SWCON104
Web & Python Programming

Variables

Department of Software Convergence

경희대학교
KYUNG HEE UNIVERSITY

Today

- Python basics
- Variables and computer memory
- Assignment statement
- Augmented statement

[Textbook]
Practical Programming
(An Introduction to Computer Science Using Python),
by Paul Gries, Jennifer Campbell, Jason Montojo,
The Pragmatic Bookshelf, 2017

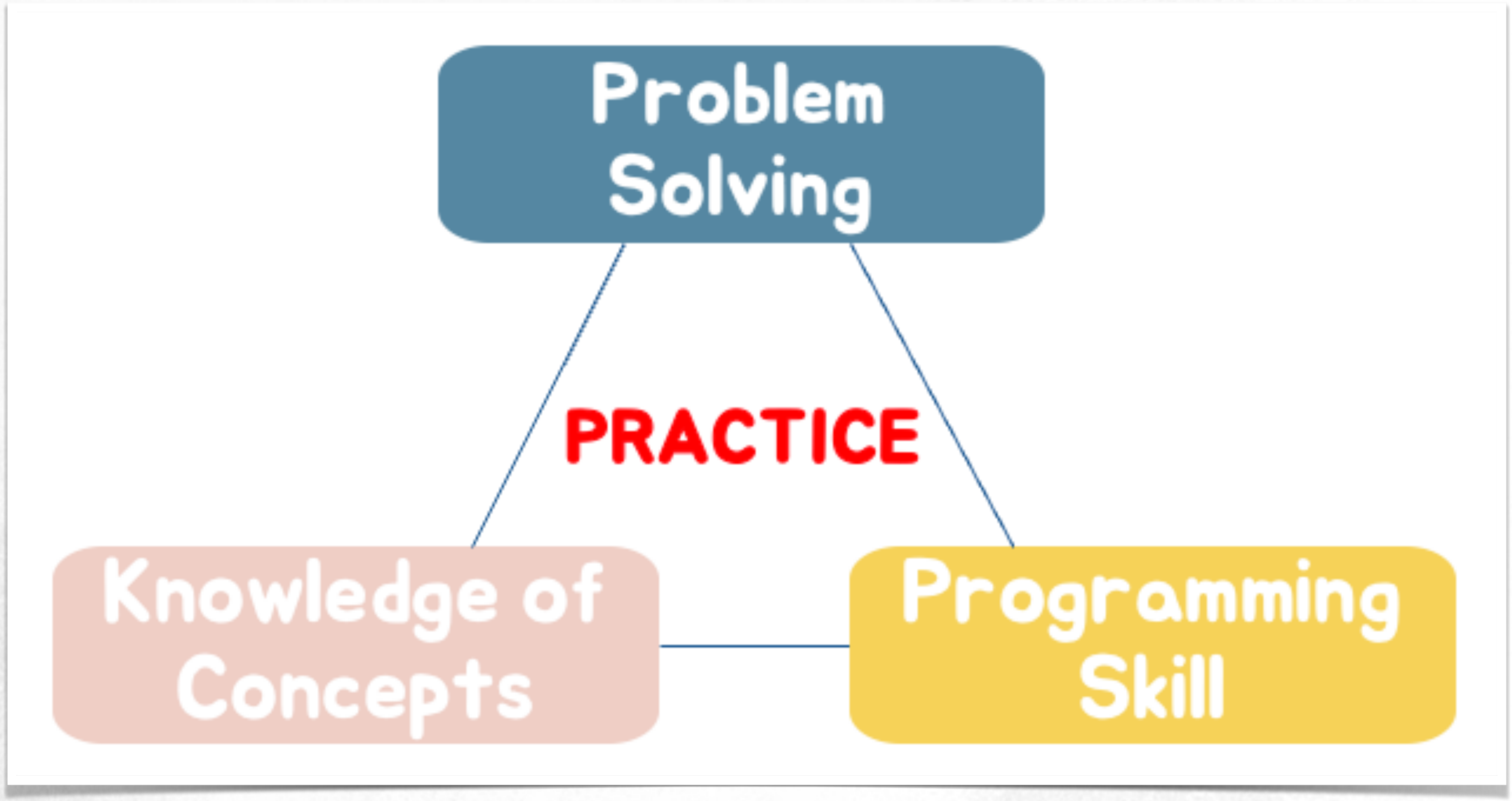
Practice

- Practice_03_Variables.ipynb

Fast paced course?

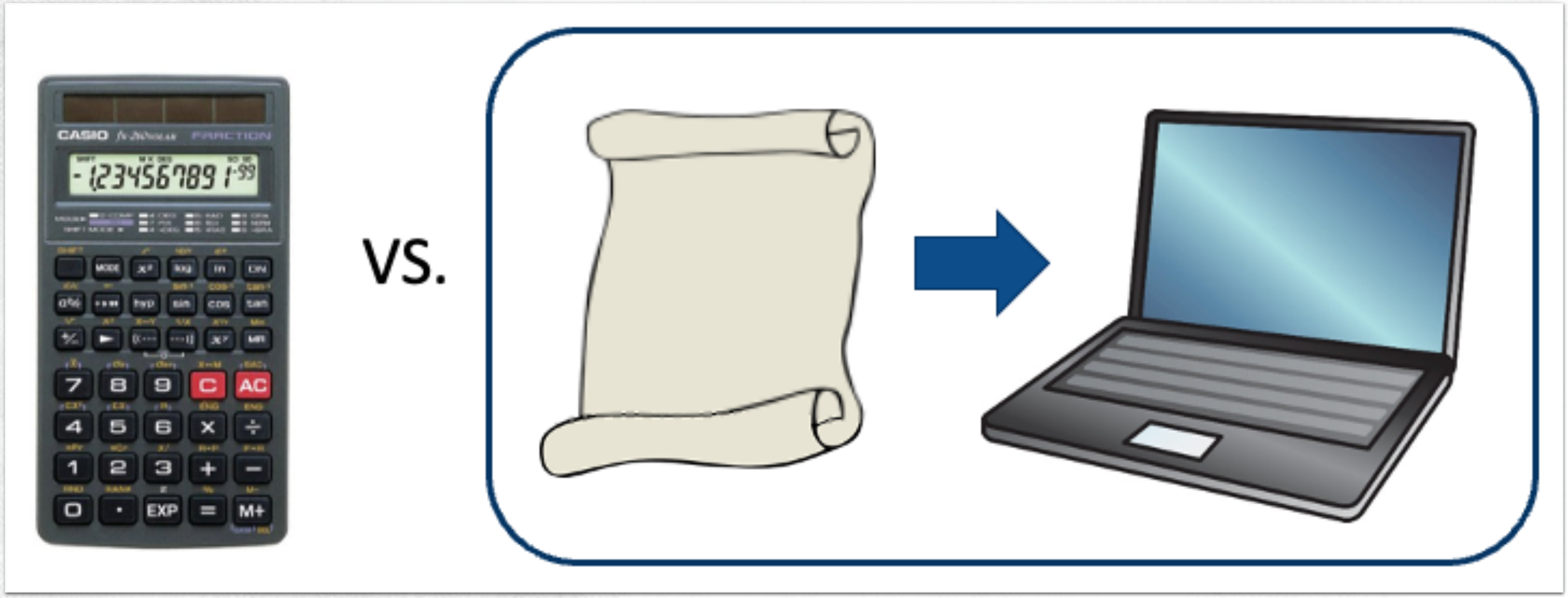
- New to programming?
- PRACTICE PRACTICE PRACTICE!!

- You can’t break your computer
- Don’t be afraid to test your code
- Worst case: reboot



What is programming?

- A program is a set of instructions
- You can "order" a computer using a software



Why Python?

- It is free and well documented
- It runs everywhere
    - supports multiple platforms
- It has a clean syntax
- It is relevant
    - many companies use it every day
- It is well supported by tools
    - Jupyter Notebook
    - MS Visual Studio Code

```
# Python 3: Fibonacci series up to n
>>> def fib(n):
>>>     a, b = 0, 1
>>>     while a < n:
>>>         print(a, end=' ')
>>>         a, b = b, a+b
>>>     print()
>>> fib(1000)
0 1 1 2 3 5 8 13 21 34 55 89 144 233 377 610 987
```

Functions Defined

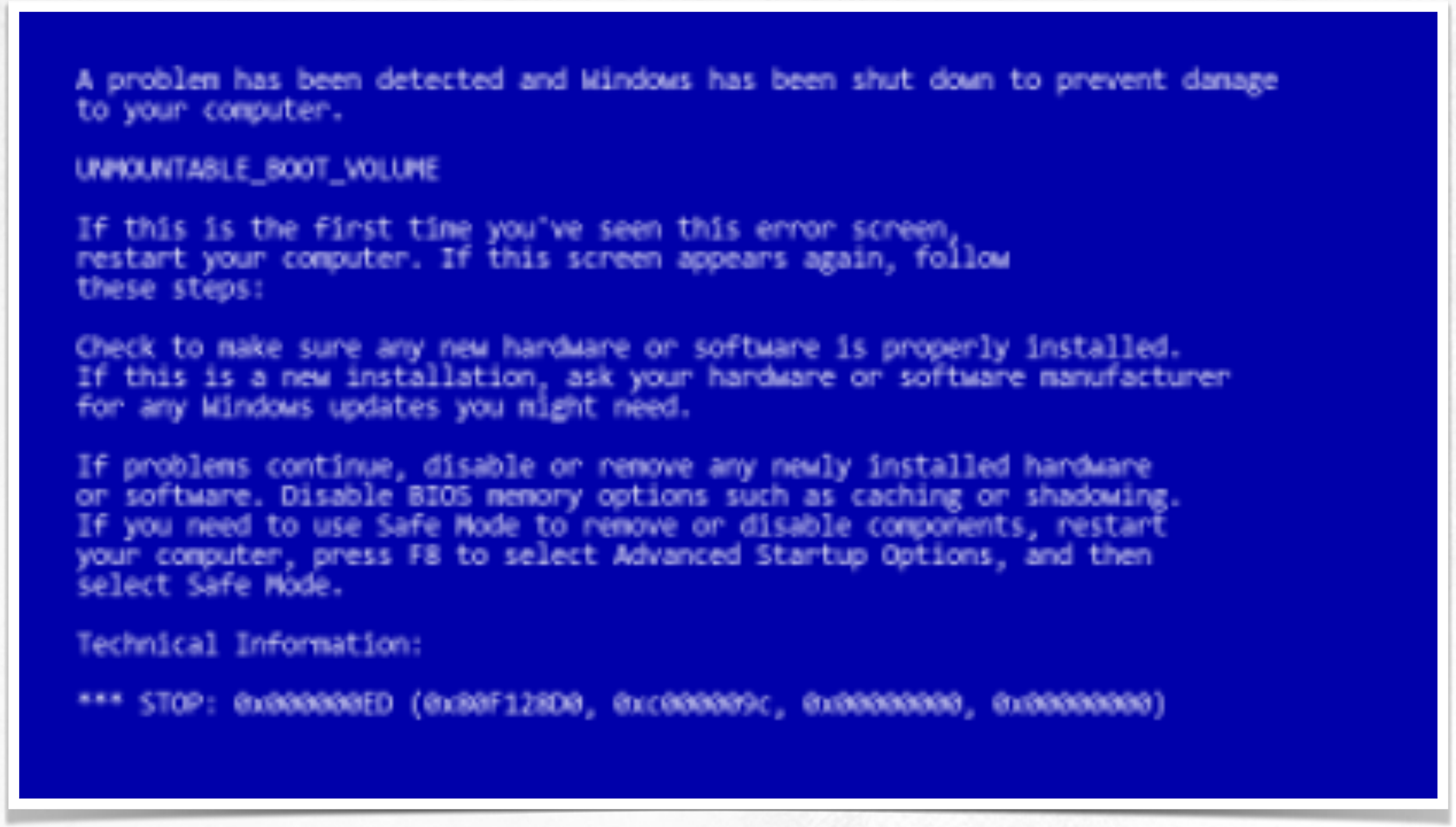
The core of extensible programming is defining functions. Python allows mandatory and optional arguments, keyword arguments, and even arbitrary argument lists. More about defining functions in Python 3

Python is a programming language that lets you work quickly and integrate systems more effectively. >>> Learn More

www.python.org

What is a Bug?

- May cause a program crash
- May give incorrect results



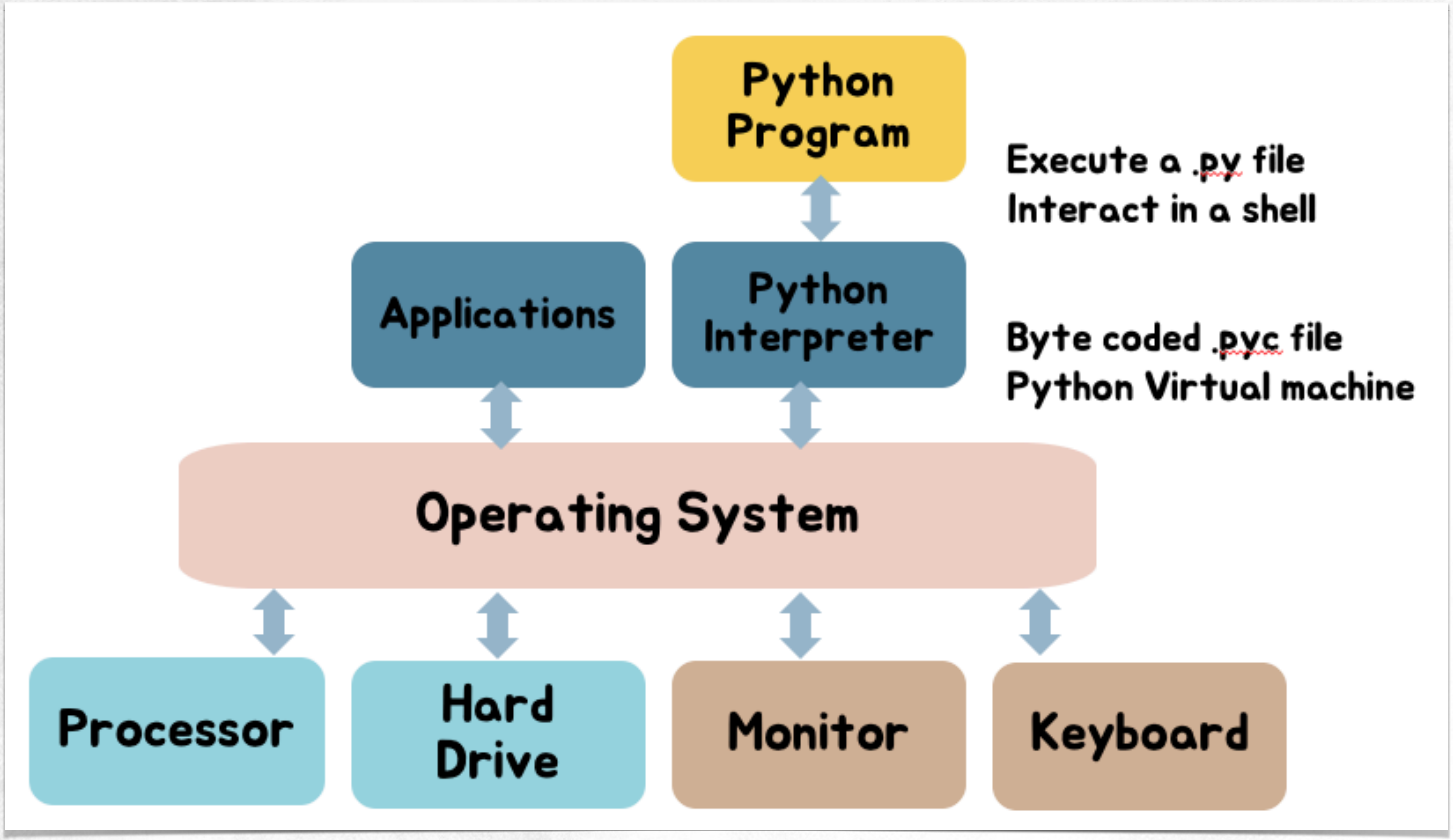
```
A problem has been detected and Windows has been shut down to prevent damage
to your computer.

UNMOUNTABLE_BOOT_VOLUME

If this is the first time you've seen this error screen,
restart your computer. If this screen appears again, follow
these steps:

Check to make sure any new hardware or software is properly installed.
If this is a new installation, ask your hardware or software manufacturer
for any Windows updates you might need.

If problems continue, disable or remove any newly installed hardware
or software. Disable BIOS memory options such as caching or shadowing.
If you need to use Safe Mode to remove or disable components, restart
your computer, press F8 to select Advanced Startup Options, and then
select Safe Mode.

Technical Information:

*** STOP: 0x000000ED (0x80F128D0, 0xc000009c, 0x00000000, 0x00000000)
```

- Every program has bugs!
- Kinds of errors
  - Syntax error: Interpreter cannot understand your code and refuses to execute it
  - Runtime error: When executing your program (at runtime), your program suddenly terminates with an error message
  - Semantic error: Your program runs without error messages, but does not do what it is supposed to do

Python basics

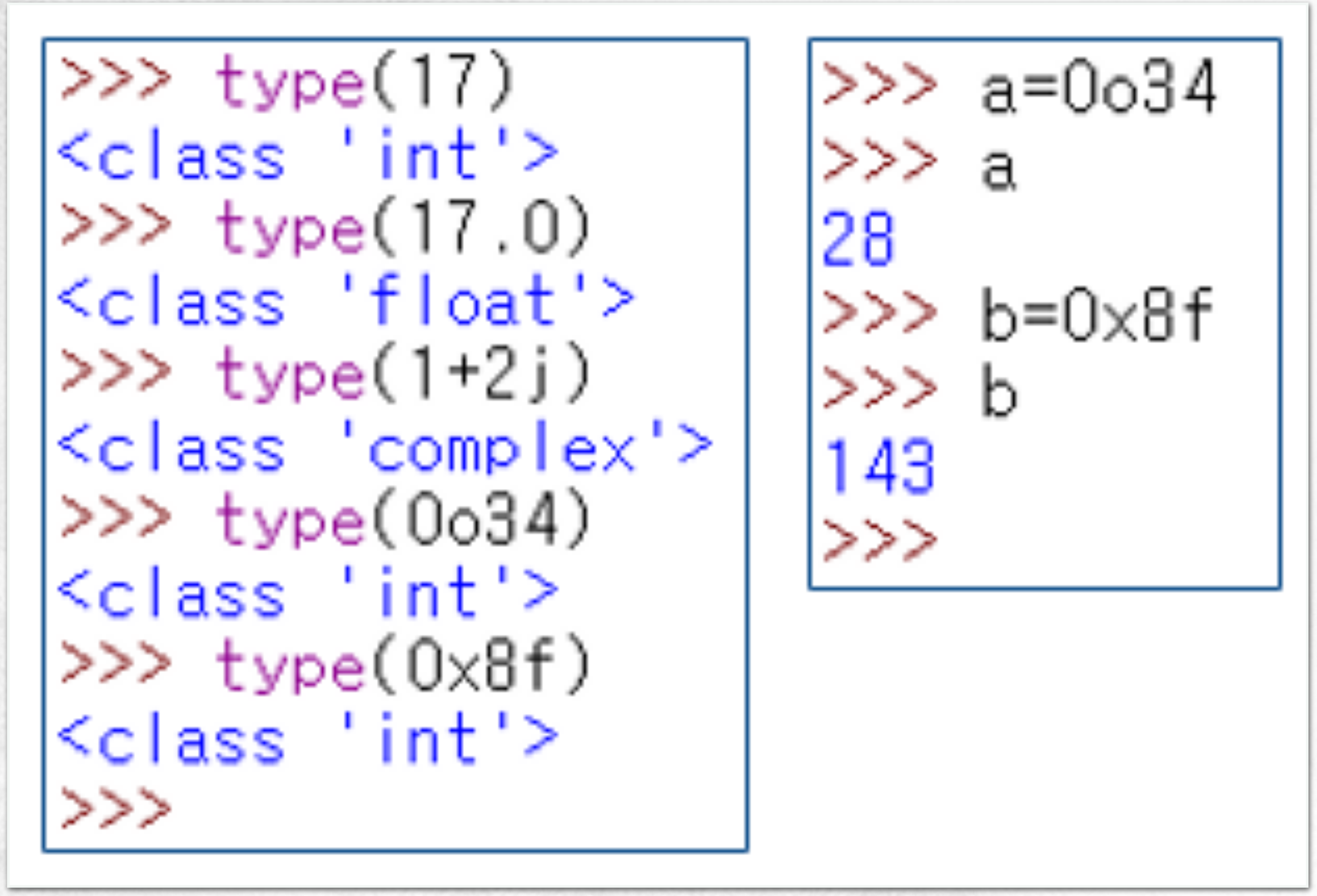
- [ ] Brackets (대괄호)
- { } Braces (중괄호)
- ( ) Parentheses (소괄호)

How does a computer run a python program?



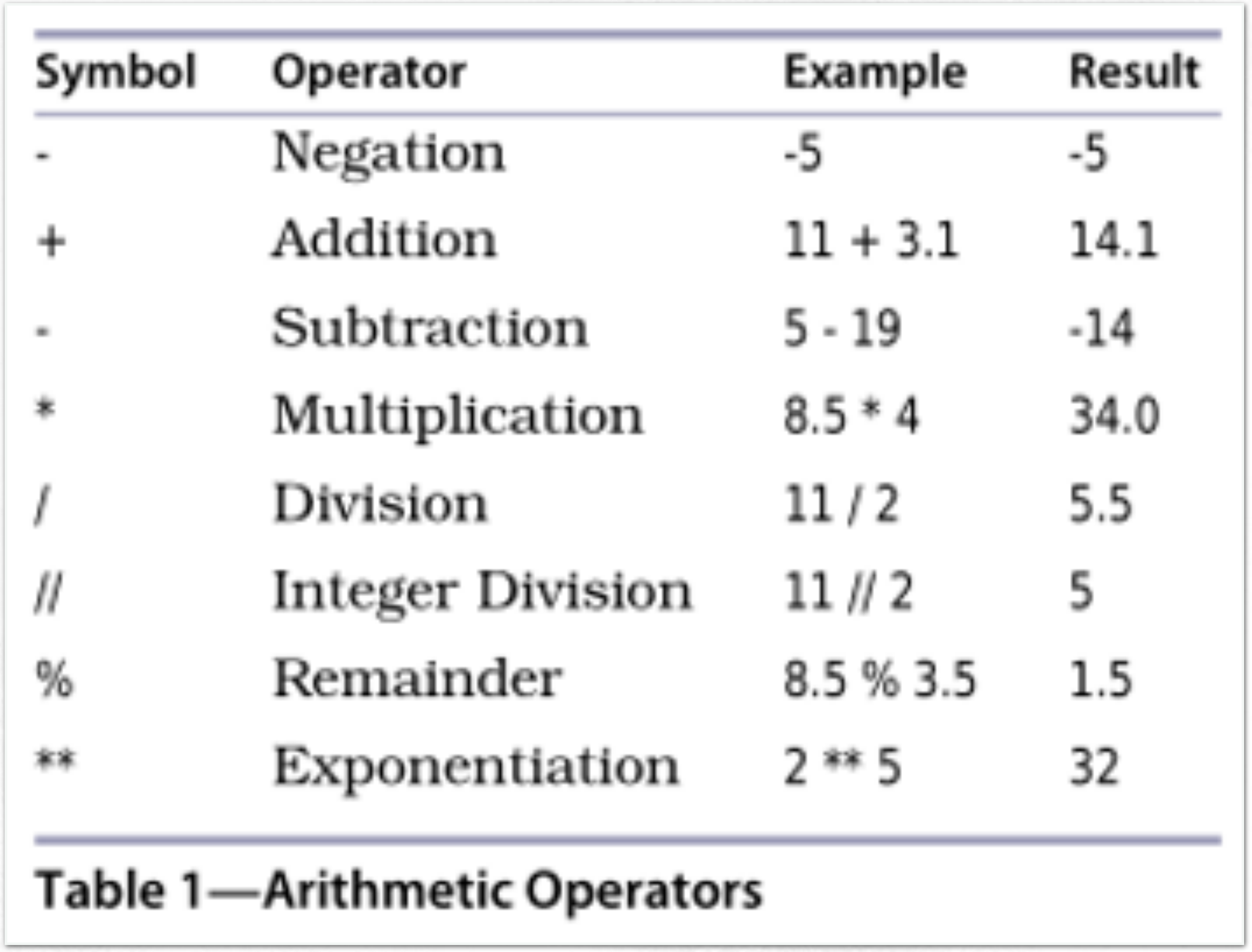
Interact in a Python shell

- Arithmetic in Python
  - Addition, subtraction, multiplication, division
- Types
  - int, float, complex



```
>>> type(17)
<class 'int'>
>>> type(17.0)
<class 'float'>
>>> type(1+2j)
<class 'complex'>
>>> type(0o34)
<class 'int'>
>>> type(0x8f)
<class 'int'>
>>>
```

```
>>> a=0o34
>>> a
28
>>> b=0x8f
>>> b
143
>>>
```

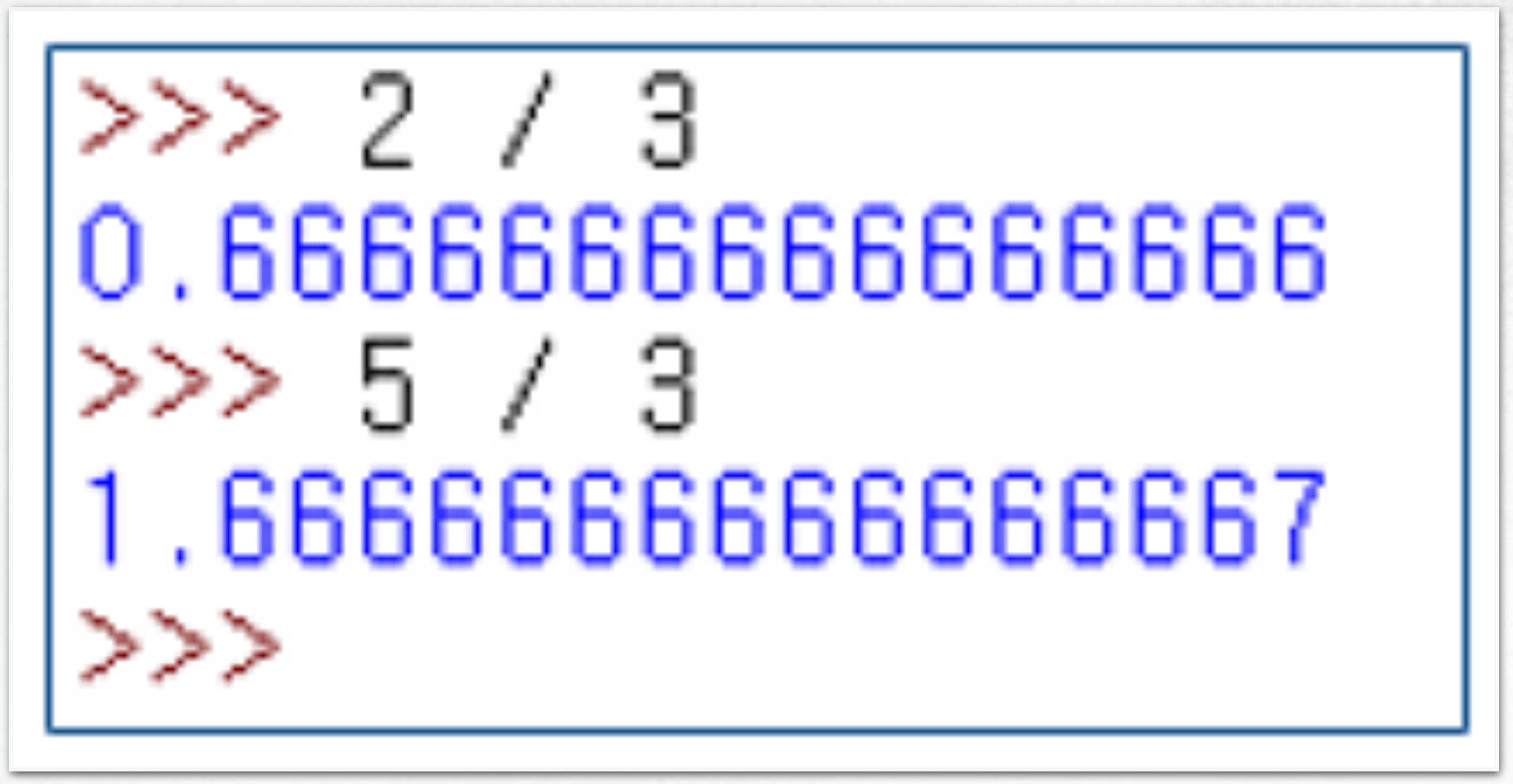


Symbol	Operator	Example	Result
-	Negation	-5	-5
+	Addition	11 + 3.1	14.1
-	Subtraction	5 - 19	-14
*	Multiplication	8.5 * 4	34.0
/	Division	11 / 2	5.5
//	Integer Division	11 // 2	5
%	Remainder	8.5 % 3.5	1.5
**	Exponentiation	2 ** 5	32

Table 1—Arithmetic Operators

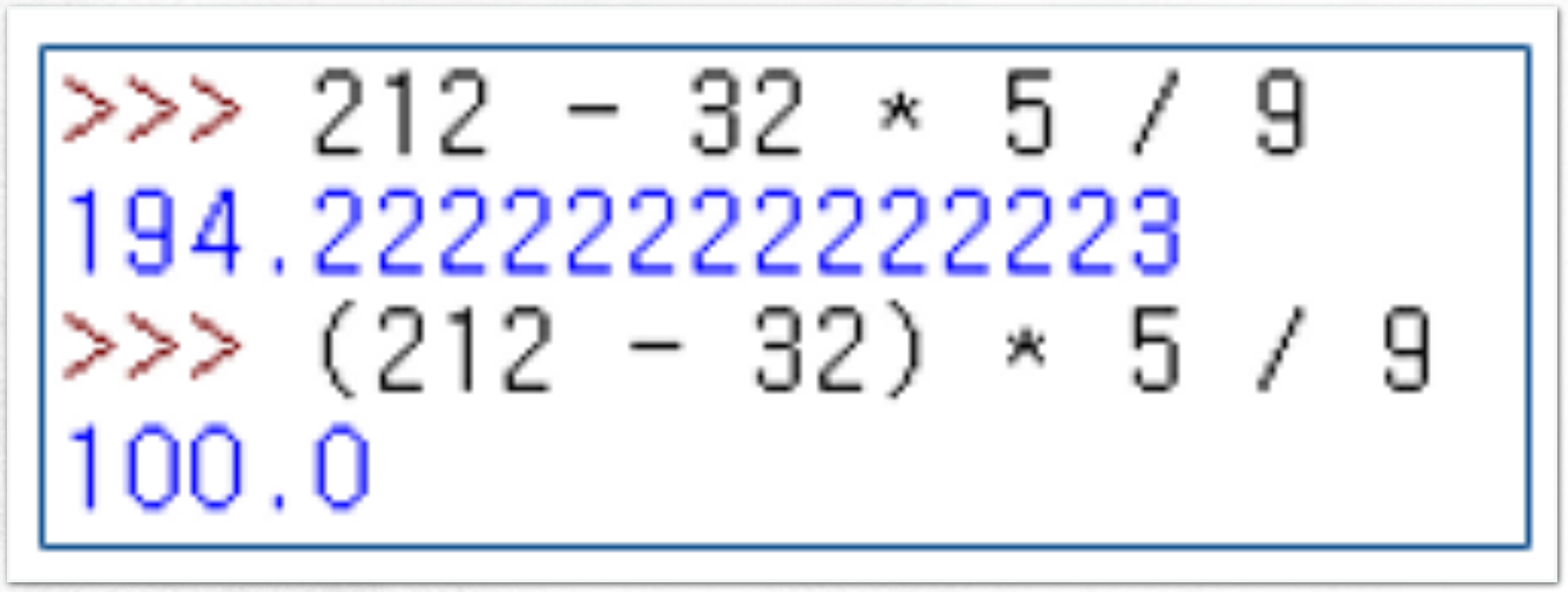
Finite precision

- Computers have a finite amount of memory



```
>>> 2 / 3
0.6666666666666666
>>> 5 / 3
1.6666666666666667
>>>
```

- Operator precedence
  - Ex) Fahrenheit to Celsius: (F - 32) * 5/9
  - Ex) 212 ^{0}F = 100 ^{0}C



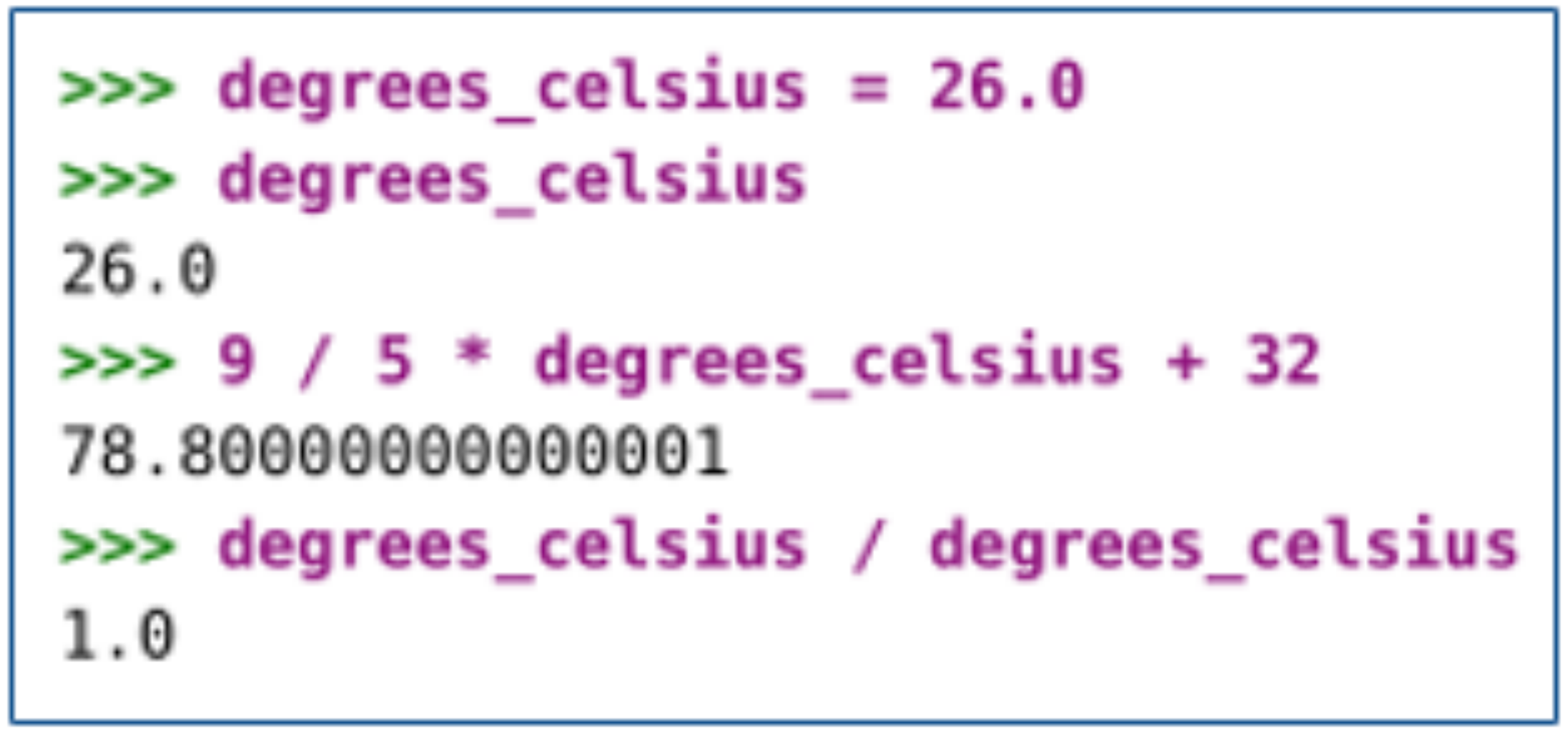
```
>>> 212 - 32 * 5 / 9
194.22222222222223
>>> (212 - 32) * 5 / 9
100.0
```

Variables

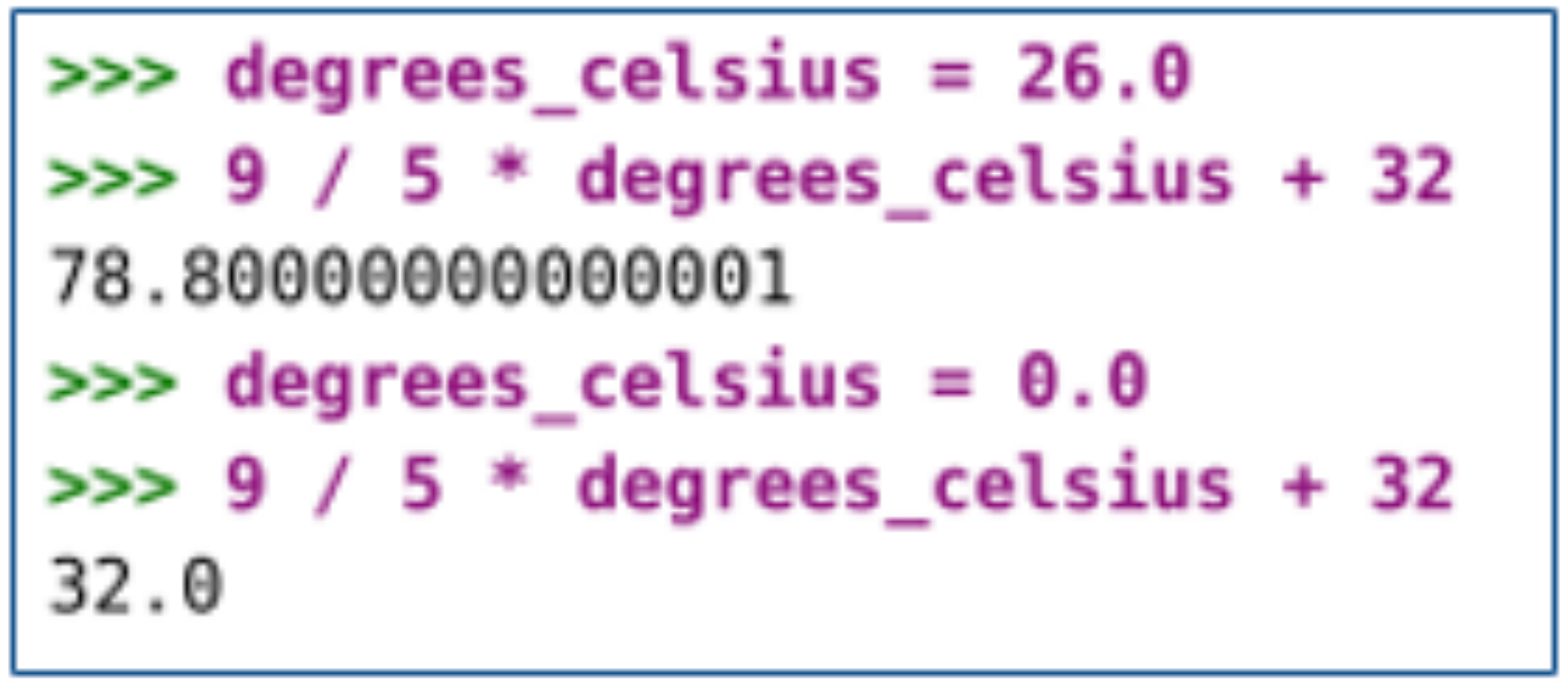
- Let's give a name to a value
  - X, species5618, degrees_celsius
  - 777obj(X), no-way(X), hello!(X)
- Assignment statement

  >>> degrees_celsius = 26.0

- You can assign a new value to the existing variable



```
>>> degrees_celsius = 26.0
>>> degrees_celsius
26.0
>>> 9 / 5 * degrees_celsius + 32
78.80000000000001
>>> degrees_celsius / degrees_celsius
1.0
```



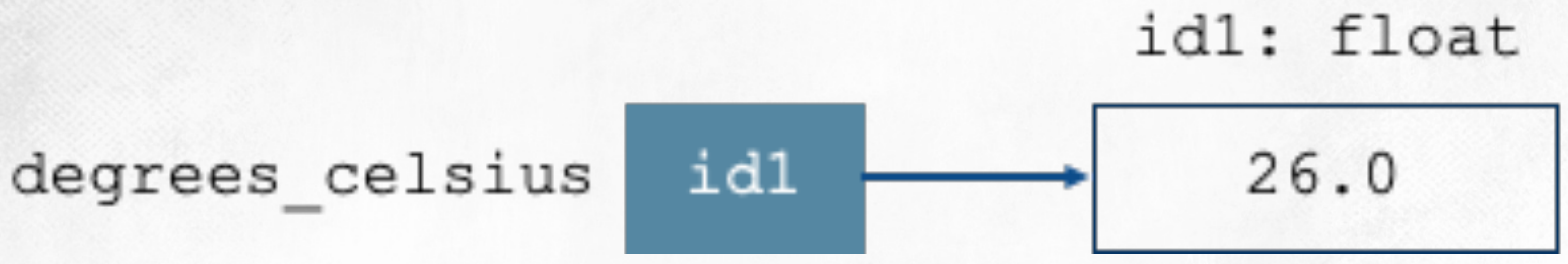
```
>>> degrees_celsius = 26.0
>>> 9 / 5 * degrees_celsius + 32
78.80000000000001
>>> degrees_celsius = 0.0
>>> 9 / 5 * degrees_celsius + 32
32.0
```

- Note that = means "assignment", not "equality"

Variable

- Every location in the computer's memory has a memory address
- Object: a value (or thing) at a memory address with a type

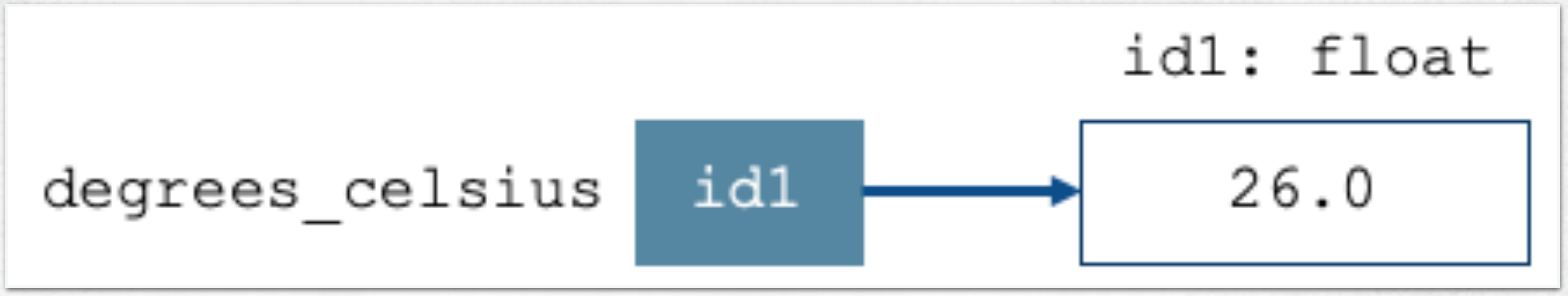
26.0 **id1** **float**



- Variable contains the memory address of the object

degrees_celsius

Values, variables, and computer memory



- Object: a value at a memory address with a type

$\underbrace{\text{a value}}_{26.0}$ at $\underbrace{\text{a memory address}}_{\text{id1}}$ with $\underbrace{\text{a type}}_{\text{float}}$

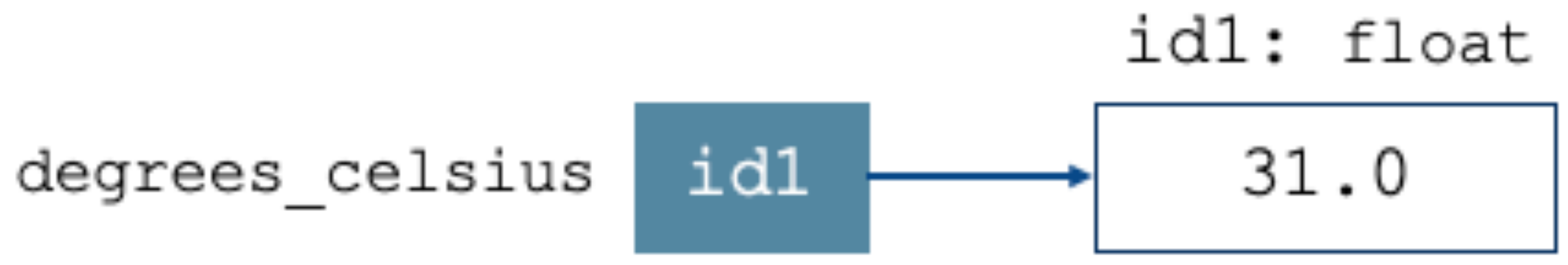
- Variable contains the memory address of the object

$\underbrace{\text{Variable}}$

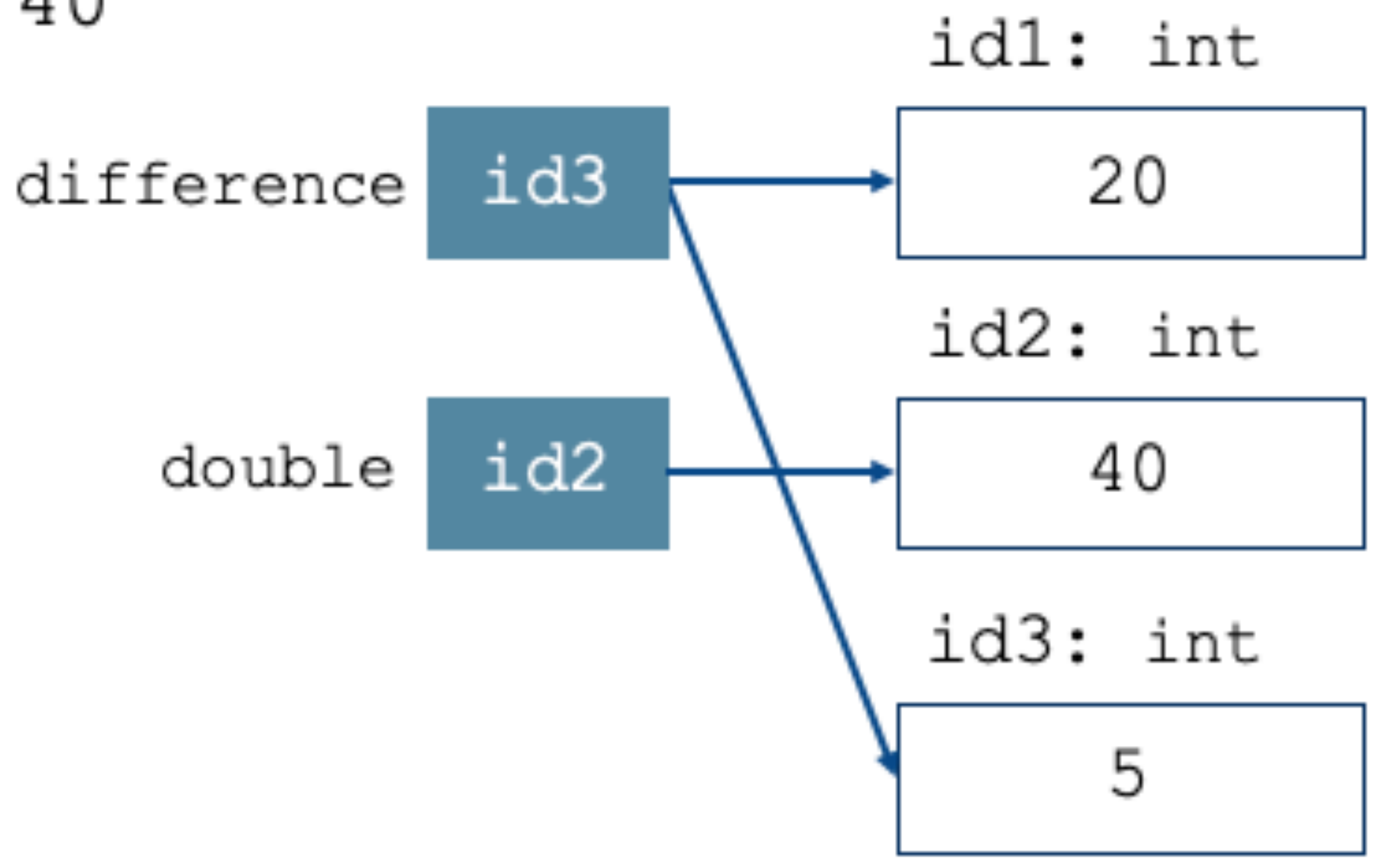
  - Value 26.0 has the memory address id1.
  - The object at the memory address id1 has type float and the value 26.0
  - Variable degree_celsius contains the memory address id1.

Assignment statement

```
>>> degrees_celsius = 26.0 + 5
>>> degrees_celsius
31.0
```



```
>>> difference = 20
>>> double = 2 * difference
>>> double
40
>>> difference = 5
>>> double
40
```



Memory visualization

- http://pythontutor.com/visualize.html

Write code in Python 3.6

```
difference = 20
double = 2 * difference
double
difference = 5
double
```

Python 3.6

```
1 difference = 20
2 double = 2 * difference
3 double
4 difference = 5
5 double
```

Edit code | Live programming
→ line that has just executed
→ next line to execute

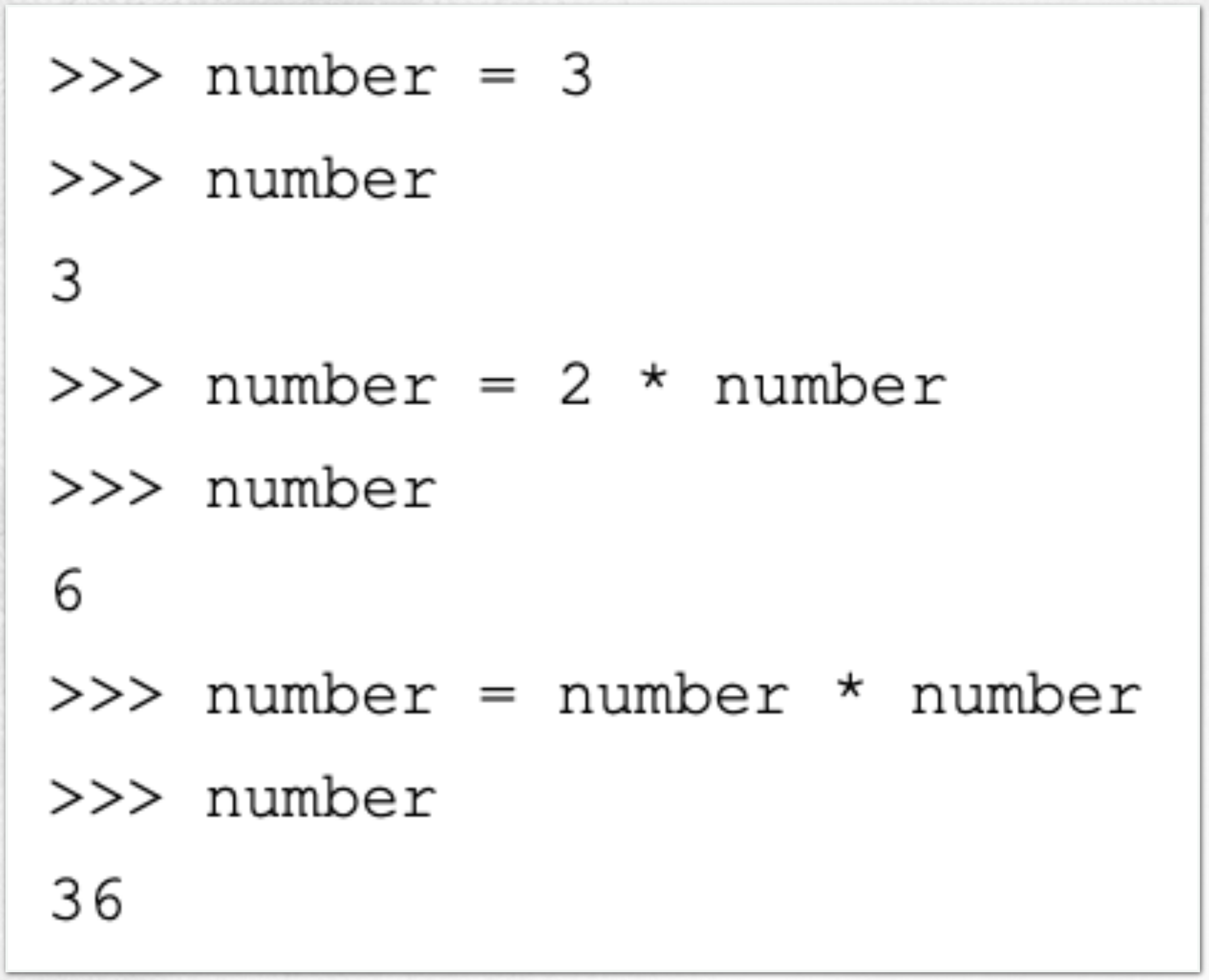
Click a line of code to set a breakpoint; use the Back and Forward buttons to jump there.

<< First
< Back
Step 5 of 5
Forward >
Last >>
Frames
Objects
Global frame
difference id3
double id2
id2:int
40
id3:int
5

Support our research and keep this tool free by filling out this survey on how your native spoken language affects how you learn programming.

Visualize Execution
Live Programming Mode
hide exited frames [default]
render all objects on the heap (Python/Java)
use text labels for pointers
Create test cases

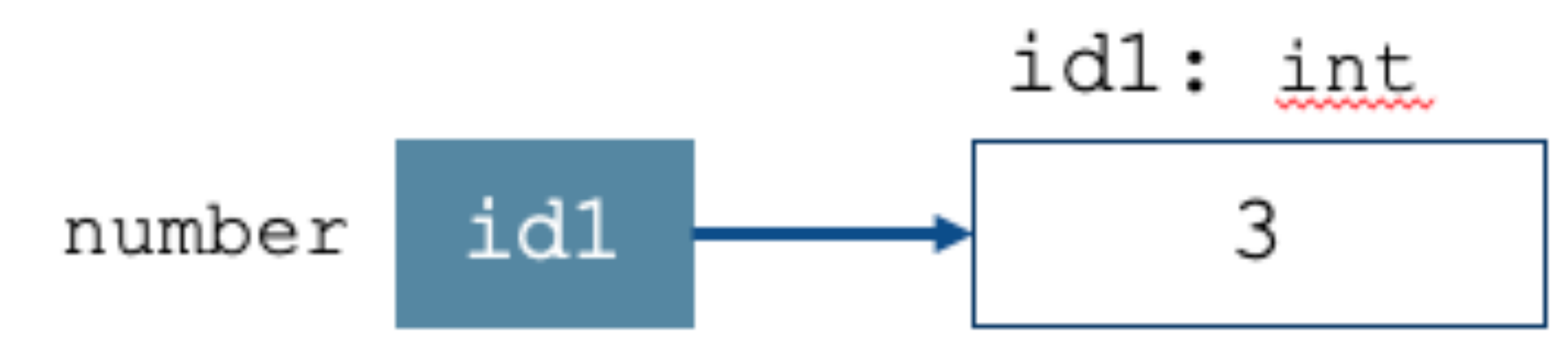
Memory visualization



```
>>> number = 3
>>> number
3
>>> number = 2 * number
>>> number
6
>>> number = number * number
>>> number
36
```

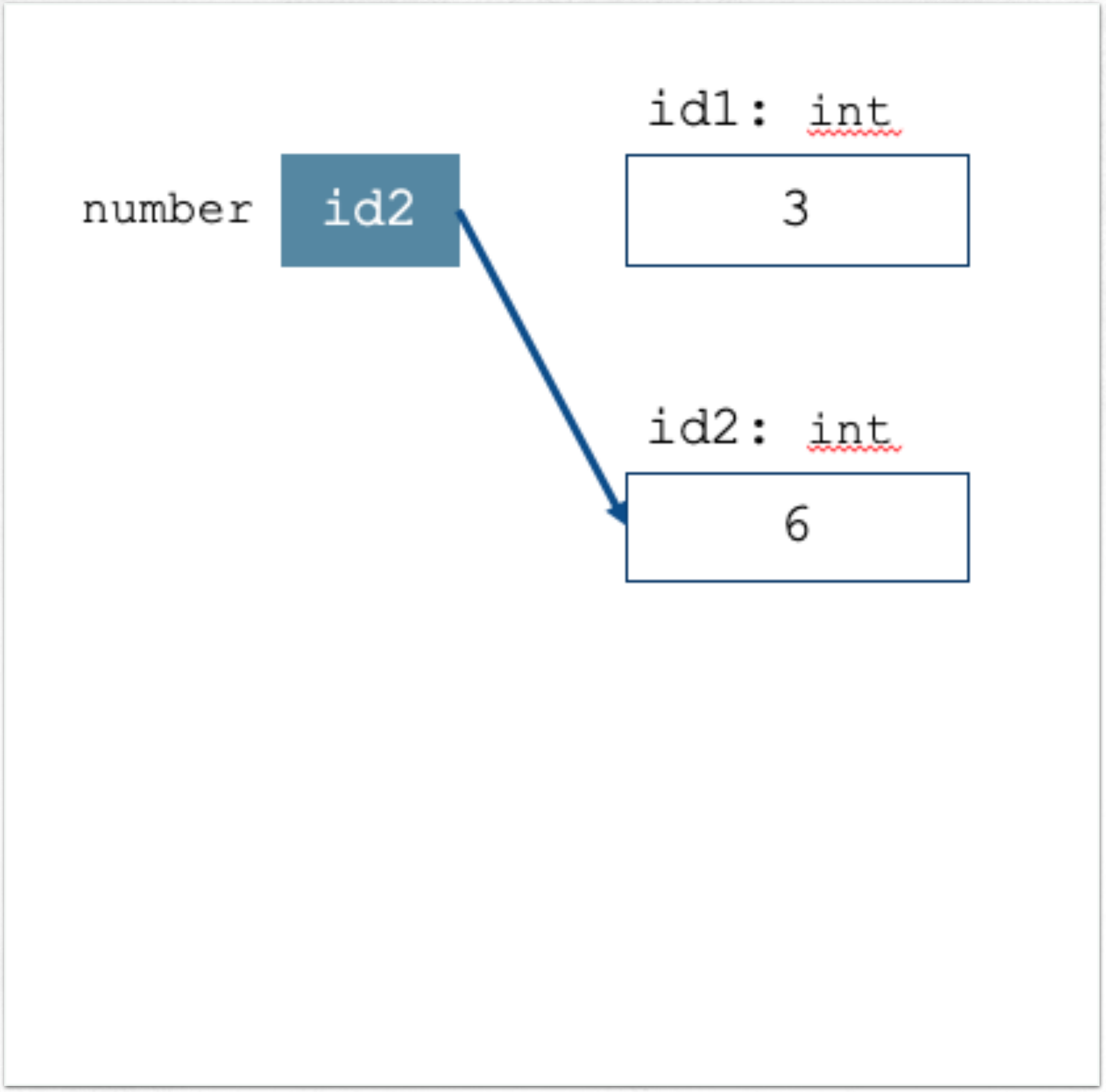
Memory visualization

```
>>> number = 3
>>> number
3
>>> number = 2 * number
>>> number
6
>>> number = number * number
>>> number
36
```



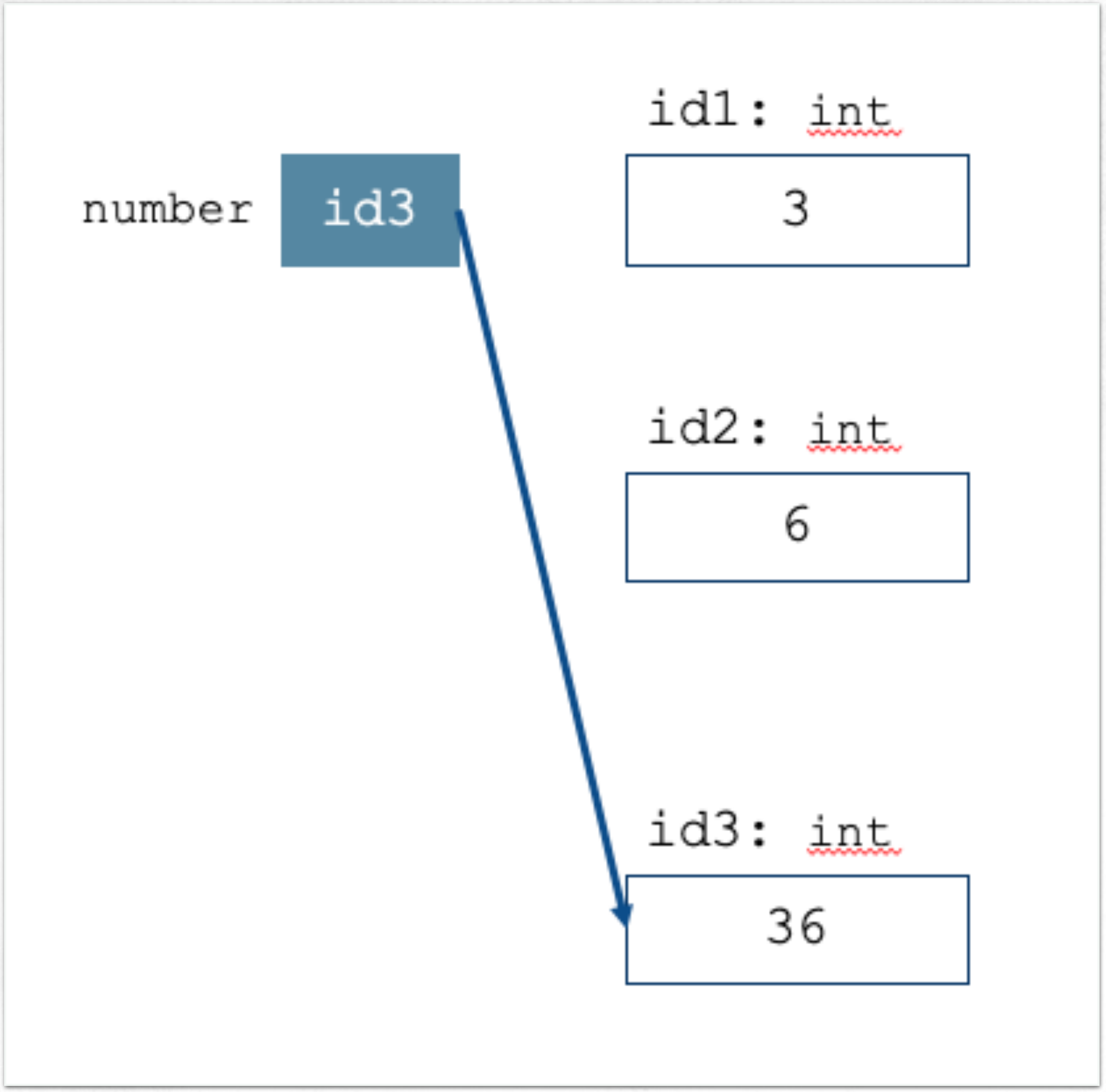
Memory visualization

```
>>> number = 3
>>> number
3
>>> number = 2 * number
>>> number
6
>>> number = number * number
>>> number
36
```

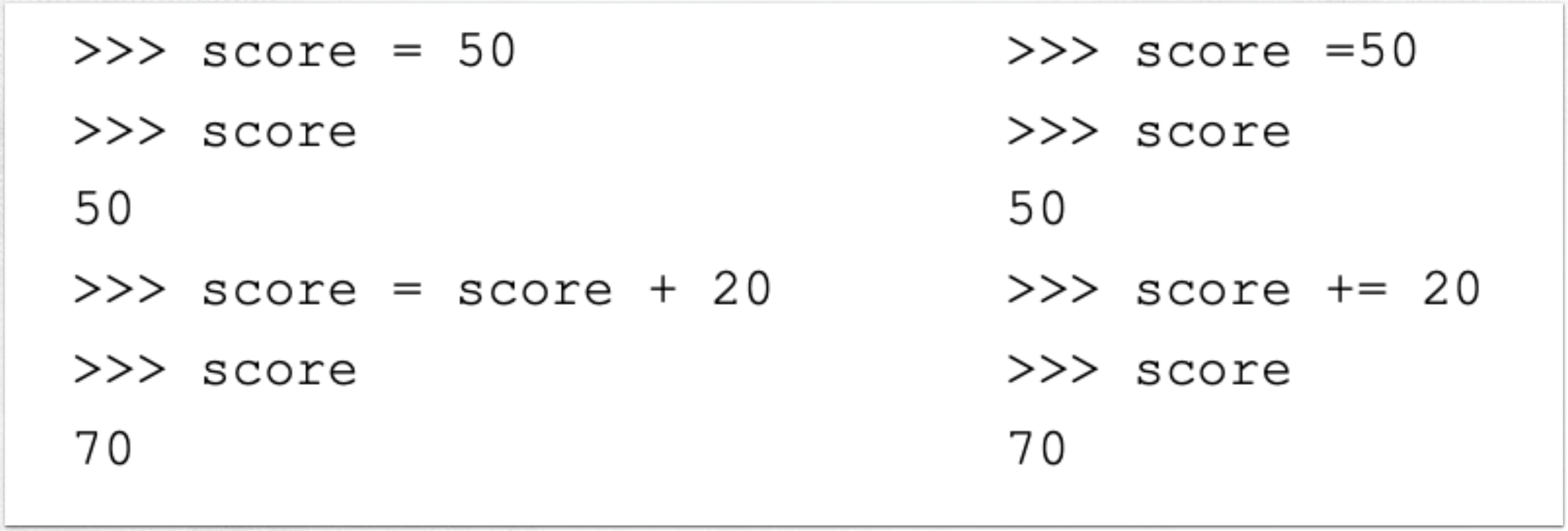


Memory visualization

```
>>> number = 3
>>> number
3
>>> number = 2 * number
>>> number
6
>>> number = number * number
>>> number
36
```



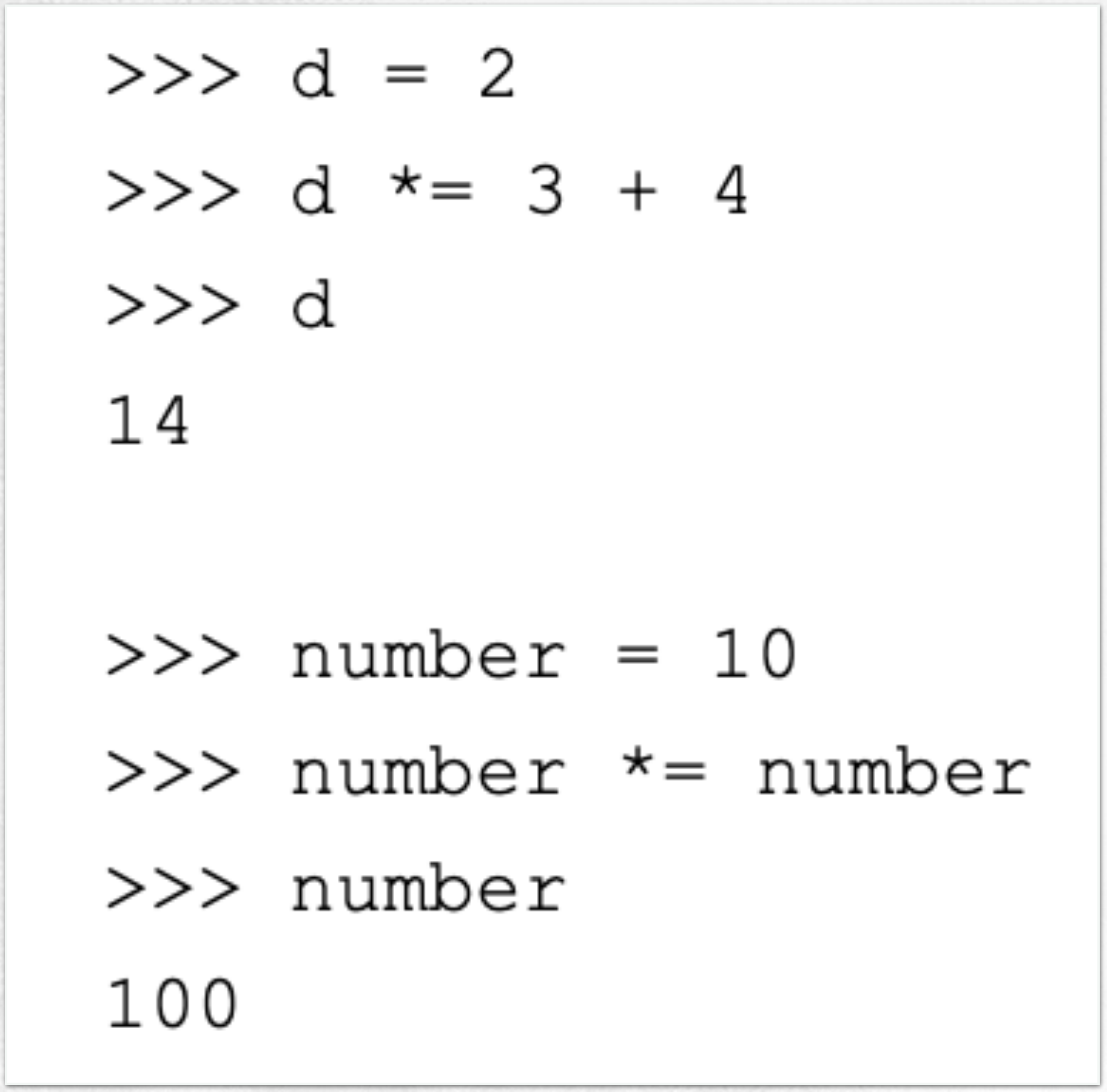
Augmented assignment



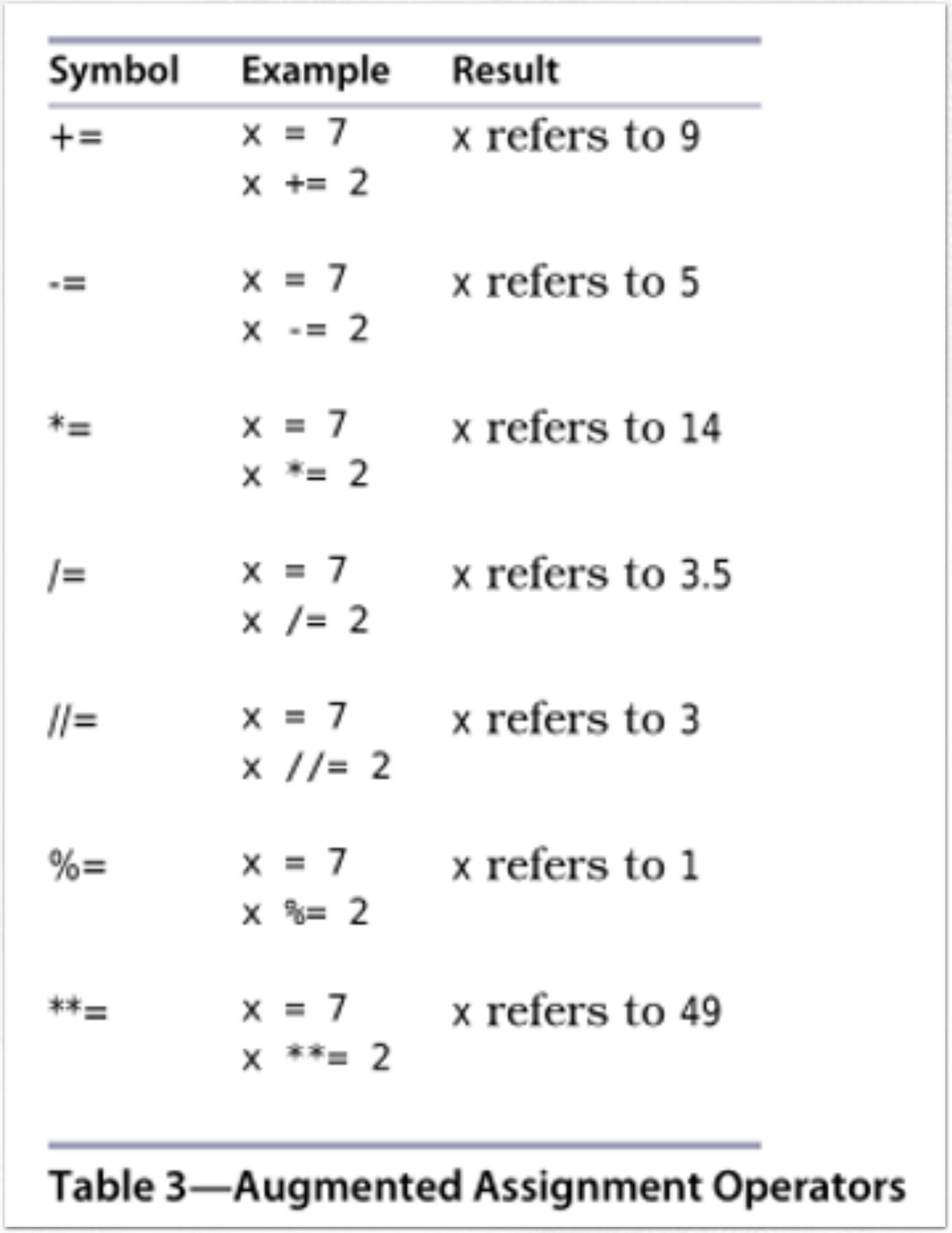
```
>>> score = 50
>>> score
50
>>> score = score + 20
>>> score
70
```

```
>>> score =50
>>> score
50
>>> score += 20
>>> score
70
```

Augmented assignment



```
>>> d = 2
>>> d *= 3 + 4
>>> d
14


>>> number = 10
>>> number *= number
>>> number
100
```



Symbol	Example	Result

+=	`x = 7`
	`x += 2`
		x refers to 9

-=	`x = 7`
	`x -= 2`
		x refers to 5

*=	`x = 7`
	`x *= 2`
		x refers to 14

/=	`x = 7`
	`x /= 2`
		x refers to 3.5

//=	`x = 7`
	`x //= 2`
		x refers to 3

%=	`x = 7`
	`x %= 2`
		x refers to 1

**=	`x = 7`
	`x **= 2`
		x refers to 49

Table 3—Augmented Assignment Operators

Summary

- Programs are made up of commands that tell the computer what to do. These commands are called statements, which the computer executes.
- This chapter described the simplest of Python's statements and shows how they can be used to do arithmetic, which is one of the most common tasks for computers and also a great place to start learning to program. It's also the basis of almost everything that follows.

Thank you

경희대학교
KYUNG HEE UNIVERSITY