

Python

Basics

A simple interpreted language

A simple interpreted language
no separate compilation step

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```
$ python  
>>>
```

A simple interpreted language
no separate compilation step

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

A simple interpreted language
no separate compilation step

```
$ 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)  
print('Charles' + 'Darwin')
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print(1 + 2)
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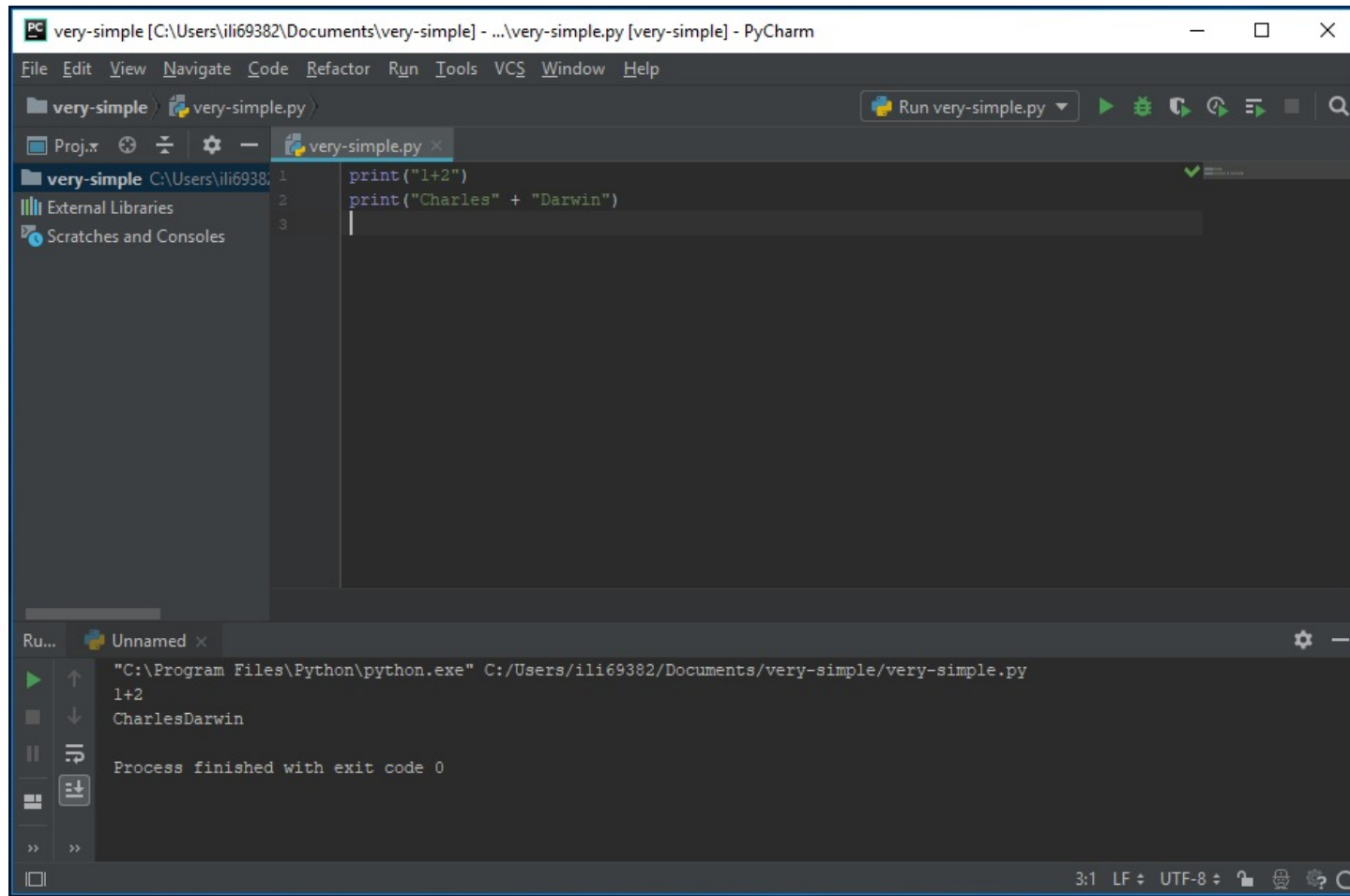
```
$ python very-simple.py
```

3

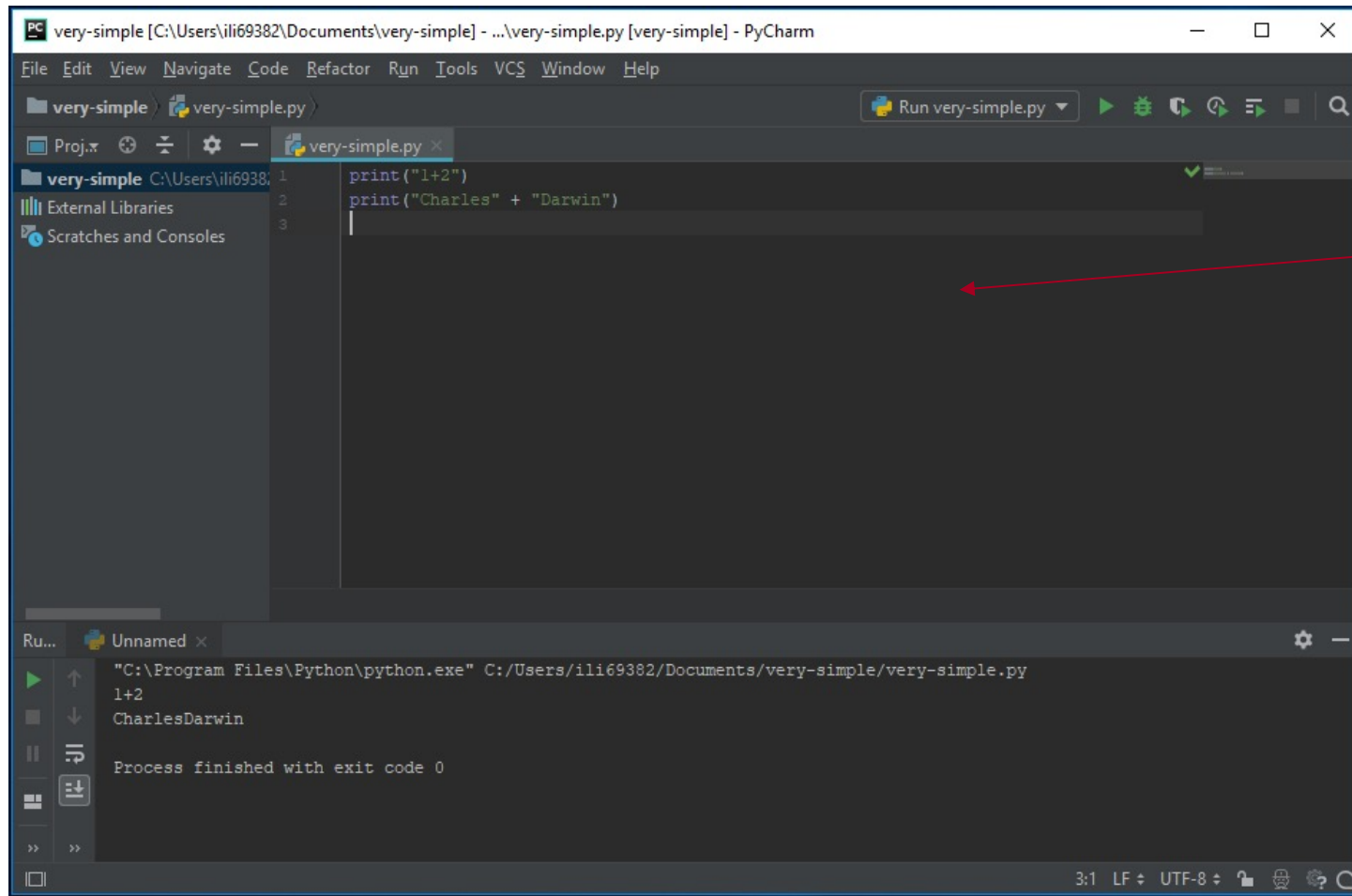
CharlesDarwin

```
$
```

Use an *integrated development environment* (IDE)

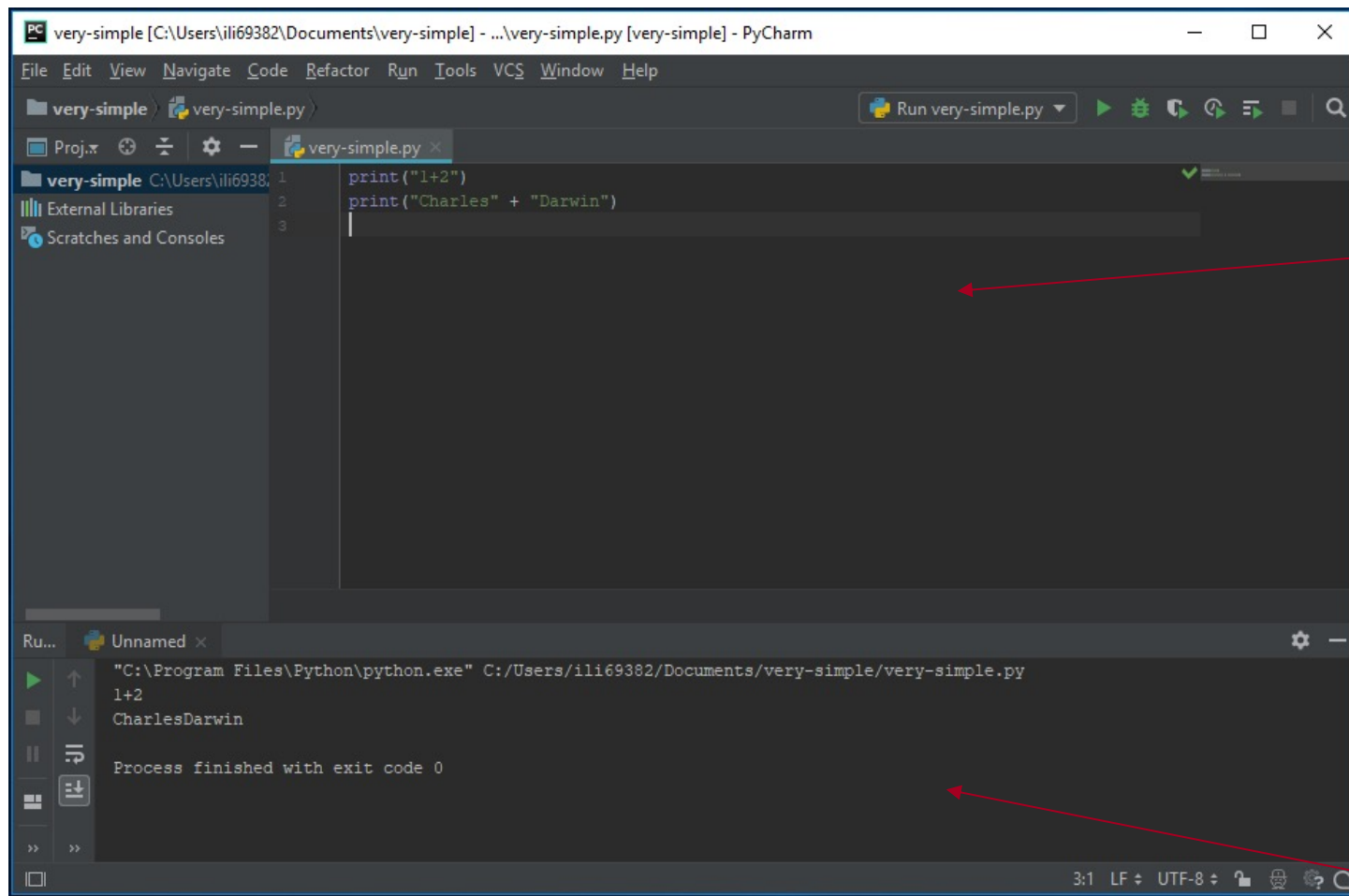


Use an *integrated development environment* (IDE)



Source
file

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Source
file

Execution
shell

Variables are names for values

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Created by use

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Created by use: no declaration necessary

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```
int x;  
x = 3;
```

Variables are names for values

Created by use: no declaration necessary

```
>>> planet = 'Pluto'  
>>>
```

Variables are names for values

Created by use: no declaration necessary

```
>>> planet = 'Pluto'  
>>> print(planet)  
Pluto  
>>>
```

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```
>>> planet = 'Pluto'
>>> print(planet)
Pluto
>>>
```

variable	value
planet	'Pluto'

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```
>>> planet = 'Pluto'  
>>> print(planet)  
Pluto  
>>> moon = 'Charon'  
>>>
```

variable	value
planet	'Pluto'
moon	'Charon'

Variables are names for values

Created by use: no declaration necessary

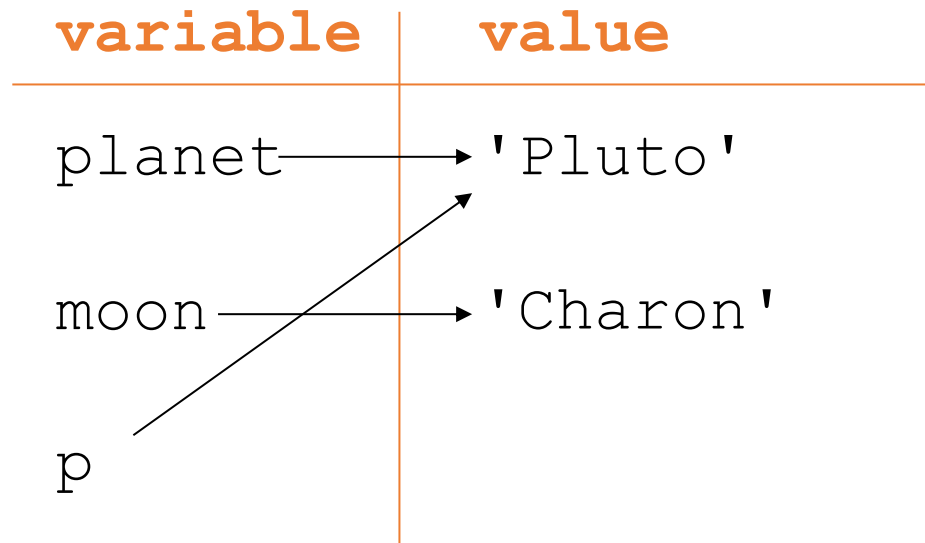
```
>>> planet = 'Pluto'  
>>> print(planet)  
Pluto  
>>> moon = 'Charon'  
>>> p = planet  
>>>
```

variable	value
planet	'Pluto'
moon	'Charon'

Variables are names for values

Created by use: no declaration necessary

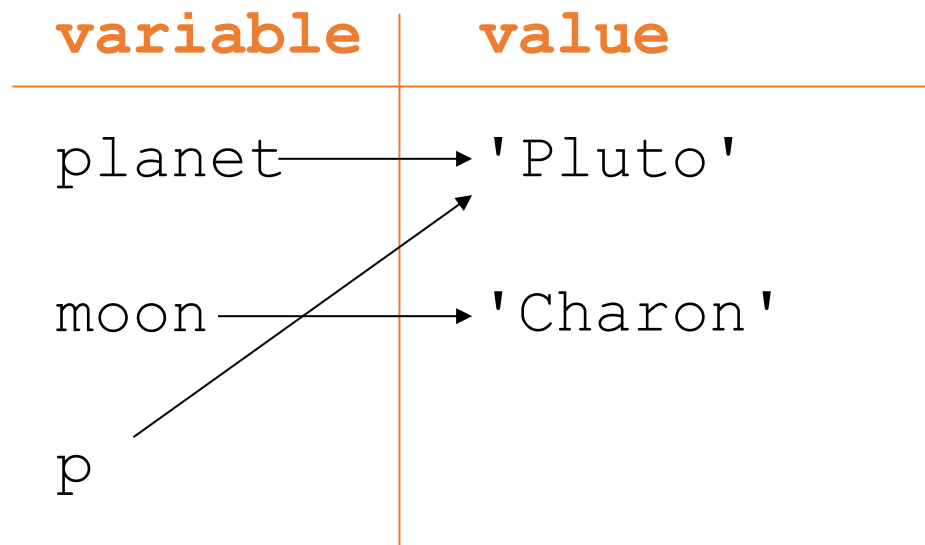
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Variables are names for values

Created by use: no declaration necessary

```
>>> planet = 'Pluto'
>>> print(planet)
Pluto
>>> moon = 'Charon'
>>> p = planet
>>> print(p)
Pluto
>>>
```



A variable is just a name

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Does not have a type

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Does not have a type

```
>>> planet = 'Pluto'  
>>>
```

Does not have a type

variable	value
planet	'Pluto'

string

Does not have a type

```
>>> planet = 'Pluto'
>>> planet = 9
>>>
```

variable	value
planet	'Pluto'
	9

integer

A variable is just a name

Does not have a type

```
>>> planet = 'Pluto'  
>>> planet = 9  
>>>
```

variable	value
planet	'Pluto'
	9

Values are *garbage collected*

A variable is just a name

Does not have a type

```
>>> planet = 'Pluto'  
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>>>
```

variable	value
planet	'Pluto'
	9

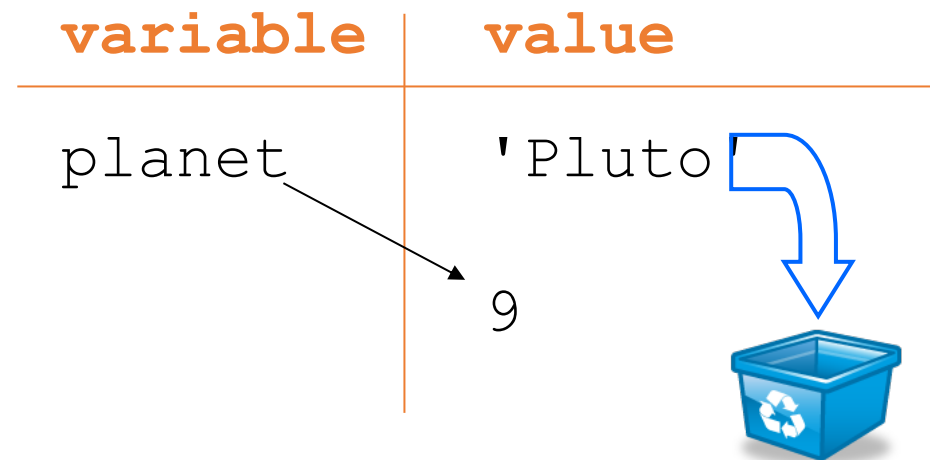
Values are *garbage collected*

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

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Values are *garbage collected*

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Must assign value to variable before using it

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```
>>> planet = 'Sedna'  
>>>
```

Must assign value to variable before using it

```
>>> planet = 'Sedna'
```

```
>>> print(plant) # note the deliberate misspelling
```

Must assign value to variable before using it

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>>> planet = 'Sedna'
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Traceback (most recent call last):
  print(plant)
NameError: name 'plant' is not defined
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```

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Traceback (most recent call last):
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Python does not assume default values for variables

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Python does not assume default values for variables

Doing so can mask many errors

Must assign value to variable before using it

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Traceback (most recent call last):
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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

Values *do* have types

```
>>> 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*

```
>>>
```

Values *do* have types

```
>>> string = "two"
```

```
>>> number = 3
```

```
>>> print(string * number) # repeated concatenation  
twotwotwo
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```
>>> print(string + number)
```

Traceback (most recent call last)

number + string

*TypeError: can only concatenate str
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```
>>>
```

Would probably be safe here to produce 'two3'

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*

```
>>>
```

Would probably be safe here to produce 'two3'

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

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

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

Use functions to convert between types

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

```
5
```

```
>>>
```

Use functions to convert between types

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

```
5
```

```
>>> print('2' + str(3))
```

```
23
```

```
>>>
```


Numbers

Numbers

14

integer with unlimited precision (as much memory as available)

Numbers

14	integer with unlimited precision (as much memory as available)
14.0	64-bit float (on most machines)

Numbers

14	integer with unlimited precision (as much memory as available)
14.0	64-bit float (on most machines)
$1+4j$	complex number (two 64-bit floats)

Numbers

<code>14</code>	integer with unlimited precision (as much memory as available)
<code>14.0</code>	64-bit float (on most machines)
<code>1+4j</code>	complex number (two 64-bit floats)
<code>x.real,</code> <code>x.imag</code>	real and imaginary parts of complex number

Arithmetic

Arithmetic

Addition

$$\begin{array}{|c|} \hline + \\ \hline \end{array} \begin{array}{|c|} \hline 35 + 22 \\ \hline \end{array} \begin{array}{|c|} \hline 57 \\ \hline \end{array}$$

Arithmetic

Addition	+	35 + 22	57
		'Py' + 'thon'	'Python'
Subtraction	-	35 - 22	13

Arithmetic

Addition	+	<code>35 + 22</code>	57
		<code>'Py' + 'thon'</code>	<code>'Python'</code>
Subtraction	-	<code>35 - 22</code>	13
Multiplication	*	<code>3 * 2</code>	6

Arithmetic

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

Arithmetic

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

Arithmetic

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

Arithmetic

Addition	+	<code>35 + 22</code>	57
		<code>'Py' + 'thon'</code>	<code>'Python'</code>
Subtraction	-	<code>35 - 22</code>	13
Multiplication	*	<code>3 * 2</code>	6
		<code>'Py' * 2</code>	<code>'PyPy'</code>
Division	/	<code>3 / 2</code>	1.5
		<code>3 // 2</code>	1
Exponentiation	**	<code>2 ** 0.5</code>	1.41421356...

Arithmetic

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

Prefer *in-place* forms of binary operators

Prefer *in-place* forms of binary operators

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

```
>>>
```

Prefer *in-place* forms of binary operators

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

Prefer *in-place* forms of binary operators

```
>>> 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
$3 \neq 5$	True

Comparisons

<code>3 < 5</code>	True
<code>3 != 5</code>	True
<code>3 == 5</code>	False

Comparisons

<code>3 < 5</code>	True
<code>3 != 5</code>	True
<code>3 == 5</code>	False

Single = is assignment

Double == is equality

Comparisons

<code>3 < 5</code>	True
<code>3 != 5</code>	True
<code>3 == 5</code>	False
<code>3 >= 5</code>	False

Comparisons

<code>3 < 5</code>	True
<code>3 != 5</code>	True
<code>3 == 5</code>	False
<code>3 >= 5</code>	False
<code>1 < 3 < 5</code>	True

Comparisons

$3 < 5$	True
$3 \neq 5$	True
$3 == 5$	False
$3 \geq 5$	False
$1 < 3 < 5$	True
$1 < 5 > 3$	True

But please don't
do this

Comparisons

<code>3 < 5</code>	True
<code>3 != 5</code>	True
<code>3 == 5</code>	False
<code>3 >= 5</code>	False
<code>1 < 3 < 5</code>	True
<code>1 < 5 > 3</code>	True
<code>3+2j < 5</code>	<i>error</i>

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"

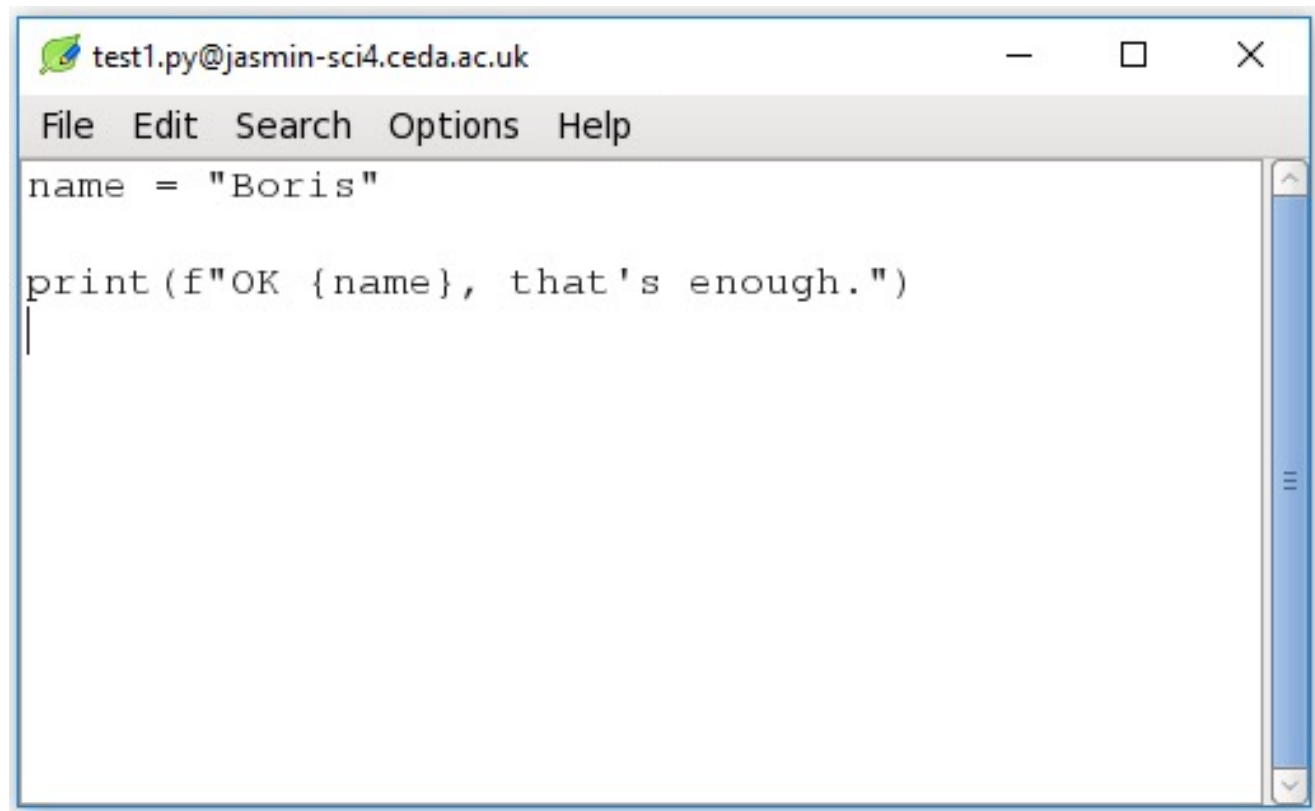
Python

Saving your code to a script

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!



```
test1.py@jasmin-sci4.ceda.ac.uk
File Edit Search Options Help
name = "Boris"

print(f"OK {name}, that's enough.")
|
```

Now run it

With...

```
$ python test1.py
```

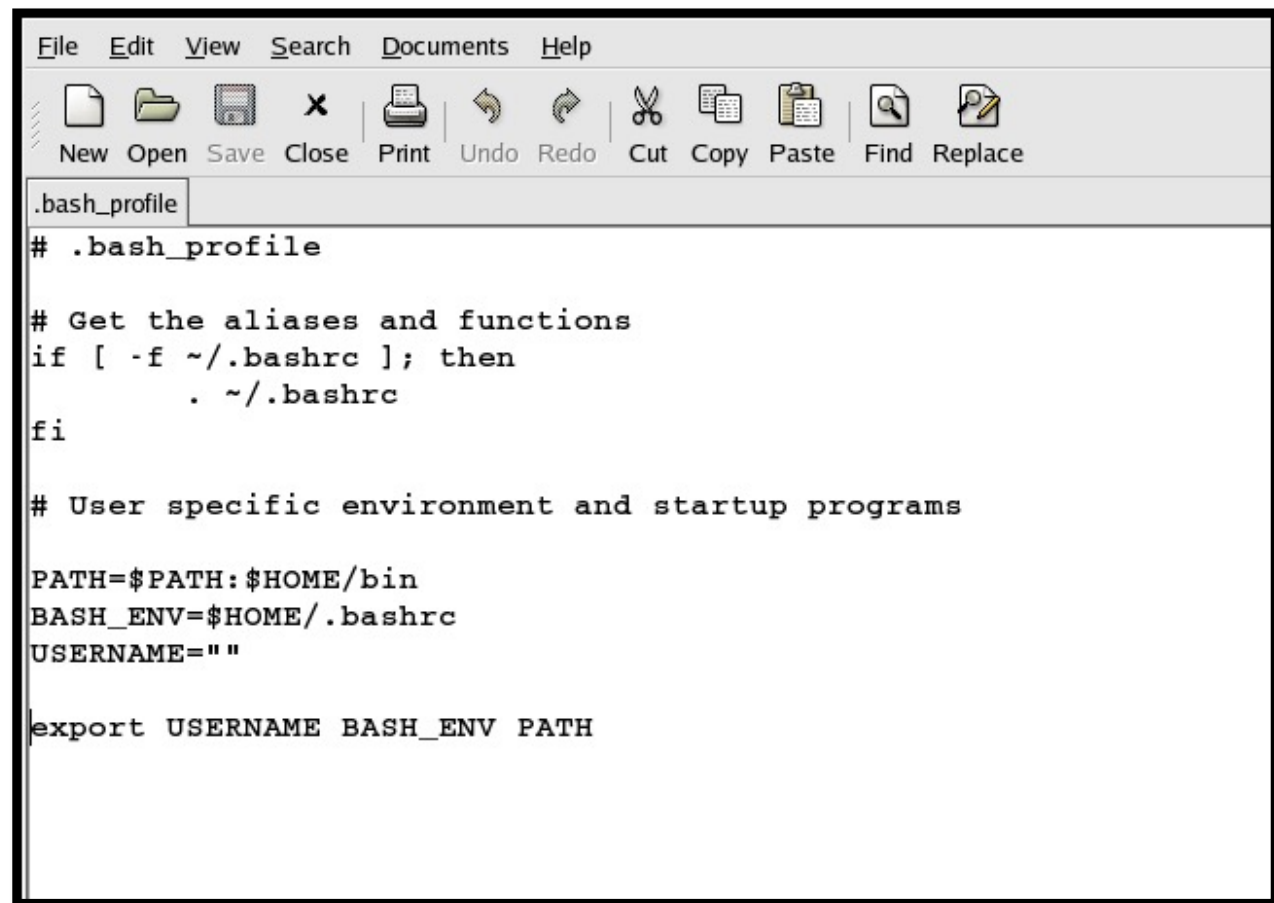
...your output appears here...

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!

A screenshot of the gedit text editor window. The title bar shows 'File Edit View Search Documents Help'. The menu bar contains icons for New, Open, Save, Close, Print, Undo, Redo, Cut, Copy, Paste, Find, and Replace. The main text area shows the contents of the .bash_profile file:

```
# .bash_profile

# Get the aliases and functions
if [ -f ~/.bashrc ]; then
    . ~/.bashrc
fi

# User specific environment and startup programs

PATH=$PATH:$HOME/bin
BASH_ENV=$HOME/.bashrc
USERNAME=""

export USERNAME BASH_ENV PATH
```



created by

Greg Wilson

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