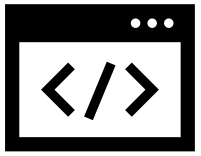
IMPERIAL



BIOE50010 – Pr🎃gramming 2

Computer Lab 4: Object-Oriented Programming

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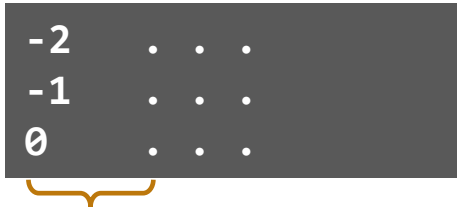
Feedback on Week 3 - **Formatting**

- Suppose the desired effect from formatting is



- … which can be achieved by

Example

```
for i in range(-2, 1):
    print(f"{i:<5}", end='')
    for j in range(3):
        print(" . ", end='')
    print()
```

The key trick here is `"{i:<5}"`

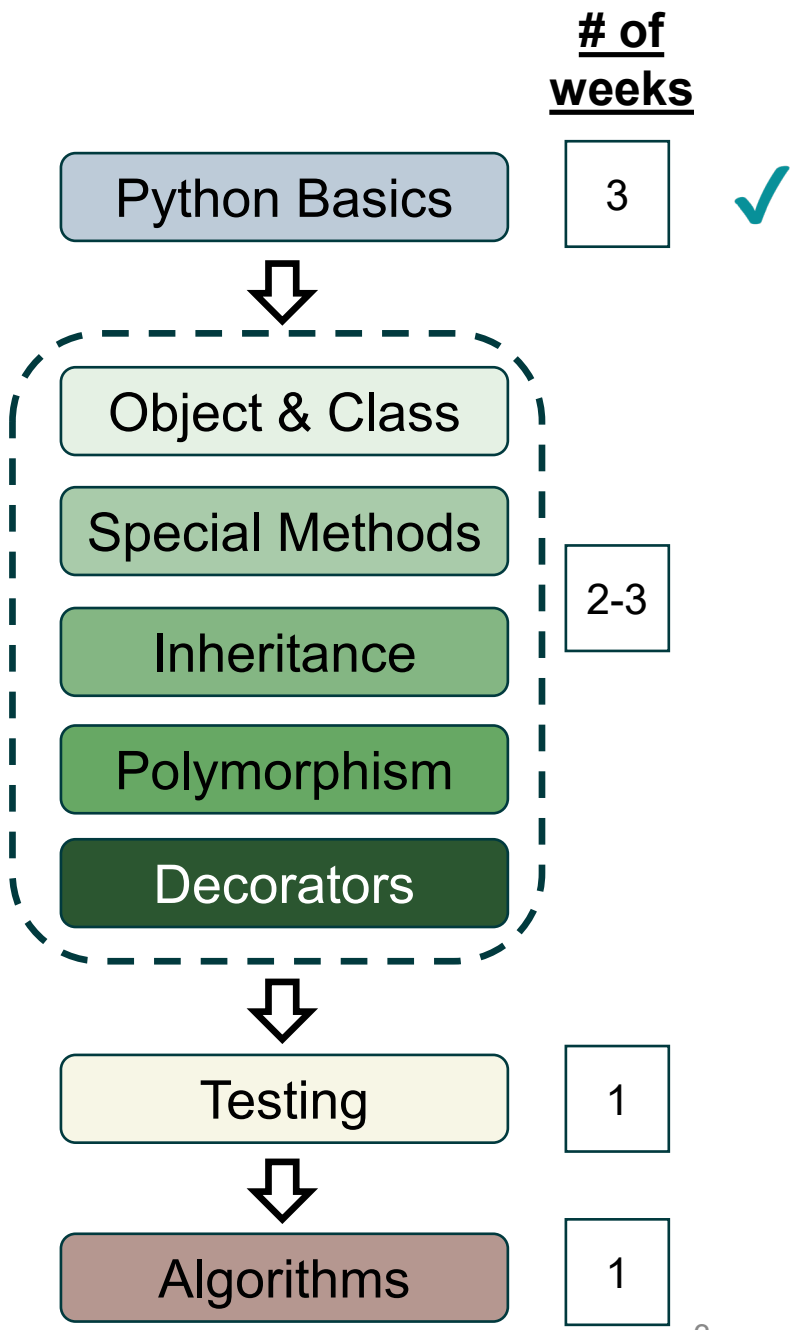
- `:<` tells Python to **left-align** the text
- **5** is the **width** of the space allocated for the text (5 characters wide inc. the printed contents).

- Similarly, we can right-align the texts (`:>`) , centrally align the texts (`:^`), or auto-fill the empty spaces (`:char>`).

* See in-class example here.

Progress Check

Week 4:
we are here



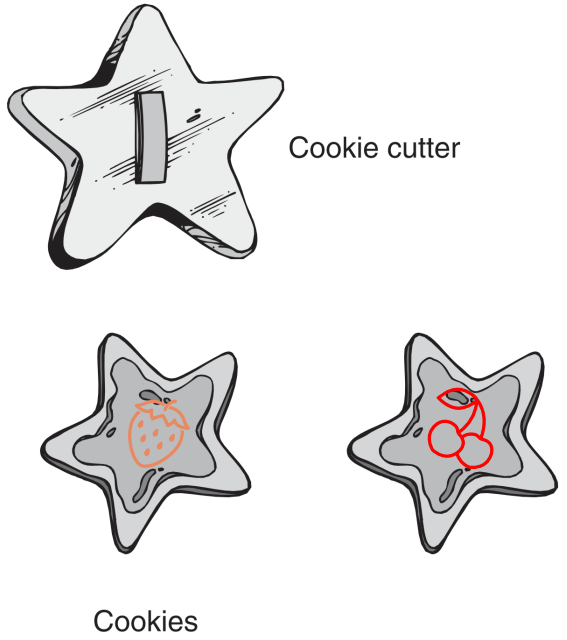
Revision Points (from weeks 3)

- **Data structures**: int, str, high-dimensional list
- **Functions,** namespaces, using return, use positional / keyword / non-keyword arguments
- **File I/O**: open, read, write, close
- **String / list methods**
- Other commonly-used **Python built-in functions**: `range()`, `enumerate()`, `len()`, *etc.*

Object-Oriented Programming

new terminology!

- Two most commonly-used programming paradigms:
  - **Procedural** (what you have done so far): programs are composed of one or more functions, executed serially;
  - **Object-oriented**: programs based on the **objects**, where data and functions are 'packed' into a **user-defined data structure**.
- **Examples of objects**: a `str`, `list`, `dict`...
  - These are the **data structures**, rather than the real data!
- The prototype / blueprint of an object is structured by the **class definition**.



Source: Starting Out with Python, 4th Ed.

A ***cookie cutter*** can be used to make different ***cookies***.

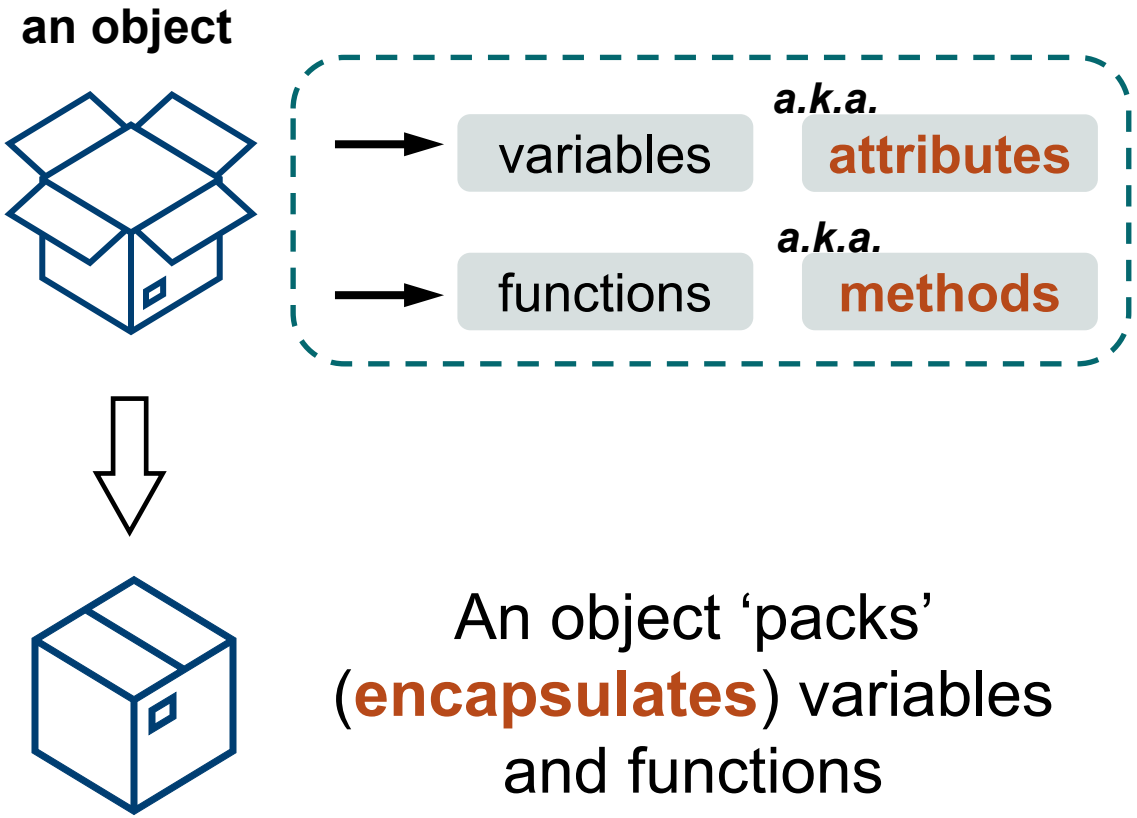
⟺

A ***class definition*** can be used to make several ***objects***.

- Sometimes, **objects** are also referred to as the **instances**.

What Does an Object Hold?

new terminology!



An object ‘packs’ (**encapsulates**) variables and functions

Suppose we have a box…

- The colour is red
- The state is closed

} attributes

… and I can do the following things to manipulate the property / state of the box:

- Open the box
- Describe its properties
- Close the box
- Fold it…

} methods

* See weekly coding example here.

Example Code (1/)

`self`: an identifier refers to the object *itself*, provides access to attributes / methods

new terminology!

Example

```
class Box:
    def __init__(self, color):
        self.color = color
        self.is_open = False

    def describe_box(self):
        print(f"This is a {self.color} box.")

    def open_box(self):
        if not self.is_open:
            self.is_open = True
            print(f"The {self.color} box is now open.")
        else:
            print(f"The {self.color} box is already open.")
```

attributes

methods

Describe the properties / states *etc.* of the object

Manipulate the behaviours the of the object

* See weekly coding example here.

Example Code (2/)

constructor: `__init__()` is triggered automatically when the object is **instantiated**.

new terminology!

Example

```
class Box:
    def __init__(self, color):
        self.color = color
        self.is_open = False

    def describe_box(self):
        print(f"This is a {self.color} box.")

    def open_box(self):
        if not self.is_open:
            self.is_open = True
            print(f"The {self.color} box is now open.")
        else:
            print(f"The {self.color} box is already open.")
```

Driver

```
box = Box(color="blue")
box.describe_box()
box.open_box()
box.open_box()
```

Console

```
This is a blue box.
The blue box is now open.
The blue box is already open.
```

* See weekly coding example here.

Your task today

Create a class **`Point`** that handles operations on Cartesian coordinates (x, y)

- Display the coordinates
- Convert (x, y) to polar coordinates (r, θ)
- Implement **operator overloading methods** *e.g.* addition, subtraction, multiplication…

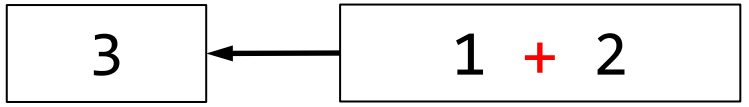
To start…

- Take advantage of the code skeleton from the live coding demonstration (Friday lecture) and example notebook.
- Read all information and the sample output provided in the lab sheet carefully.
- Read sec. 17.5-17.8 in 'Think Python 2e' for **special methods** and **operator overloading**. *e.g.*, `__init__`, `__str__`, `__add__`, `__radd__`

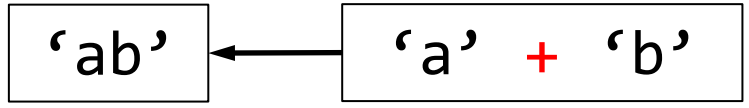
Operator Overloading

- A same operator can have different behaviors when it is applied to different data types. For example, with the '**+**' operator;

`int + int`: arithmetic addition

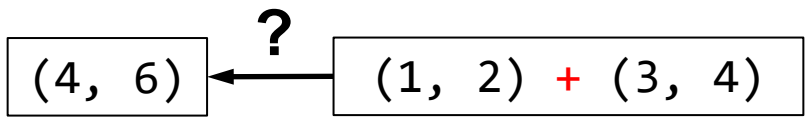


`str + str`: concatenation



- **Operator overloading** enables users to define the rules of an operator when it is applied to the user-defined data types. *e.g.*, `+`, `-`, `*`, `==`, `<=`

`Point + Point`: what will happen?



- In this situation, the rule(s) for '+' need to de defined with the special (magic) method **`__add__`** in `Point`