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Python

Basics

Centre for Environmental Data Analysis
SCIENCE AND TECHNOLOGY FACILITIES COUNCIL
NATURAL ENVIRONMENT RESEARCH COUNCIL

software carpentry

National Centre for Atmospheric Science
NATURAL ENVIRONMENT RESEARCH COUNCIL

National Centre for Earth Observation
NATURAL ENVIRONMENT RESEARCH COUNCIL

A simple interpreted language

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no separate compilation step

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```
$ python
>>>
```

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```
$ python
>>> print(1 + 2)
3
>>>
```

A simple interpreted language

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```
$ python
>>> print(1 + 2)
3
>>> print('Charles' + 'Darwin')
CharlesDarwin
```

Or remove print (when in the interactive python shell):

```
>>> 'Charles' + 'Darwin'
CharlesDarwin
```

Put commands in a file and execute that

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```
$ gedit very-simple.py
```

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print(1 + 2)
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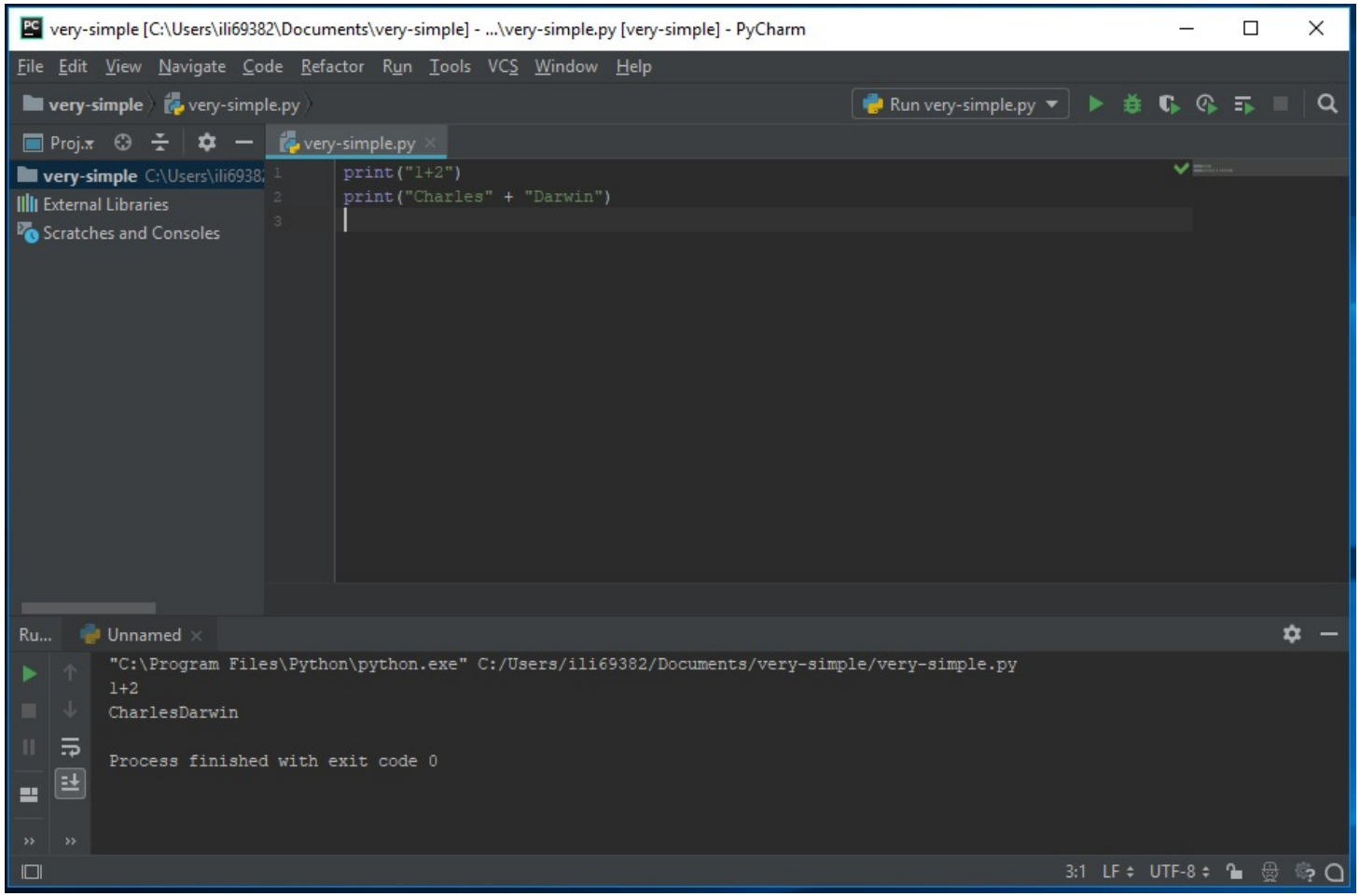
3
CharlesDarwin
$
```

Use an *integrated development environment* (IDE)



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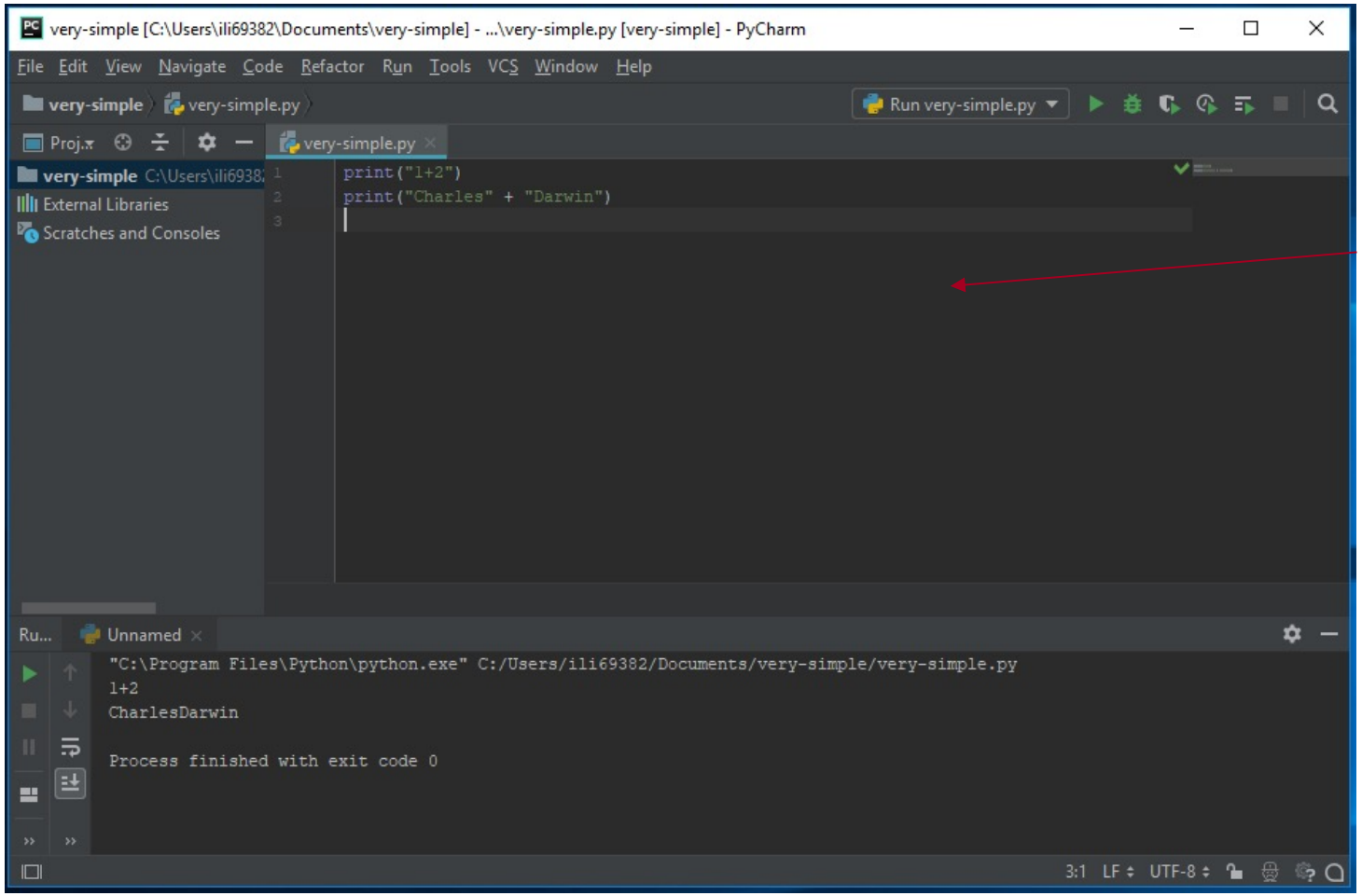
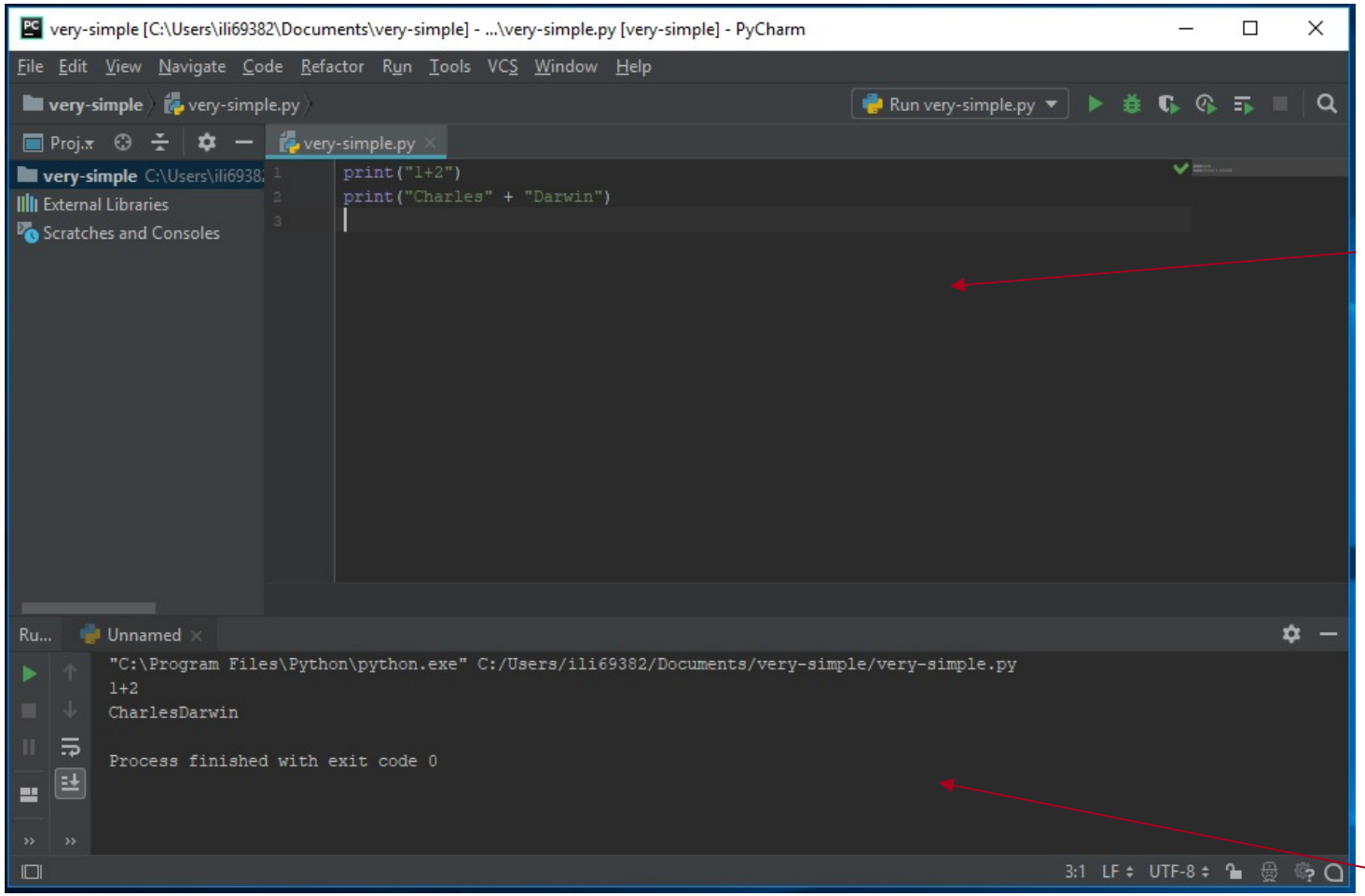


Source file

Use an *integrated development environment* (IDE)



Source file

Execution shell

Variables are names for values

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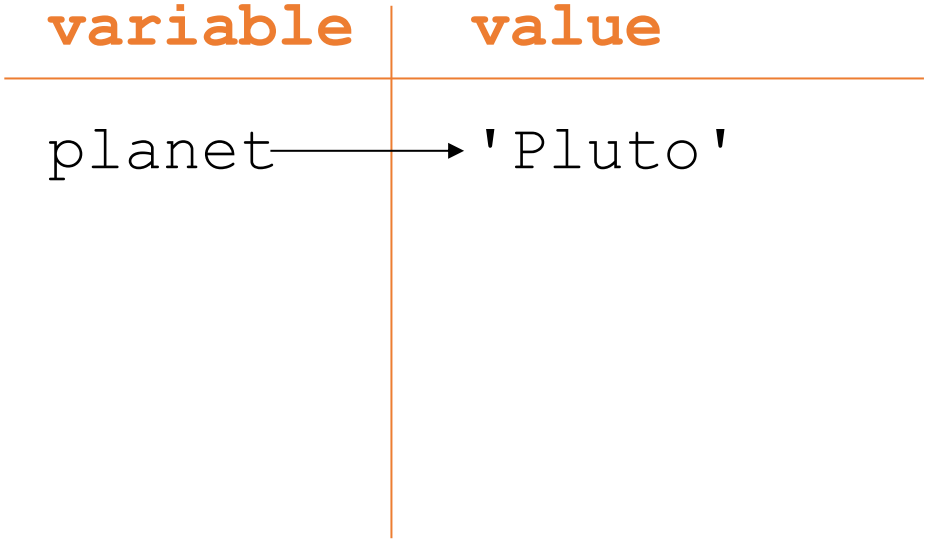

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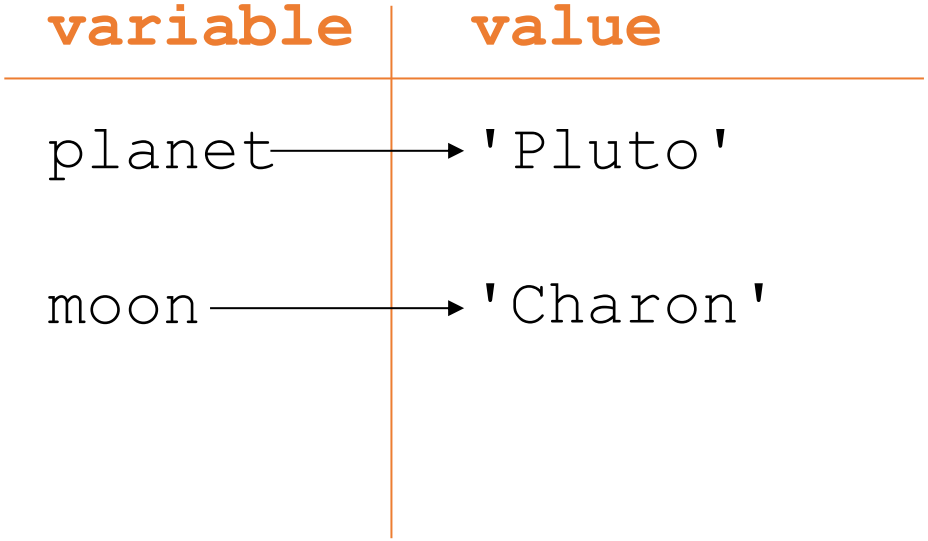

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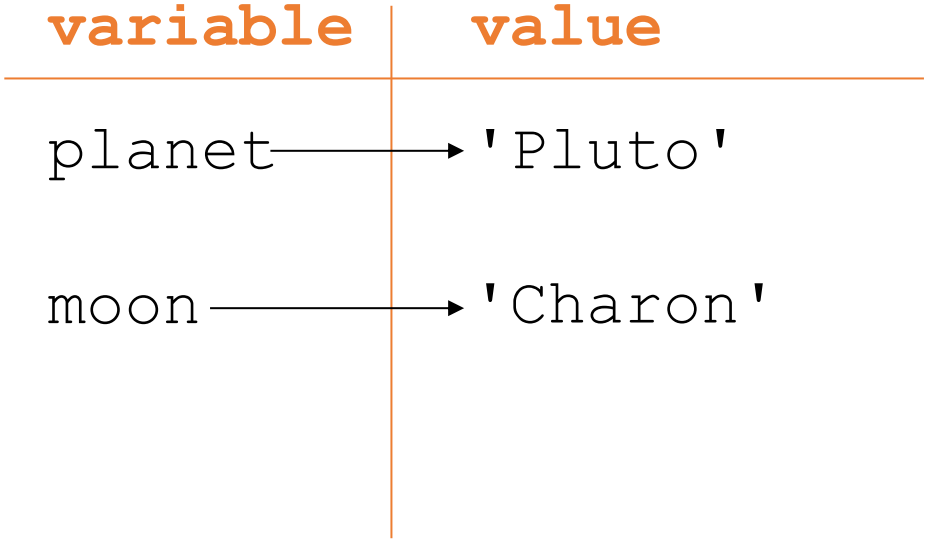

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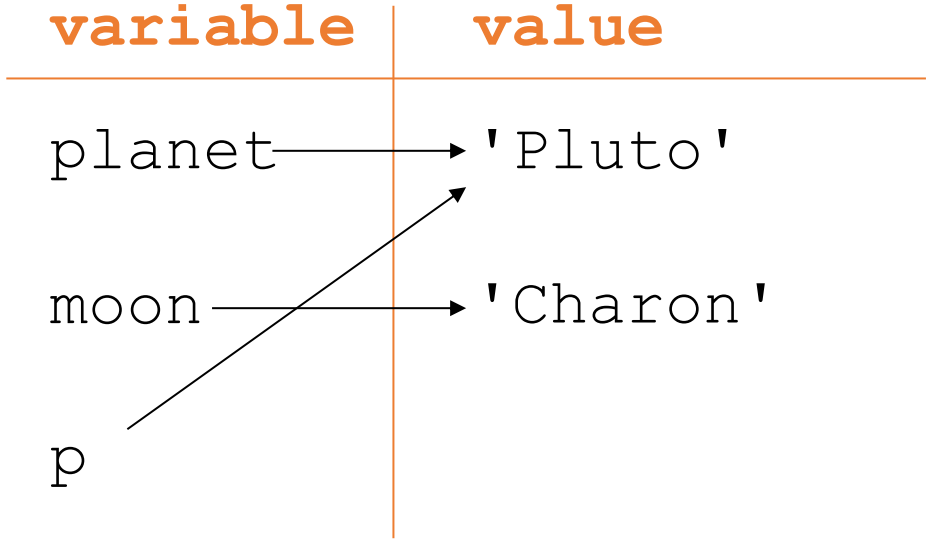

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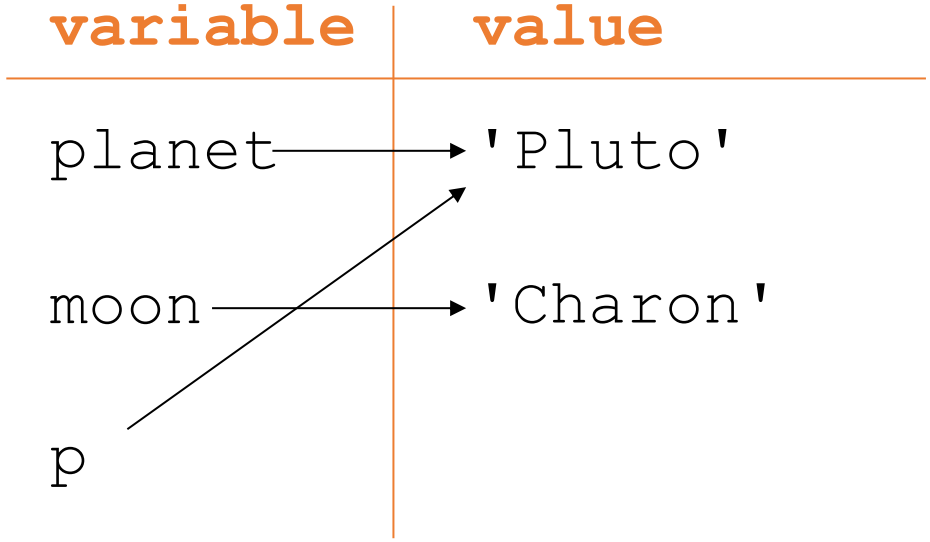

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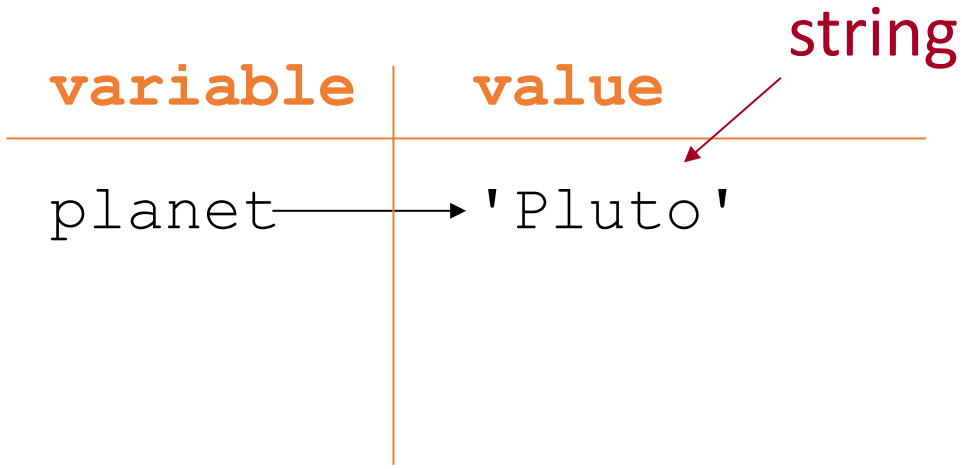

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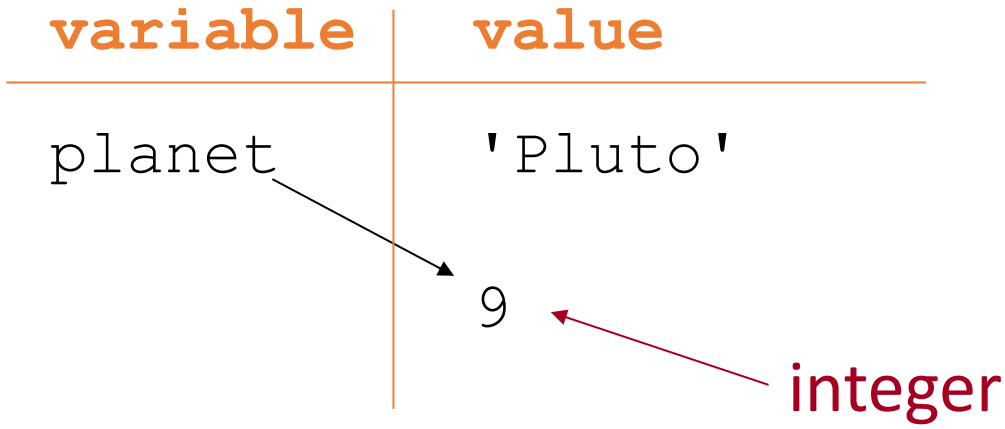

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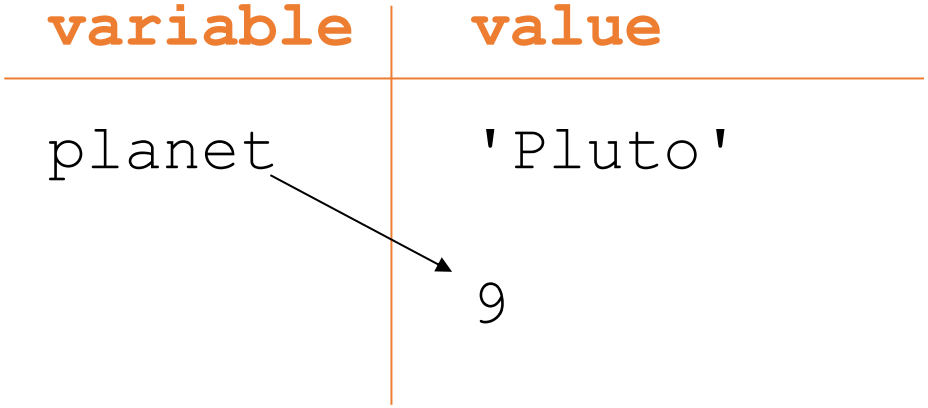

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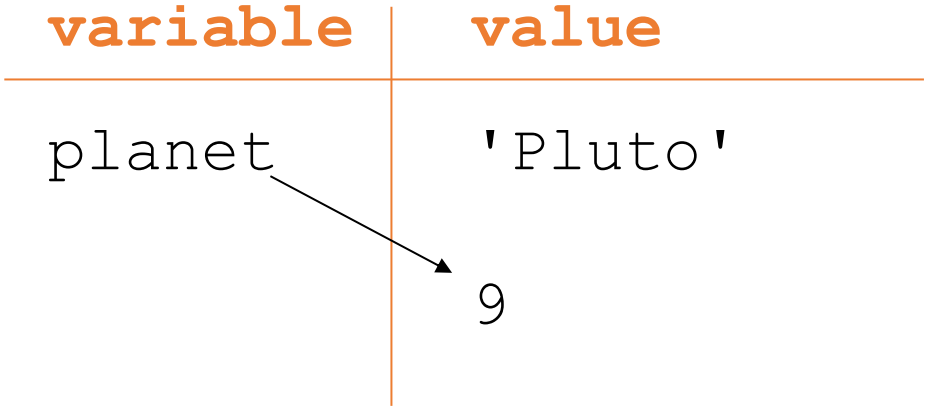

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If nothing refers to data any longer, it can be recycled

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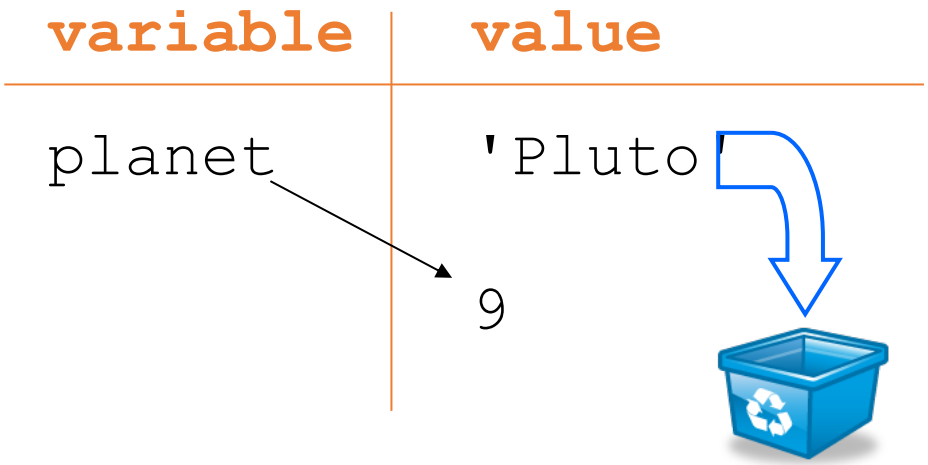

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Must assign value to variable before using it

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>>> planet = 'Sedna'
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Must assign value to variable before using it

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Traceback (most recent call last):
    print(plant)
NameError: name 'plant' is not defined
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Doing so can mask many errors

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Python does not assume default values for variables

Doing so can mask many errors

Anything from # to the end of the line is a comment

Values *do* have types

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```
>>> string = "two"
>>> number = 3
>>> print(string * number)# repeated concatenation
twotwotwo
>>>
```

Values *do* have types

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>>> string = "two"
>>> number = 3
>>> print(string * number)# repeated concatenation
twotwotwo
>>> print(string + number)
Traceback (most recent call last)
    number + string
TypeError: can only concatenate str
(not "int") to str
>>>
```

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Would probably be safe here to produce `'two3'`

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Would probably be safe here to produce `'two3'`

But then what should `'2'+'3'` be?

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Traceback (most recent call last)
    number + string
TypeError: can only concatenate str
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>>>
```

Would probably be safe here to produce `'two3'`

But then what should `'2'+'3'` be?

Doing too much is as bad as doing too little…

Use functions to convert between types

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```
>>> print(int('2') + 3)
5
>>>
```

Use functions to convert between types

```
>>> print(int('2') + 3)
5
>>> print('2' + str(3))
23
>>>
```

Numbers

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`14`	integer with unlimited precision (as much memory as available)

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`14.0`	64-bit float (on most machines)
`1+4j`	complex number (two 64-bit floats)
`x.real`, `x.imag`	real and imaginary parts of complex number

Arithmetic

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Addition	+	35 + 22	57

Arithmetic

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		`'Py' + 'thon'`	`'Python'`

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		`'Py' + 'thon'`	`'Python'`
Subtraction	-	`35 - 22`	`13`

Arithmetic

Addition	+	`35 + 22`	`57`
		`'Py' + 'thon'`	`'Python'`
Subtraction	-	`35 - 22`	`13`
Multiplication	*	`3 * 2`	`6`

Arithmetic

Addition	+	`35 + 22`	`57`
		`'Py' + 'thon'`	`'Python'`
Subtraction	-	`35 - 22`	`13`
Multiplication	*	`3 * 2`	`6`
		`'Py' * 2`	`'PyPy'`

Arithmetic

Addition	+	`35 + 22`	`57`
		`'Py' + 'thon'`	`'Python'`
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Multiplication	*	`3 * 2`	`6`
		`'Py' * 2`	`'PyPy'`
Division	/	`3 / 2`	`1.5`

Arithmetic

Addition	+	`35 + 22`	`57`
		`'Py' + 'thon'`	`'Python'`
Subtraction	-	`35 - 22`	`13`
Multiplication	*	`3 * 2`	`6`
		`'Py' * 2`	`'PyPy'`
Division	/	`3 / 2`	`1.5`
		`3 // 2`	`1`

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Addition	+	`35 + 22`	`57`
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		`'Py' * 2`	`'PyPy'`
Division	/	`3 / 2`	`1.5`
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Exponentiation	**	`2 ** 0.5`	`1.41421356...`

Arithmetic

Addition	+	`35 + 22`	`57`
		`'Py' + 'thon'`	`'Python'`
Subtraction	-	`35 - 22`	`13`
Multiplication	*	`3 * 2`	`6`
		`'Py' * 2`	`'PyPy'`
Division	/	`3 / 2`	`1.5`
		`3 // 2`	`1`
Exponentiation	**	`2 ** 0.5`	`1.41421356...`
Remainder	%	`13 % 5`	`3`

Prefer *in-place* forms of binary operators

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```
>>> years = 500
>>>
```

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```
>>> years = 500
>>> years += 1
>>>
```

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```
>>> years = 500
>>> years += 1
>>>
```

The same as `years = years + 1`

Prefer *in-place* forms of binary operators

```
>>> years = 500
>>> years += 1
>>> print(years)
501
>>>
```

Prefer *in-place* forms of binary operators

```
>>> years = 500
>>> years += 1
>>> print(years)
501
>>> years %= 10
>>>
```

Prefer *in-place* forms of binary operators

```
>>> years = 500
>>> years += 1
>>> print(years)
501
>>> years %= 10
>>>
```

← The same as: `years = years % 10`

Prefer *in-place* forms of binary operators

```
>>> years = 500
>>> years += 1
>>> print(years)
501
>>> years %= 10
>>> print(years)
1
>>>
```

Comparisons

Comparisons

```
3 < 5          | True
```

Comparisons

`3 < 5`	`True`
`3 != 5`	`True`

Comparisons

`3 < 5`	`True`
`3 != 5`	`True`
`3 == 5`	`False`

Comparisons

`3 < 5`	`True`
`3 != 5`	`True`
`3 == 5`	`False`

Single = is assignment

Double == is equality

Comparisons

`3 < 5`	`True`
`3 != 5`	`True`
`3 == 5`	`False`
`3 >= 5`	`False`

Comparisons

`3 < 5`	`True`
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Comparisons

`3 < 5`	`True`
`3 != 5`	`True`
`3 == 5`	`False`
`3 >= 5`	`False`
`1 < 3 < 5`	`True`
`1 < 5 > 3`	`True`

But please don't do this

Comparisons

`3 < 5`	`True`
`3 != 5`	`True`
`3 == 5`	`False`
`3 >= 5`	`False`
`1 < 3 < 5`	`True`
`1 < 5 > 3`	`True`
`3+2j < 5`	***error***

Python

Boolean types

What is a Boolean?

A simple data type in Python is the Boolean. It has only two possible values:

```
True
False
```

Comparisons result in Boolean values:

```
(3 > 5) is False
(2 == 2.0) is True
```

Tests in if/while result in a Boolean

```
if x > 3:    # Will run if (x > 3) is True
  ...do something...

while my_list:    # Will loop until my_list is empty
   ...something that reduces size of my_list...
```

Note: Boolean values are case-sensitive!

```
True      # but not "true"
False     # but not "false"
```

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Python

Saving your code to a script

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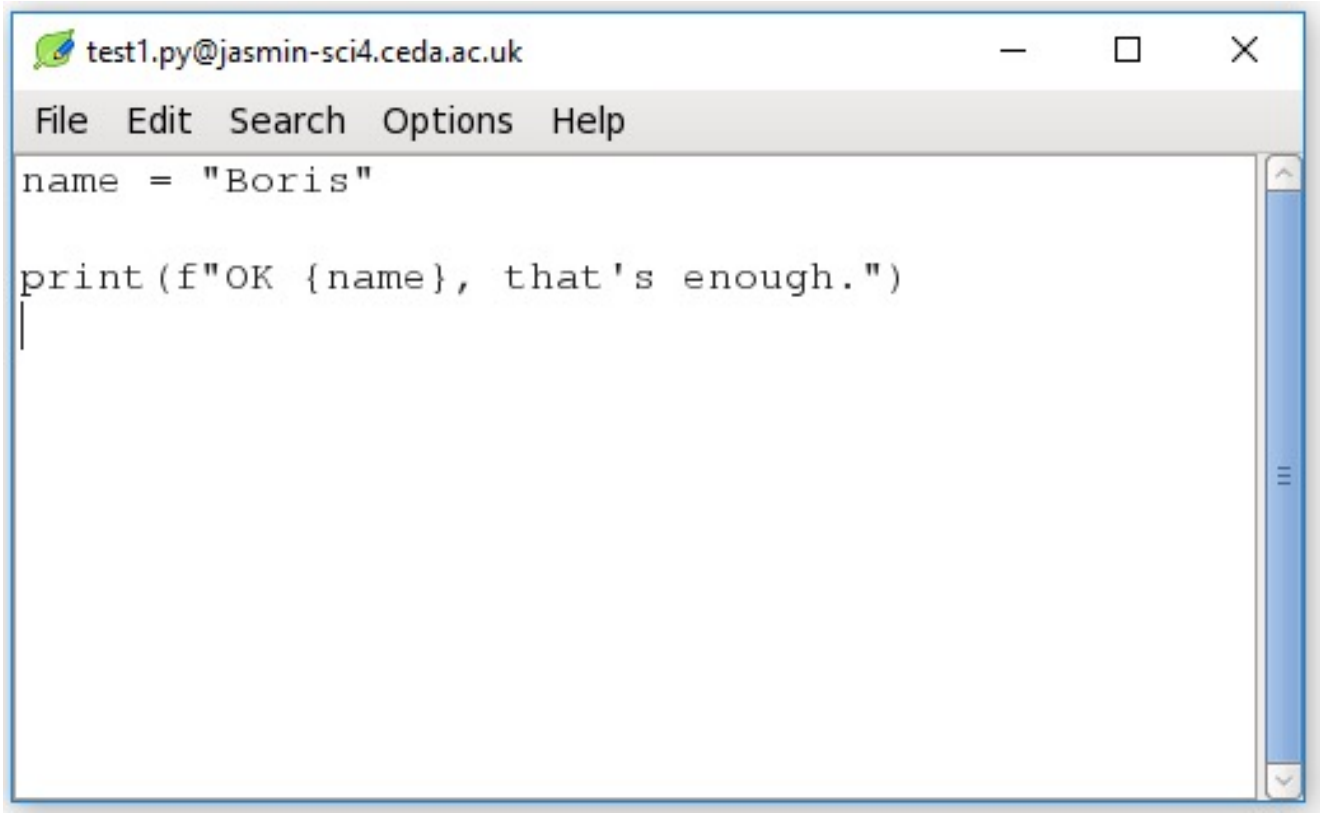
Open an editor (leafpad)

```
$ leafpad test1.py & # "&" means run in background
                     so you can still type here.
```

Opens an editor window... make a change... and **Save!**



Now run it

With...

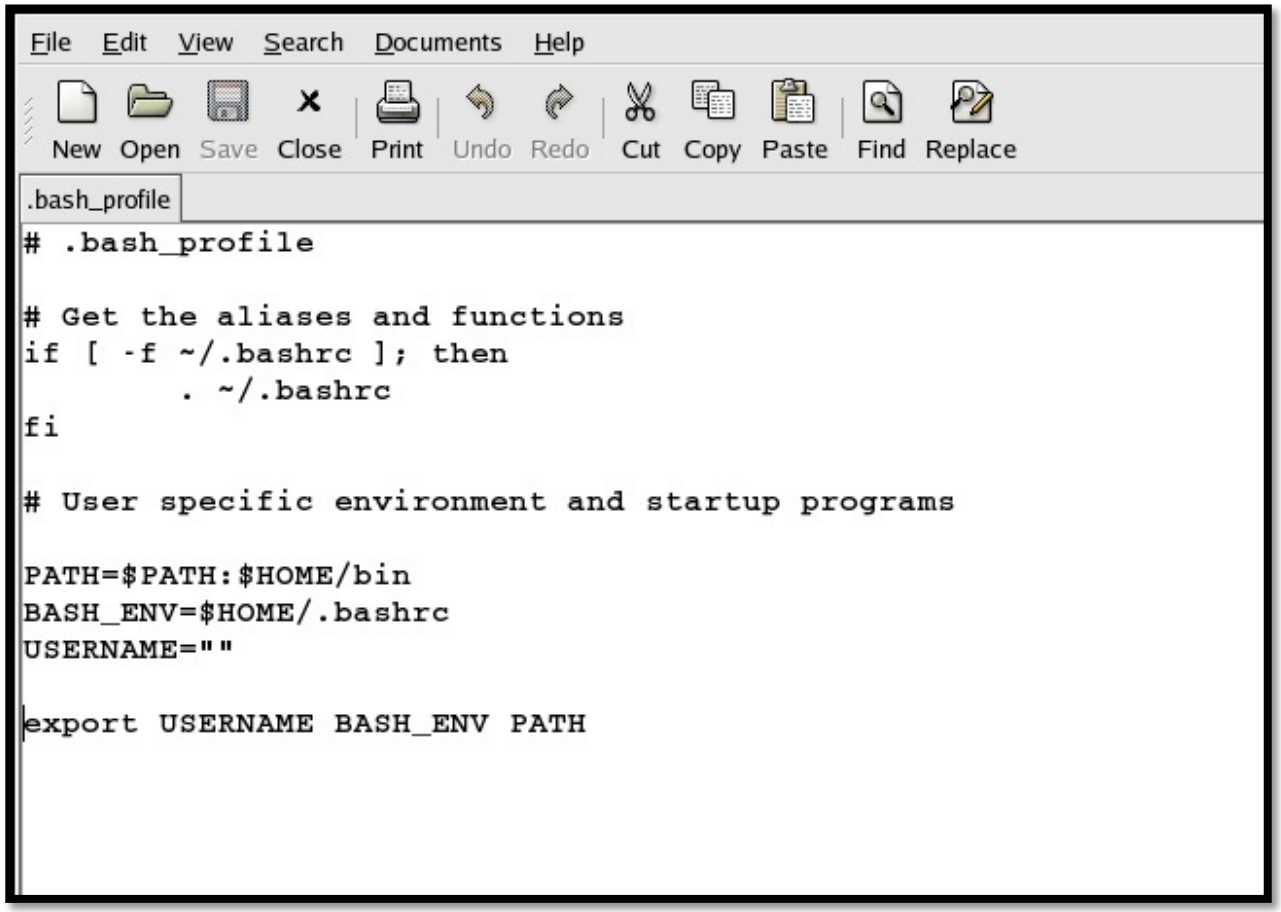
```
$ python test1.py
```

...your output appears here...

Open an editor (gedit)

```
$ gedit .bash_profile &
# "&" means run in background so you can still type here.
```

Opens an editor window... make a change... and **Save!**



created by

Greg Wilson

October 2010