Python basics

- Comments
- ";"
- Variable names
- int, float, str
- type conversion
- assignment (=)
- print(), help(), type()

Python comments

A ‘#’ indicates the beginning of a comment. From ‘#’ until of end of line is ignored by Python.

```
x = 42 # and here goes the comment
```

Comments useful to describe what a piece of code is supposed to do, what kind of input is expected, what is the output, side effects...

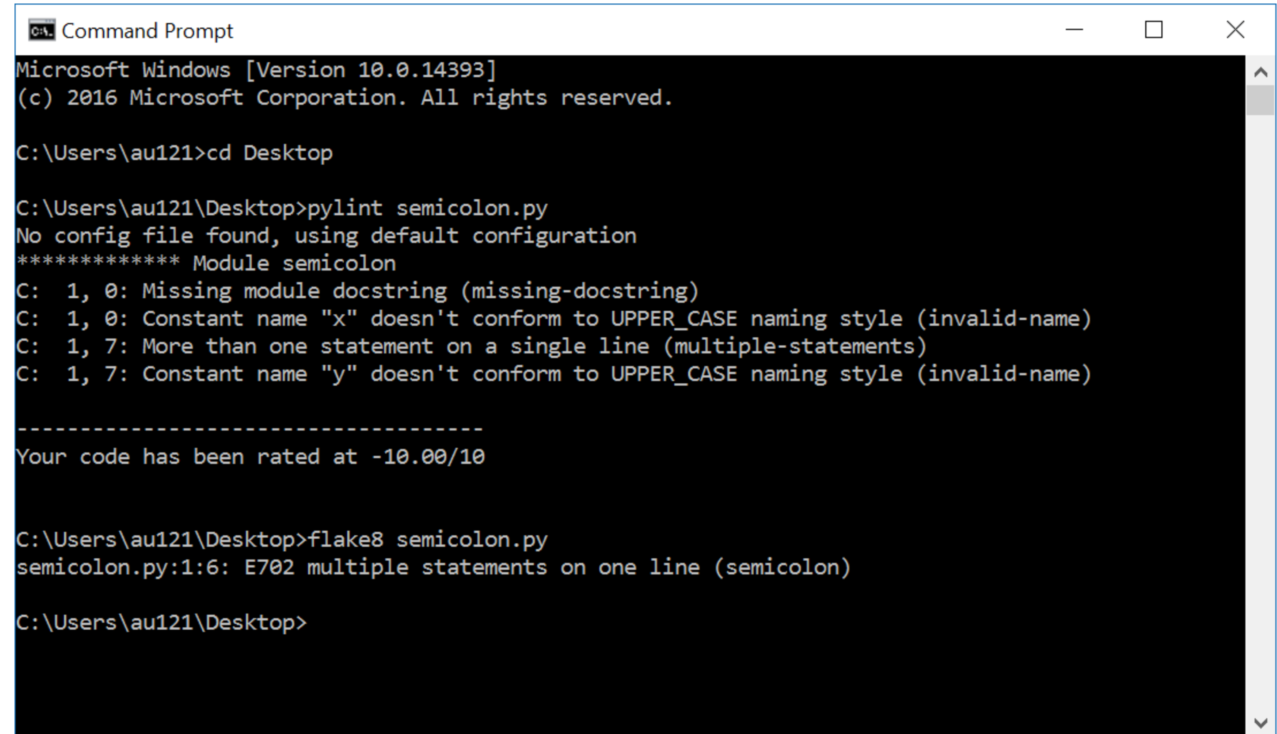
The ";" in Python

- Normally statements follow in consecutive lines with identical indentation

```
x = 1
y = 1
```

- but Python also allows multiple statements on one line, separated by ";"

```
x = 1; y = 1
```



neither **pylint** or **flake8** like ";"

- General Python guideline: **avoid using ";"**
- Other languages like C, C++ and Java require ";" to end/separate statements

Variable names

- Variable name = sequence of **letters** ‘a’-’z’, ‘A’-’Z’, **digits** ‘0’-’9’, and **underscore** ‘_’

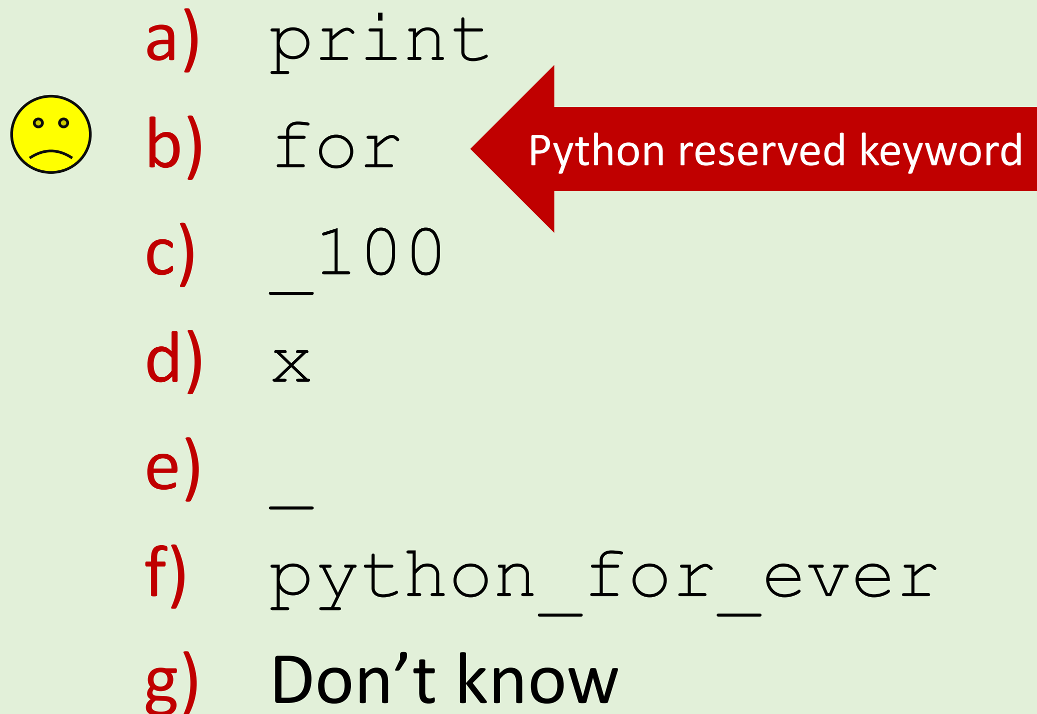
```
v, volume, height_of_box, WidthOfBox, x0, _v12_34B, _
```

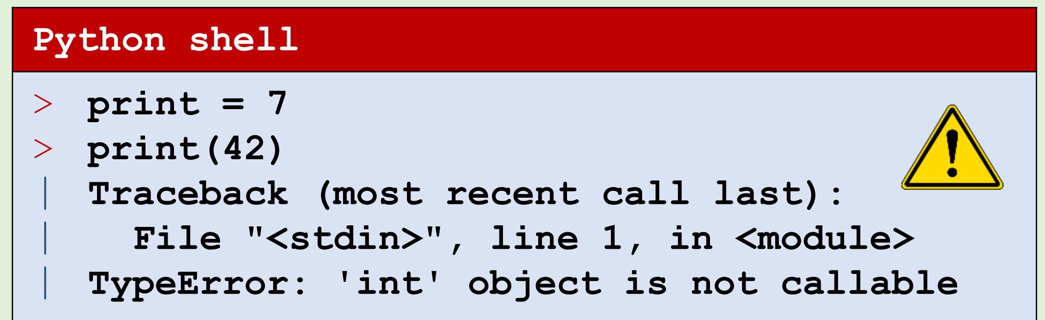
(snake_case) (CamelCase)

  - a name cannot start with a digit
  - names are case sensitive (AB, Ab, aB and ab are different variables)

- Variable names are references to objects in memory
- **Use meaningfull variables names**
- **Python 3 reserved keywords:** and, as, assert, break, class, continue, def, del, elif, else, except, False, finally, for, from, global, if, import, in, is, lambda, nonlocal, None, not, or pass, raise, return, True, try, while, with, yield

Question – Not a valid Pyton variable name?





`print` is a valid variable name, with default value a builtin *function* to print output to a shell – assigning a new value to `print` is very likely a bad idea

Integer literals

- .... `-4, -3, -2, -1, 0, 1, 2, 3, 4` ....
- Python integers can have an arbitrary number of digits
  (only limited by machine memory)
- Can be preceded by a plus (+) or minus (-)
- For readability underscores (_) can be added between digits,

  `2_147_483_647`

  (for more, see PEP 515 - Underscores in Numeric Literals)

Question – What statement will not fail?

a) `x = _42`

b) `_10 = -1_1`

c) `x = 1__0`

d) `x = +1_0_`

e) Don't know

Float literals

- Decimal numbers are represented using **float** – contain "." or "e"
- ⚠ Floats are often only approximations, e.g. `0.1` is not 1/10
- Extreme values (CPython 3.6.4)
  - max = 1.7976931348623157e+308
  - min = 2.2250738585072014e-308
- Examples
  - `3.1415`
  - `-.00134`
  - `124e3` = $124 \cdot 10^3$
  - `-2.345e2 = -234.5`
  - `12.3e-4 = 0.00123`

Associativity rule does not apply to floats

Python shell

```
> 0.1+0.2+0.3
| 0.6000000000000001
> (0.1+0.2)+0.3
| 0.6000000000000001
> 0.1+(0.2+0.3)
| 0.6
> 0.1+(0.2+0.3) == (0.1+0.2)+0.3
| False
> type(0.1)
| <class 'float'>
> 1e200*1e300
| inf
```

Question – What addition order is ”best”?

a) `1e10 + 1e-10 + -5e-12 + -1e10`

b) `1e10 + -1e10 + 1e-10 + -5e-12`

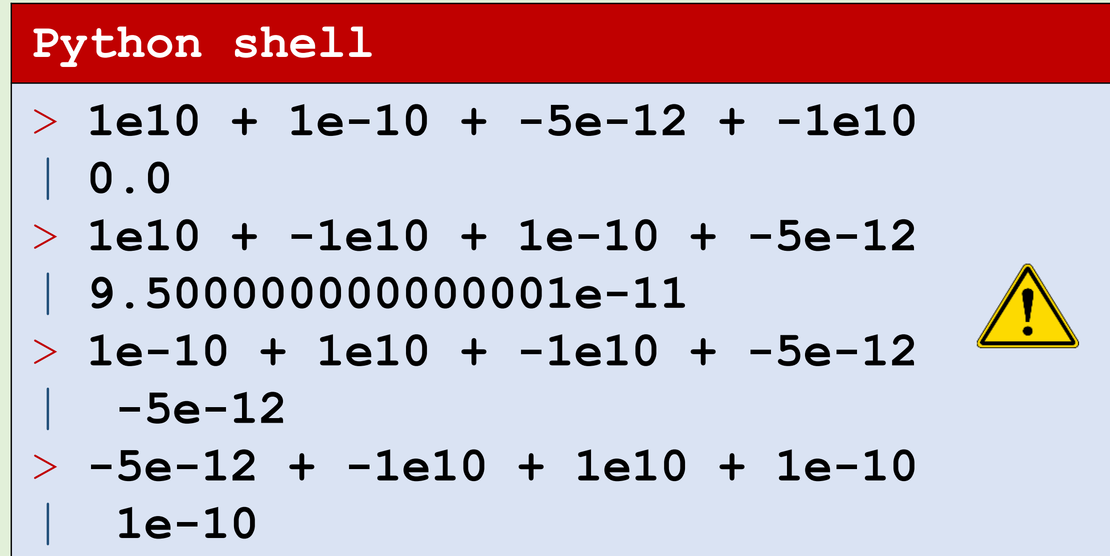
c) `1e-10 + 1e10 + -1e10 + -5e-12`

d) `-5e-12 + -1e10 + 1e10 + 1e-10`

e) Any order is equally good

f) Don’t know

```
 1e10  =  10000000000
-1e10  = -10000000000
 1e-10 =            0.0000000001
-5e-12 =           -0.000000000005
```



a) - d) give four different outputs

Approximating
π = 3.14159265359...

$$\frac{\pi^2}{6} = \sum_{k=1}^{+\infty} \frac{1}{k^2} = 1.6449340668\ldots$$

Riemann zeta function ζ(2)

pi_approximation_riemann.py

```
apx = 0.0
k = 0.0
while True:
    k = k + 1.0
    apx = apx + 1.0/(k*k)
    print(k, apx)
```

Output

```
...
94906261.0 1.6449340578345741
94906262.0 1.6449340578345744
94906263.0 1.6449340578345746
94906264.0 1.6449340578345748
94906265.0 1.644934057834575
94906266.0 1.644934057834575
94906267.0 1.644934057834575
94906268.0 1.644934057834575
94906269.0 1.644934057834575
94906270.0 1.644934057834575
...
```

This is not a course in numeric computations – but now you are warned....

String literals (type `str`)

- Sequence of characters enclosed by single (') or double (") quotes

```
"a 'quoted' word"    "Hello World"   'abc'
'a "quoted" word'    '_"_\'_"_'
```

- Escape characters

`\n`	newline
`\t`	tab
`\\`	backslash
`\'`	single quote
`\"`	double quote

- A backslash (\) a the end of line, will continue line/string on next line
- Use triple single or double quotes (''' or """) for enclosing strings spanning more lines

  (in particular for Python Dosctrings, see PEP 257)

string-test.py

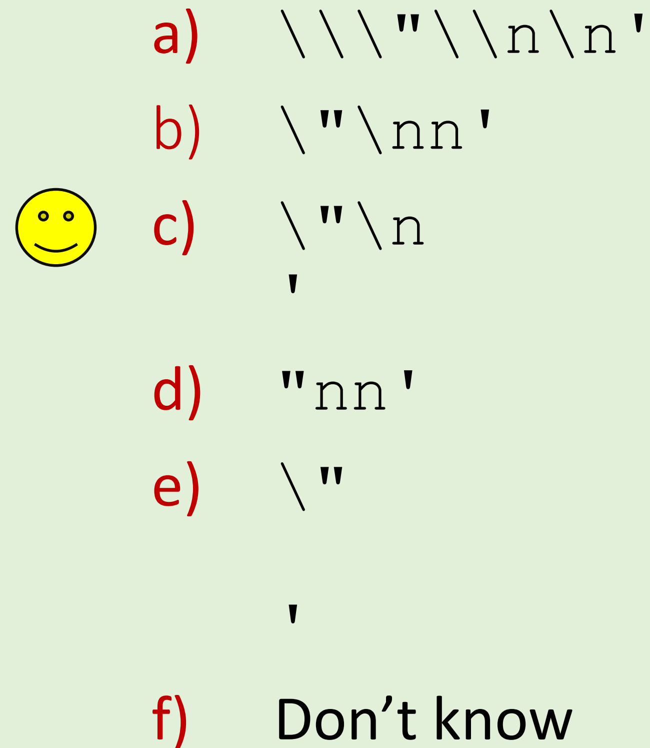
```
print("abc")
print('de\'f')
print("'ghi'")
print("'jk\nl'\"")
print("mn\
o")
print("p\\q\tr")
```

Output

```
$ python string-test.py
abc
de'f
'ghi'
'jk
l'"
mno
p\q     r
```

Question – What does the following print ?

```
print("\\\"\\n\n'")
```



print(...)

- `print` can print zero, one, or more values
- default behavior
  - print a space between values
  - print a line break after printing all values
- default behavior can be changed by **keyword arguments** “`sep`“ and “`end`“

Python shell

```
> print()
|
> print(7)
| 7
> print(2, 'Hello')
| 2 Hello
> print(3, 'a', 4)
| 3 a 4
> print(3, 'a', 4, sep=':')
| 3:a:4
> print(5); print(6)
| 5
| 6
> print(5, end=', '); print(6)
| 5, 6
```

print(...) and help(...)

Python shell

```
> help(print)
| Help on built-in function print in module builtins:
|
| print(...)
|     print(value, ..., sep=' ', end='\n', file=sys.stdout, flush=False)
|
|     Prints the values to a stream, or to sys.stdout by default.
|     Optional keyword arguments:
|     file:  a file-like object (stream); defaults to the current sys.stdout.
|     sep:   string inserted between values, default a space.
|     end:   string appended after the last value, default a newline.
|     flush: whether to forcibly flush the stream.
```

Assignments

- *variable* = *expression*

```
x = 42
```

- Multiple assignments – right hand side evaluated before assignment

```
x, y, z = 2, 5, 7
```

- Useful for swapping

```
x, y = y, x
```

- Assigning multiple variables same value in left-to-right

```
x = y = z = 7
```

Warning

```
i = 1
i = v[i] = 3  # v[3] is assigned value 3
```

In languages like C and C++ instead v[1] is assigned 3

Python is dynamically typed, type(...)

- The current type of a value can be inspected using the **type()** function (that returns a type object)
- In Python the values contained in a variable over time can be of different type
- In languages like C, C++ and Java variables are declared with a given type, e.g.

```
int x = 42;
```

and the different values stored in this variable must remain of this type

Python shell

```
> x = 1
> type(x)
| <class 'int'>
> x = 'Hello'
> type(x)
| <class 'str'>
> type(42)
| <class 'int'>
> type(type(42))
| <class 'type'>
```

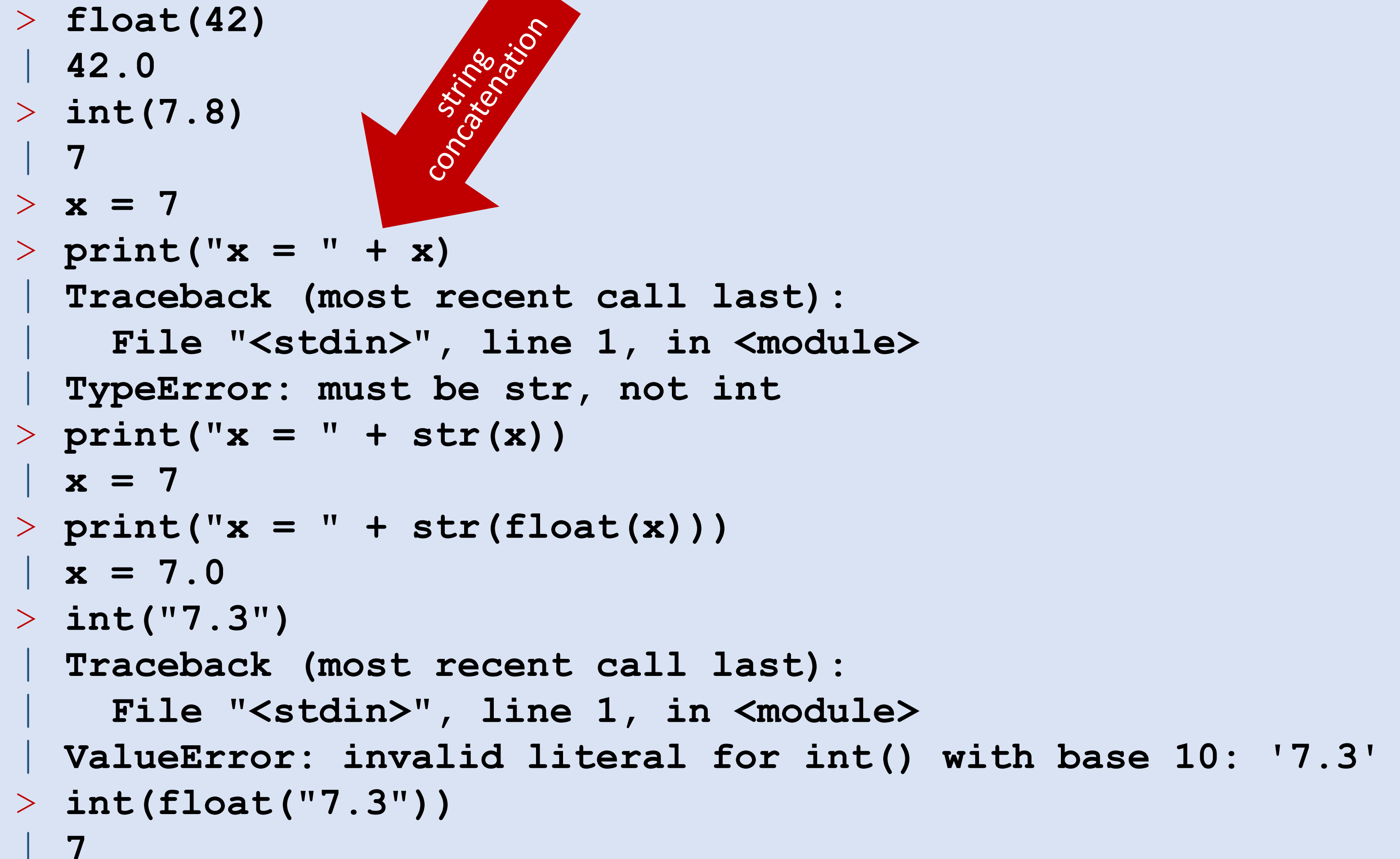
Type conversion

- Convert a value to another type:

  new-type(*value*)

- Sometimes done automatically:

1.0+7=1.0+float(7)=8.0



Questions – `str(float(int(float("7.5"))))` ?

a) 7
b) 7.0
c) 7.5
d) "7"

e) "7.0"
f) "7.5"
g) Don’t know