

Python

Object Oriented Programming: Classes, Objects,
Inheritance

In this lecture

- Object Oriented Programming Theory
- Classes and Objects in Python
 - 'self' reference
 - `__init__()` constructor
- Inheritance
 - Parent and Child terminology
 - 'super()' reference
 - Extending Classes

Reminder!

type() function

```
In[ ]: 1 | age = 30
        2 | print(type(age))
        3 | name = "Nick"
        4 | print(type(name))
```

type() function

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In[ ]: 1 | age = 30
        2 | print(type(age))
        3 | name = "Nick"
        4 | print(type(name))
```

```
<class 'int'>
```

```
<class 'str'>
```

Classes and Objects

OOP

- The Object-Oriented Paradigm originated in the 1980s.
- C++ was originally known as 'C with classes'.
- Procedural programming would separate data from procedures.
- Object Oriented Programming encapsulates both data and procedures into a package (an object).
- As we have seen, Python build primitive types as classes: int, str, float, bool

Classes and Objects



Classes are the **blueprint**

Unique objects can be created from this blueprint

Two parts

Variables
Functions

Other terms!

Variables / data / properties / attributes

Functions / methods / behaviours / subroutines

Classes and Objects in Python

Classes and objects

```
In[ ]: 1 | class Student:
        2 |     def print_name(self):
        3 |         print("Hi Nick")
        4 |
        5 | obj = Student() # call constructor
        6 | obj.print_name()
```

Classes and objects

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In[ ]: 1 | class Student:
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Classes and objects

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In[ ]: 1 | class Student:
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Classes and objects

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In[ ]: 1 | class Student:
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Classes and objects

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In[ ]: 1 | class Student:
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Classes and objects

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In[ ]: 1 | class Student:
        2 |     def print_name(self):
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        5 | obj = Student() # call constructor
        6 | obj.print_name()
```

Hi Nick

Object addr

```
In[ ]: 1 | class Student:
        2 |     def print_name(self):
        3 |         print("Hi Nick")
        4 |
        5 | obj = Student() # call constructor
        6 | print(obj)
```

Object addr

```
In[ ]: 1 | class Student:
        2 |     def print_name(self):
        3 |         print("Hi Nick")
        4 |
        5 | obj = Student() # call constructor
        6 | print(obj)

<__main__.Student at 0x1046a0be0>
```

Two objects

```
In[ ]: 1 | class Student:
        2 |     def print_name(self):
        3 |         print("Hi Nick")
        4 |
        5 |     nick = Student() # one object
        6 |     print(nick)
        7 |     sam = Student() # another object!
        8 |     print(sam)
```

Two objects

```
In[ ]: 1 | class Student:
        2 |     def print_name(self):
        3 |         print("Hi Nick")
        4 |
        5 |     nick = Student() # one object
        6 |     print(nick)
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        8 |     print(sam)

<__main__.Student at 0x1046a0be0>
<__main__.Student at 0x10458bf40>
```

Two objects

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In[ ]: 1 | class Student:
        2 |     def print_name(self):
        3 |         print("Hi Nick")
        4 |
        5 |     nick = Student() # one object
        6 |     nick.print_name()
        7 |     sam = Student() # another object!
        8 |     sam.print_name()
```

Problem!

```
In[ ]: 1 | class Student:
        2 |     def print_name(self):
        3 |         print("Hi Nick")
        4 |
        5 |     nick = Student() # one object
        6 |     nick.print_name()
        7 |     sam = Student() # another object!
        8 |     sam.print_name()
```

Hi Nick

Hi Nick

'self' reference

Self

- 'self' can be substituted for any given object created of the class.
- Rather than specifying one object that will be referred to every time the method is run, 'self' can refer to the object that the method is being called on.
- In Python, self is automatically passed (so we don't have to), but it is received, so has to be defined in class methods.

Self

```
In[ ]: 1 | class Student:
        2 |     def set_name(self, name):
        3 |         self.name = name
        4 |
        5 | nick = Student() # call constructor
        6 | nick.set_name("Nick")
        7 | print(nick.name)
```

Self

```
In[ ]: 1 | class Student:
        2 |     def set_name(self, name):
        3 |         self.name = name
        4 |
        5 |     nick = Student() # call constructor
        6 |     nick.set_name("Nick")
        7 |     print(nick.name)
```

Self

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In[ ]: 1 | class Student:
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Self

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Self

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In[ ]: 1 | class Student:
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Self

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In[ ]: 1 | class Student:
        2 |     def set_name(self, name):
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        4 |
        5 | nick = Student() # call constructor
        6 | nick.set_name("Nick")
        7 | print(nick.name)
```

Nick

Self - unique values

```
In[ ]: 1 | class Student:
        2 |     def set_name(self, name):
        3 |         self.name = name
        4 |
        5 |     nick = Student() # One object
        6 |     nick.set_name("Nick")
        7 |     sam = Student() # Another object
        8 |     sam.set_name("Sam")
```


__init__() constructor

Constructor

- A constructor is a method which has the same name as the class.
- In Python, we can use the dunder method (**d**ouble **u**nderscore) `__init__()` to refer to the constructor. Dunder methods are called by the **Python interpreter**. It **initialises** the object and sets values for attributes (variables).
- The constructor is called when we create an object of the class.
- In Python we can still call the constructor (same name as the class). The Python interpreter then calls the `__init__()` **method**

__init__()

```
In[ ]: 1 | class Student:
        2 |     def __init__(self, name):
        3 |         self.name = name
        4 |
        5 |     nick = Student("Nick")
        6 |     print(nick.name)
```

__init__()

```
In[ ]: 1 | class Student:
        2 |     def __init__(self, name):
        3 |         self.name = name
        4 |
        5 | nick = Student("Nick")
        6 | print(nick.name)
```

Nick

Two objects

```
In[ ]: 1 | class Student:
        2 |     def __init__(self, name):
        3 |         self.name = name
        4 |
        5 |     nick = Student("Nick")
        6 |     print(nick.name)
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        8 |     print(sam.name)
```

Two objects

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In[ ]: 1 | class Student:
        2 |     def __init__(self, name):
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        5 |     nick = Student("Nick")
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        7 |     sam = Student("Sam")
        8 |     print(sam.name)
```

Nick

Sam

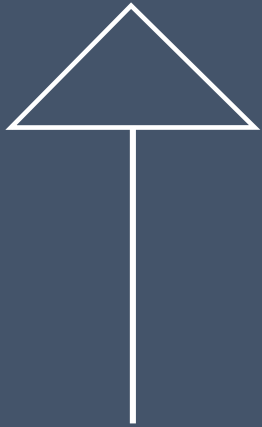
Inheritance in Python

Inheritance

- In our social world; inheritance means the passing down of assets from generation to generation; children inherit from their parents.
- In programming, inheritance is modelled by allowing 'child' classes to access variables and methods from the 'parent' class.
- Furthermore, Children classes often extend (are specialist versions of) the Parent classes.

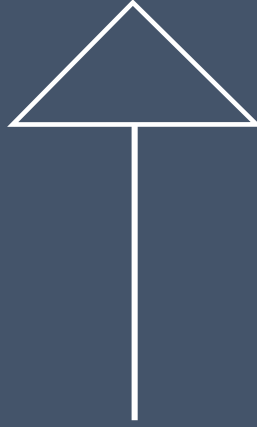
Inheritance terms

Parent



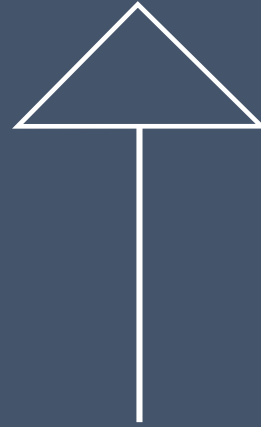
Child

Base



Derived

Super



Sub

Inheritance in C and Java

- Java:
 - ChildClass `extends` ParentClass
- C family languages use the : (colon) operator
 - ChildClass : ParentClass
- In Python, we have to pass the Parent reference to the Child class.

Inheritance

```
In[ ]: 1 | class Parent:
        2 |     def print(self):
        3 |         print("Hi from Parent Class")
        4 |
        5 |     class Child(Parent):
        6 |         def print(self):
        7 |             print("Hi from Child Class")
        8 |
        9 | childobj = Child() # call constructor
       10 | childobj.print()
```

Inheritance

```
In[ ]: 1 | class Parent:
        2 |     def print(self):
        3 |         print("Hi from Parent Class")
        4 |
        5 | class Child(Parent):
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        9 | childobj = Child() # call constructor
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```

Inheritance

In[]:

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1 | class Parent:
2 |     def print(self):
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5 | class Child(Parent):
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```

Inheritance

In[]:

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1 | class Parent:
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```

'super()' reference

Super

- We've used the keyword `self` within class constructors to refer to variables of any given object that is created.
- In an inheritance hierarchy, the child constructor may want to invoke the parent constructor to initialise values for inherited attributes.
- The `super()` is a reference to the parent's constructor.
- You can also refer to attributes and functions through the `super()` reference.

super()

```
In[ ]: 1 | class Parent:
        2 |     def print(self):
        3 |         print("Hi from Parent Class")
        4 |
        5 | class Child(Parent):
        6 |     def print(self):
        7 |         super().print()
        8 |
        9 | obj = Child() # call constructor
       10 | obj.print()
```

super()

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In[ ]: 1 | class Parent:
        2 |     def print(self):
        3 |         print("Hi from Parent Class")
        4 |
        5 | class Child(Parent):
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        7 |         super().print()
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super()

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super()

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```


Inheritance extension

Inheritance

```
In[ ]: 1 | class Student:
        2 |     def __init__(self, name):
        3 |         self.name = name
        4 |
        5 | class PartTimeStudent(Student):
        6 |     def __init__(self, name):
        7 |         super().__init__(name)
        8 |
        9 | nick = PartTimeStudent("Nick")
       10 | print(nick.name)
```

Inheritance

In[]:

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In[]:

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Inheritance

```
In[ ]: 1 | class Student:
        2 |     def __init__(self, name):
        3 |         self.name = name
        4 |
        5 |     class PartTimeStudent(Student):
        6 |         def __init__(self, name, hours):
        7 |             super().__init__(name)
        8 |             self.hours = hours
        9 |
       10 | nick = PartTimeStudent("Nick", 6)
```

Inheritance

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