

A photograph of a herd of African elephants. In the center, a large adult elephant with prominent, curved, yellowish-white tusks faces forward. To its left, a smaller elephant, possibly a juvenile, also faces forward. To the right, another elephant is partially visible, facing right. The elephants have thick, wrinkled, greyish-brown skin. The background is a plain, light-colored surface.

This lecture will
start at 10:02
Central

Python Fundamentals

Thursday: Putting it all together

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NU IT Research Computing Services

About this bootcamp

Cameras are **not** required during these lectures.

We have Dan Turner and Haley Carter back as our TAs

If my internet goes out during a lecture, that means everyone gets a 10-minute break!

Plan for the week - **6 basic objects**

LEARN PYTHON

Monday

- Objects
 - **integers**
 - **floats**
 - **booleans**
 - **strings**
- Functions
 - basic operators
 - convert between objects
 - string functions
- Concepts
 - naming variables
 - indexing strings

Tuesday

- Objects
 - **lists**
- Functions
 - list functions
- Concepts
 - for loops
 - if statements
 - error handling
 - importing functions from modules

Wednesday

- Objects
 - **dictionaries**
 - files
- Concepts
 - writing files
 - looping through dictionaries
 - writing your own functions

Thursday

- Concepts
 - interactive coding
 - writing scripts
 - running scripts
 - putting it all together

DATAFRAMES

Friday

- Objects
 - pandas dataframes
 - pandas series
 - plots
- Functions
 - dataframe functions
 - series functions
- Concepts
 - selecting data
 - filtering data
 - plotting data

What should you do after Friday?

Try to find a project you can do in Python.

Ideas:

- If you have students, use Python to calculate statistics on their grade distributions
- Look for a matching project in your own work
- Ask your advisor or someone else in your lab if they have a small project for you
- Check out this LinkedIn Learning site (free for NU people):
<https://www.linkedin.com/learning/python-code-challenges/put-your-python-skills-to-the-test>

What should you do after Friday?

Keep learning.

What should you learn next? List comprehensions.

I do a workshop series of short lessons called Next Steps in Python, which will start up again in January.

I also have self-guided tutorials from the Next Steps in Python series available on the NUIT Research Computing Services GitHub site: <https://github.com/nuitrcs/NextStepsInPython>

What should you do after Friday?


Get help.

When you get stuck on your Python project, we provide free consultations to help you debug a script, plan out your next steps, or recommend the right package for you to learn.

bit.ly/rcsconsult

Give help.

Teaching others is a great way to learn.



Simple Debugging Demo

TODAY

We will be running a script outside of a Jupyter Notebook.

Three ways to participate:

1. Use Jupyter Lab on your own computer.
2. Online option:
<https://www.pythonanywhere.com/>. Please create a free account.
3. If you are experienced, you can use your own command line console and text editor.

Everyone needs to download the materials to their own computer today. Go to:

<http://www.github.com/agithasnoname/pythonbootcampthursday>

Click the green Clone button and choose Download Zip. Unzip the folder.

Python is a language

Your computer also has a language for talking to your operating system. We call this a **command line language**.

On Windows it is called PowerShell. On a Mac or a Linux server (like Quest) it is called Unix Bash (or just Bash) or zsh (new).



Python is a language

You can talk to your operating system through a **command line terminal or shell**.

On Windows this is PowerShell or Anaconda Prompt.
On a Mac this is Terminal.

Python is a language

At the command line, you can also switch the shell to speak Python, as long as you have Python installed on your computer.

When you start Python this way, it is **interactive coding** – line by line. I'll show you.

Python console

There are also shells/terminals/consoles just for interactive programming in Python.

All IDEs include an interactive shell.

Let's experience some interactive coding.

pythonanywhere

1. Click on Dashboard
2. Under Files, Click Browse Files
3. Click the "Upload a file" button
4. Navigate to today's materials
5. Choose acre_script.py
6. Click the "Upload a file" button
7. Navigate to today's materials
8. Choose conversionMeasures.csv
9. Click on Dashboard at the top of the screen
10. You'll see Consoles on the left - Click the blue button that says ">>> Python" and select 3.8



Jupyter Lab

1. Open Anaconda Navigator
2. Open Jupyter Lab
3. Navigate to today's folder
4. Go to File > New > Console
5. Make sure Python3 is selected and click Select

Try this code in the console

```
6 + 4
```

```
name = "Molly"
```

```
for i in name:  
    print(i)
```

```
for i in name:  
    if i.isupper():  
        print(i)
```

```
name.replace("M", "H")
```

Every console works differently - does yours automatically indent under a for loop? Do you have to press enter to run a line of code or shift+enter?



When might you use a Python console?

When you're testing out code while writing a script

When you need to check a piece of code or do something quickly



Scripts

A Python script is a plain text file that you save to end in .py

A script runs all the code in the file from top to bottom



Scripts

Also called a computer program

A Python module like Statistics is just a Python script containing several functions

Scripts

There are two ways to run a script:

1. On the command line – you type:
`python myscript.py`
2. In an IDE

Let's look at a script

Jupyter Lab:

- open the script
acre_script.py

pythonanywhere:

- Click the menu icon on the top right and choose Files
- Open acre_script.py

Let's run the script

Jupyter Lab:

- right-click anywhere on the script and choose Create Consult For Editor
- to run a script, go to the Run menu and choose Run All Code

pythonanywhere:

- Click the blue ">>> Run" button on the top right

When might you use a Python script?

When you want to run code while you do something else

This could be because your code is doing complicated calculations or looping through a very large dataset

You can run scripts on your own computer or a remote server

When might you use a Python script?

When you want to combine your Python code with other scripts and other software programs in a computational pipeline

You don't want to have to be there to start each new step in your workflow

When might you use a Python script?

When you want to parallelize your code and run the same code on multiple datasets at the same time.

When might you use a Python script?

When you want to write a piece of software.

When you want to write your own Python module.

When might you use a Jupyter Notebook?

When you are exploring your data.

When you are cleaning data.

When you are visualizing your data.

When you want to include text, images, links alongside your code.

When might you use a Jupyter Notebook?

Ten simple rules for writing and sharing computational analyses in Jupyter Notebooks

Adam Rule, Amanda Birmingham, Cristal Zuniga, Ilkay Altintas, Shih-Cheng Huang, Rob Knight, Niema Moshiri, Mai H. Nguyen, Sara Brin Rosenthal, Fernando Pérez, Peter W. Rose

PLOS Computational Biology July 25, 2019

<https://journals.plos.org/ploscompbiol/article?id=10.1371/journal.pcbi.1007007>



THURSDAY HOMEWORK

**Write your own
conversion script (or
notebook)**

thursdayHW.docx
contains your
instructions

You can either do the work in a new Jupyter Notebook or try to write a script.

You are going to create a conversion calculator.

In today's folder, there is a file called conversionMeasures.csv.

THURSDAY HOMEWORK

**Write your own
conversion script (or
notebook)**

thursdayHW.docx
contains your
instructions

unit 1, factor, unit 2

```
kilometer,1000,meter|
meter,100,centimeter
inch,2.54,centimeter
foot,30.48,centimeter
mile,1.609,kilometer
centimeter,0.3937,inch
meter,39.37,inch
kilometer,0.6214,mile
square_meter,10.76,square_foot
square_mile,640,acres
square_foot,929,cm2
acre,43560,square_foot
liter,1000,cm3
liter,1.057,quart
liter,61.02,cubic_inch
liter,0.03532,cubic_foot
cubic_meter,1000,liter
cubic_meter,35.32,cubic_foot
```

unit 1 x factor = unit 2

continues...



THURSDAY HOMEWORK

**Write your own
conversion script (or
notebook)**

thursdayHW.docx
contains your
instructions

Write a script or notebook that converts a given value from its original unit to a different unit:

- store the conversion data in some format
- include a function to convert between units
- print out a full sentence response
- anticipate some errors
- run your script on the provided test examples



THURSDAY HOMEWORK

**Write your own
conversion script (or
notebook)**

thursdayHW.docx
contains your
instructions

There are also BONUS challenges included, if you complete the original assignment.

If you get stuck, I've included more explicit instructions in `thursdayHWhelp.docx`.



THURSDAY HOMEWORK

**Write your own
conversion script (or
notebook)**

thursdayHW.docx
contains your
instructions

If you want help debugging your script
OR if you hit a place where you're not
sure what to do next OR if you want to
show off the script you wrote...

post your questions and scripts in the
Discussion tab on Canvas.

You can also email me with questions.



THURSDAY HOMEWORK

**Write your own
conversion script (or
notebook)**

thursdayHW.docx
contains your
instructions

If you're using pythonanywhere, this site only lets you have two consoles open at a time. Follow these instructions to clear your consoles and start a new empty Python script:

1. Go to the Consoles page
2. Click the blue X next to your consoles.
3. Go to the Files page.
4. Under the word Files, in the box, enter `myscript.py` and then click New file on the right



FOR FRIDAY

Working with
DataFrames in
Pandas

We'll be back to Jupyter Notebooks
tomorrow!