Why?

* You can see what you type, so it is much easier to find mistakes.

* Very good for repetitive calculations.

* You can save what you did and go back to look at it if you need.

Math Opperations

* Python can perform most mathematical operations that you might want to use.

* The basic ones are built into python. Advanced operations require importing additional packages.

Basic Operators

* Basic operations are performed with symbols from the keyboard. They can differ slightly from what you have on a calculator:

    * addition   +   5+3

    * subtraction -   5-3

    * multiplication * 5*3

    * division /   5/3

    * exponentiation ** 5**3

    * modulus   %   5%3

    * integer division //   5//3

Assignment

* Variables can be used in computer calculations, but they are very different than the way you use variables in algebra.

* In algebra variables have unknown values and you solve for them.

* In normal use on a computer variables are just names that are assigned a certain value.

* The = sign is used for assignment.

* a = 5 assigns the value of 5 to a

* 5 = a will result in an error because a has no value and you can't assign values to numbers. In other words 5 has the value of 5 you can't assign any other value to it.

Assignment

* allowed

a=5

b= 7 * (5 + a) #parenthesis give order of operations just like normal math

c = b**2 * 2.998E8. # e or E can be used as scientific notation

a= 32 #one can reassign variables, they keep the last assigned value

a=a+5 #this is a weird one, but works the new value of a is the old value of a plus 5

* not allowed

7 =3

b = 5 * a #a has not been assigned a value

a = a +5 #a has not been assigned a value and you are using it on the right side

Repeating Calculations

* What is the advantage of using variables? Later we will see many, but to start one advantage is that you can run the same operations over and over if you need. For example,

a = 4

#a = 5

#a = 6

b= 17*a**2 + 6*a + 25

print(b**2 + 5*a)

* The commented parts are skipped. If you run this code and then uncomment the a=5 line you can run it again for a=5 with out having to retype all the other parts. Again with 6.

* print is a python function therefore you must pass it values inside parenthesis, print("word"), or print(a).

More Operations

* In order to access more math operations we will need to import packages. Let's look at one called math first.

import math   #this imports the math package

answer_a=math.sqrt(16)

answer_b=math.exp(-0.5*answer_a)

answer_c=math.sin(0.223) #note radians not degrees

* These are all functions so you must pass the value inside parenthesis.

* Note that you aren't supposed to memorize the names of these functions. You can get the full list from the web, https://docs.python.org/3/library/math.html, or in python using help(math) after it has been imported. You can also get the list without explanation with dir(math).

Numpy Arrays

* One way to greatly increase the power of parallel calculations in python is to make use of numpy arrays. For now let us just consider an array as a series of numbers. One can then perform operations on all the numbers in that series at the same time. For example,

import numpy as np #call the package np for short

array = np.array([1,2,3,4,5])

answer = 5*array - 32

* And answer is now not one number, but 5 numbers each one multiplied by 5 and subtracting 32.

* One important thing to note is you can't use the math package on numpy arrays, instead you have to use similar functions in the numpy package. So you can do

import numpy as np

theta = np.array([0.1,0.2,0.3,0.4,0.5])

answer = np.sqrt(np.sin(theta))

* However, math.sqrt or math.sin would both give errors.

Problems

1. (57+92/17 × 85)/4?

2. $2.998 \times 10^8 \times 3.14 \times 107$?

3. $18x^2 - 12x + 5 = 0$. What is x?

4. The tangent of 30, 45 and 60 degrees?

5. What is the acceleration of gravity from the Earth at the Earth's surface, twice the Earth's radius, and five times the Earth's radius? Earth mass is 5.972E24 kg, Earth radius is 6378km, G=6.674E-11.