Writing your First Python Program

February 24, 2015
Today’s Class

• Brief discussion on Project 1
• More Python!
Get **Full** Credit on Project 1

- Use sheets for intermediate results, interactivity
- Display your data in different ways (graph, table, etc.)
- Follow the rules:
  - only data, parameters, labels, and formulas.
- Use “notes” on cells for explanation
  - only if anything out of the ordinary
- Try to avoid “hand work” and use formulas instead!
Get **Full** Credit on Project 1

- Remember to address your claim
  - My hypothesis is correct/incorrect because ...
  - X% of the time, my hypothesis was correct...
- Be sure to explain what obstacles you encountered
- Have a “Discussion and Conclusion”
  - Reflect on things like:
    - “Is this data too unreliable for me to trust the conclusion?”
    - “Was a threshold of 80% really reasonable?”
    - “Did eliminating countries that lacked data for any single year make the analysis compromised somehow?”
- Look at the rubric!
Intermediate Results

Put your raw data on its own sheet and refer to it using a formula when you do your analysis on other sheets.
Intermediate Results

Use a **new sheet** when the current sheet already has a table with some meaningful data in it.

Don’t lose that data.
Interactivity

Use **data validation**, probably with a list (pull down), to add some interactive component.

See ACT1-3 for an example using MATCH and OFFSET.
Presentation

Try out different ways to present your data.

Make a chart from your final results.

If you’re not sure what to do, ask a TA or me.
Address Your Hypothesis

Remember to relate your results back to the hypothesis.

Was it true?
Was it true in some cases?
Why might it have been false?
Obstacles and Reflection

What was difficult? What are the limitations of the analysis you did?

You must reflect on your project and what you learned.
Check the rubric before you submit
Define Problem

Find Data

Write a set of instructions

Solution

Python

Textual Analysis

Build a Concordance of a text

- **Locations** of words
- **Frequency** of words

- Word frequencies across time
  - Determine authorship
  - Count labels to determine liberal media bias

ACTACGTCGACTACGATCA
CGATCGCCGATCACGTAT
TTACGATCAGCTACGATCG
ATCTACGATCGTAGCTGTG
ATCG
The Big Picture

Overall Goal
Build a Concordance of a text
• Locations of words
• Frequency of words

Today
• Briefly review expressions, assignments, & types
• Learn about defining functions
• Learn how to read in a text file and create a list of words
• Write a program to count the number of words in Moby Dick
Python So Far (to be updated/refined!)

1. Expressions
   • Evaluate *input* and returns some *output* (calculator)

2. Variable Assignments: `<variable> = <expression>`
   • Store the value of the expression in the variable instead of outputting the value.
   • There is *always* an equals sign in an assignment
   • Variables can be named many things
   • List assignments: `<listvar>[<index>] = <expression>`

3. Types
   • Integers vs. Floats (Decimals)
   • Strings in single quotes
   • Lists are sets of other types

General Rule: Expressions for a particular type will *output* that same type!
Interactive sessions

```python
>>> myList = [2, 5, 9]
>>> mySum
16
>>> myAvg = sum/3.0
>>> myAvg
5.333333333333333
>>> x = 3
>>> y = x + 1
>>> y
4
>>> x = 4
>>> y
4
```
# This program calculates the average of numbers in the 3-element list myList below,
# do semi-uselessss things with variable x,
# and prints “4″ twice

myList = [2, 5, 9]
myAvg = mySum/3.0

print(myAvg)
x = 3
y = x + 1
print(y)
x = 4
print(y)
Module Files

Allow us to **save** code (‘.py’ extension)

• Download `Example.py` from the website and open it in IDLE. Take a moment to look at it.

• Run...Run Module *(or press F5)*

• **To write your own file:**
  
  – File...New Window
  
  – Write your function definitions. Save the file.
  
  – Run...Run Module *(or press F5)*
Subtleties already: names

• We said you could use almost anything as a variable-name
  – Avoid certain words used by Python ("keywords")
    • We’ll mention these as we encounter them
Subtleties: Assignment

• When we enter a formula in cell B2 of a spreadsheet, saying “=A1”, whenever A1 changes, B2 updates
  – That only works for spreadsheets, not Python (nor most other programming languages)

• In Python, assignments “happen once”: the value of the right hand side, right now, is assigned to the left hand side
Subtleties: Assignment (2)

• Details. In the assignment statement
  \[ x = y + 3 \]

  – The expression on the right is evaluated;
    • if there are variable names there, the values are looked up in the memory table

  – If there’s not already an assigned value in the memory table for the variable on the left (\( x \) in this case), Python makes space for it

  – The computed value is placed in the memory as the value for the variable
Pictorial version of assignment

```python
>>> x = 5
```

- Evaluate RHS: 5
- There’s no memory spot for `x`: create one

- Put the value of the RHS in the “value” table

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Pictorial version of assignment, v2

>>> x = 5
• Evaluate RHS: 5
• There’s already a memory spot for \( x \): do nothing

• Put the value of the RHS in the “value” table

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<td>int</td>
<td>0</td>
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\[ x = x + 1 \quad (x \text{ already defined}) \]

>>> 

- Evaluate RHS: \( x + 1 \)
  - Lookup \( x \), get 0
  - Add 1, to get 1

- There’s already a memory spot for \( x \): do nothing

- Put the value of the RHS in the “value” table
\[ x = x + 1 \] (x not previously defined)

- Evaluate RHS: \( x + 1 \)
  - Lookup x...it’s not there
  - ERROR!

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What’s “evaluate” mean?

• Lookup variable names to find values
• Do math or string or list operations in the order specified to combine these values and get a result
Key Points

• Some variable names should not be used.
• Variables don’t have values until you assign them

• Assignment is a 3-step process
  – Evaluate right hand side
  – Make room in memory table if needed
  – Place value from first step in table
List Indexing

• To get a range of elements from a list, use the expression `>>> myList[i:j]` where `i` is the start index (inclusive) and `j` is the end index (exclusive).

```python
>>> myList
[5, 4, 15]
>>> myList[0:2]
[5, 4]
>>> myList[1:3]
[4, 15]
>>> newList = [2, 5, 29, 1, 9, 59, 3]
>>> newList
[2, 5, 29, 1, 9, 59, 3]
>>> newList[2:6]
[29, 1, 9, 59]
```
List Indexing

- **Indexing** and **ranges** also work on Strings.

```python
>>> myString = "hi there"
>>> myString
'hi there'
>>> myString[0]
'h'
>>> myString[5]
'e'
>>> myString[6]
'r'
>>> myString[0:6]
'hi the'
```
List indexing

• When you have a list:
  >>> myList = [1, 3, 5, 4, 6]

• You can refer to individual items:
  >>> myList[0]
  1

• Or pieces of it
  >>> myList[0:3]
  [1, 3, 5]
List Indexing, reloaded

From previous slide:

```python
>>> myList = [1, 3, 5, 4, 6]
```

• Pieces of list:
  – Can also use `:3` or `2:` to refer to “stuff up to but not including item 3” or “stuff including and after item 2”

```python
>>> myList[:3]
[1, 3, 5]
>>> myList[2:]
[5, 4, 6]
```

• Handy for the cookie monster task on HW
List Indexing, more tricks

- Those “pieces of lists” (sometimes called “slices”) can appear on the left-hand side of an assignment

```python
>>> myList = [1, 3, 5, 4, 6]
>>> myList[0] = 5
>>> myList
[5, 3, 5, 4, 6]
>>> myList[0:2] = [9]
>>> myList
[9, 5, 4, 6]
>>> myList[0:3] = []
>>> myList
[6]
```
• Do Task 1
The Big Picture

Overall Goal
Build a Concordance of a text
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Steps
• Briefly review expressions, assignments, & types
• Learn about defining functions
• Learn how to read in a text file and create a list of words
• Write a program to count the number of words in Moby Dick
Python Functions

• Functions are multi-step operations that **we** define

• Allows us to execute many statements in sequence.

```python
>>> myList = [2, 5, 9]
>>> def avg3(someList):
    s = someList[0] + someList[1] + someList[2]
    avg = s/3.0
    return avg

>>> 
```
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>>> avg3(myList)
5.333333333333333
>>> myList = [1, 2, 3]
>>> finalValue = avg3(myList)
>>> finalValue
2.0
```
Python Functions

- Functions are multi-step operations that **we** define
- Allows us to execute many statements in sequence.

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>>> avg3(myList)
5.333333333333333
>>> myList = [1,2,3]
>>> finalValue = avg3(myList)
>>> finalValue
2.0
```

**WARNING:** do not name a variable `sum`. It is a predefined function (it turns purple in IDLE)
Python Functions

Define a new function using the keyword `def`

- Can take zero or more inputs (called *arguments*)
- Does some computation using the inputs
- Returns a value
- Form of a function definition:
  ```python
def <functionName>(arg1, ..., argn) :
  statement1
  statement2
  ...
  statementn
  return <value>
  ```
- `arg1, ..., argn` must be variable names
- There might be none of them...but parentheses are still required
Expanded model of Python execution

• There’s a table for *variable* names and their values

• There’s a table for *function* names and their associated functions
  – That table has two parts:
    • preloaded (i.e., part of Python)
    • user-defined (which we call “new functions”)
Expanded model of Python execution

• When a function is *used* (or “called” or “invoked” or ...)
  – ... a further *temporary* memory table is created

• This table disappears when the function “returns” (or terminates, or finishes)

• Why? Because doing it this way prevents a TON of programming mistakes!

• More details later: let’s see it in action
Python Functions

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# Python Functions

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```python
# Assignment statement
myList = [2,5,9]

>>> def avg3(sL):
    s = sL[0] + sL[1] + sL[2]
    avg = s/3.0
    return avg

>>> avg3(myList)
5.333333333333333

>>> myList = [1,2,3]

>>> finalValue = avg3(myList)

>>> finalValue
2.0
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>>> myList = [1, 2, 3]
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“Inputs” are also called Arguments.
Python Functions

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```

Function invocation inside expression

```python
avg3(myList)
```

5.333333333333333

```python
>>> myList = [1, 2, 3]
>>> finalValue = avg3(myList)
>>> finalValue
2.0
```
### Python Functions

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<td>16</td>
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>>> myList = [2, 5, 9]
>>> def avg3(sL):
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>>> avg3(myList)
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>>> myList = [1, 2, 3]

>>> finalValue = avg3(myList)

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Python Functions

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Python Functions

```python
>>> def someFunction(inputs):
    output = <some expression>
    return output
```

- **Function Definition**
- **Function Inputs / Arguments** (Optional)
- **Function Output** (Optional)
- **Indentation Matters!!**
ACT2-1

• Do Task 2

```python
>>> def someFunction(inputs):
    output = <some expression>
    return output
```
Module Files

Allow us to **save** code (`.py` extension)

- Download `ACT2-1.py` from the website and open it in IDLE. Take a moment to look at it.
- Run...Run Module (or press F5)

- **To write your own file:**
  - File...New Window
  - Write your function definitions. Save the file.
  - Run...Run Module (or press F5)
The Big Picture

Overall Goal
Build a Concordance of a text
- Locations of words
- Frequency of words

Steps
- Briefly review expressions, assignments, & types
- Learn about defining functions
- Learn how to read in a text file and create a list of words
- Write a program to count the number of words in *Moby Dick*
General Rules for Writing Functions in CSCS0931

• These rules are here to help you!

• Variables used within function definitions should be one of two things:
  1. An input (also called an argument)
  2. Previously assigned within the function def.

• *Do not modify arguments within a function definition (define new variables instead)*

• *Do not have nested function definitions.*

• *Use only the returned values outside the function definition.*