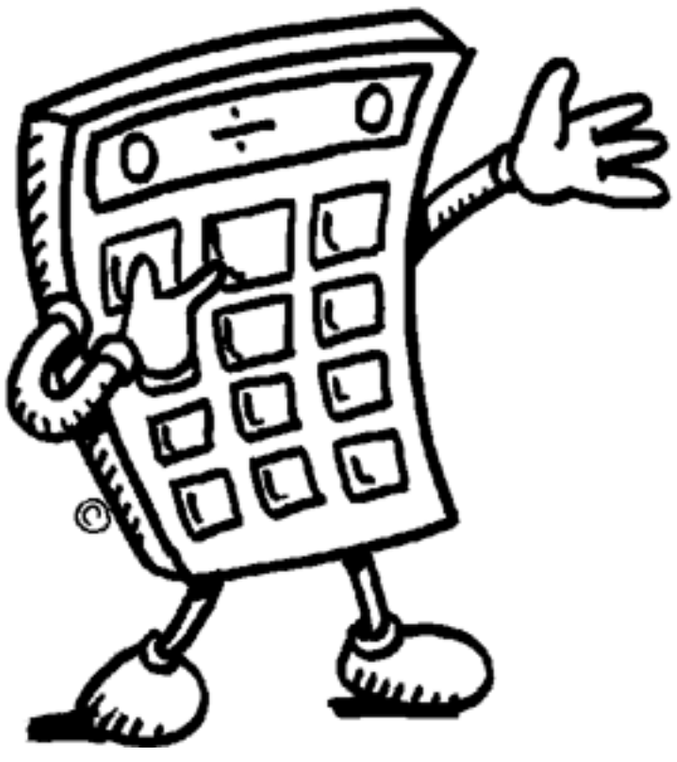
Let's talk to Python!

Math

Try doing some math at the prompt:

```
>>> 1 + 2
>>> 12 - 3
>>> 9 + 5 - 15
```



Operators:

add: +

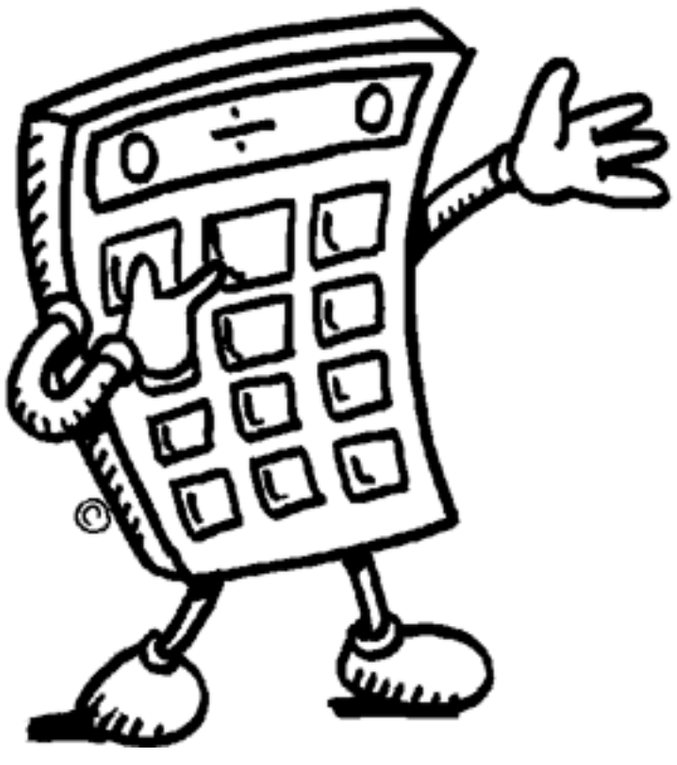
subtract: -

Math

More operators:

divide: /

multiply: *

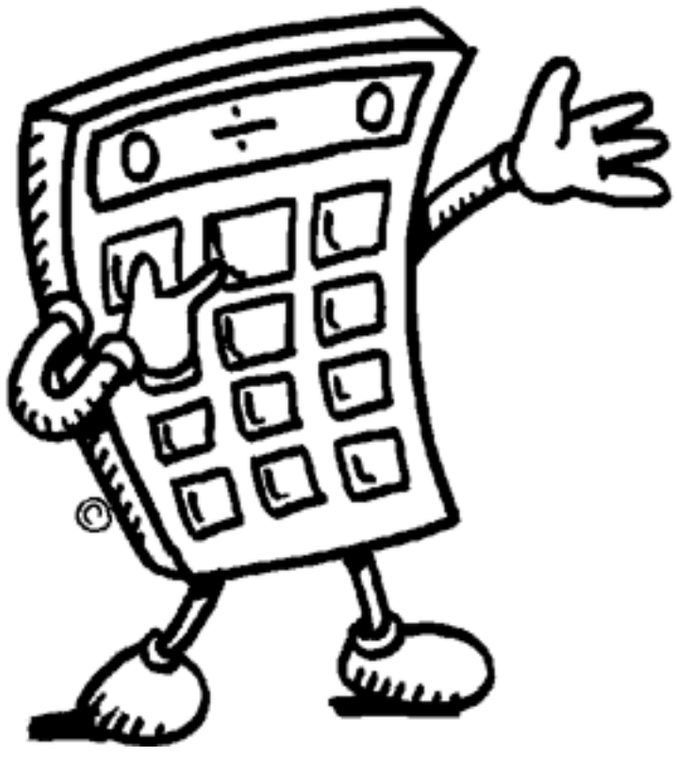


```
>>> 6 * 5
>>> 6 / 2
>>> 10 * 5 * 3
```

Math

Try some more division:

```
>>> 8 / 4
>>> 20 / 7
>>> 10 / 3
```



Are you getting the results you expected?

Math

Floats (decimals):

10.0

17.31

Integers:

9,

-55

```
>>> 10/3
3.3333333333333335
>>> 10/2
5.0
```

```
>>> round(10/3)
3
>>> round(10/2)
5
```

Math

Comparison operators:

==	Equal to
!=	Not equal to
<	Less than
>	Greater than
<=	Less than or equal to
>=	Greater than or equal to

Math

Practice:

```
>>> 5 < 4 + 3

>>> 12 + 1 >= 12

>>> 16 * 2 == 32

>>> 16 != 16

>>> 5 >= 6
```

==	Equal to
!=	Not equal to
<	Less than
>	Greater than
<=	Less than or equal to
>=	Greater than or equal to

Math

Practice:

```
>>> 5 < 4 + 3
True
>>> 12 + 1 >= 12
True
>>> 16 * 2 == 32
True
>>> 16 != 16
False
>>> 5 >= 6
False
```

Strings

Strings

Examples:

```
>>> "Hello!"
>>> "puppy breath"
>>> "redstone"
```

Try typing one without quotes:

```
>>> apple
```

What's the result?

★ Rule:
A string must be in quotes

```
>>> "apple"
>>> "What's for lunch?"
>>> "3 + 5"
```

Strings

String operators:

concatenation: +
multiplication: *

Try concatenating:

```
>>> "Hi" + "there!"
```

Try multiplying:

```
>>> "HAHA" * 250
```

Strings: Indexes

Strings are made up of **characters**:

```
>>> "H" + "e" + "l" + "l" + "o"
'Hello'
```

Each character has a position called an *index*:

```
H  e  l  l  o
0  1  2  3  4
```

In Python, indexes start at **0**

Strings: Indexes

```
>>> print("Hello"[0])
H
```

```
>>> print("Hello"[4])
```

```
>>> print("Hey, Bob!"[4])
```

```
>>> print("Hey, Bob!"[6-1])
```

Strings: Indexes

Rules:

- Each character's position is called its *index*.
- Indexes start at 0.
- Spaces inside the string are counted.

Variables

Variables

Calculate a value:

```
>>> 12 * 12
144
```

How can you save that value?

Give the value a <u>name</u>:

```
>>> donuts = 12 * 12
>>> donuts
144
```

Variables

Create a variable and give it a value:

```
>>> color = "yellow"
>>> color
'yellow'
```

Now assign a new value:

```
>>> color = "red"
>>> color
'red'
```

```
>>> color = "fish"
>>> color = 12
```

Variables

- ★ Calculate once, keep the result to use later
- ★ Keep the same name, change the value

Variables

Some other things we can do with variables:

Math operations

```
>>> donuts = 12 * 12
>>> fishes = 3
>>> fishes + donuts
```

String operations

```
>>> color = "yellow"
>>> day = “Monday”
>>> color + day
>>> color * fishes
>>> color + day * fishes
```

Variables

More things we can do with variables:

Get an index from a string:

```
>>> fruit = "watermelon"
>>> print (fruit[2])
```

Do some math to get the index:

```
>>> mynumber = 3
>>> print (fruit[mynumber-2])
```

Variables

Assigning values or making comparisons?

```
>>> fruit = "watermelon"
>>> 5 = 6
```

```
>>> fruit == "watermelon"
>>> 5 == 6
```

Errors

Errors

```
>>> "friend" * 5
‘friendfriendfriendfriendfriend’

>>> "friend" + 5
 Error

Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
TypeError: Can't convert 'int' object to str implicitly
```

What do you think ‘str’ and ‘int’ mean here?

Does this error message tell you what’s wrong?

Errors

```
>>> "friend" + 5

Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
TypeError: Can't convert 'int' object to str implicitly
           ^          ^          ^                  ^
```

- ‘int’ is an integer
- ‘str’ is a string
- Python cannot concatenate objects of different *types*

Errors

How can we fix this error? Concatenation won't work.

```
>>> "friend" + 5
Error
```

What if we make 5 a string?

```
>>> "friend" + "5"
friend5
```

What's another way that we could fix this error?

Let's do something new with the `print` command:

```
>>> print("friend", 5)
friend 5
```

Types of data

Data types

We already know about three types of data:

"Hi!"	string
27	integer
15.238	float

Python can tell us about types using the `type()` function:

```
>>> type("Hi!")
<class 'str'>
```

Can you get Python to output `int` and `float` types?

Data type: Booleans

Booleans

A Boolean value can be: `True` or `False`

Is 1 equal to 1?

```
>>> 1 == 1
True
```

Is 15 less than 5?

```
>>> 15 < 5
False
```

Booleans

What happens when we type Boolean values in the interpreter?

```
>>> True
>>> False
```

When the words ‘True’ and ‘False’ begin with *upper case* letters, Python knows to treat them like Booleans instead of strings or integers.

```
>>> true
>>> false
>>> type(True)
>>> type(“True”)
```

Booleans

and

If both are True:

```
>>> 1==1 and 2==2
True
```

If only one is True:

```
>>> 1==1 and 2==3
False
```

If both are False:

```
>>> 1==2 and 2==3
False
```

Booleans

or

If both are True:

```
>>> 1==1 or 2==2
True
```

If only one is True:

```
>>> 1==1 or 2!=2
True
```

If both are False:

```
>>> 1==2 or 2==3
False
```

Booleans

not

You can use the word **not** to reverse the answer that Python gives:

```
>>> 1==1
True
```

```
>>> not 1==1
False
```

Any expression that is True can become False:

```
>>> not True
False
```

Booleans

You can also use booleans in their own expressions:

```
>>> True and True
>>> True and False
>>> False and False

>>> True or True
>>> False or True
>>> False or False

>>> not True and True
>>> not True or True
```

Booleans: Practice

Try some of these expressions in your interpreter.

See if you can predict what answers Python will give back.

```
>>> True and True
>>> False and True
>>> 1 == 1 and 2 == 1
>>> "test" == "test"
>>> 1 == 1 or 2 != 1
>>> True and 1 == 1
>>> False and 0 != 0
>>> True or 1 == 1
>>> "test" == "tests"
>>> 1 != 0 and 2 == 1
```

Data type: Lists

Lists

List: a sequence of objects

```
>>> fruit = ["apple", "banana", "grape"]
>>> numbers = [3, 17, -4, 8.8, 1]
```

Guess what this will output:

```
>>> type(fruit)
```

```
>>> type(numbers)
```

Lists

List: a sequence of objects

```
>>> fruit = ["apple", "banana", "grape"]
>>> numbers = [3, 17, -4, 8.8, 1]
```

Guess what this will output:

```
>>> type(fruit)
<class 'list'>

>>> type(numbers)
<class 'list'>
```

Lists

Index: Where an item is in the list

```
>>> fruit = ["apple", “banana", "grape"]
>>> fruit[0]
'apple'
```

```
['apple', 'banana', 'grape']
    0         1         2
```

Python always starts at zero!

Lists

Make a **list** of three of your favorite colors.

Use an **index** to print your favorite color's name.

Lists

Make a **list** of three of your favorite colors.

```
>>> colors = ["red", "orange", "purple"]
```

Use an **index** to print your favorite color's name.

```
>>> print(colors[1])
```

Logic

`if` Statements

`if` Statements

Making decisions: "**If** you're hungry, let's eat lunch."

"**If** the trash is full, go empty it."

If a condition is met, perform an action:

```
>>> name = "Meg"
>>> if name == "Meg":
        print("Hi Meg!")

Hi Meg!
```

`if` Statements

Adding a choice: "**If** you're hungry, let's eat lunch now.
Or **else** we can eat in an hour."

"**If** there's mint ice cream, I'll have a scoop.
Or **else** I'll take vanilla."

Adding a choice in our code with the *else clause*:

```
>>> if name == "Meg":
        print("Hi Meg!")
    else:
        print("Impostor!")
```

`if` Statements

Adding many choices:

"**If** there's mint ice cream, I'll have a scoop.
Or **else** if we have vanilla, I'll have 2!
Or **else** if there's chocolate, give me 3!
Or I'll just have a donut."

Adding more choices in our code with the *elif clause*:

```
>>> if name == "Meg":
        print("Hi Meg!")
    elif name == "Barbara":
        print("Hi Barbara!")
    else:
        print("Who are you?")
```

`if` Statements

`if/elif/else` practice

Write an if statement that prints "Yay!" if the variable named color is equal to "yellow".

Add an *elif clause* and an *else clause* to print two different messages for other values of the variable.

(Here's our last example)

```
>>> name = "Meg"
>>> if name == "Meg":
        print("Hi Meg!")
    elif name == "Barbara":
        print("Hi Barbara!")
    else:
        print("Who are you?")
```

`if` Statements

`if/elif/else` practice

Write an if statement that prints "Yay!" if the variable named color is equal to "yellow".

Add an *elif clause* and an *else clause* to print two different messages for other values of the variable.

```
>>> color = "blue"
>>> if color == "yellow":
        print("Yay!")
elif color == "purple":
    print("Try again!")
else:
    print("We want yellow!")
```

Loops

Loops

Loops are chunks of code
that repeat a task over and over again.

★*Counting* loops repeat a certain number of times.

★*Conditional* loops keep going until a certain thing happens (or as long as some condition is True).

Loops

Counting loops repeat a certain number of times - they keep going until they get to the end of a count.

```
>>> for mynum in [1, 2, 3, 4, 5]:
        print("Hello", mynum)

Hello 1
Hello 2
Hello 3
Hello 4
```

The *for* keyword is used to create this kind of loop, so it is usually just called a *for loop*.

Loops

Conditional loops repeat until something happens
(or as long as some condition is True).

```
>>> count = 0
>>> while (count < 4):
        print("The count is:", count)
        count = count + 1

The count is: 0
The count is: 1
```

The *while* keyword is used to create this kind of loop,
so it is usually just called a *while loop*.

Functions

Functions

What it's like in our minds:

"Make a peanut butter and jelly sandwich."

In Python, you could say it like this:

```
make_pbj(bread, pb, jam, knife)
```

function **name** function **parameters**

Functions

What if we wanted to make many kinds of sandwiches?

"Make a peanut butter and jelly sandwich."
"Make a cheese and mustard sandwich."

In Python, it could be expressed as:

```
make_sandwich(bread, filling, toppings)
```

*function **name*** *function **parameters***

Functions

Let's define a function in the interpreter:

```
>>> def say_hello():
        print("Hello")
```

Now we'll call the function:

```
>>> say_hello()
Hello
```

Functions

Let's define a function with parameters:

```
>>> def say_hello(myname):
        print("Hello", myname)

>>> say_hello("Meg")
Hello Meg

>>> say_hello("Barbara")
Hello Barbara
```

Functions

A few things to know about functions ...

```
>>> def say_hello(myname):
        print("Hello", myname)
```

`def`	This is a **keyword**	We use this to let Python know that we're defining a function.
`myname`	This is a **parameter** (and a **variable**).	We use this to represent values in the function.
`print(...)`	This is the **body**	This is where we say what the function *do*es.

Functions: Practice

1. Work alone or with a neighbor to create a function that **doubles a number** and prints it out.

(Here's our last example)

```
>>> def say_hello(myname):
        print("Hello", myname)
```

Functions: Practice

1. Work alone or with a neighbor to create a function that **doubles a number** and prints it out.

```
>>> def double(number):
        print(number * 2)

>>> double(14)
28

>>> double("hello")
hellohello
```

Functions: Practice

2. Work alone or with a neighbor to create a function that takes **two numbers**, multiplies them together, and prints out the result.

(Here's our last example)

```
>>> def double(number):
        print(number * 2)

>>> double(14)
28
```

Functions: Practice

2. Work alone or with a neighbor to create a function that takes **two numbers**, multiplies them together, and prints out the result.

```
>>> def multiply(num1, num2):
        print(num1 * num2)

>>> multiply(4, 5)
20

>>> multiply("hello", 5)
hellohellohellohellohello
```

Functions: Output

`print` displays something to the screen.

```
>>> def double(number):
        print(number * 2)
```

We call the function, passing it the number 12:

```
>>> double(12)
24
```

We call the function again, passing it the number 12 and assigning it to the variable new_number:

```
>>> new_number = double(12)
24
```

But what happens here?

```
>>> new_number
```

Functions: Output

This time let's use `return` instead of `print`.

```
>>> def double(number):
        return number * 2
```

We call the function, passing it the number 12:

```
>>> double(12)
24
```

We call the function again, passing it the number 12 assigning the value to the variable new_number:

```
>>> new_number = double(12)
>>> new_number
```

Now what happens?

Functions

- ★ Functions are **defined** using **`def`**.
- ★ Functions are **called** using **parentheses**.
- ★ Functions take **parameters** and can return **outputs**.
- ★ `print` *displays* information, but does not give a value
- ★ `return` **gives a value** to the caller (that's you!)

Input

Input

Input is information we pass to a function so that we can do something with it.

```
>>> def hello_there(myname):
        print("Hello", myname)
```

In this example, the string "Meg" is the input, represented by the variable myname.

```
>>> hello_there("Meg")
'Hello there Meg'
```

Input

The `input()` function takes *input* from the user - you give that input to the function by typing it.

```
>>> def hello_there():
        print "Type your name:"
        name = input()
        print("Hi", name, "how are you?")
```

Input

```
>>> def hello_there():
        print "Type your name:"
        name = input()
        print("Hi", name, "how are you?")

>>> hello_there()
Type your name:
Barbara
Hi Barbara how are you?
```

Input

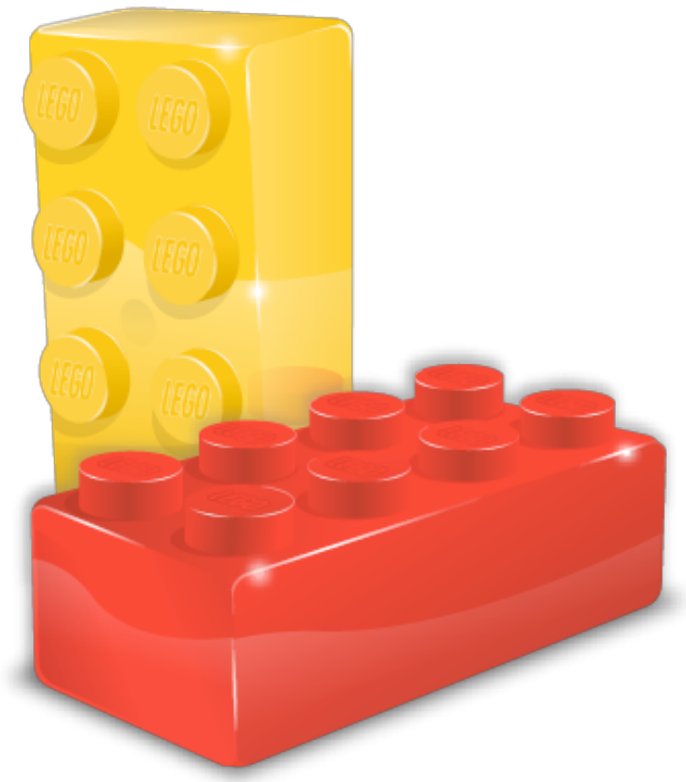
A shortcut:

```
>>> def hello_there():
        name = input("Type your name: ")
        print ("Hi", name, "how are you?")

>>> hello_there()
Type your name: Barbara
Hi Barbara how are you?
```

Modules

Modules



A module is a block of code that can be combined with other blocks to build a program.

You can use different combinations of modules to do different jobs, just like you can combine the same LEGO blocks in many different ways.

Modules

Lots of modules are included in the Python Standard Library.

Here's how you can use a few of these modules:

Generate a random number between 1-100:

```
>>> import random
>>> random.randint(1,100)
```

What timezone does your computer think it's in?:

```
>>> import time
>>> time.tzname
```

Print a calendar for this month!:

```
>>> import calendar
>>> calendar.prmonth(2016, 6)
```

Modules

Print the names of all the files in a directory:

```
>>> import os
>>> for file in os.listdir("/home/pi"):
        print(file)
```

Open a web page and read it:

```
>>> import urllib.request
>>> myurl = "http://www.google.com"
>>> data = urllib.request.urlopen(myurl).read()
>>> print(data)
```

Congratulations!

You're now a Pythonista!