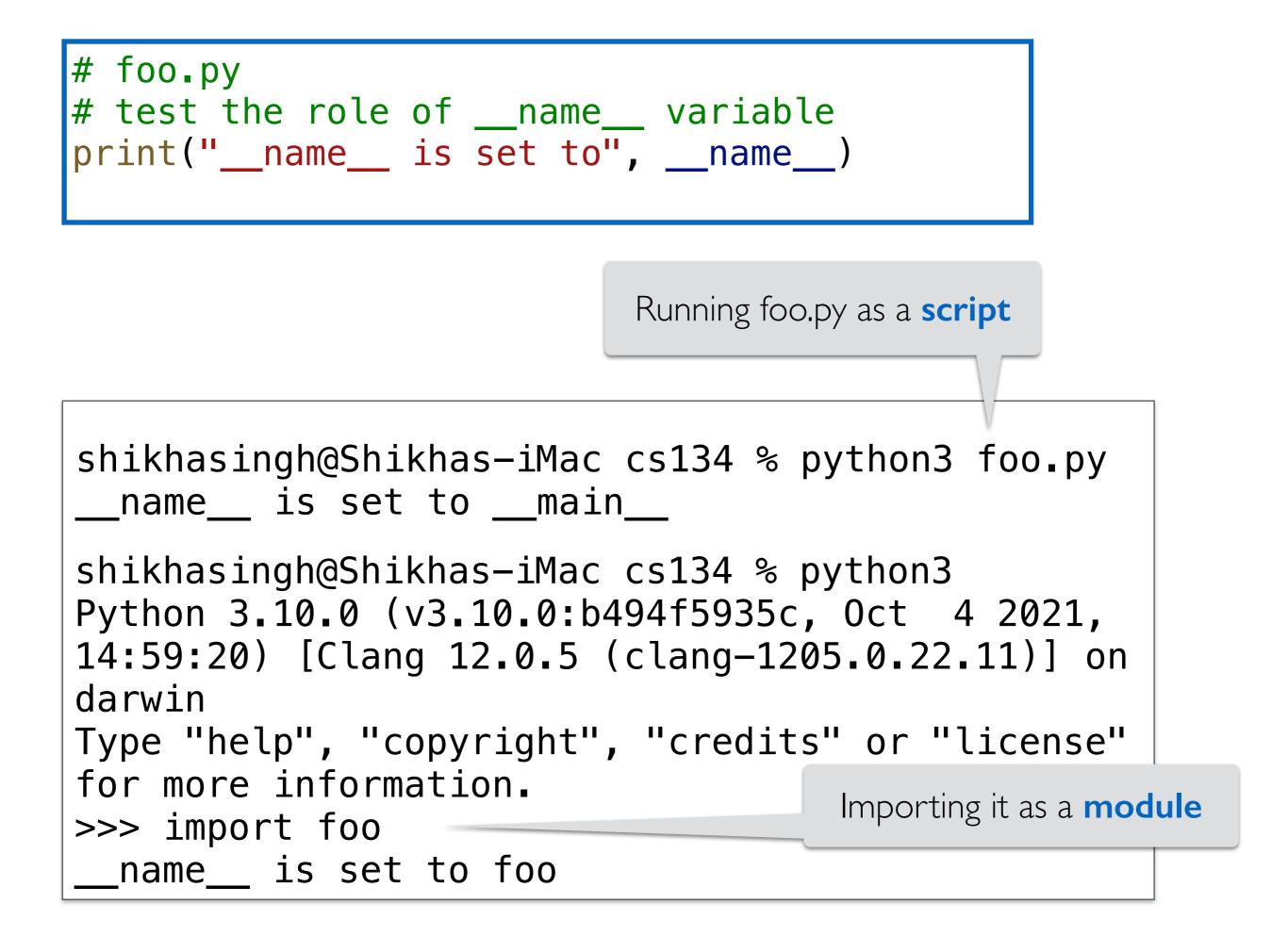
```
def is_palindrome_range(string) :
    # Since we need to compare each char in the "first half"
    # to corresponding char in the "second half",
    # we need to execute len(string) // 2 comparisons
    for i in range(len(string) // 2) :
        if string[i] != string[-(i+1)] :
            return False
    return True
```

Loops: Take-Aways

- for..Loops allow us to look at each element in a sequence
 - The **loop variable** defines what the name of that element will be in the loop
 - An optional **accumulator variable** is useful for keeping a running tally of properties of interest
 - Indentation works the same as with if--statements: if it's indented under the loop, it's executed as part of the loop

Importing Functions vs Running as a Script

- Question. If you only have function definitions in a file funcs.py, and run it as a script, what happens?
 % python3 funcs.py
- For testing functions, we want to call /invoke them on various test cases, in Labs, we do this in a separate file called **runtests.py**
 - To add function calls in runtests.py, we put them inside the guarded block if ____name___ == "___main___":
- The statements within this special guarded are only run when the file is run as a *script* but not when it is imported as a *module*
- Let's see an example



Takeaway: if ____name___ == "___main__"

- If you want some statements (like test calls) to be run ONLY when the file is run as a script
 - Put them inside the guarded if ____name__ ==
 "___main__" block
- When we run our automatic tests on your functions we **import them** and this means name is NOT set to main
 - So nothing inside the guarded if ____name__ ==
 "___main__" block is executed
- This way your testing /debugging statements do not get in the way