

Computational Structures in Data Science

Lecture 3: Functions and Loops

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Announcements

- Lab Attendance:
 - Please review your autograder feedback to make sure the attendance choice is correct
- Earning points is based on *correctness*
 - Applies to all labs, self-checks, homework, projects.
 - You get as many tries as you need, but the results must work, at the end of the day.
 - If you need an extension, you can ask for one, but be careful with time. ☺
- My "Tea" Hours: Weds 5pm, 784 Soda – may move occasionally.

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Learning Process & Debugging



Process NOT Memorization

- This is not a class about memorization.
- This is a class about *problem solving* and *process*.
- You will not know everything, but you will be able to figure it out.
- Focus on building intuition!
 - **Predict** what will happen **first**
 - Then **try and inspect**
 - Now, Figure out **why!**
 - Was your prediction correct or incorrect?

Let's talk Python

- Expression $3.1 * 2.6$
 - Call expression `max(0, x)`
 - Variables `my_name`
 - Assignment Statement `my_name = <expression>`
 - **Define Statement:** `def function_name(<arguments>):`
 - **Control Statements:** `if ...`
`while ...`
`for ...`
 - Comments `# Text after the # is ignored.`

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Python: Functions (Again)



Learning Objectives

- Create your own functions.
- Write a loop to run the same code multiple times
- Use conditionals to control when a loop stops

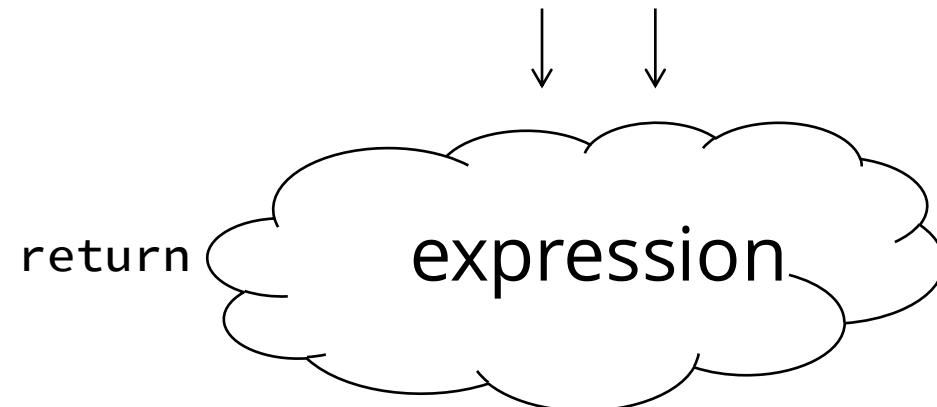
Variables In Python

- Variables "bind" (or assign) a name to a value (or expression)
- Variables can also come from function arguments
- Python has some specific rules about names...
 - Don't memorize them all!
 - Mostly: **No spaces**, use _
- Important: Use meaningful names!
 - It's a bit embarrassing to come to OH and try to explain the purpose of "buttface" ☺ (This actually happened!)
 - `my_favorite_class = 'C88C'`

Defining Functions

- Abstracts an expression or set of statements to apply to lots of instances of the problem
- A function should do one thing well
- arguments become accessible inside the function body.

```
def <function name> (<argument list>) :
```



Functions in Python

- We "define" them with def
- We typically name_them_using_underscores ("Snake case")
- The first line ends in a :
- The body is indented by 4 spaces
- Arguments (parameters) create 'names' that exist only in our function
- Most functions will return a value, but some do not.
 - If you don't specify a return statement, the value is None

```
def print_greet(name):  
    print("Hello, " + name)  
  
def greet(name):  
    return "Hello, " + name
```

Aside: String and Text

- Strings, or sequences of text are incredibly common!
- In Python we use ' or "
- We combine strings with +, or by using *string interpolation*:
- f-strings allow us to embed an expression inside some text!

```
def print_greet(name):  
    # print("Hello, " + name)  
    print(f"Hello, {name}")
```

What happens?

```
def print_greet(name):  
    #Same as: print("Hello, " + name)  
    print(f"Hello, {name}")  
  
x = print_greet('C88C')  
x  
# What's x?  
y = print_greet(c88c)  
y  
# What's y?
```

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Python: Control Flow

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Conditional Statements

- Do some statements, conditional on a predicate expression

```
if <predicate>:  
    <true statements>  
else:  
    <false statements>
```

- Example:

```
if temperature > 98.6:  
    print("fever!")  
else:  
    print("no fever")
```

Live Coding Demo

```
course = 'C88C'  
time = '3:00'  
  
if time == '2:00':  
    print(f"Go to {course}")  
else:  
    print("Go get some ☕")
```

What is shown?

Live Coding Demo

```
course = 'C88C'  
time = '3:00'  
  
if time == '2:00':  
    print(f"Go to {course}")  
else:  
    print("Go get some ☕")
```

Go to C88C

Extending Conditional Statements

- Only 1 set of true statements OR the else body will be executed.
- The else body is optional.

```
if <predicate A>:  
    <predicate A statements>  
elif <predicate B>:  
    <predicate B statements>  
elif <predicate C>:  
    <predicate C statements>  
...  
else:  
    <false statements>
```

Consider these two cases

```
year_in_school = 4
if year_in_school >= 4:
    print('Senior')
elif year_in_school >= 3:
    print('Junior')
```

Conditional Expression Shorthand

- Return a Value Based on some condition

```
<true expression> if <predicate> else <false expression>
```

- Example:

```
status = "it's hot!" if temperature > 85 else 'not hot...'
```

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Python: Functions

(with conditionals)



Functions: Example

```
•>>> y = 5  
•>>> x = 3  
•>>> z = max(3, 5) * 10  
•>>> z  
•50
```

```
def max(x, y):  
    if x > y:  
        return x  
    else:  
        return y
```

Returns and Values

- All functions always return SOME value.
- If you don't specify return, the value is None.
- Using print does not change how the function works, but does affect the output.

Functions: Calling and Returning Results

Python Tutor

```
def max(x, y):
    if x > y:
        return x
    else:
        return y

x = 3
y = 4 + max(17, x + 6) * 0.1
z = x / y
```

Doctests

- Write the docstring to explain what it does
 - What does the function return? What are corner cases for parameters?

```
def max(x, y):  
    """Returns the larger value of arguments x and y  
>>> max(6, 0)  
6  
"""  
  
    return x if x > y else y
```

- Write doctest to show what it should do
 - Before you write the implementation.
 - `python3 -m doctest [-v] file.py`

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Iteration with while Loops



Learning Objectives

- Use a while loop to repeat some task.
- Write an expression to control when a while loop stops executing

while Statement – Iteration Control

- Repeat a block of statements until a predicate expression is satisfied

```
<initialization statements>
while <predicate expression>:
    <body statements>
```

```
<rest of the program>
```

```
x = 1
while x < 10:
    print(x)
    x = x + 1 # or commonly x += 1
```

x

while Statement – Iteration Control

- Consider these two programs.
- What's different?

```
x = 1
while x < 10:
    print(x)
    x = x + 1 # or commonly x += 1
x
```

```
x = 1
while x <= 10:
    print(x)
    x += 1
x
```

Sum The Numbers

- This is a task we'll see many times!
- Do these do the same thing?

```
total = 0
n = 1
while n <= 10:
    total += n
    n += 1
print(total)
```

```
total_backwards = 0
z = 10
while z > 0:
    total_backwards += z
    z -= 1
print(total_backwards)
```

What happens if we mess up?

- What will happen here?

```
total = 0
n = 1
while n <= 10:
    total += n
    n -= 1
print(total)
```

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Iteration With for Loops



Learning Objectives

- Compare a for loop and a while loop.
- Learn to use range()
- Use a string as a sequence of letters

for Statement – Iteration Control

- Repeat a block of statements for a structured sequence of variable bindings

<initialization statements>

for <variables> **in** <sequence expression>:
<body statements>

<rest of the program>

<sequence expression> — What's that?

- Sequences are a type of data that can be broken down into smaller parts.
- Common sequences:
 - `range()` – give me all the numbers
 - Strings, e.g, "Hello, C88C!"
 - What is it a sequence of? Characters!
 - lists (next!)
- We'll start with two basic facts:
 - `range(10)` is the numbers 0 to 9, or `range(0, 10)`
 - `[]` means "indexing" an item in a sequence.
 - `"Hello"[0] == "H"`

Data-Driven Iteration

- describe an expression to perform on each item in a sequence
- let the data dictate the control

```
[ <expr with loop var> for <loop var> in <sequence expr > ]
```