

Let's talk to Python!

Math

Try doing some math at the prompt:

>>> 1 + 2

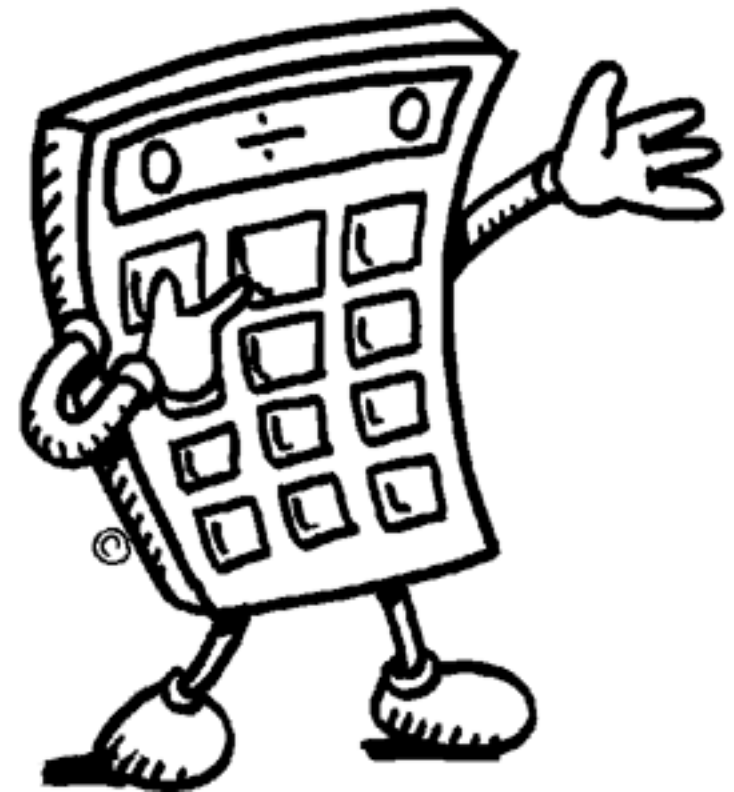
>>> 12 - 3

>>> 9 + 5 - 15

Operators:

add: +

subtract: -



Math

More operators:

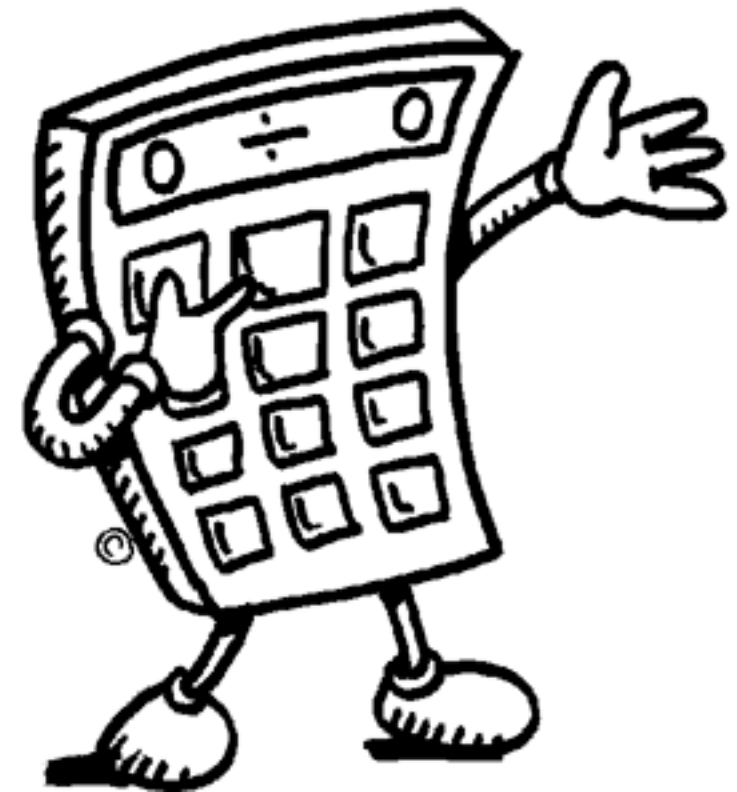
divide: /

multiply: *

```
>>> 6 * 5
```

```
>>> 6 / 2
```

```
>>> 10 * 5 * 3
```



Math

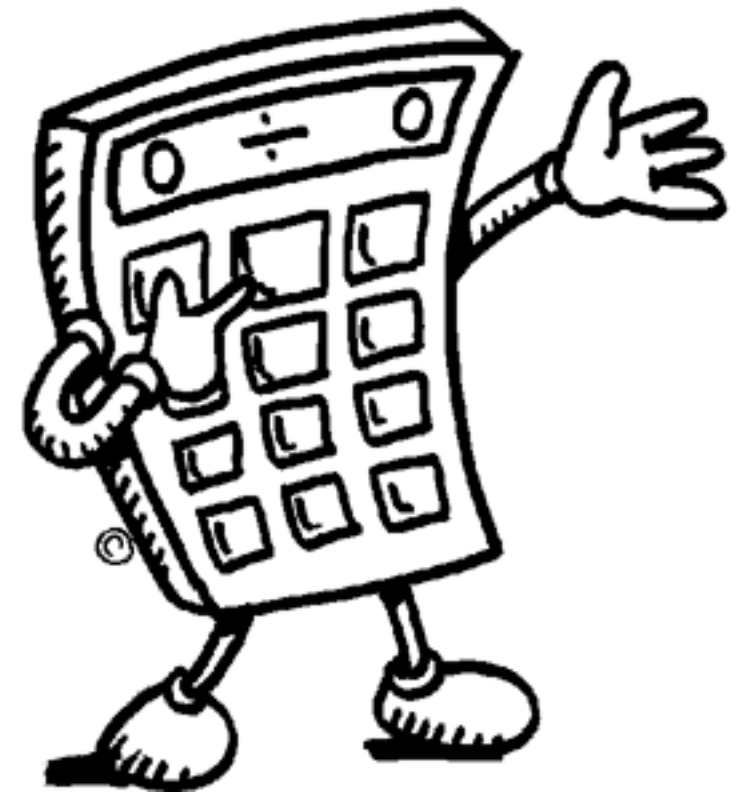
Try some more division:

>>> 8 / 4

>>> 20 / 7

>>> 10 / 3

Are you getting the
results you expected?



Math

Floats (decimals):

10.0

17.31

```
>>> 10/3
```

```
3.3333333333333335
```

```
>>> 10/2
```

```
5.0
```

Integers:

9,

-55

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

```
3
```

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

```
5
```

Math

Comparison operators:

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

What's the result?

```
>>> apple
```



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 name: `>>> 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: $>>> 1==1 \text{ or } 2==2$
True

If only one is True: $>>> 1==1 \text{ or } 2!=2$
True

If both are False: $>>> 1==2 \text{ or } 2==3$
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".

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

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

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

Remember our PB&J example?

Which looks easier?:

1. Get bread
2. Get knife
4. Open peanut butter
3. Put peanut butter on knife
4. Spread peanut butter on bread
5. ...

1. Make PB&J

Functions are a way to *group* instructions.

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)
```

A diagram illustrating the components of a Python function call. It shows the function name 'make_pbj' and its four parameters: 'bread', 'pb', 'jam', and 'knife'. Red arrows point from the labels 'function name' and 'function parameters' below to their respective parts in the code above. The 'function name' label points to 'make_pbj', and the 'function parameters' label points to the entire argument list '(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)
```

<code>def</code>	This is a keyword	We use this to let Python know that we're defining a function.
<code>myname</code>	This is a parameter (and a variable).	We use this to represent values in the function.
<code>print(...)</code>	This is the body	This is where we say what the function <i>does</i> .

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.

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

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

Modules

Turtles!

```
>>> import turtle
>>> turtle.reset()
>>> turtle.forward(20)
>>> turtle.right(20)
>>> turtle.forward(20)
>>> turtle.bye()
```

You can find out about other modules at: <http://docs.python.org>

Let's make a game!

Games!

Open a new window (File > New File) and type these lines:

```
secret_number = 7

guess = input("What number am I thinking of? ")

if secret_number == guess:
    print("Yay! You got it.")
else:
    print("No, that's not it.")
```

Choose Run > Run Module. Save to Desktop as 'guess.py'.

Games!

Open a new window (File > New File) and type these lines:

```
from random import randint  
secret_number = randint(1, 10)  
while True:  
    guess = input("What number am I thinking of? ")  
  
    if secret_number == guess:  
        print("Yay! You got it.")  
        break  
    else:  
        print("No, that's not it.")
```

Choose Run > Run Module. Save to Desktop as 'guess2.py'.

Games!

Open a new window (File > New File) and type these lines:

```
from random import randint

secret_number = randint(1, 10)

while True:
    guess = input("What number am I thinking of? ")

    if secret_number == guess:
        print("Yay! You got it.")
        break
    elif secret_number > guess:
        print("No, that's too low.")
    else:
        print("No, that's too high.")
```

Choose Run > Run Module. Save to Desktop as 'guess3.py'.

Congratulations!

You're now a Pythonista!