COMP 204

Variables

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based on material from Mathieu Blanchette, Carlos Oliver and Christopher Cameron

Quiz 4 password

Basic operations on numbers and strings

Operations on numbers:

Operations	Example	Value	Type
Addition	7+12	19	int
Subtraction	3.14 - 2.78	0.3600000000000003	float
Multiplication	2 * 3.1416	6.2832	float
Division	33 / 8	3.3	float
	33 / 11	3.0	float
Modulus	27 % 10	7	int
Exponentiation	4**3	$4^3 = 64$	int
Combination	2 + 6*2 - 8**2 / 4	-2.0	float
	(2+6)*(2 - 8**2/4)	-112.0	float

Precedence of arithmetic operators:

Exponentiation $>$ multiplication/division $>$ addition/subtraction

Use parentheses to group terms as desired

String Operations	Example	Value	Type
Concatenation	'Hello'+'World'	'HelloWorld'	str

Basic operations on booleans

- Conjunction (and)

```
True and True # True
True and False # False
False and True # False
False and False # False
```

- Disjunction (or):

```
True or True # True
True or False # True
False or True # True
False or False # False
```

- Negation (not):

```
not True # False
not False # True
```

Comparisons

A comparison is an operation that compares two objects and yields a boolean value

- Test equality

```
# Note the use of double-equal sign
3.14 == 3.14 # True
'ACTG' == 'GTCA' # False
'ACTG' == 'acgt' # False
```

- Test non-equality

```
3.14 != 3.1416 # True
'ACGT' != 'ACGT' # False
```

- Smaller-than, smaller-or-equal

```
3.14 < 3.1416 # True
3.14 > 3.14 # False
3.14 <= 3.14 # True
'ACGT'< 'ACTT' #True
```

Mixing it up

Manually check them and check them in Python shell

```
(2*3.14)<6  and 'TGA' == 'TGA' # False
((2*3.14)<6 or (17-3==14)) and 'TGA' == 'TGA' # True
not ('TGA' =='TGA'  or 'TGA'  != 'TGA' ) # False
'AA'  > 4          # TypeError: '>' not supported between
                   # instances of 'str' and 'float'
```

- So Python is just a fancy calculator?

  No! Programming is about linking multiple operations together
- For this, it is useful to be able to save to memory the results of an operation
- To this end, we use **variables**

Variables

Variables allow a program to remember values throughout the execution of the program.
This is how a program uses the computer's memory.
A variable has a *name* and a *value*.
A program can

- Create new variables
- Set the value of variables
- Look up the value of variables to include them in expressions
- Change the value of variables (hence the name)

Example of Variable: calculate the molecular mass of CO_2

```
weightCarbon = 12
# This creates a variable weightCarbon,
# assigns it value 12

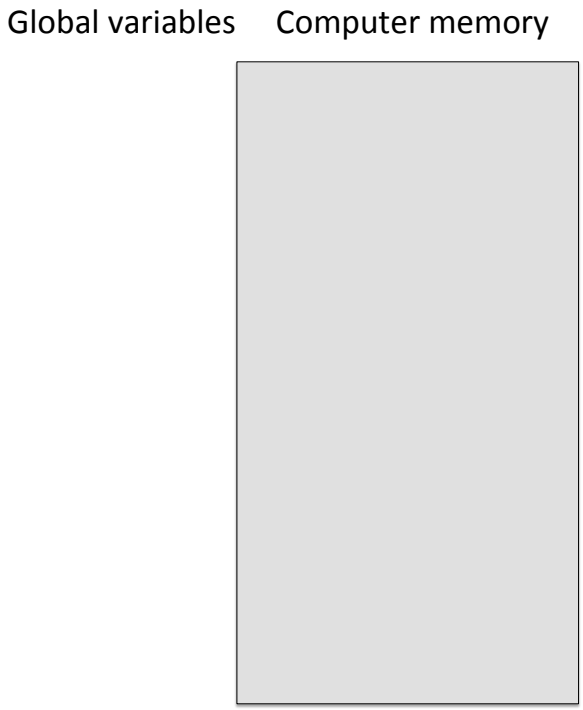
weightOxygen = 16
# This creates a variable weightOxygen,
# assigns it value 16

print('The weight of carbon is:', weightCarbon)
# This looks up the value of variable weightCarbon,
# performs the print statement

print('The weight of oxygen is:', weightOxygen)

weightCO2 = weightCarbon + 2 * weightOxygen
# This first evaluates the right-hand side,
# based on the current values of weightCarbon
# and weightOxygen. This yields 44.
# It then creates the variable weightCO2
# and assign it the value 44.
# Nothing gets printed so far

print('The weight of CO2 is:', weightCO2)
```



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print('The weight of oxygen is:', weightOxygen)

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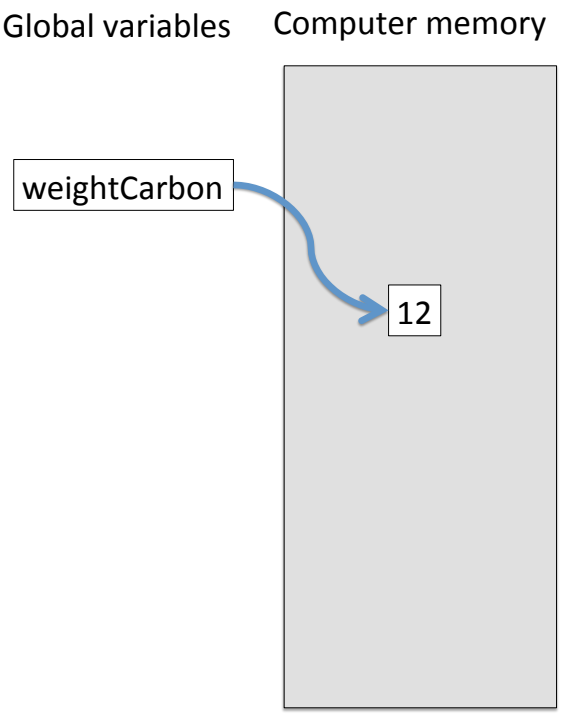

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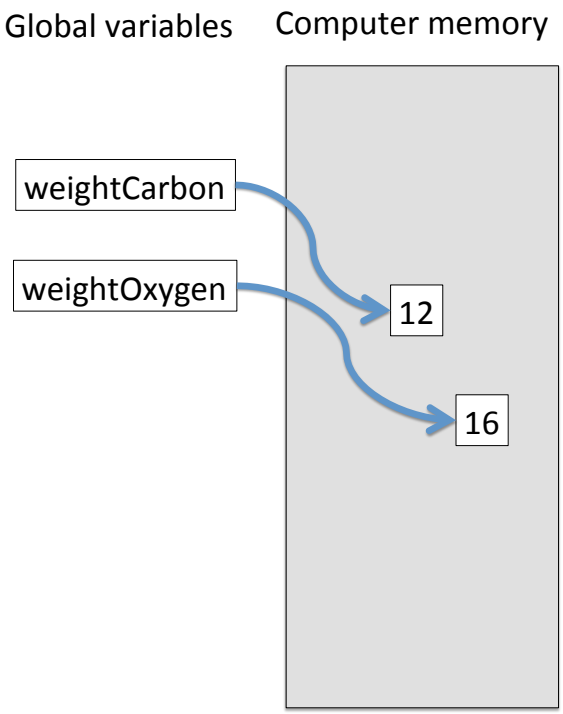

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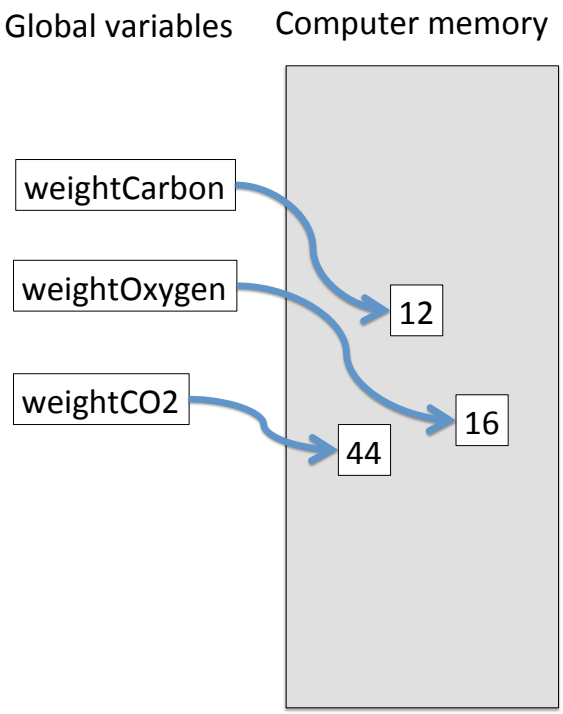
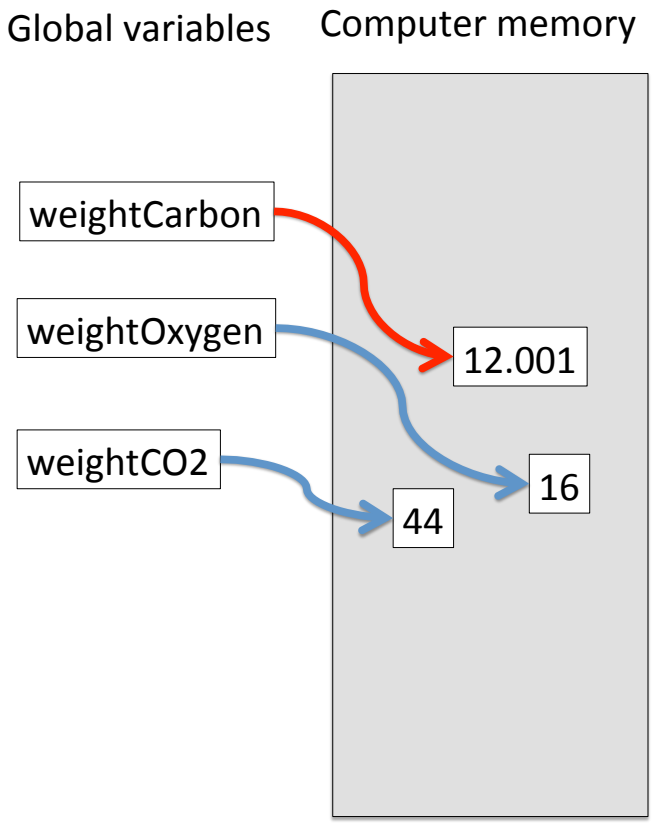


Variables - example

```
weightCarbon = 12
weightOxygen = 16
print('The weight of carbon is:', weightCarbon)
print('The weight of oxygen is:', weightOxygen)
weightCO2 = weightCarbon + 2 * weightOxygen
print('The weight of CO2 is:', weightCO2)

# Improved measurement of atomic masses
weightCarbon = 12.001
print('The weight of CO2 is:', weightCO2)
# weightCO2 remains 44
```



Variables - example

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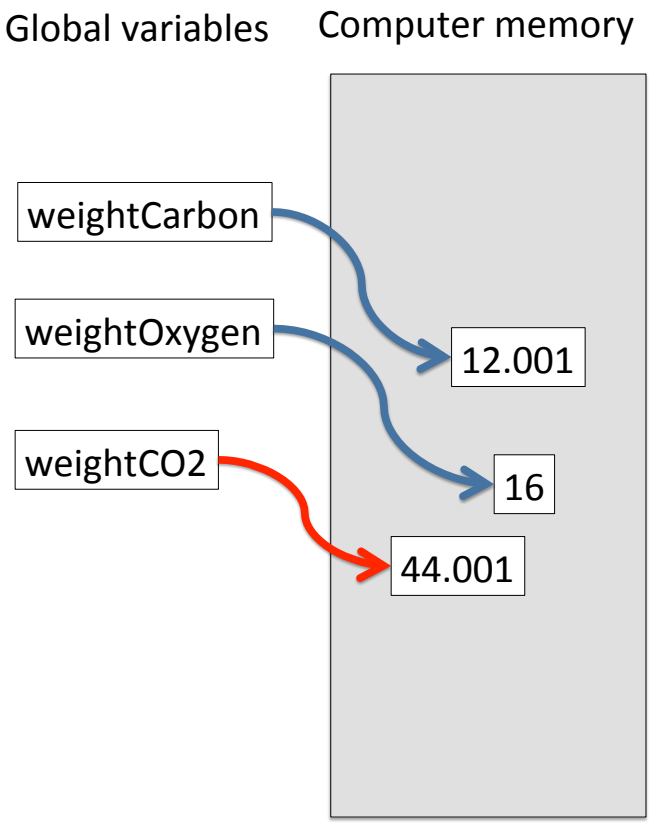
print('The weight of carbon is:', weightCarbon)
print('The weight of oxygen is:', weightOxygen)
weightCO2 = weightCarbon + 2 * weightOxygen
print('The weight of CO2 is:', weightCO2)

# Improved measurement of atomic masses
weightCarbon = 12.001
print('The weight of CO2 is:', weightCO2)
# weightCO2 remains 44

weightCO2 = weightCarbon + 2 * weightOxygen
# now weightCO2 becomes 44.001
print('The weight of CO2 is:', weightCO2)
```



Change of value in one variable will affect values of other variables involving that variable

Variables - example 2

Goal: Write a program that computes the body mass index (BMI) of a person: $BMI = weight/(height^2)$

```
weight = 69
height = 1.8
BMI = weight/(height**2)
print('A person with weight', weight, 'and height',
        height, 'has BMI =', BMI)

weight = 74 # suppose the weight changes
# The value of BMI still has not changed
print('A person with weight', weight, 'and height',
        height, 'has BMI =', BMI)

# We need to recalculate BMI to get the correct BMI
BMI = weight/(height**2)
print('A person with weight', weight,
        'and height', height, 'has BMI =', BMI)
```

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Variables - example 3 (user input)

Goal: Write a program that asks the user for their weight and height and then computes BMI.
How? Use the input(String) function, which prompts the user to enter data, and returns the string that was typed.

```
weight = input('Please enter your weight (in kg): ')
height = input('Please enter your height (in m): ')
BMI = weight/(height**2)
print('Your BMI is', BMI)
```

Problem: We get a *runtime error*:
TypeError: unsupported operand type(s) for ** or pow(): 'str' and 'int'
Use the Python shell to find out what the type of the weight and height variables are.

```
type(weight) # Aha, it's a String, not an integer
type(height) # and this one too!
```

That's because the *input* function always produces a string, irrespective of what is actually typed by the user.

Converting between types

Python allows data to be converted from one type to another using type conversion functions:

```
int(someObject) # convert someObject to an integer
float(someObject) # convert someObject to a float
str(someObject) # convert someObject to a string
```

Example,

```
name='Yue' # name is a String
weight='66' # weight is a String
height='1.8' # height is a String
weightInt = int(weight) # weightInt is an integer 68
heightFloat = float(height) # heightInt is a float 1.8
heightInt = int(height) # heightInt is an integer 1
        #Note: int() truncates decimal values
nameInt = int(name) # this causes an error, because
# the content of name cannot be converted to number
```

BMI program corrected

We use the type conversion functions to convert the output of the input function to float.

```
weight = input('Please enter your weight (in kg): ')
weightFloat= float(weight)
height = input('Please enter your height (in m): ')
heightFloat= float(height)
BMI = weightFloat/(heightFloat**2)
print('Your BMI is ' ,BMI)
```

Or more succinctly, we directly convert the output of the input function to a float, without saving the String in a variable:

```
weight=float(input('Please enter your weight (in kg): ')
height=float(input('Please enter your height (in m): '))
BMI = weight/(height**2)
print('Your BMI is ' ,BMI)
```

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Sneak peak of Assignment 1