Python Expressions

Announcements/ Logistics

- **Homework 0** due in class today
- Lab 1 for
  - Section 04 will be held today afternoon at 1 pm
  - Section 05 will be held today afternoon at 2.30 pm
  - Section 08 will be held tomorrow afternoon at 1 pm
  - Section 09 will be held tomorrow afternoon at 2.30 pm
- TA schedule is up on the course webpage
  - **Sun-Thurs 7 - 9.30 pm in TCL 217a and TCL 216**
- I have office hours today 2.30-4 pm in TBL 309B

Python and Interfaces

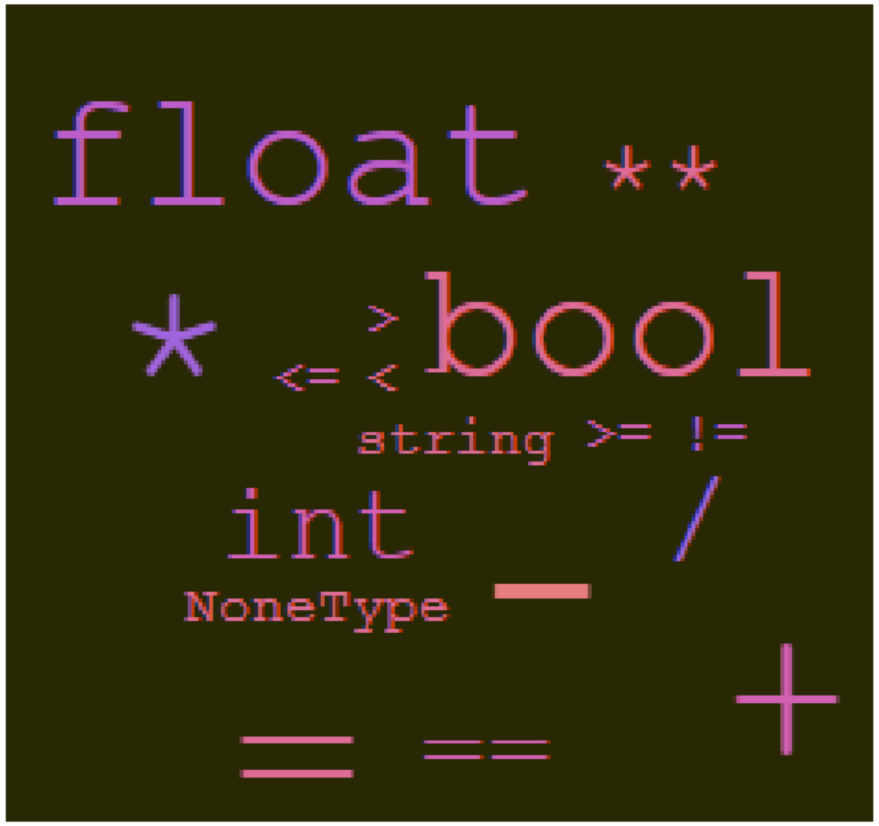
- Interfaces we will use to Python:
  - **IPython**
    - Interactive command-line terminal for Python
    - Created by Fernando Perez
    - Powerful interface to use Python
    - Often called a **REPL (‘Read-Eval-Print-Loop’)**
  - **Jupyter Notebook**
    - Created in 2011, a new web-based interface for Python
    - Teaching aid in class—makes teaching programming more interactive and efficient
    - Also Popular tool for scientific exposition, especially data science (even in languages such as R and Julia)
- In labs you will be writing python programs as a script with extension .py that can be executed from the terminal

Installing Python

- Checking version of Python on machine (Mac, Linux)
  - `python --version`
- For this class, we need P`ython 3.6.4` or above
- Installing Python3 on your machine
  - https://www.python.org/downloads/
- **Preinstalled on all lab machines**
- If your personal machine is Windows
  - It is possible to get everything set up
  - Lots of information online
- Initially, recommend doing lab work on machines in the CS labs

Aspects of Languages

- **Primitive constructs**
  - English: words
  - Programming languages: numbers, strings, simple operators



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Aspects of Languages

- **Syntax**
  - English: “cat dog boy” (incorrect), “cat hugs boy” (correct)
  - Programming language: “hi”5 (incorrect), 4*5 (correct)

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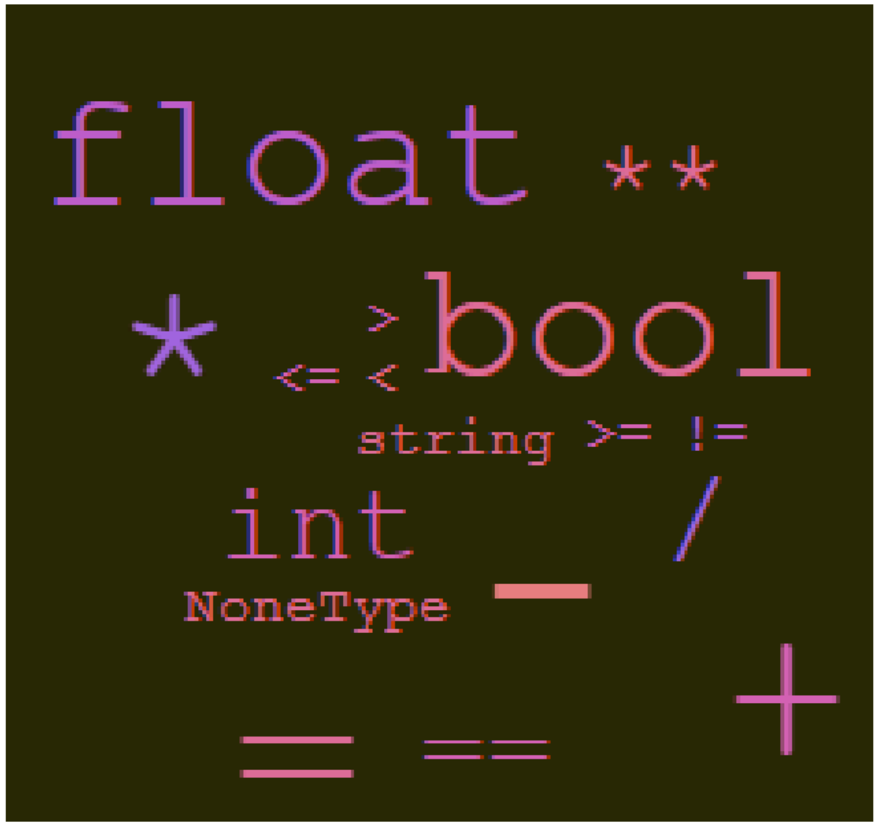

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Aspects of Languages

- **Semantics** is the meaning associated with a syntactically correct string of symbols
  - English: can have many meanings (ambiguous), e.g.
    - "Flying planes can be dangerous"

- **Programming languages:**
    - Must be unambiguous
    - Can only have one meaning
    - Actual behavior can sometimes be not what is intended !

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Python Program

- A **program** is a sequence of definitions and commands
  - Definitions are evaluated
  - Commands are executed by the Python interpreter in a shell
- **Commands** instruct interpreter to do something
- Can be typed directly in a shell or stored in a **file** that is read and evaluated
  - In lectures, we'll use Jupyter for instant evaluation and output
  - In labs, you'll write your program as a script and save it with a .py extension, e.g. `` `hellowold.py'. `` You can execute the program from the terminal: `python3 helloworld.py`

Python Primitives

- **Values**:
    - E.g. 10 (integer), 3.145 (float), ‘Williams’ (string)
- **Types**:
    - E.g. int, float, str, bool, NoneType
    - Can use type() to see the type of an value
    - Knowing the **type** of a value allows us to choose the right **operator** when creating **expressions**
- **Operators:**
    - E.g. + - * / % // =
- **Expressions:**
    - E.g. ‘3+4’ , ‘Williams’ * 3, len(‘shikha’)
    - Always produce a value as a result
- **Built-in functions:**
    - int, float, str, print, input, max, min, len

Knowing the **type** of a **value** allows us to choose the right operator for expressions.

Python: Interactive Ways

“>>” tells you it is an interactive python session in the terminal

```
>> 1 + 2

3

>> 3* 4

12
```

“In [] and Out” tells you it is an interactive python session in Jupiter

```
In [10]:  12/3

Out [10]: 4.0
```

Out vs Print: “Print” means it is printed onto the console and will actually be shown to the user when you edit/run the script

```
In [11]:  print(25//5)

5
```

Operator Precedence

- Operator precedence without parenthesis

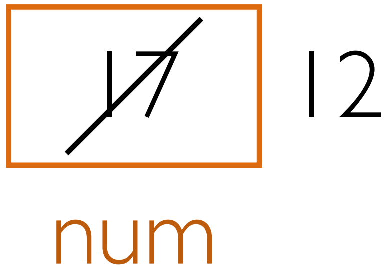
  **
  *
  /
  + and - (left to right as they appear)

- Parenthesis used to override precedence and tell Python do these operations within parenthesis first

Variable Assignment

- A variable names a value that we want to use later in a program
- **Variables as a box model.**
  An assignment statement var = exp stores the value of exp in a "**box**" labeled by the variable name
- Later assignments can change the value in a variable box.
  Note: The symbol '=' is pronounced **"gets" not "equals"**!

```
In [1] num = 17
In [2] num
Out [2] 17
In [3] num = num - 5
In [4] num
Out [4] 12
```



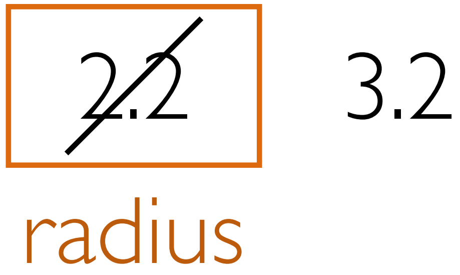
Abstracting Expressions

- Why give names to values of expressions?
- To reuse names instead of values
- Easier to change code later

```
In [1] pi = 3.14159
In [2] radius = 2.2
In [3] area = pi * (radius**2)
In [4] area
Out [4] 15.205295600000001
In [5] round(area, 2)
Out [5] 15.21
```

Programming vs Math

- In programming, “we don’t solve for x”



```
pi = 3.14159
radius = 2.2
area = pi * (radius**2)
radius = radius + 1   #can be shortened to radius +=1
```

An assignment: expression on the right evaluated first and the value is stored in the variable name on the left

Built-in functions: input()

- `input` displays its single argument as a prompt on the screen and waits for the user to input text, followed by **Enter/ Return**. It returns the entered value as a **string**.

```
In [1] input('Enter your name: ')
Enter your name: Harry Potter
Out [1] 'Harry Potter'
In [2] age = input('Enter your age : ')
Enter your age: 17
In [3] age
Out [3] ’17'
```

Prompts in Maroon. User input in blue.
Inputted values are by default a **string**

Built-in functions: print()

- `print` displays a character-based representation of its argument(s) on the screen and returns a special **None** value (not displayed).

```
In[1] name = 'Harry Potter'
In [2] print('Your name is', name)
Your name is Harry Potter
In [3] age = input('Enter your age : ')
Enter your age: 17
In [4] print('The age of ' + name + ' is ' + age)
The age of Harry Potter is 17
```

Printed on the console; Comma as a separator adds a space

Can also add spaces through string concatenation

Built-in functions: int()

- When given a string that’s a sequence of digits, optionally preceded by +/-, `int` returns the corresponding integer. On any other string it raises a `ValueError` (correct type, but wrong value of that type).
- When given a float, `int` return the integer the results by truncating it toward zero.
- When given an integer, `int` returns that integer.

```
In [1] int('42')
Out [1] 42
In [2] int('-5')
Out [2] -5
In [3] int('3.141')
ValueError
```

Built-in functions: float()

- When given a string that’s a sequence of digits, optionally preceded by `+/-`, and optionally including one decimal point, `float` returns the corresponding floating point number. On any other string it raises a `ValueError`.
- When given an integer, `float` converts it to floating point number.
- When given a floating point number, float returns that number.

```
In [1] float('3.141')
Out [1] 3.141
In [2] float('-273.15')
Out [2] -273.15
In [3] float('3.1.4')
ValueError
```

Expressions vs Statement

Expressions

- They always produce a value

```
10 + 12 - 3
num + 4
“CS” + “134”
```

- Expressions can be composed of any combination of values, variables, and function calls

```
max(10, 20)
```

Statements

- They perform an action (that can be visible, invisible or both)

```
age = 12
print(‘Hello World’)
```

- Statements may contain expressions, which are evaluated **before** the action is performed

```
print('She is ' + str(age) + ' years old')
```

- Some statements return a **None** value which is not normally displayed

Error Messages

- **Type Errors**

```
'134' + 5
len(134)
```

- **Value Errors**

```
int('3.142')
float('pi')
```

- **Name Errors**

```
int('3.142')
float('pi')
```

- **Syntax Errors**

```
2ndValue = 25
1 + (ans = 42)
```

Submitting Labs: Git

- Git is a version control system that lets you manage and keep track of your source code history

- **GitHub** is a cloud-based git repository management & hosting service
  - **Collaboration**: Lets you share your code with others, giving them power to make revisions or edits

- **GitLabs** is similar to GitHub but we maintain it internally at Williams and will use to handle submissions and grading

Acknowledgments

- These slides have been adapted from:
  - http://cs111.wellesley.edu/spring19 and
  - https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-0001-introduction-to-computer-science-and-programming-in-python-fall-2016/