http://www.cs.cornell.edu/courses/cs1110/2018sp

Lecture 5: Strings

(Sections 8.1, 8.2, 8.4, 8.5, 1st paragraph of 8.9)

CS 1110

Introduction to Computing Using Python

[E. Andersen, A. Bracy, D. Gries, L. Lee, S. Marschner, C. Van Loan, W. White]

Announcements

Having trouble finding Piazza?

- New link on our webpage should help!

Today

- More about the `str` type
  - New ways to use strings
- More examples of functions
  - Functions with strings!
- Learn the difference between `print` and `return`

Strings are Indexed (Question 1)

- s = 'abc d'

0	1	2	3	4
a	b	c		d

- Access characters with []
  - s[0] is 'a'
  - s[4] is 'd'
  - s[5] causes an error
  - s[0:2] is 'ab' (excludes c)
  - s[2:] is 'c d'
- Called "string slicing"

- t = 'Hello all'

0	1	2	3	4	5	6	7	8
H	e	l	l	o		a	l	l

- What is t[3:6]?

A: 'lo a'
B: 'lo'
C: 'lo '
D: 'o '
E: I do not know

Strings are Indexed (Solution 1)

- s = 'abc d'

0	1	2	3	4
a	b	c		d

- Access characters with []
  - s[0] is 'a'
  - s[4] is 'd'
  - s[5] causes an error
  - s[0:2] is 'ab' (excludes c)
  - s[2:] is 'c d'
- Called "string slicing"

- t = 'Hello all'

0	1	2	3	4	5	6	7	8
H	e	l	l	o		a	l	l

- What is t[3:6]?

A: 'lo a'
B: 'lo'
C: 'lo ' **CORRECT**
D: 'o '
E: I do not know

Strings are Indexed (Question 2)

- s = 'abc d'

0	1	2	3	4
a	b	c		d

- Access characters with []
  - s[0] is 'a'
  - s[4] is 'd'
  - s[5] causes an error
  - s[0:2] is 'ab' (excludes c)
  - s[2:] is 'c d'
- Called "string slicing"

- t = 'Hello all'

0	1	2	3	4	5	6	7	8
H	e	l	l	o		a	l	l

- What is t[:3]?

A: 'all'
B: 'l'
C: 'Hel'
D: Error!
E: I do not know

Strings are Indexed (Solution 2)

- s = 'abc d'

0	1	2	3	4
a	b	c		d

- Access characters with []
  - s[0] is 'a'
  - s[4] is 'd'
  - s[5] causes an error
  - s[0:2] is 'ab' (excludes c)
  - s[2:] is 'c d'
- Called "string slicing"

- t = 'Hello all'

0	1	2	3	4	5	6	7	8
H	e	l	l	o		a	l	l

- What is t[:3]?

A: 'all'
B: 'l'
C: 'Hel' **CORRECT**
D: Error!
E: I do not know

Other Things We Can Do With Strings

Operator in: s_1 in s_2

- Tests if s_1 "a part of" (or a *substring* of) s_2
- Evaluates to a bool

Examples:

```
>>> s = 'abracadabra'
>>> 'a' in s
True
>>>  'cad' in s
True
>>>  'foo' in s
False
```

Built-in Function len: len(s)

- Value is # of chars in s
- Evaluates to an int

Examples:

```
>>> s = 'abracadabra'
>>> len(s)
11
>>> len(s[1:5])
4
>>> s[1:len(s)-1]
'bracadabr'
>>>
```

Defining a String Function

Want to write function middle which returns the middle 3rd of a string (length divisible by 3).

How we want it to behave:

```
>>> middle('abc')
'b'
>>> middle('aabbcc')
'bb'
>>> middle('aaabbbccc')
'bbb'
```

Important Questions:

1. What are the parameters?
2. What is the return value?
3. What goes in the body?

```
def middle(text):
    ???
    return middle_third
```

Steps to writing a program

1. Work an instance yourself
2. Write down exactly what you just did
3. Generalize your steps from 2
4. Test your steps
5. Translate to Code
6. Test program
7. Debug (if necessary)

Steps to writing a program

1. Work an instance yourself
2. Write down exactly what you just did
3. Generalize your steps from 2
4. Test your steps
5. Translate to Code

~~>>> middle('abc')~~ middle_third = text[1] *Too easy!!*

~~>>> middle('aabbcc')~~ middle_third = text[2:4] *Still too easy!!*

>>> middle('It was the best of times, it was the worst of times, it was the age of wisdom, it was the age of foolishness, it was the epoch of belief, it was the epoch of incredulity, it was the season of Light, it was the season of Darkness, it was the spring of hope, it was the winter of despair, we had everything before us, we had nothing before us, we were all going direct to Heaven, we were all going direct the other way...')

Definition of **middle**

```
def middle(text):
    """Returns: middle 3rd of text
    Param text: a string with
    length divisible by 3"""

    # Get length of text
    size = len(text)

    # Start of middle third
    start2 = size//3

    # End of middle third
    start3 = (2*size)//3

    # Get the substring
    middle_third = text[start2:start3]

    return middle_third
```

IMPORTANT:
Precondition requires that arguments to **middle** have length divisible by 3.

If not? Bad things could happen, and we blame the user (not the author) of the function.

Advanced String Features: Method Calls

- Strings have some useful *methods*
  - Like functions, but "with a string in front"
- **Format**: *<string name>*.*<method name>*(*x*,*y*,…)
- **Example**: upper() returns an upper case version

```
>>> s = 'Hello World'
>>> s.upper()
'HELLO WORLD'
>>> s
'Hello World'
```

```
>>> s[1:5].upper()
'ELLO'
>>> 'scream'.upper()
'SCREAM'
>>> 'cs1110'.upper()
'CS1110'
```

Examples of String Methods

- s_1.index(s_2)
  - Returns position of the first instance of s_2 in s_1
  - error if s_2 is not in s_1
- s_1.count(s_2)
  - Returns number of times s_2 appears inside of s_1
- s.strip()
  - Returns a copy of s with white-space removed at ends

- s = 'abracadabra'

0	1	2	3	4	5	6	7	8	9	10
a	b	r	a	c	a	d	a	b	r	a

- s.index('a') 0
- s.index('rac') 2
- s.count('a') 5
- s.count('b') 2
- s.count('x') 0
- ' a b '.strip() 'a b'

See Python Docs for more

String Extraction, Round 1

```
def firstparens(text):
    """Returns: substring in ()
    Uses the first set of parens
    Param text: a string with ()"""

    # Find the open parenthesis
    start = text.index('(')

    # Find the close parenthesis
    end = text.index(')')

    return text[start+1:end]
```

```
>>> s = 'One (Two) Three'
>>> firstparens(s)
'Two'
>>> t = '(A) B (C) D'
>>> firstparens(t)
'A'
```

Steps to writing a program

1. Work an instance yourself
2. Write down exactly what you just did
3. Generalize your steps from 2
4. Test your steps
5. Translate to Code
6. **Test program**
7. Debug (if necessary)

Think of all the corner cases

What could possibly go wrong?

String Extraction, Round 2

```
def firstparens(text):
    """Returns: substring in ()
    Uses the first set of parens
    Param text: a string with ()"""

    # Find the open parenthesis
    start = text.index('(')

    # Store part AFTER paren
    substr = text[start+1:]

    # Find the close parenthesis
    end = substr.index(')')

    return substr[:end]
```

```
>>> s = 'One (Two) Three'
>>> firstparens(s)
'Two'
>>> t = '(A) B (C) D'
>>> firstparens(t)
'A'
```

String Extraction Puzzle

```
def second(thelist):
    """Returns: second word in a list
    of words separated by commas, with
    any leading or trailing spaces from the
    second word removed
    Ex: second('A, B, C') => 'B'
    Param thelist: a list of words with
    at least two commas """"

1   start = thelist.index(',')
2   tail = thelist[start+1:]
3   end = tail.index(',')
4   result = tail[:end]
5   return result
```

```
>>> second('cat, dog, mouse, lion')
expecting: 'dog'          get: ' dog'

>>> second('apple,pear   , banana')
expecting: 'pear'         get: 'pear   '
```

Where is the error?

A: Line 1
B: Line 2
C: Line 3
D: Line 4
E: There is no error

String Extraction Fix

```
def second(thelist):
    """Returns: second word in a list
    of words separated by commas, with
    any leading or trailing spaces from the
    second word removed
    Ex: second('A, B, C') => 'B'
    Param thelist: a list of words with
    at least two commas """"
```

```
>>> second('cat, dog, mouse, lion')
expecting: 'dog'          get: ' dog'

>>> second('apple,pear   , banana')
expecting: 'pear'         get: 'pear   '
```

```
1   start = thelist.index(',')
2   tail = thelist[start+1:]  ➡  tail = thelist[start+2:]   #possible fix ??
3   end = tail.index(',')
4   result = tail[:end]  ➡  result = tail[:end].strip()      #better fix!
5   return result
```

What if there are *multiple* (*or no!*) spaces?

String: Text as a Value

- String are quoted characters
  - 'abc d' (Python prefers)
  - "abc d" (most languages)
- How to write quotes in quotes?
  - Delineate with "other quote"
  - **Example**: " ' " or ' " '
  - What if need both " and ' ?
- **Solution**: escape characters
  - Format: \ + letter
  - Special or invisible chars

Type: `str`

Char	Meaning
\'	single quote
\"	double quote
\n	new line
\t	tab
\\	backslash

Not All Functions Need a Return

```
def greet(n):
    """Prints a greeting to the name n

    Parameter n: name to greet
    Precondition: n is a string"""
    print('Hello '+n+'!')
    print('How are you?')
```

Displays these strings on the screen

No assignments or return (returns None)

print vs. return

- Displays a value on screen
- Used primarily for **testing**
- Not useful for calculations

- Sends a value from a function call frame back to the caller
- Important for **calculations**
- Does not display anything

```
def print_plus(n):
    print(n+1)

>>> print_plus(2)
3
>>>
```

```
def return_plus(n):
    return n+1

>>> return_plus(2)
3
>>>
```

?

unexpected printing courtesy of:

Python Interactive Mode

- executes both *statements* and *expressions*
- if *expression:*
  1. *evaluates*
  2. prints value (if one exists)

```
>>> 2+2
4
>>> return_plus(2)
3
>>>
```

evaluates (performs addition)

prints value (4)

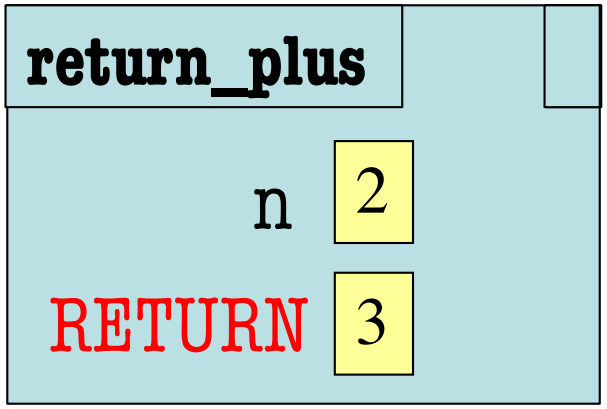
evaluates (makes function call, gets return value)

prints value (3)

return_plus in action

```
def return_plus(n):
    return n+1
```

call frame



Python Interactive Mode

```
>>> return_plus(2)
3
>>>
```

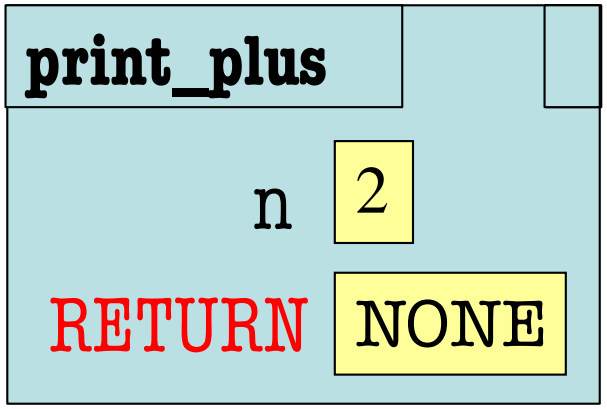
1. Evaluates : makes function call, evaluates to return value

2. prints value

print_plus in action

```
def print_plus(n):
    print(n+1)
```

call frame



Python Interactive Mode

```
>>> print_plus(2)
3
>>>
```

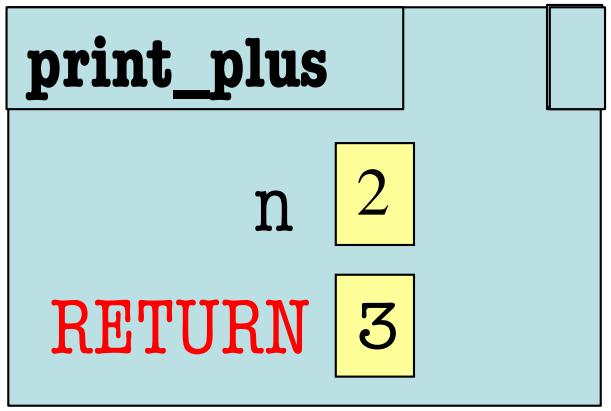
1. Evaluates : makes function call, evaluates to return value

2. does not print value b/c it's NONE

hybrid_plus in action

```
def hybrid_plus(n):
    print(n)
    return n+1
```

call frame



Python Interactive Mode

```
>>> print_plus(2)
2
3
>>>
```

1. Evaluates : makes function call, evaluates to return value

2. print value

See the difference in the Python Tutor

```
def print_plus(n):
    print(n+1)
def return_plus(n):
    return n+1
x1 = print_plus(2)
x2 = return_plus(2)
print(x1)
print(x2)
```

Program output:

```
3
None
3
```

http://cs1110.cs.cornell.edu/visualizer/#mode=edit

Exercise 1

Module Text

```
# module.py

def foo(x):
    x = 1+2
    x = 3*x
```

Python Interactive Mode

```
>>> import module
>>> print(module.x)
...
```

What does Python give me?

A: 9
B: 10
C: 1
D: None
E: Error

Exercise 1, Solution

Module Text

```
# module.py

def foo(x):
    x = 1+2
    x = 3*x
```

Python Interactive Mode

```
>>> import module
>>> print(module.x)
...
```

What does Python give me?

A: 9
B: 10
C: 1
D: None
E: Error **CORRECT**

Exercise 2

Module Text

```
# module.py

def foo(x):
    x = 1+2
    x = 3*x

y = foo(0)
```

Python Interactive Mode

```
>>> import module
>>> print(module.y)
...
```

What does Python give me?

A: 9
B: 10
C: 1
D: None
E: Error

Exercise 2, Solution

Module Text

```
# module.py

def foo(x):
    x = 1+2
    x = 3*x

x = foo(0)
```

Python Interactive Mode

```
>>> import module
>>> print(module.x)
...
```

What does Python give me?

A: 9
B: 10
C: 1
D: None **CORRECT**
E: Error

Exercise 3

Module Text

```
# module.py

def foo(x):
    x = 1+2
    x = 3*x
    return x+1

y = foo(0)
```

Python Interactive Mode

```
>>> import module
>>> module.y
...
```

What does Python give me?

A: 9
B: 10
C: 1
D: None
E: Error

Exercise 3, Solution

Module Text

```
# module.py

def foo(x):
    x = 1+2
    x = 3*x
    return x+1

y = foo(0)
```

Python Interactive Mode

```
>>> import module
>>> module.y
...
```

What does Python give me?

A: 9
B: 10 **CORRECT**
C: 1
D: None
E: Error

Exercise 4

Function Definition

```
def foo(a,b):
    x = a
    y = b
    return x*y+y
```

Function Call

```
>>> x = 2
>>> foo(3,4)
>>> x
...
```

What does Python give me?

A: 2
B: 3
C: 16
D: None
E: I do not know

Exercise 4, Solution

Function Definition

```
def foo(a,b):
    x = a
    y = b
    return x*y+y
```

Function Call

```
>>> x = 2
>>> foo(3,4)
>>> x
...
```

What does Python give me?

A: 2 **CORRECT**
B: 3
C: 16
D: None
E: I do not know