CS177 Python Programming

Recitation 2 - Computing with Numbers

Outline

- Data types.
- Variables
- Math library.
- Range Function

What is data (in the context of programming)?

- Values that are stored and manipulated by computer programs.
- In Python, data can be: numbers, strings (character, word, sentence, etc.), or objects (will be discussed in the later chapter)

Numeric Data Type

- Numeric is the most common data type
- Numbers can be classified as natural numbers, integers, rational numbers, real numbers, complex numbers, computable numbers …

Numbers in Python

- In Python, whole numbers are referred to *integers*; fractions are referred to *floating point*
  - A numeric literal **WITHOUT** a decimal point produces an int value
  - A literal that **WITH** a decimal point is represented by a float (even if the fractional part is 0)

String Data Type in Python

- A sequence of characters e.g., “Programming is cool!”
- Strings are encloses with
  - single quotes ‘this is string’
  - double quotes “This is a string”
  - triple double quote “””This is a string”””
- Two useful functions are used with Strings are *input()* and *eval()*

String Data Type in Python

- *input()* is used to obtain data from user

  - Example

```
>>>applicant = input("Enter the applicant's name: ")
>>>interviewer = input("Enter the interviewer's name: ")
>>>time = input("Enter the appointment time: ")
>>>print(interviewer, "will interview", applicant, "at", time)
```

String Data Type in Python

- *eval(expression)*
- The *expression* argument is parsed and evaluated as a Python expression

- Example

```
>>>x = input("Enter the value of x: ")
Enter the value of x:  1
print(eval(x))
```

Result: 1

String Data Type in Python

- We can perform + operation within *eval()*

 - Example

x = “10”

print(eval(x+”1”))

Result: 101

- Notice that the *expression* argument should be a string type

Arithmetic Operators

- Arithmetic operators inherit their definitions on numerical data types (int/floating point).
- Operations on floats produce floats.
- Operations on int produce int (except for /).
- What if one operand is int and the other is floating point?
  - 2+3.0

Variables

- Are names for objects that have values in main memory.
- We define variables by assigning values to names:

  Example:

  >>>a = 9

  >>>b = 13.54

  >>>c = “Computer”

- Variables can change their values during the program.

- It’s important to choose ***good*** names that describes the variable. Example: firstName, courseNo, etc.

Assignment Statement

Example:

X = 10

- Variable is also called **Left Hand Side**.
- Value is also called **Right Hand Side.**

Assignment Statement

- The value can be: a number, a string of characters, but also a variable, or an expression.
- Example:

  X = 10

  Y = X

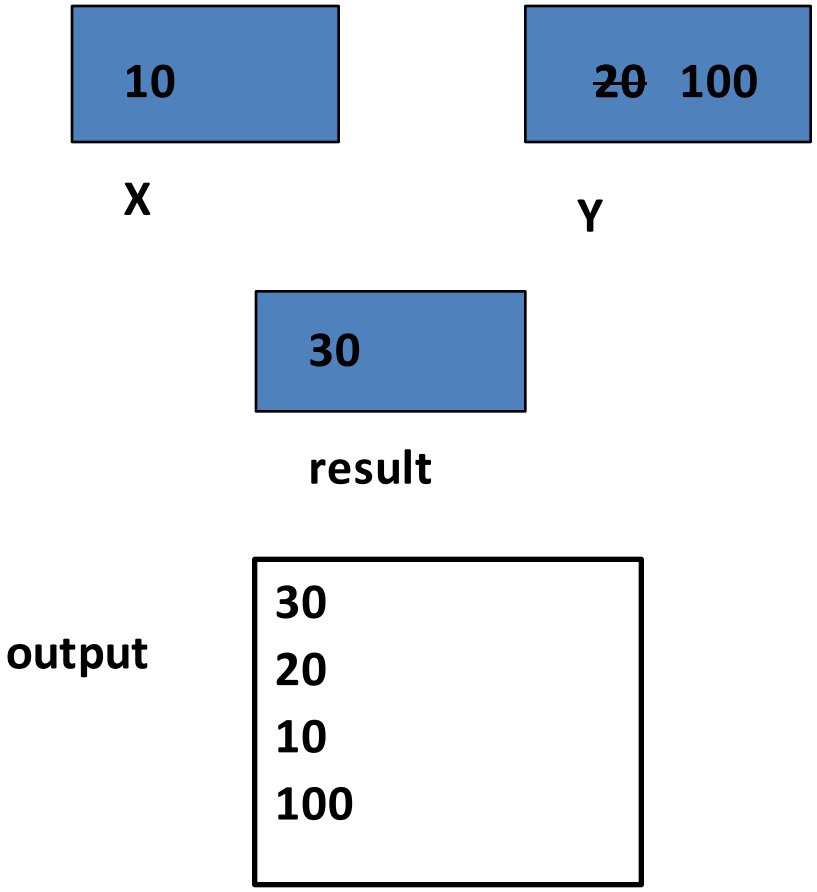
  Y = X + 5

  Z = Y

Example 1

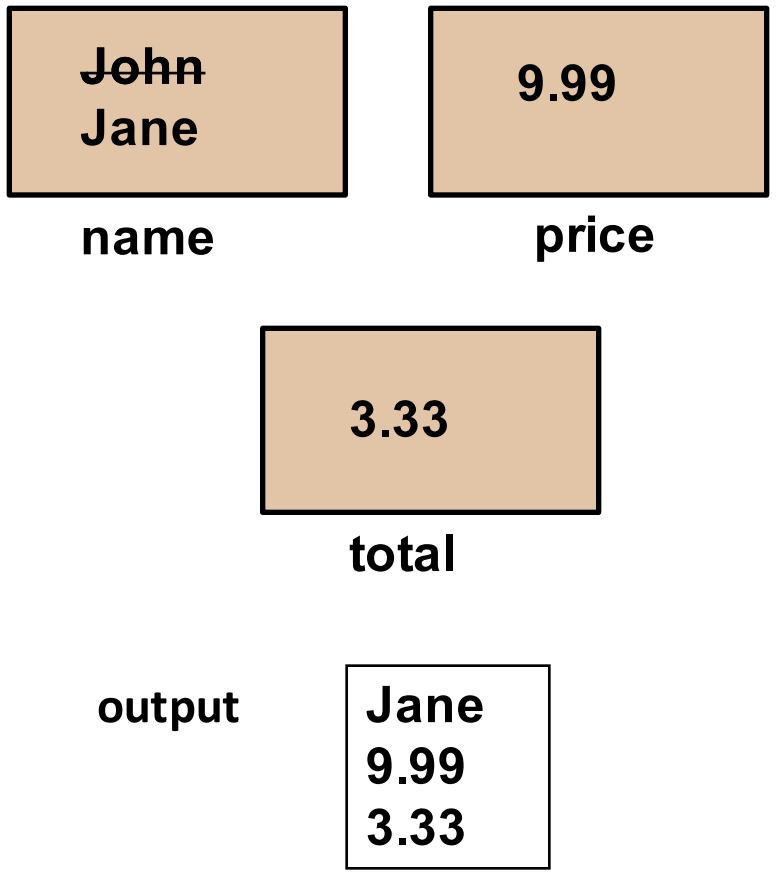
What is the output of the following statements:

```
>>> X = 10
>>> Y= 20
>>> result = X+ Y
>>> print (result)
>>> Y= 100
>>> print (x + 10)
>>> print (x)
>>> print (y)
```



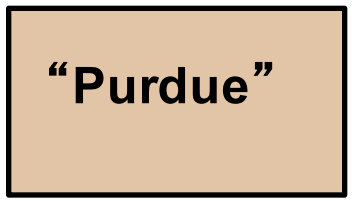
Exercise 1

```
>>> name = “John”
>>> price = 9.99
>>> total = price / 3.0
>>> name = “Jane”
>>>print (name)
>>>print (price)
>>>print (total)
```



Exercise 2

```
>>> var1 = “Purdue”
>>> var2 = “University”
>>>print (var1)
>>>print (var2)
>>>var2 = var1
>>>print (var1)
>>>print (var2)
```



var1

var2

output

```
Purdue
University
Purdue
Purdue
```

What about …

>>> X + 2 = 15

>>> Y = “Hello” + 10

Tips:

- Left Hand Side should always be a variable
- You can’t perform operations (such as sum) on two values of different types (numeric and string)

Math Library

- Python has math library that can perform powerful computations
  - *time*: provides various time-related functions
  - *math*: provides access to the mathematical functions defined by the C standard
  - *random*: generates pseudo-random numbers with various common distributions.

Math Library

- before using a library, we need to import the library into our program:
- Example
  - **import math**
- Then we can do…

math.pow(*x*, *y*) - Return x raised to the power y.

math.sqrt(*x*) - Return the square root of *x*.

math.factorial(*x*) - Return *x* factorial.

math.ceil(*x*) - Return the ceiling of *x.*

math.floor(*x*) - Return the floor of *x.*

Math Library Examples

```
>>> import math
>>> a = math.factorial(6)
>>> print(a)
720

>>> b = math.sqrt(123)
>>> print(b)
11.0905365064
```

Math Library Examples

```
>>> c = math.floor(5.9)
>>> print(c)
5

>>> x = math.factorial(4) * math.pow(2, 3)
>>> print(x)
192.0
```

Math Library Examples

```
>>> y = 5.5
>>> z = math.floor(y) * math.ceil(y)
>>> print(z)

>>> y = -5.5
>>> z = math.floor(y) * math.ceil(y)
>>>print(z)
```

The results for both code snippets are 30, but does math.floor(5.5) equal to abs(math.floor(-5.5))?

Function range

- Range is a function that returns a sequence
- If ***range*** has only one input parameter: (i.e range(**input**))
  - It generates the sequence of all the non-negative integers that are less than the **input** parameter value
  - the generated sequence starts with **0**
  - increment is 1
  - the last element of the sequence is the value of **input** parameter **– 1**

```
>>> list(range(3))
[0,1,2]
>>> list(range(9))
[0, 1, 2, 3, 4, 5, 6, 7, 8]
```

```
>>> list(range(1))
[0]
>>> list(range(0))
[]
```

```
>>>list( range(- 1))
[]
>>>list(range(- 5))
[]
```

Function range

- If two inputs (i.e range(first_input, second_input)):
  - It generates the sequence of all the integers that are greater than or equal to the **first_input** value and less than the **second_input** value
  - the first element of the sequence is the value of **first_input**
  - increment is 1
  - the last element of the sequence is the value of **second_input – 1**

```
>>> list(range(0, 3))
[0, 1, 2]
>>> list(range(0, 10))
[0, 1, 2, 3, 4, 5, 6, 7, 8, 9]
```

```
>>>list(range(4, 7))
[4, 5, 6]
>>> list(range(7, 4))
[]
```

```
>>>list(range(- 2, 2))
[- 2, - 1, 0, 1]
>>>list(range(- 2, - 5))
[]
```

Function range

- If three inputs (i.e. range(first_input, second_input, third_input)):
  - the sequence starts with the **first_input** value
  - increment is **third-input**
  - If increment is positive the sequence ends with the largest value less than **second_input**
  - If increment is negative the sequence ends with the smallest value greater than **second_input**

```
>>> list(range(0, 3, 1))
    [0, 1, 2]
>>>list(range(0, 6, 3))
    [0, 3]
```

```
>>>list(range(1, 7, 2))
    [1, 3, 5]
>>> list(range(-7, -1, 2))
    [-7, -5, -3]
```

```
>>>list(range(-5, 5, 3))
    [-5, -2, 1, 4]
>>> list(range(7, 1, -2))
    [7, 5, 3]
```

Exercises

type(9.5)

type(2)

type(2.0)

type(0.0)

type(0)

Exercises

type(2)

type(0.0)

type(2+3)

type(2.0+3)

type(2*3)

type(2/3)

type(2//3)

type(2%3)

Questions from past exams

- What is the output of the following Python program?

  ```
  x = list(rang(7, 1, -2))
  print(x[-2])
  ```

  A. 1

  B. 2

  C. 3

  D. 5

  E. 7

Questions from past exams

- What is the result of evaluating the following expression 2**4+9/3*2-2?

  A. 2.166666667

  B. 14.666666668

  C. 20.0

  D. 36.0

  E. None of the above

Questions from past exams

- What is the output of the following Python program?

```
def testFun(a, b, c):
    print(a+b+c)

testFun(11, 12, '13')
```

A. 36 B. 2313 C. '2313' D. 23+'13' E. TypeError

Questions from past exams

- What is the output of the following Python program?

```
def func(x, y):
    y = y*2
    x = x+y
    return x

print(func('1', '2'))
```

A.5
B.23
C.14
D.122
E.211