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Introduction to Python



"Ars longa, vita brevis." (Art is long, life is short.)

Week 1: A 50-Minute Language Overview

Course overview

- Lectures will be fast-paced (at first) so you can have exposure to enough material to be able to write interesting programs
- Lectures are for *exposure*, exercises are for *learning*
 - Feel free to ask questions during lectures
- I am not assigning grades; this course is for your own personal development and enrichment
 - This means that you should focus on work for your actual classes first
- Topics: Python syntax, programming concepts, (very) basic data structures and algorithms, applications to biology
- Recommended: try solving bioinformatics problems on Rosalind (<http://rosalind.info/>)
 - Some of the exercises I assign may be inspired by Rosalind problems
- Set up a convenient folder (in Dropbox, on the Desktop, etc...) for your Python scripts
- Independent effort on your part is required
- You can collaborate with others, but struggle on your own first

Installing Python

Visit <https://www.python.org/downloads/>

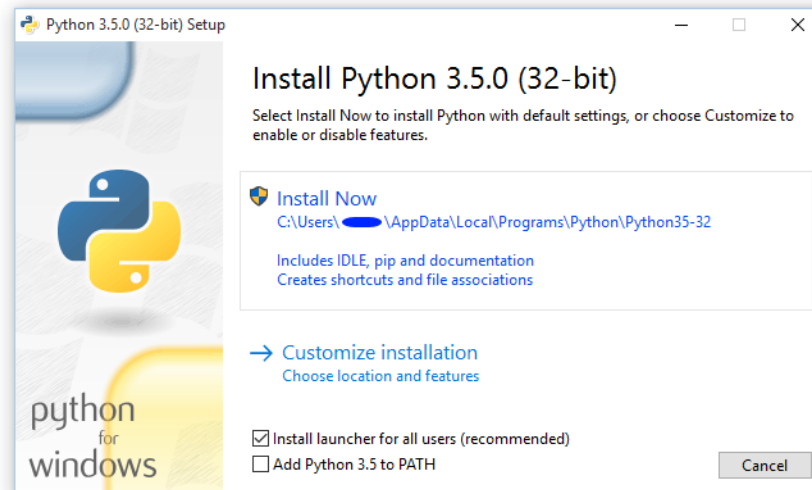
Directions linked on the mini-course website under "Readings"

Mac OS and Linux users may already have Python

However, do not use Python 2.x

Type `python --version` in Terminal to check which version you have

Make sure to use **Python 3.x** (latest: **3.5.1** as of March 2016)



Interactive mode

In Command Prompt/PowerShell/Terminal: type python to enter Python's interactive mode

In IDLE: IDLE automatically launches in interactive mode

Expressions are combinations of values, variables, and operators

Expressions to try in interactive mode (use Python as a calculator):

2 + 2	2 ** 3
3.6 / 3	7 - 9 * 8
3.6 // 3	(7 - 9) * 8
17 % 4	9 + 2 // 3

What do you think //, %, and ** do?

Each expression in the table above **returns** a **value**

Three distinct numeric **types**: **int** (integers), **float** (floating-point numbers), and **complex** (complex numbers, which we will likely not use in this course)

Integers: 4, 99, -2, 0

Floating-point numbers: 3.3, 3.33, 7.0, -2.3, 7e9

First program (script mode)

In IDLE, go to File > New File to begin writing a new script. Type the following line.

```
print("Hello world!")
```

Save this in a folder with a sensible name, like "hello.py".

Then, run your program (in IDLE, go to the Run > Run Module or press F5).

`print()` is a **function** (more on functions later).

"Hello world!" is a **string** that is passed to the `print()` function as a **parameter**.

You can print out multiple items on the same line using `print()` as long as the items are separated by a comma.

Strings

Strings are basically sequences of characters.

They are surrounded by straight quotation marks (single or double, as long as they match on both sides of the string).

Do not use curly quotes.

Examples of strings:

"Hello"

"test string"

"12345"

"testing"

"2 + 2"

"ACTGGTCGATCGAT"

" " (straight)
“ ” (curly)

Variables

If you want to hold on to data, **assign** it to a **variable**.

Examples:

```
pi = 3.14159
```

```
greeting = "Bonjour."
```

Variable **identifiers** (names) are often lowercase and derived from English words, but you can use almost any sequence of letters, numbers, and underscores, as long as the sequence **begins with a letter** and is **not a reserved keyword** (a word reserved for the Python language).

Not valid names:

2chainz

#winning

space bar

Reserved keywords

False	class	finally	is	return
None	continue	for	lambda	try
True	def	from	nonlocal	while
and	del	global	not	with
as	elif	if	or	yield
assert	else	import	pass	
break	except	in	raise	

Don't try to use any of these for variable names!

Variables cont.

You can reassign values to variables you have already assigned values to.

Example:

```
number = 2
print(number)
number = 7 * 7
print(number)
number = "This is a string."
print(number)
```

Variable updating

You can update variables by adding a value to the value already stored by the variable.

Example:

```
x = 4
print(x)
x = x + 2
print(x)
x += 2
print(x)
```

Besides addition, you can also subtract, multiply, divide, and even use the modulo (remainder) operator (%).

String concatenation

The + operator is useful for more than adding numbers; you can also use it to **concatenate** (combine) strings, creating a new string.

```
string_one = "Hello "  
string_two = "world!"  
print(string_one + string_two)
```

You cannot "subtract" a string from another string the way you can concatenate strings together.

You cannot concatenate a string and an integer without converting the integer to a string first using `str()`.

Comments

Use the pound sign (#) to mark off the rest of the line as a comment that will not affect the running of the program. This is useful for leaving notes to yourself or for disabling code while debugging.

Example:

```
number = 3
```

```
# number = 4
```

```
print(number) # TODO: add new features
```

Commenting is very important! Why?

You might leave a project for a few months, then come back to it and not remember why you wrote the original code that way.

You may work on a team where other people may have to build upon your code but have not seen it before and need to get up to speed quickly.

Getting user input

You can prompt the user to type in something, like his/her name, and save the value that is given.

This is useful for numerous things, like text-based games.

Use the `input()` function to get input ; like `print()`, `input()` accepts a string **parameter** (or **argument**).

```
name = input("Enter your name: ")  
print("Hello " + name + "!!")
```

The string passed as a parameter to `input()` is the prompt that will be displayed to the user.

Try to come up with some creative ideas for using user input!

Logic and control flow

Logic

- `if` statement

- `else` statement

- `elif` statement

Preview of lists

Loops

- `for` loops (`range()` function in Week 2)

- `while` loops

More control flow

- `break`, `continue`, `pass` statements (Week 2)

Boolean values (True and False)

In Python, the objects `True` and `False` are **Boolean values**. When you perform a test using **relational (comparison) operators** (like `<`, `>=`, or `!=`), the test returns one of these values.

Examples:

```
3 > 2 # returns True
```

```
3 < 2 # returns False
```

At home: what do you think would happen if you tried to add a number to a Boolean value in Python?

Examples:

```
1 + True # can you guess what happens?
```

```
3 + False # what happens here?
```


if statements

if statements allow certain actions to be performed when a specific **condition** is met.

Example:

```
x = 5
if x > 2:
    print("x is greater than 2")
```

Here, $x > 2$ is the condition. The if statement checks if the condition is **true** or **false**; if the condition is true, the code under the if statement is executed.

Specifically, $x > 2$ returns a value of True in the case above because x was assigned the value of 5.

At home: Truth values

What will this code output?

```
if 238:  
    print("success!")
```

How about this?

```
if 0:  
    print("success!")
```

How about this?

```
if -49:  
    print("success!")
```

else statements

else statements are often seen with if statements. The code under an else statement runs when a condition is not met.

```
name = input("Please enter your name: ")
if name == "Paul":
    print("Greetings, " + name + "!")
else:
    print("Hello, " + name + ".")
```

Nesting if statements

When you have multiple conditions you want to check, one thing you can do is **nest** if statements.

```
if grade > 90:
    if grade > 93:
        if grade > 97:
            print("Grade = A+")
        else:
            print("Grade = A")
    else:
        print("Grade = A-")
else:
    print("Grade is less than A-")
```

(There are better ways to write this code, by the way.)

elif statements

elif is short for "else if" and helps reduce the indentation you need.

```
if name == "Paul":  
    print("Greetings, " + name + "!")  
elif name == "Farzam":  
    print("Salutations, " + name + "!")  
else:  
    print("Hello, " + name + ".")
```

Logical operators: and

You can evaluate whether multiple conditions are all true by using the **logical operator** and.

Example:

```
x = 20
```

```
if x > 5 and x < 21:
```

```
    print("Success 1")
```

```
    # "Success 1" is printed
```

```
if x > 5 and x > 21:
```

```
    print("Success 2")
```

```
    # "Success 2" is not printed
```

Logical operators: or

You can evaluate whether *at least* one condition in a set of conditions is true by using the **logical operator** `or`.

Example:

```
x = 20
if x > 5 or x < 21:
    print("Success 1")
    # "Success 1" is printed
if x < 5 or x < 21:
    print("Success 2")
    # "Success 2" is printed even though the first
    # condition is false
if x < 5 or x > 21:
    print("Success 3")
    # "Success 3" is not printed
```

Logical operators: not

(not a) returns True if a returns False and returns False if a returns True. This is called **negation**.

Example:

```
x = 20
print(x > 3) # prints "True"
print(not (x > 3)) # prints "False"
if x > 5 or x < 21:
    print("Success 1")
    # "Success 1" is printed
if not (x > 5 or x < 21):
    print("Success 2")
    # "Success 2" is not printed
```


At home: summary (truth table)

a	b	a and b	a or b	not a
True	True	True	True	False
True	False	False	True	False
False	True	False	True	True
False	False	False	False	True

A sneak peek at lists

A **list** is a **mutable** sequence of items. By "mutable," we mean that you can change the list (such as by adding items to the list or changing the items in the list).

You can construct lists with brackets. Lists are zero-indexed, meaning that the first item in a list has index 0, the next item has index 1, and so on...

You can retrieve the first item from list `a` by typing `a[0]`.

Examples:

```
a = [] # empty list
```

```
b = [2, 3, 5, 7]
```

```
c = ["Hello", "Goodbye"]
```

```
d = ["Hello", 32] # lists can contain items of  
# different types
```

Something to think about...

Notice that strings are sequences of characters (as mentioned earlier), while lists are sequences of items! Just like with indices for list items, you can use `[]` with indices for characters in strings.

```
string_one = "ABCDEFGFG"
```

```
string_one[1] # returns "B"
```

In the future, we will talk about **slicing** as well as about **tuples**, another built-in sequence type in Python. We will also talk more about useful sequence operations.

for loops

for can be used to **iterate** over sequences such as lists! This is extremely powerful. We will talk more about iteration in the future.

```
fruits = ["apple", "banana", "cherry"]
for fruit in fruits:
    print(fruit)
```

```
numbers = [2, 3, 4, 5]
for number in numbers:
    number = number * 2
    print(number)
print(numbers)
```

for loops cont.

Since for loops work on sequences (because sequences are **iterable**), you can use for loops on strings too!

```
vowels = "AEIOU"
string = "facetiously"
vowel_count = 0
for letter in string.upper(): # make string uppercase
    if letter in vowels:
        vowel_count += 1
print("The number of vowels is: " + str(vowel_count))
```

while loops

while loops continually execute the statements within while a condition is met. Be careful about accidentally writing infinite loops! You should either update the condition that the while loop is checking or otherwise break out of the loop.

```
x = 0
while x <= 5:
    print(x, x*x)
    x += 1
```