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Assignment 2 - Simple Types

Instructions

Follow the instructions for submitting a Jupyter Notebook assignment in the submitting assignments documentation.

1. Numeric Operations (20 Points)

```
a = 402
b = 1855

x = 41.151309
y = -95.919741
```

Given the preceding variable definitions, answer complete the questions below.

a. Compute the absolute value of `y`

b. Add `x` and `y` and multiple the result by `a`

c. Calculate the remainder leftover after dividing `b` by `a` (i.e. `b/a`)

d. Calculate `a` to the power of `3`

e. Show how to convert `a` to a floating point number

f. Multiple `x` by `y` and round the result to two signficant digits

g. Compute the bitwise *or* of `a` and `b`

h. Compute `x` divided by negative `y`

i. Compute `a` added to `b` divided by `x` minus `y`

j. Compute the floored quotient of `b` and `x`

In [1]:
```
a = 402
b = 1855

x = 41.151309
y = -95.919741
```

a) Compute the absolute value of y

In [2]:
```
abs(y)
```

Out[2]:
```
95.919741
```

b) Add x and y and multiply the result by a

In [3]:
```
(x + y)*a
```

Out[3]:
```
-22016.909664000003
```

c) Calculate the remainder leftover after dividing `b` by `a` (i.e. `b/a`)

In [4]:
```
b/a
```

Out[4]:
```
4.614427860696518
```

d) Calculate `a` to the power of `3`

In [5]:
```
a**3
```

Out[5]:
```
64964808
```

e) Show how to convert `a` to a floating point number. You can use float() or multiply by a floating point number.

In [6]:
```
print (float(a))
print(a*1.0)
```

```
402.0
402.0
```

f) Multiply `x` by `y` and round the result to two signficant digits

In [7]:
```
round(x*y,2)
```

Out[7]:
```
-3947.22
```

g) compute the bitwise or of a and b

In [8]:
```
a|b
```

Out[8]:
```
1983
```

h) Compute x divided by negative y

In [9]:
```
x/(-y)
```

Out[9]:
```
0.4290181413229629
```

i) Compute a added to b divided by x minus y

In [10]:
```
(a+b)/(x-y)
```

Out[10]: 16.465913115862172

j) Compute the floored quotient of b and x

In [11]:
```
print(b//x)
```

```
45.0
```

2. Integer Division (2 Points)

What is the difference between dividing using the `//` operator and the `/` operator? For instance, what is the difference between `4/2` and `4//2` ?

Dividing by "/" is called True Division, returning a float result that keeps any remainders. Dividing by "//" is Floor Division, which truncates the remainder and returns an integer.

In [12]:
```
print(4/2)
print(4//2)
```

```
2.0
2
```

3. Number Representations (4 Points)

Pick an integer number between 33 and 126. Print the following information about this number.

1. Its binary representation
2. Its hexadecimal representation
3. Its octal representation
4. The character corresponding to its Unicode point code.

In [13]:
```
#Chosen Number
I = 42

#Binary
print("Binary: " + bin(I))

#Hexadecimal
print("Hexadecimal: " + hex(I))

#Octal
print("Octal: " + oct(I))

#Unicode point code
print("Character: " + chr(I))
```

```
Binary: 0b101010
Hexadecimal: 0x2a
Octal: 0o52
Character: *
```

4. Variable Assignment (4 Points)

Consider the following two Python code examples. In both cases, we assign a value to variable `a`, assign variable `b` to `a` and then make changes variable `a`. Why is it that in the first example, changes to `a` do not affect `b`, but in the second example they do?

Example 1:

```
In [1]:  a = 1
         b = a
         a += 1
         print(b)

Out [1]: 1
```

Example 2:

```
In [2]:  a = [1, 2, 3]
         b = a
         a.append(4)
         print(b)

Out [2]: [1, 2, 3, 4]
```

In example 1, we are making a new object and setting 'a' to reference this new object. So 'b' doesn't change. In example 2, we are appending the object referenced by 'a'. Since 'b' references that same object, we see the change.

5. Dynamic Typing (6 Points)

Static typing vs. dynamic typing is one of computer programmings most bitter "holy wars (http://wiki.c2.com/?HolyWar)'. As a data scientist, it is important to understand the difference between static and dynamic typing and the pros/cons of each approach.

Answer each of the following questions in your own words.

a. What is the difference between static and dynamic typing?

b. What are the benefits of static typing over dynamic typing?

c. What are the benefits of dynamic typing over static typing?

Answers:
a) A statically typed language checks types before runtime. A dynamically typed language checks types during runtime.

b) A static typing sees better performance during runtime since types have already been checked. It is also good for catching errors prior to execution, which is particularly useful if you have long code.

c) A dynamic typing requires less code and is more flexible by allowing variables to change types.

6. Garbage Collection (4 Points)

a. Explain what *garbage collection* means in connection to programming languages.

b. How does CPython implement garbage collection?

Answers:
a) Garbage collection in connection to programming is an automatic reclamation of an object's space.

b) CPython implements garbage collection by placing a counter in every object that tracks the number of references pointing to that object. Once it hits 0, the memory space is reclaimed.