Python

Bootcamp 2021

Outline for today

- Setup Anaconda
- Running Python
- Variables and Assignment
- Data Type
- Built-in functions
- Conditionals
- Loops

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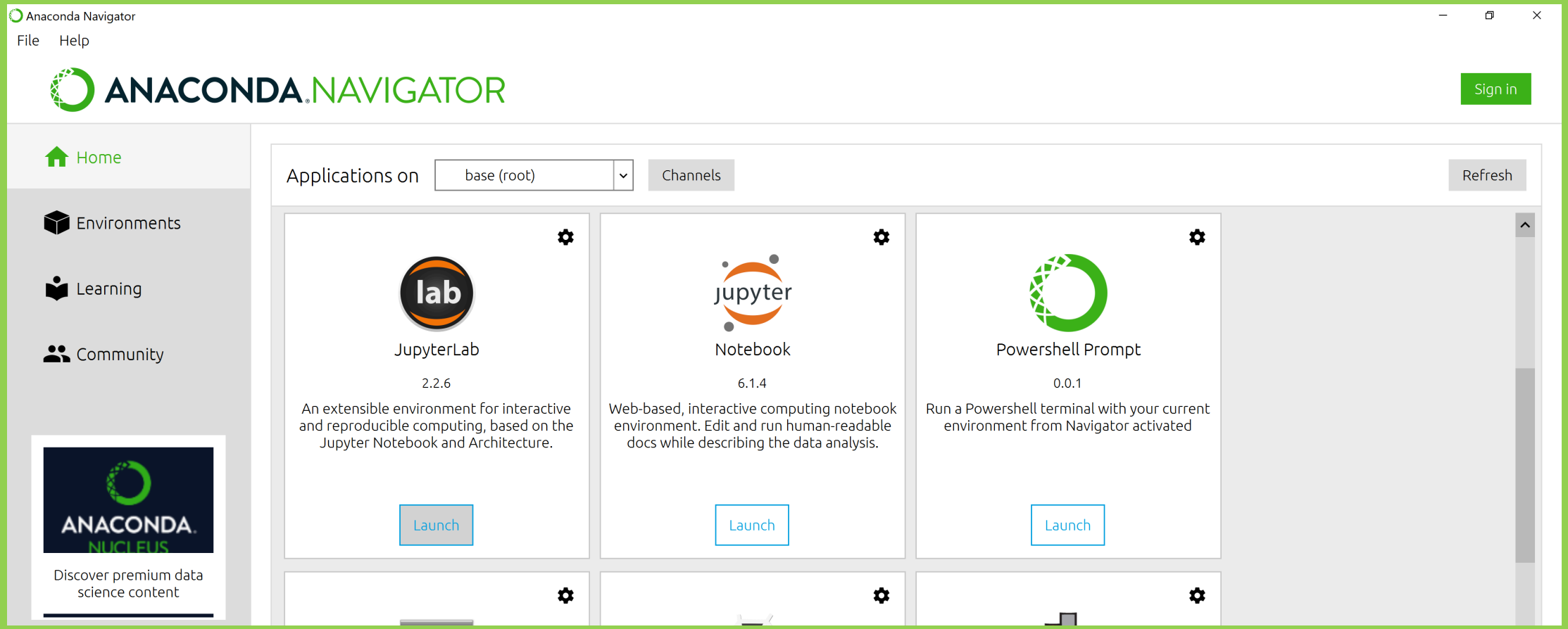
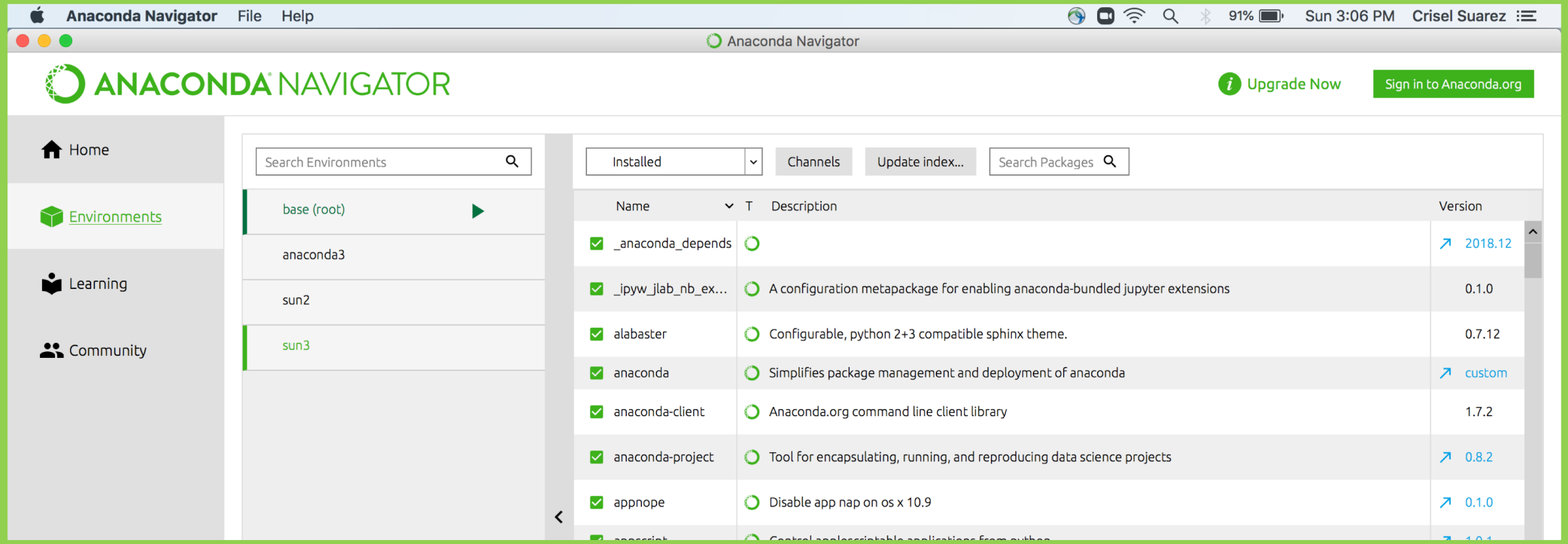
Setup Anaconda



Setup Anaconda



Setup Anaconda

- >On your bash shell

- $ conda create --name bootcamp2021
- proceed ([y]/n)?
- Y
- $ conda info --envs
- $ conda env list
- $ conda activate bootcamp2021
- $ conda list -n bootcamp2021
- $ conda install package-name
- $ conda install package-name=2.3.4

- https://conda.io/projects/conda/en/latest/user-guide/tasks/manage-environments.html
- https://docs.anaconda.com/anaconda/user-guide/tasks/install-packages/
- $conda create –name bootcamp2021 –clone base

Scripts /Spyder/Jupyter Notebook/JupyterLab

- All have pros/cons
- Choose what works best for you
- It is okay to switch between platforms

Python Scripts

- Run scripts on your bash shell
  - $python

    >>>

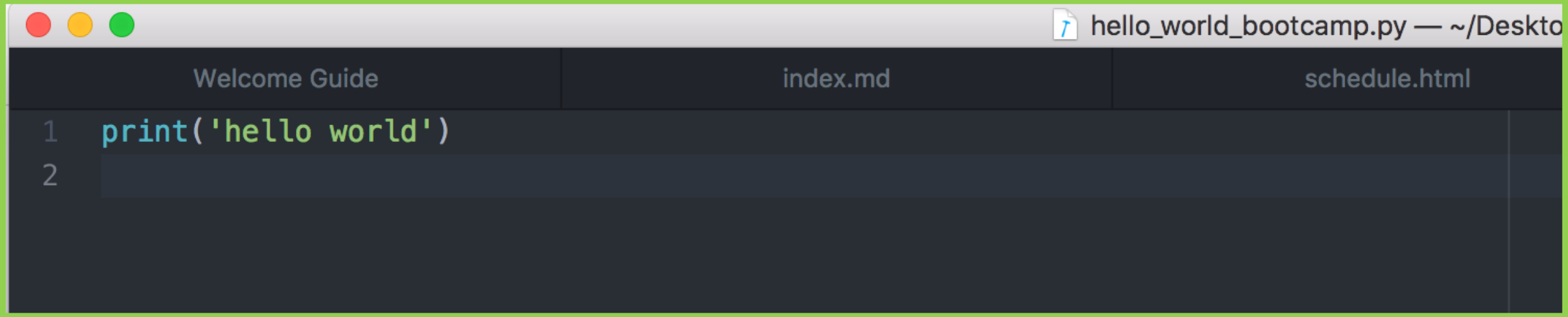
    >>>print('hello world')

    >>>exit() #Go back to your bash shell ($)

- $ vim hello_world.py
- print('hello world')
- $python hello_world.py

- vim
- Insert mode (i)
- Type your script/notes
- esc
- :wq

Python Scripts-Atom/Text Editor

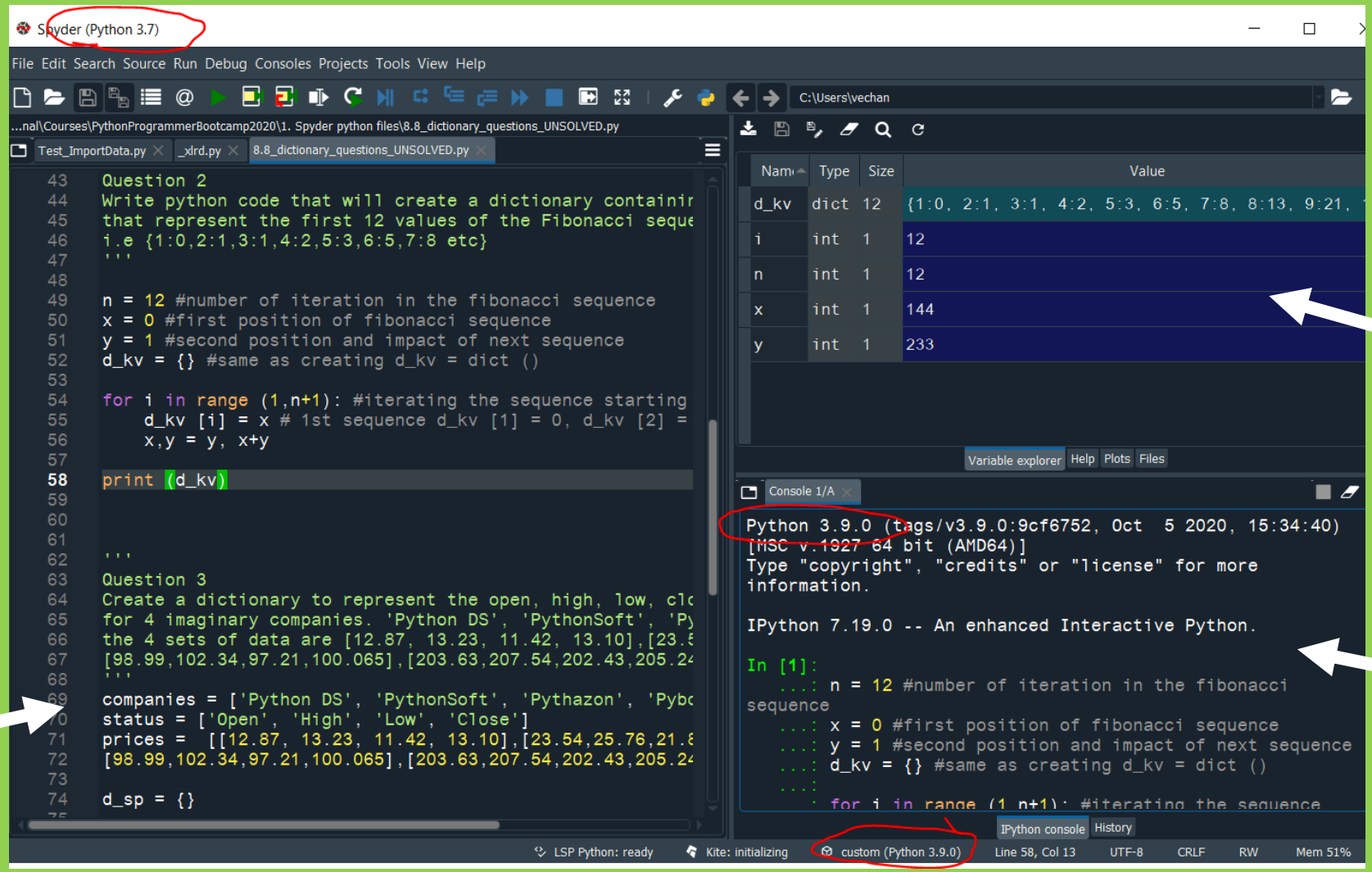


On your bash shell

$python hello_world_bootcamp.py

hello world

Spyder



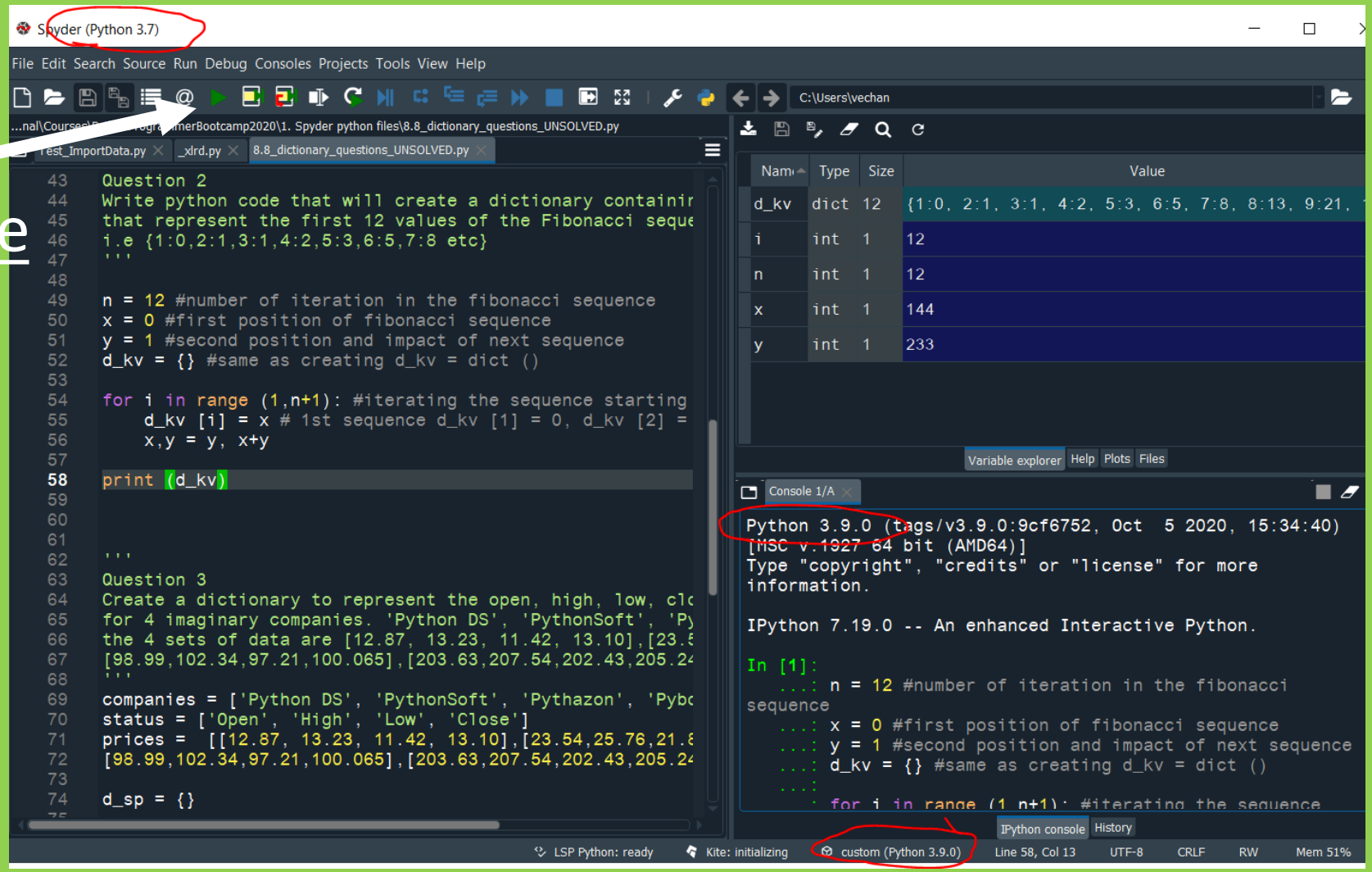
Declared Variables

Script Code goes here

Output

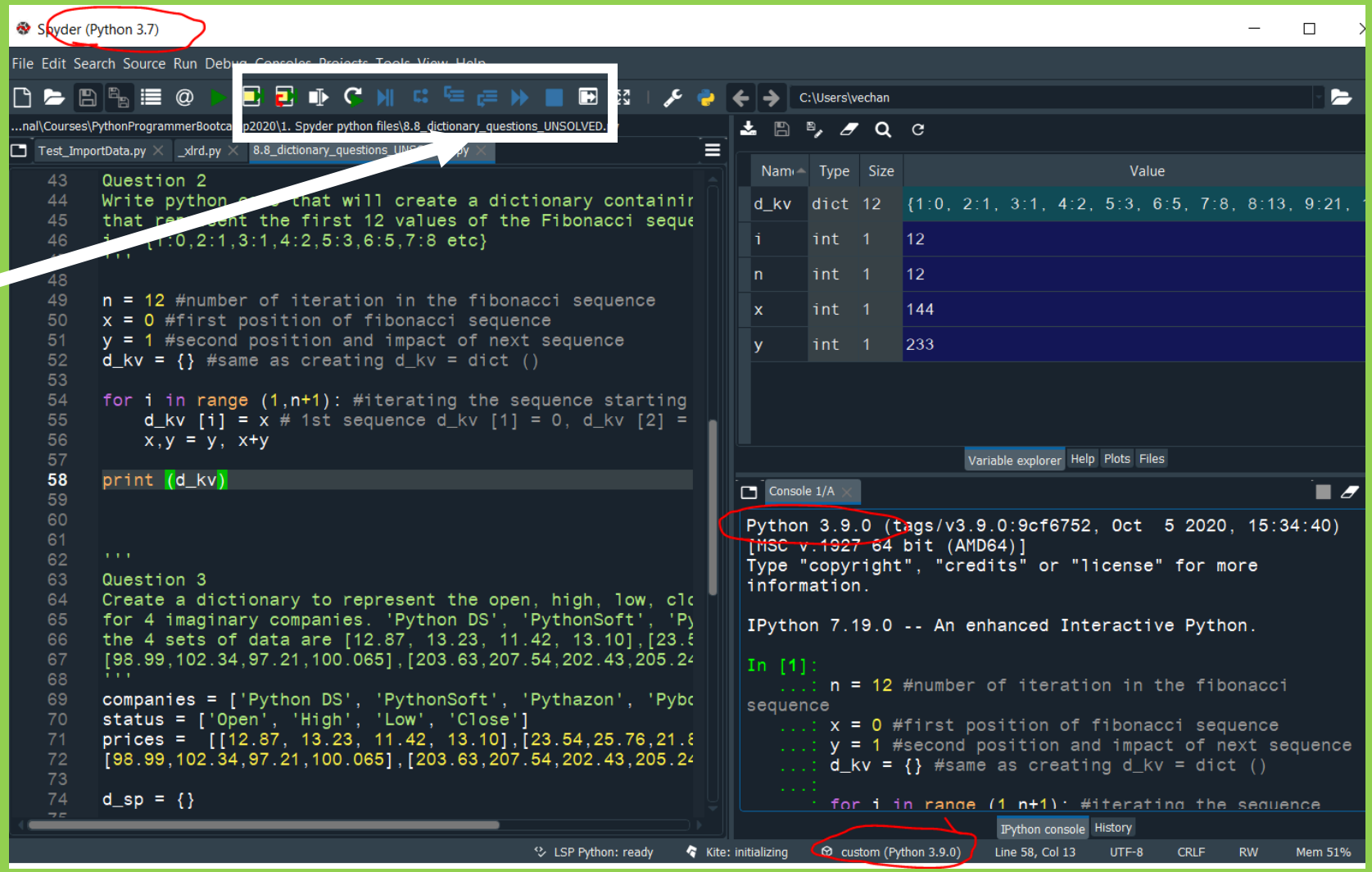
Spyder

Run your code



Spyder

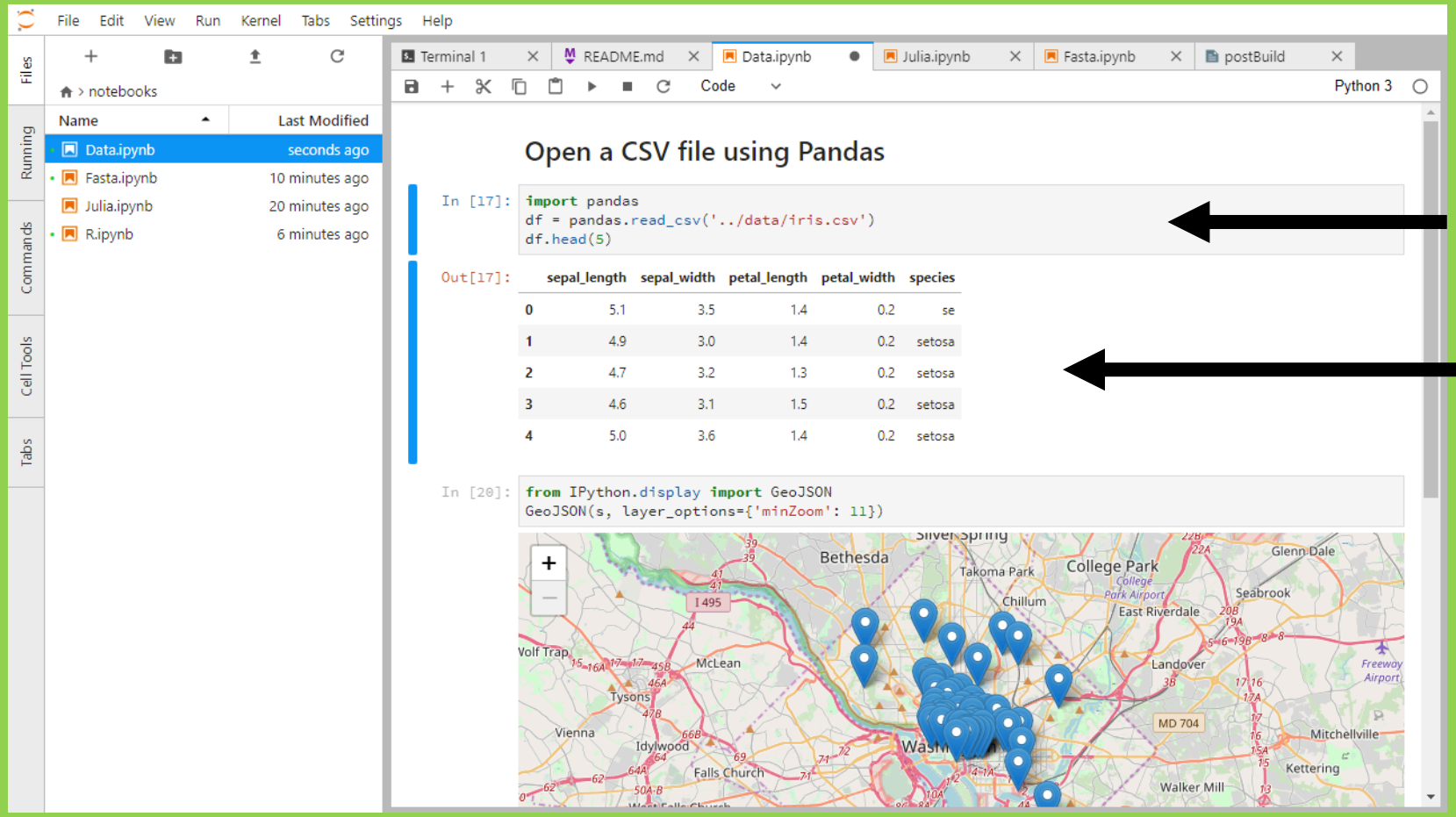
Debug your code



More on this later

Jupyter Lab (.ipynb)

$ jupyter lab



Cell – Code

Output

To run a cell:
shift + enter

https://jupyterlab.readthedocs.io/en/stable/user/notebook.html

Jupyter notebook (.ipynb)

$ jupyter notebook

- When in Command mode (esc/gray),
  - The b key will make a new cell below the currently selected cell.
  - The a key will make one above.
  - The x key will delete the current cell.
  - The z key will undo your last cell operation (which could be a deletion, creation, etc).

https://jupyter-notebook.readthedocs.io/en/latest/notebook.html

Jupyter notebook (.ipynb)

- Markdown great for commenting/adding notes to your code!

- A simple plain-text format for writing lists, links, and other things that might go into a web page.

Turn the current cell into a **Markdown cell** by entering the Command mode (**Esc**) and press the **M** key.

In [ ]: will disappear to show it is no longer a code cell and you will be able to write in Markdown.

Turn the current cell into a **Code** cell by entering the Command mode (**Esc**) and press the **y** key

Markdown – html

* Use asterisks
* to create
* bullet lists.

Lists

A Level-1 Heading

Headings

A Level-2 Heading (etc.)

[Create links](http://software-carpentry.org) with `[...](...)`.

urls + links

Or use [named links][data_carpentry]. [data_carpentry]: http://datacarpentry.org

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Variables and Assignments

- In Python the **=** symbol assigns the value on the right to the name on the left
- age = 42
- my_name = ‘Crisel Suarez’
- Grade1 = ‘A’

- Variable names
  - can **only** contain letters, digits, and underscore _
  - cannot start with a digit
  - are **case sensitive** (age, Age and AGE are three different variables)

Variables and Assignments

- first_name = ‘Kathy ’
- age = 10
- **print**(first_name, 'is', age, 'years old’)

- Variables can be used in calculations:
  - new_age = age +10

- Indexing
- print(first_name[0]

*** Python indexing starts at 0 ***

Outline Wednesday

- Jupyter Magic Commands 
- Indexing and Slices
- Lists
- Built-in Functions
- Conditionals
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Key Points

- Use variables to store values.
- Use print() to display values.
- Variables persist between cells.
- Variables must be created before they are used.
- Variables can be used in calculations.

Jupyter Magic Commands

- %run hello.py
- %%time
- % who
- %who str | % who int
- %pinfo <variable>
- %env
- %matplotlib inline
- %load hello.py
- %lsmagic

https://www.tutorialspoint.com/jupyter/ipython_magic_commands.htm

Jupyter Magic Commands

- Can run Unix commands straight from your Jupyter Notebooks
- !
- !head –n 5 haiku.txt
- !pip install astropy

- Almost all the things we learned in Unix we can use in Jupyter Notebooks

Data Types

- str() – String
  - Concatenation +
  - Repetition *
- int()- integer
- Float() - decimals
- Type() > What kind of data type

Math

- Add +
- Subtract -
- Multiply *
- Divide /
- Power **
- Reminder %
- Absolute value abs()

Operators

- Equal to ==
- Not equal to !=
- Greater than >
- Less than <
- Greater or equal >=
- Less or equal <=

Operators

- and
- or
- in (Membership)
- not in (Membership)
- True
- False

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Indexing and Slices

- [start:stop]
- atom_name = 'sodium’
- print(atom_name[0:3])
  - > sod

- len(atom_name)
- 6

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Lists

- Storing multiple variables

- pressures = [0.273, 0.275, 0.277, 0.275, 0.276]

- **print**('pressures:', pressures)
- **print**('length:', len(pressures))
- **print**('zeroth item of pressures:', pressures[0])

- pressures[0] = 0.265

-

Lists – Appending

- list_name.append()
- primes = [2, 3, 5]
- **print**('primes is initially:', primes)
- primes.append(7)
- **print**('primes has become:', primes)

Lists – Deleting

- del list_name[index] to remove an element from a list

- primes = [2, 3, 5, 7, 9]
- **print**('primes before removing last item:', primes)
- **del** primes[4]
- **print**('primes after removing last item:', primes)

List- Empty []

- Empty_list = []

- Helpful as a starting point for collecting values

Practice:

- **print**('string to list:', list('tin’))
- **print**('list to string:', ''.join(['g', 'o', 'l', 'd’]))

What does list do?

What does .join do?

*We will come back to list with Numpy’s version …arrays

Key Points

- Use an index to get a single character from a string.
- Use a slice to get a substring.
- Use the built-in function len() to find the length of a string.
- Python is case-sensitive.
- Use meaningful variable names

Dictionaries {} or dict()

- Mutable key-value pairs

- zoo = {‘cats’ : 4 , ‘dogs’: 5, ‘goats’: 3, ‘camels’ : 2 }
- person = dict(name = "John", age = 36, country = "Norway")

- zoo[‘cats’]
  - > 4

- zoo.keys()
- zoo.values()
- zoo.items()

Dictionaries

- food = {‘breakfast’ : 2 , ‘lunch’: ‘salad’,
  ‘dinner’: {‘first_course’ : ‘soup’,
  ‘second_course’: ‘chicken’ }
  desert = [‘flan’, ’coockies’, ‘NY_cheesecakes’]}

- food['dinner']['first_course’]
- food['dessert'][0]

Tuple – ()

- Tuples are used to store multiple items in a single variable.
- A tuple is a collection which is ordered and **unchangeable**.
- Tuples are written with parentheses ()
- Allows duplicated items

```
thistuple = ("apple", "banana", "cherry")

thistuple = ("apple", "banana", "cherry", "apple", "cherry")
```

Sets – {}

- Unordered
- Unchangeable
- No duplicate values.

```
thistuple = {"apple", "banana", "cherry”}

thistuple = {"apple", "banana", "cherry", "apple", "cherry”}
```

Python Collections

- **List** is a collection which is ordered and changeable. Allows duplicate members.
- **Tuple** is a collection which is ordered and unchangeable. Allows duplicate members.
- **Set** is a collection which is unordered and unindexed. No duplicate members.
- **Dictionary** is a collection which is ordered* and changeable. No duplicate members.

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Built-in functions

- Think math function
- f(x) = x + 5
- x -> input
- f(x) -> output

- Functions can take 0 or many arguments
- print()
- f(x1, x2, x3,…) = x1+ x2+x3 +…..

Built-in functions

- max(1,2,3)
- min(5,6,7)
- round(3.712, 1) #rounds to 1 decimal place

- help(round)

Functions attached to objects are called methods

- Methods have parentheses like functions, but come after the variable.

```
my_string = 'Hello world!' # creation of a string object

print(my_string.swapcase())
# calling the swapcase method on the my_string object
```

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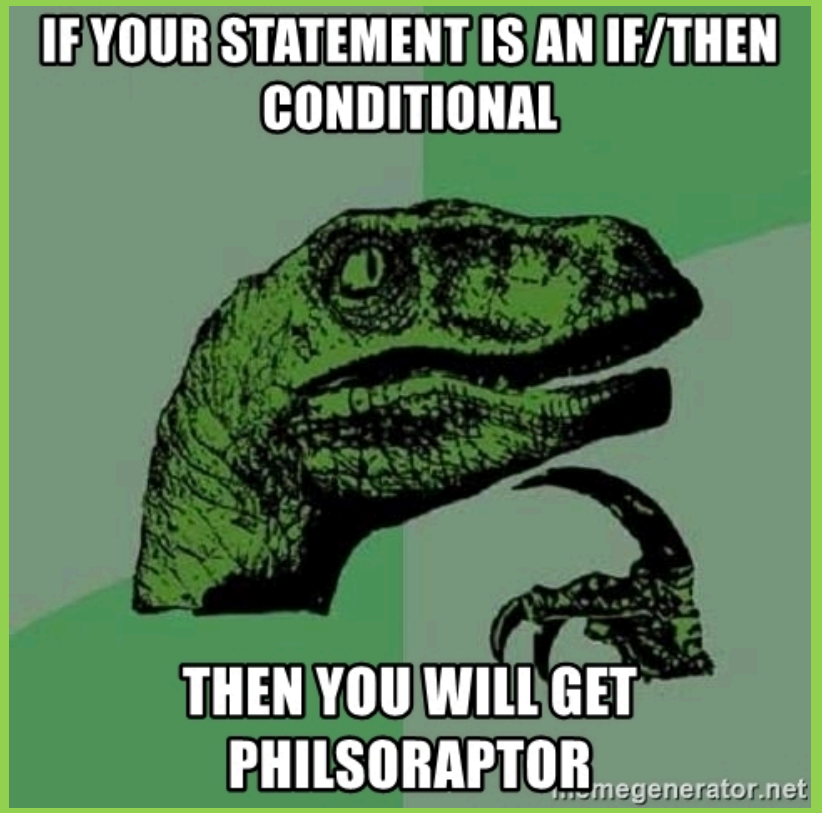
Conditionals

- if (condition is True):
  then do something

- if (condition is True):
  then do something
- else:
  - Do something else

- if (condition is True):
  then do something
- elif (this condition is true):
  - then do this
- else:
  - Do this



Conditionals – Try it out

- mass = 3.4
- If mass > 3.0:
  - print(‘Mass is ’ , mass)

- if mass > 3:
  - print(‘Mass is less than 3’)
- else:
  - print(‘Mass is more than 3’)

- if mass < 3.7:
  print(‘mass less than 3.7’)
- elif (if mass > 3.2):
  - print(‘mass greater than 3.2’)
- else:
  - print(mass greater than 3.7 or less than 3.2)

Conditionals – Try it out

- mass = 3.4
- If ((mass < 3.7) and (mass >3.2)):
  - print(mass less than 3.7 or greater than 3.2)

- mass = 3.4
- If ((mass < 3.7) or (mass >3.2)):
  - print(mass less than 3.7 or greater than 3.2

- mass = 3.8
- If ((mass < 3.7) and (mass >3.2)):
  - print(mass less than 3.7 or greater than 3.2

- mass = 3.8
- If ((mass < 3.7) or (mass >3.2)):
  - print(mass less than 3.7 or greater than 3.2

Conditionals

p	q	p and q
TRUE	TRUE	TRUE
TRUE	FALSE	FALSE
FALSE	TRUE	FALSE
FALSE	FALSE	FALSE

p	q	p or q
TRUE	TRUE	TRUE
TRUE	FALSE	TRUE
FALSE	TRUE	TRUE
FALSE	FALSE	FALSE

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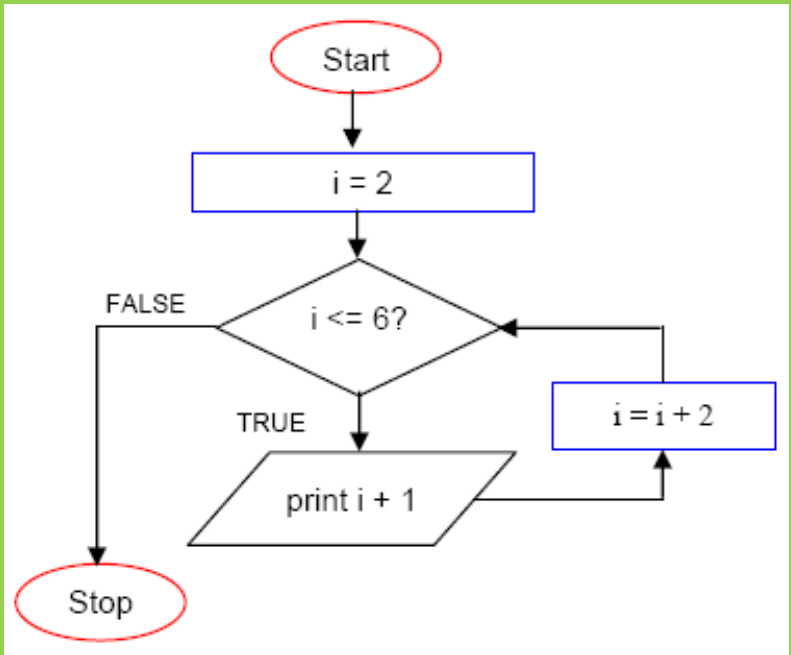
Loops

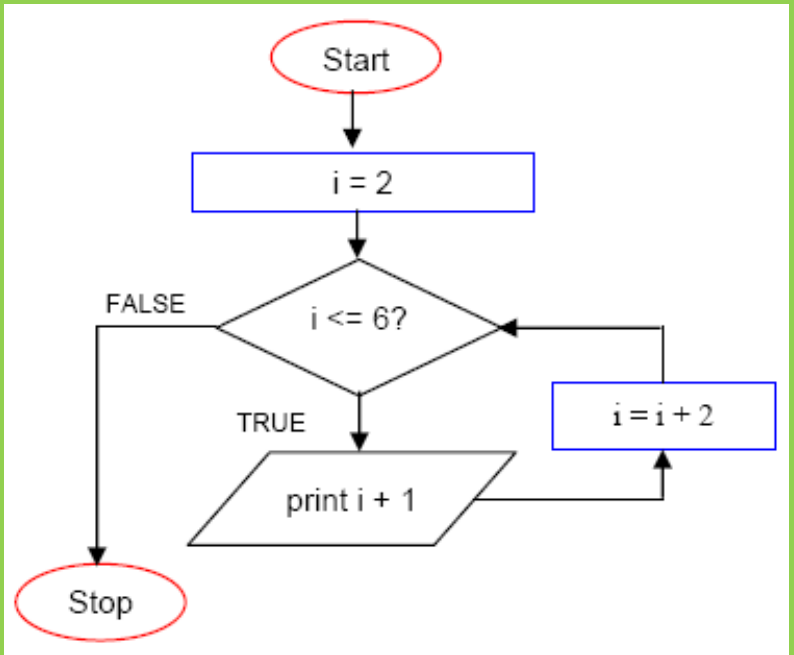
Loops are a programming construct which allow us to repeat a command or set of commands for each item in a list. As such they are key to productivity improvements through automation

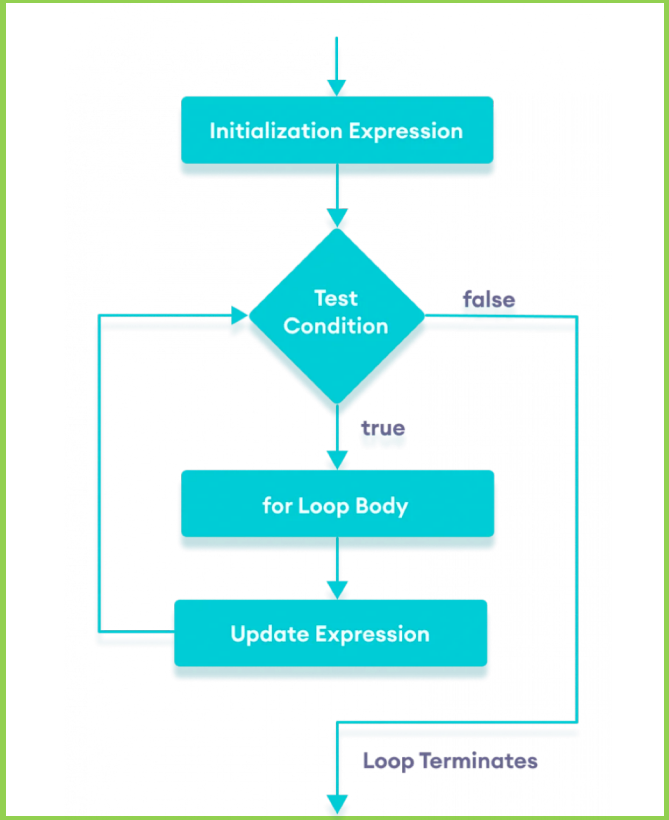


i	i<= 6	Output
2	True	3
4	True	5
6	True	7
8	False	

Loops

Loops are a programming construct which allow us to repeat a command or set of commands for each item in a list. As such they are key to productivity improvements through automation





Loops

- **for** number **in** [2, 3, 5]:
  - **print**(number)

- primes = [2, 3, 5]
- **for** p **in** primes:
  - squared = p ** 2
  - cubed = p ** 3
  - **print**(p, squared, cubed)

Loops

- The built-in function range produces a sequence of numbers.
- *Not* a list: the numbers are produced on demand to make looping over large ranges more efficient.

- **print**('a range is not a list: range(0, 3)’)
- **for** number **in** range(0, 3):
  - **print**(number)

Loops – Practice

- *# List of word lengths: ["red", "green", "blue"] => [3, 5, 4]*
- lengths = ____
- **for** word **in** ["red", "green", "blue"]:
  - lengths.____(____)
- **print**(lengths)

Loops – Practice

- *# List of word lengths: ["red", "green", "blue"] => [3, 5, 4]*
- lengths = []
- **for** word **in** ["red", "green", "blue"]:
  - lengths.append(len(word))
- **print**(lengths)

Loops – Practice

- *# Concatenate all words: ["red", "green", "blue"] => "redgreenblue”*
- words = ["red", "green", "blue"]
- result = ____
- **for** ____ **in** ____:
  - ____
- **print**(result)

Loops – Practice

- *# Concatenate all words: ["red", "green", "blue"] => "redgreenblue”*
- words = ["red", "green", "blue"]
- result = ””
- **for** word **in** words:
  - result = result+word
- **print**(result)

Practice

- Write a program that prints the following pattern:

```
*
**
***
****
*****
******
```

Practice

- Write a program that prints the following pattern:

```
*
**
***
****
*****
******
```

```
for star in range(7):
    print('*’ * star)
```

While Loops

- Need to define an indexing variable***

```
i = 1
while i < 6:
        print(i)
        i += 1
```

```
i = 1
while i < 6:
        print(i)
        i += 1
else:
        print("i is no longer less than 6")
```

*****Loop can run forever*****

Conditionals + Loops

```
i = 0
while i < 6:
        i += 1
        if i == 3:
                print(”i is 3”)
        print(i)
```

```
masses = [3.54, 2.07, 9.22, 1.86, 1.71]
for m in masses:
        if m > 3.0:
                print(m, 'is large’)
        else:
                print(m, ‘is small’)
```

Loops

- **continue** - stop the current iteration, and continue with the next

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

```
i = 0
while i < 6:
  i += 1
  if i == 3:
    continue
  print(i)
```

Loops

- **break** - stop the loop even if the while condition is true

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

```
i = 1
while i < 6:
  print(i)
  if i == 3:
    break
  i += 1
```

Loops

- **pass** – ”Empty loop”

```
for x in [0, 1, 2]:
  pass
```

Nested Loops

```
persons = [ "John", "Marissa", "Pete", "Dayton" ]
restaurants = [ "Japanese", "American", "Mexican",
"French" ]

for person in persons:
    for restaurant in restaurants:
        print(person + " eats " + restaurant)
```

Nested Conditionals

```
num = float(input("Enter a number: "))
if num >= 0:
        if num == 0:
                print("Zero")
        else:
                print("Positive number")
 else:
        print("Negative number")
```

Keypoints

- Use if statements to control whether or not a block of code is executed.
- Conditionals are often used inside loops.
- Use else to execute a block of code when an if condition is ***not*** true.
- Use elif to specify additional tests.
- Create a table showing variables' values to trace a program's execution.

Keypoints

- A *for loop* executes commands once for each value in a collection.
- A for loop is made up of a collection, a loop variable, and a body.
- The first line of the for loop must end with a colon, and the body must be indented.
- Indentation is always meaningful in Python.
- Make meaningful loop variables
- The body of a loop can contain many statements.
- Use range to iterate over a sequence of numbers.

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Functions def()

***Functions return something

```
def print_greeting():
        print('Hello!')

def print_date(year, month, day):
        joined = str(year) + '/' + str(month) + '/' + str(day)
        print(joined)


def average(values):
if len(values) == 0:
          return None
 return sum(values) / len(values)
```

Practice

- Fill in the blanks to create a function that takes a list of numbers as an argument and returns the first negative value in the list. What does your function do if the list is empty?

```
def first_negative(values):
    for v in ____:
        if ____:
            return ____
```

Practice

- Fill in the blanks to create a function that takes a list of numbers as an argument and returns the first negative value in the list. What does your function do if the list is empty?

```
def first_negative(values):
    for v in values:
        if v<0:
            return v
```

Functions + Variable Scope

- ***Global variable***
  - Defined outside any particular function.
  - Visible everywhere.

- ***Local variable***
  - Defined inside the function.
  - Not visible in the main program.

```
pressure = 103.9
def adjust(t):
        temperature = t * 1.43 / pressure
        return temperature
```

Keypoints

- Break programs down into functions to make them easier to understand.
- Define a function using def with a name, parameters, and a block of code.
- Defining a function does not run it.
- Arguments in call are matched to parameters in definition.