Prepared by Julian García, based on material by
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Lecture 15
Classes and Objects

FIT 1008
Introduction to Computer Science

MONASH University
Information Technology

Objectives

- Learn some **Object Oriented Programming** (in Python)
- In particular, to learn:
  - How to **define basic <u>classes</u>**
  - How to **instantiate them into <u>objects</u>**
  - How to define **<u>methods</u>** and how to use them
  - An example of classes for implement stacks
  - The importance of **namespaces and scoping rules**

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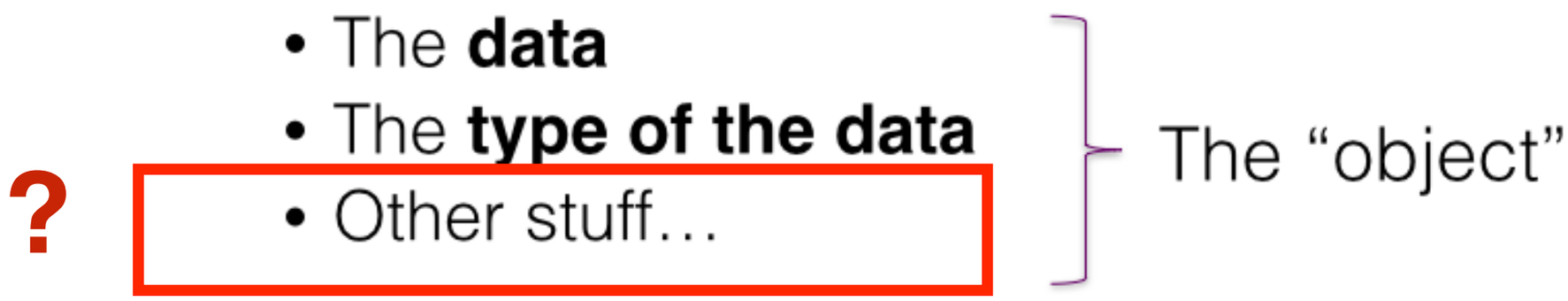
  - How to define **<u>methods</u>** and how to use them
  - An example of classes for implement stacks
  - The importance of **namespaces and scoping rules**

- We will **NOT** learn about a major OO component: **inheritance**
  - Not needed for FIT1008
  - Central to the idea of OO

Objects

- **Objects**: blocks of memory containing some data.



- Objects are more than **data** fields (or data attributes).
  They **also** have **methods** that can be performed by the object.

- Like real life: **Objects** interact with each other (through methods.)

- **Example**: a human "object" would have:
  - Data describing the human (by its attributes):
    - Name, age, height, weight, eye colour, etc
  - Methods that can be performed by/on the human:
    - Eat, sleep, run, study, etc
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Remember:
In Python every value is an object.

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Remember:
In Python every value is an object.

- The **data**
- The **type of the data**
- Other stuff…

} The "object"

Using Objects

- Every value is an object with **data and methods.**

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  Through the **“dot”** notation:

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```
>>> "abcd".upper()
'ABCD'
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>>> x = [1,2,3,4]
>>> x.append(5)
>>> x
[1, 2, 3, 4, 5]
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- So, how do we access the data and methods of an object? Through the **"dot"** notation:

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>>> x = [1,2,3,4]
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- Also referred to as "**qualifying**" a variable or method.

- The **dot notation is common** to many languages (e.g. Java.)

blueprint

Objects:

blueprint

Class:

Objects:

Class:

blueprint

Objects:

Class:

blueprint

Objects:

instances…

blueprint

noun

1 *the blueprints of the aircraft and its components*: PLAN, design, draft, diagram, drawing, scale drawing, outline, sketch, pattern, map, layout, representation; technical drawing.

2 *the Thai programme provides a blueprint for similar measures in other developing countries*: MODEL, plan, template, framework, pattern, design, example, exemplar, guide, prototype, paradigm, sample, pilot, recipe.

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class ClassName:
    <statement-1>
      ......
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Statement-i are mostly "methods"

- Every object is created by **instantiating** a class (see later).

- That is why we say that an **object is an instance of a class.**

Methods

- Define **operations** that can be performed by any object created as an instance of the class
- A method definition looks like a function definition
- Except that:
  - It must appear inside the class (in the body)
  - Its first argument must be a reference to the instance whose method was called
    - By **(a very strong) convention**, this argument is named **self**
    - You must **explicitly** add **self** to the method **definition**
    - But it is **automatically** added in a **method call**

The __init__ method

- By **convention** it is the first method in a class.
- First code **executed when creating an instance** (automatically!)
- You can choose not to define it.
- Its first argument (**self**) is a reference to the **instance** whose method was called.

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Point Class

```
class Point:
    def __init__(self, x, y):
        self.x_coordinate = x
        self.y_coordinate = y
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don't forget **self**

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Instance variables

- **Instance variables** start with **self**:
  - Their **value** is specific to each instance.
  - Their **name** is global to all methods in the class. You can access it from every method in the class.

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```

Instance variables

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  - Their **value** is specific to each instance.
  - Their **name** is global to all methods in the class. You can access it from every method in the class.

- If a variable does not start with self it is **local** to the method that binds it. Local variables <u>can't be seen</u> by <u>other</u> methods.

The argument **self** in methods in a Python class refers to:

A) The address of the **class**.

B) The address of the **object** calling the method containing the argument **self**.

C) The address of the **method** using the argument self.

D) None of the above.

Let's put this into a file called *point.py*

```
class Point:
    def __init__(self, x, y):
        self.x_coordinate = x
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```

point is the name of the file where the class is defined.

```
>>> import point
```

Let's put this into a file called *point.py*

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class Point:
    def __init__(self, x, y):
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```

We **instantiate** the class by "calling it" as if it was a function with the arguments of __init__.
p1 is now an instance of Point.

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```
>>> import point
>>> p1 = point.Point(1,3)
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1
>>> p1.y_coordinate
3
```

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p2 is now another instance

```
>>> import point
>>> p1 = point.Point(1,3)
>>> p1.x_coordinate
1
>>> p1.y_coordinate
3
>>> p2 = point.Point(-4,7)
>>> p2.x_coordinate
-4
>>> p2.y_coordinate
7
```

Let's put this into a file called *point.py*

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class Point:
    def __init__(self, x, y):
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p2 is now another instance

Every instance has some built-in attributes. For example **__class__**

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>>> p2.y_coordinate
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>>> p1.__class__
<class 'point.Point'>
```

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>>> p2.y_coordinate
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>>> p1.__class__
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```

Recap

- We create a **class** by:
  - Simply writing class Name, in some file.
  - Adding **indented statements** (such as methods) to it
  - All methods have **self** as first argument

- We create an **<u>object</u>**:
  - By instantiating the class. Calling Name() with the appropriate arguments, as given by **__init__**
  - The object has access to all the **attributes** defined by the class using the **"dot" notation** (e.g., the_stack.push)

Class variables

Variables whose values are shared by **all instances** of the class

```
>>> class Silly:
...     i = 8
...
```

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Defined in the body of a class, but **outside** any methods.

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Variables whose values are shared by **all instances** of the class

Defined in the body of a class, but **outside** any methods.

```
>>> class Silly:
...     i = 8
...
>>> Silly.i
8
```

Belongs to the **class**. It exists without the object. Values are accessed through the **class**.

Class variables

Variables whose values are shared by **all instances** of the class

```
>>> class Silly:
...     i = 8
...
>>> Silly.i
8
>>> s1 = Silly()
>>> s1.i
8
```

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Can also be accessed through instances.

Class variables

Variables whose values are shared by **all instances** of the class

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>>> class Silly:
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>>> s1.i
8
>>> s2 = Silly()
>>> s2.i
8
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Defined in the body of a class, but **outside** any methods.

Belongs to the **class**. It exists without the object. Values are accessed through the **class**.

Can also be accessed through instances.

All instances share the same value.

Class variables

```
>>> Silly.i = 11
```

You can <u>modify</u> the value of a **class variable**

Class variables

```
>>> Silly.i = 11
>>> s1.i
11
>>> s2.i
11
```

You can modify the value of a **class variable**

All instances will share the new value

Class variables

```
>>> Silly.i = 11
>>> s1.i
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>>> s2.i
11
>>> s1.i = 6
```

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Class variables

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>>> Silly.i = 11
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Modifying the value of a **class variable through the instance**?

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Modifying the value of a **class variable through the instance**?

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Names and scoping!

Summary

- Classes and instances (objects)
- Methods (the **__init__** method in particular)
- Class variables