Python

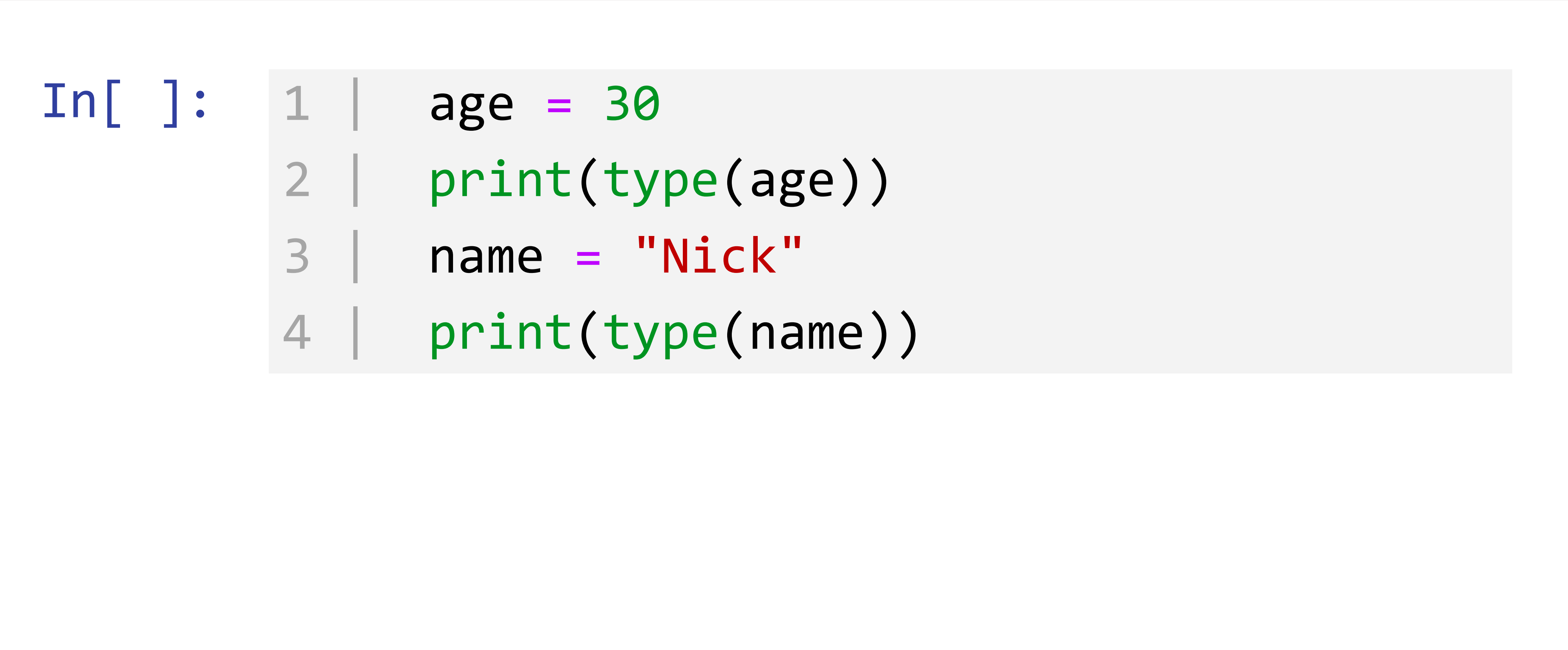
Object Oriented Programming: Classes, Objects, Inheritance

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

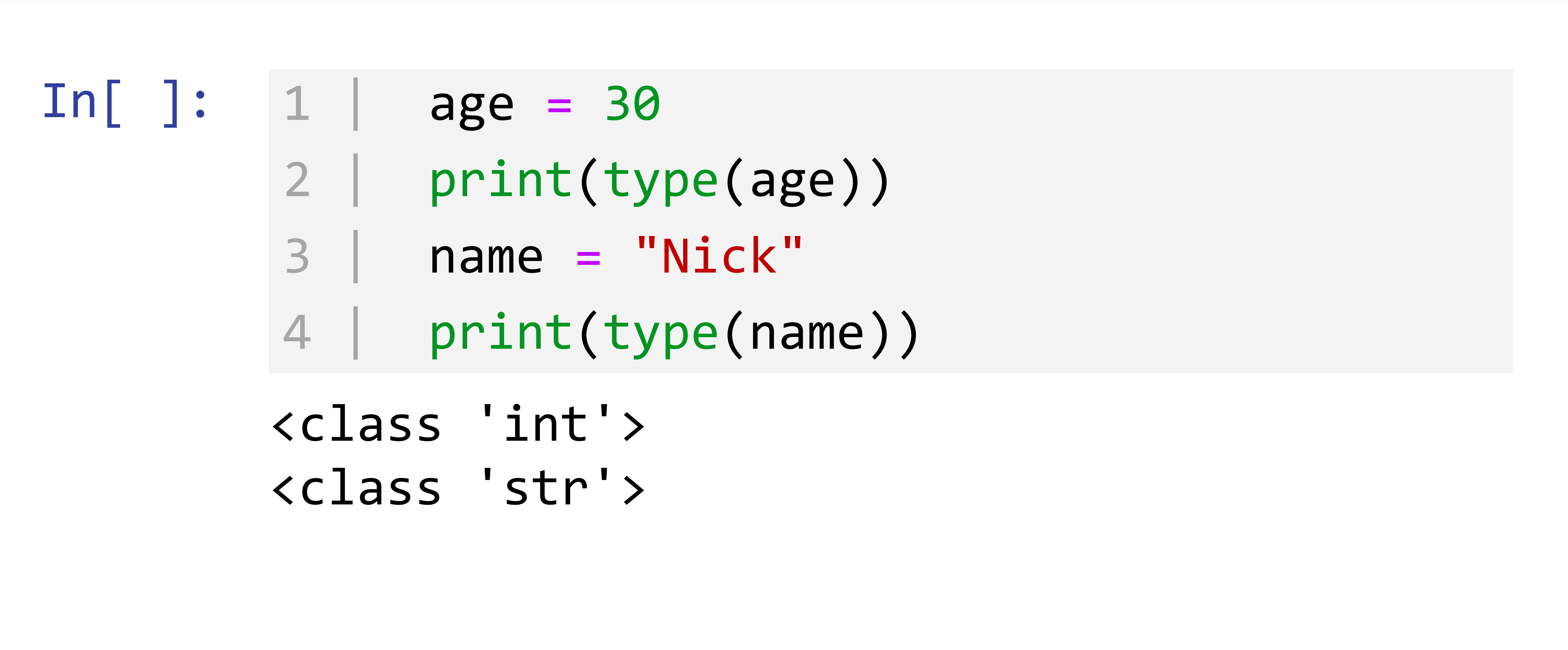
Reminder!

type() function



```python
age = 30
print(type(age))
name = "Nick"
print(type(name))
```

type() function



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```

```
<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

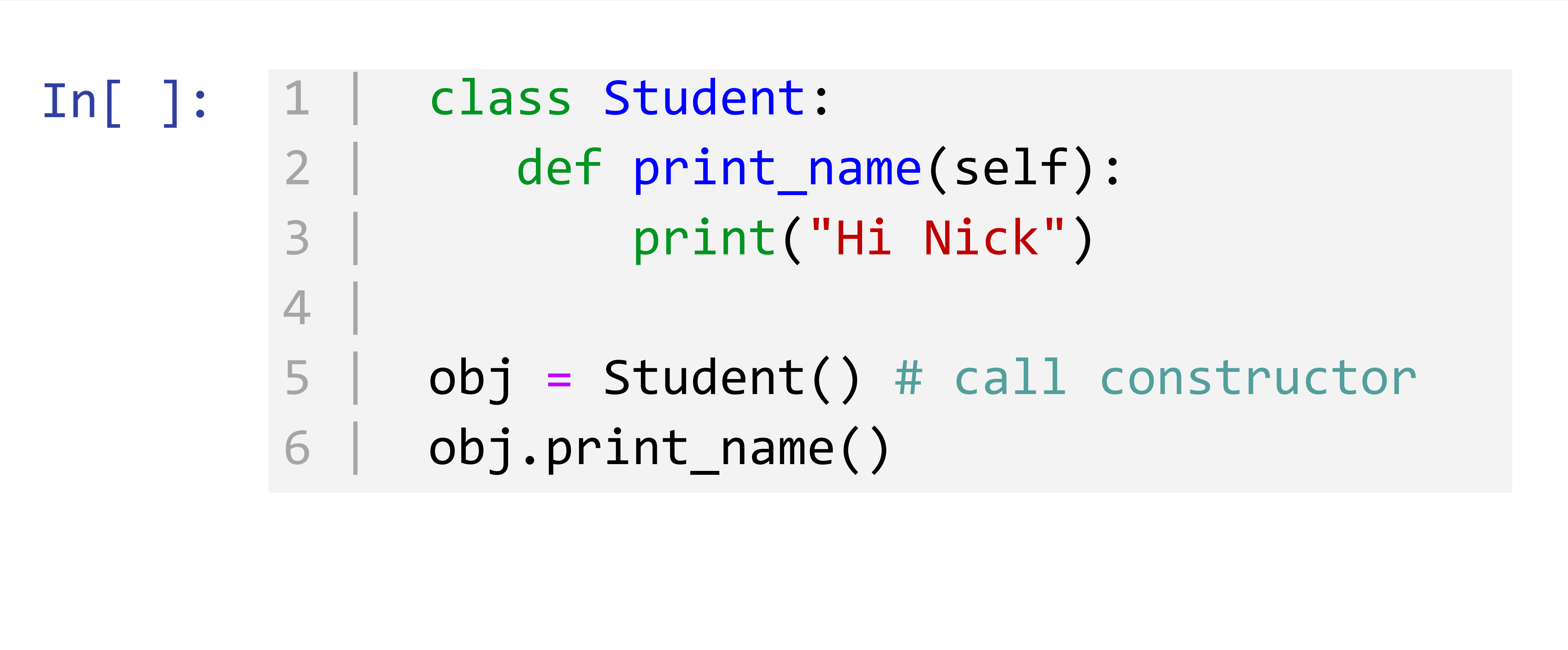
Other terms!

Variables / data / properties / attributes

Functions / methods / behaviours / subroutines

Classes and Objects in Python

Classes and objects



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class Student:
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obj = Student() # call constructor
obj.print_name()
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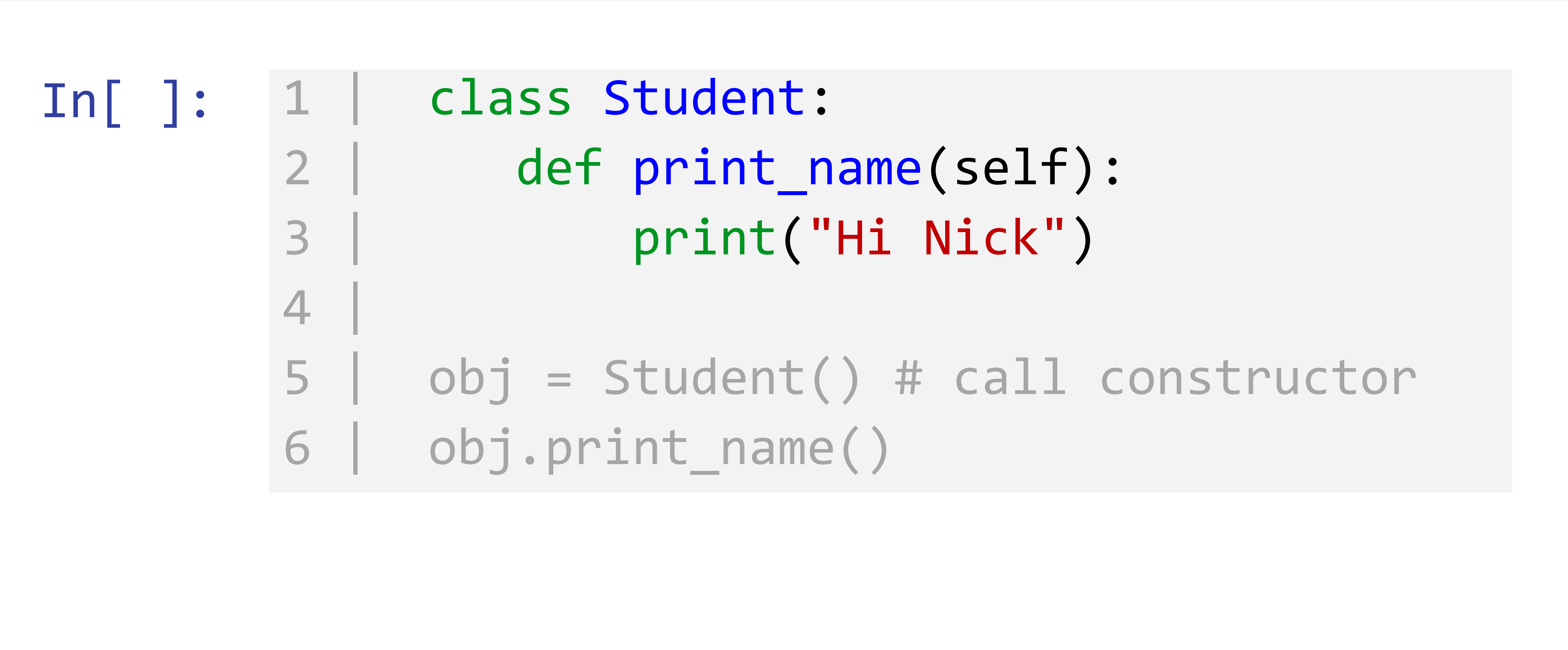
Classes and objects



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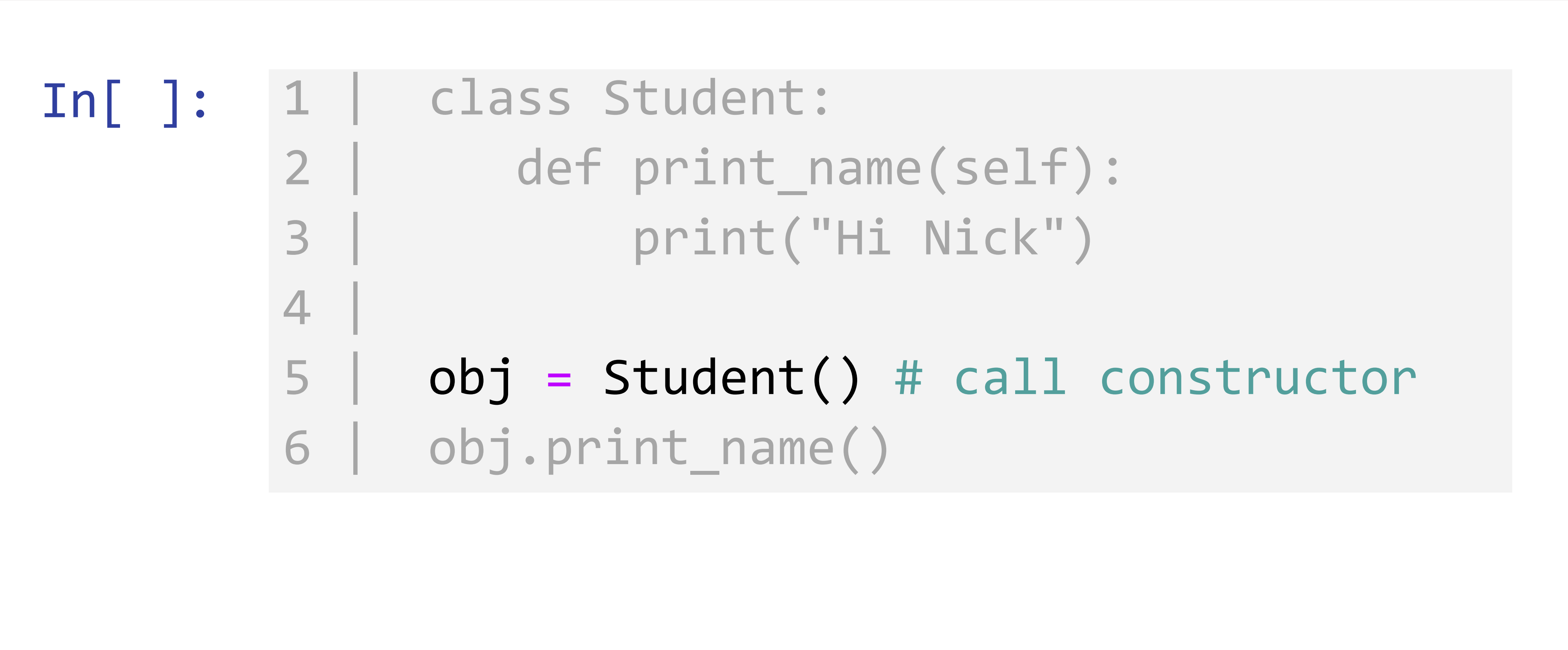

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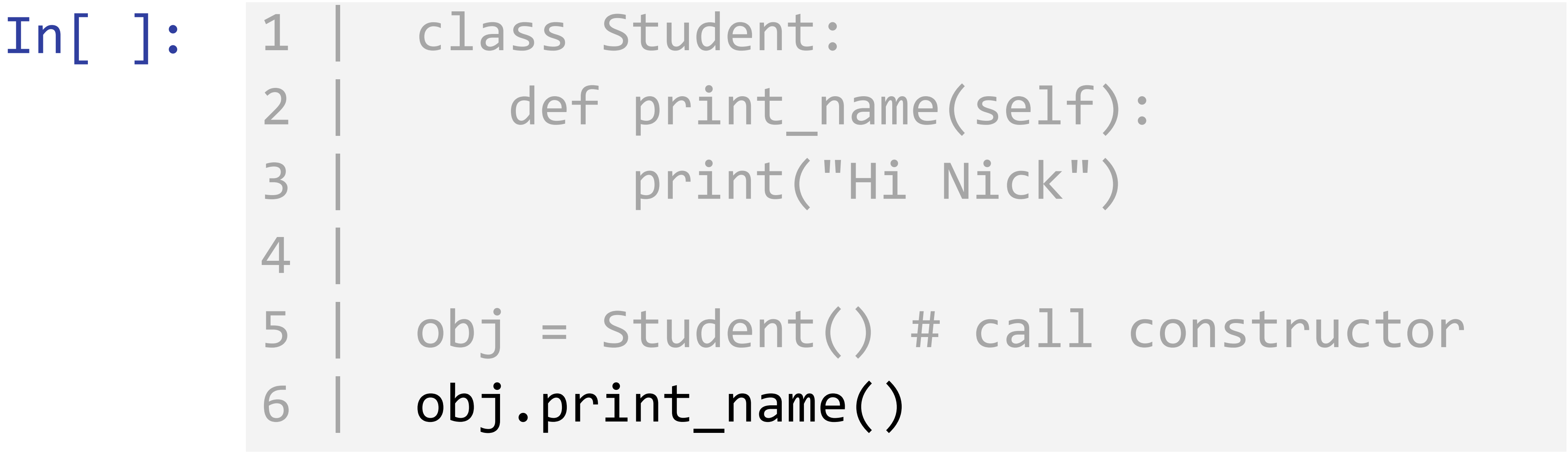

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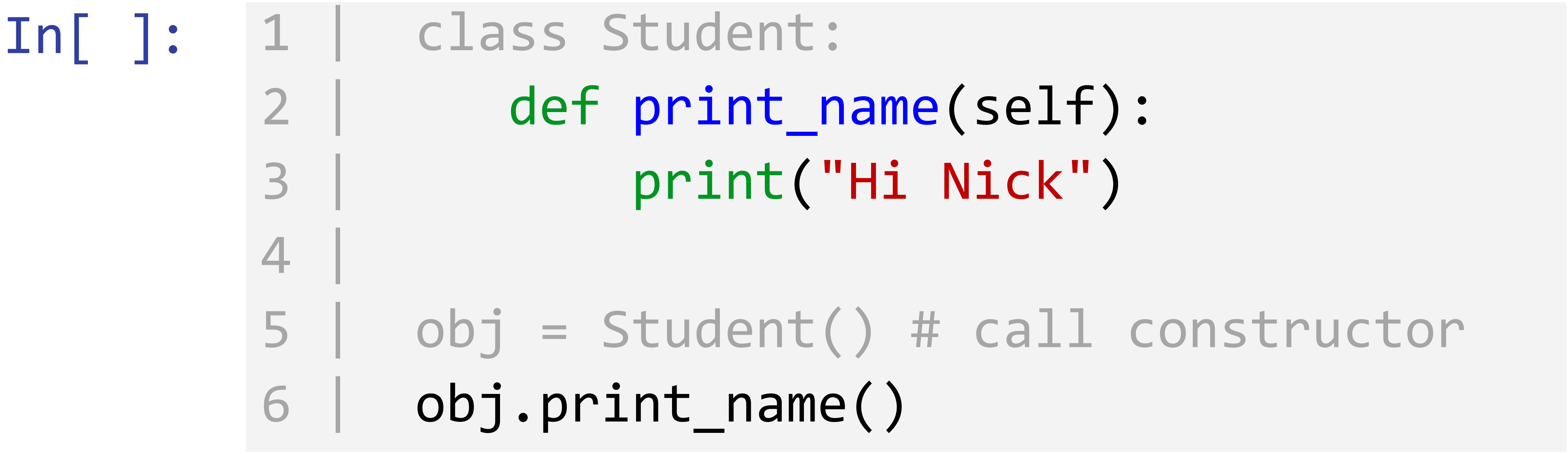

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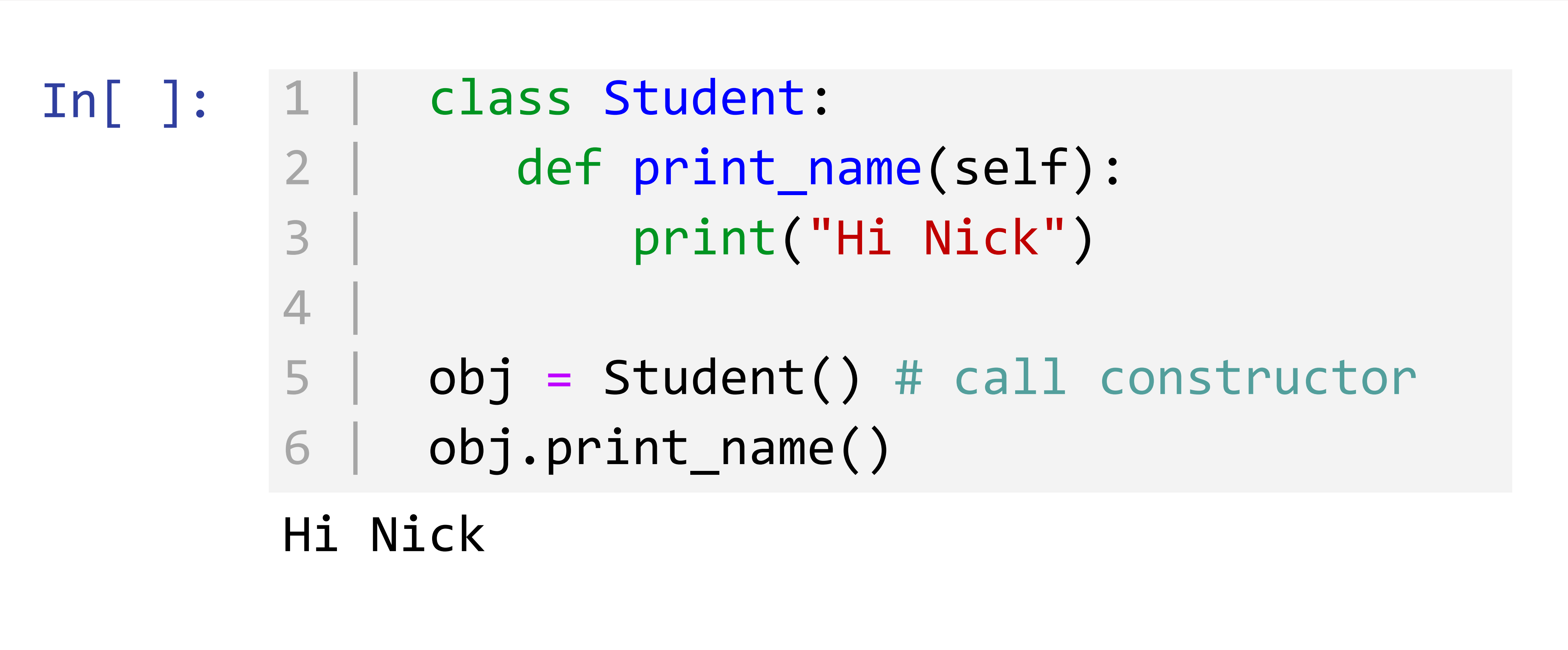
Classes and objects



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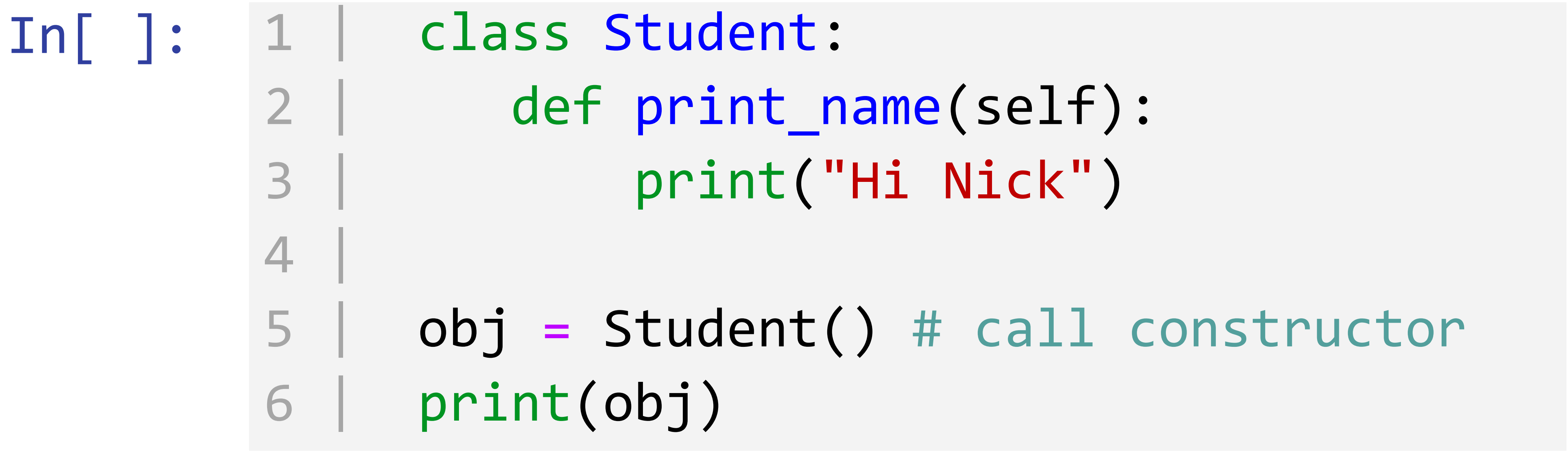
```

```
Hi Nick
```

Object addr



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class Student:
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obj = Student() # call constructor
print(obj)
```

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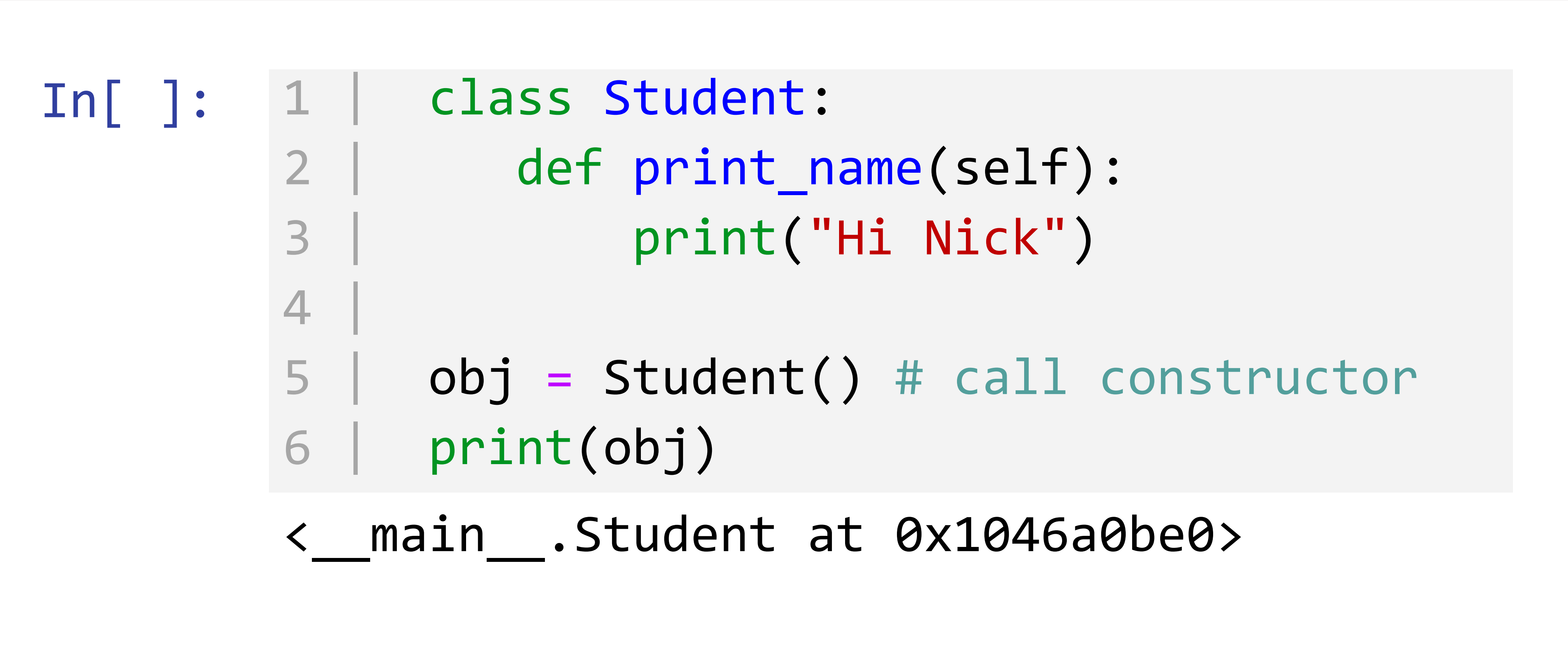

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class Student:
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obj = Student() # call constructor
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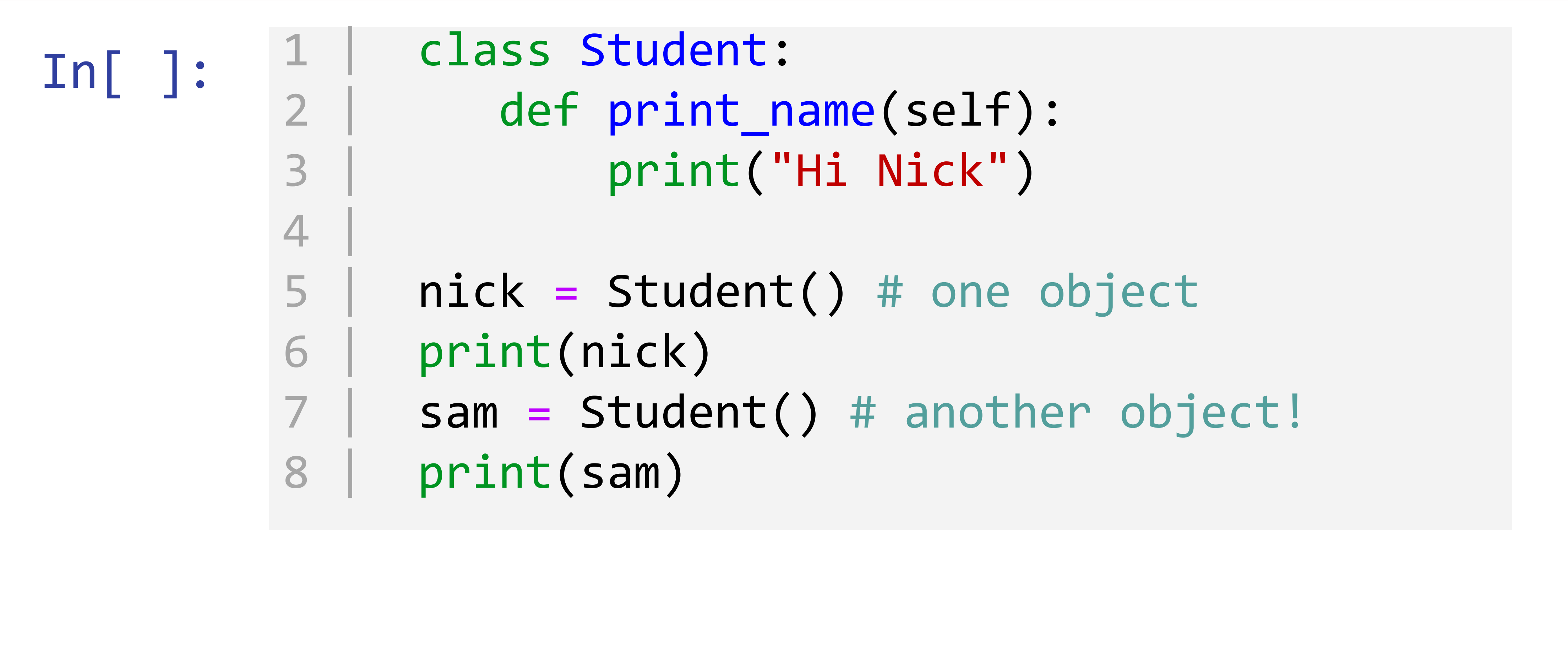
```

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

Two objects



```
class Student:
   def print_name(self):
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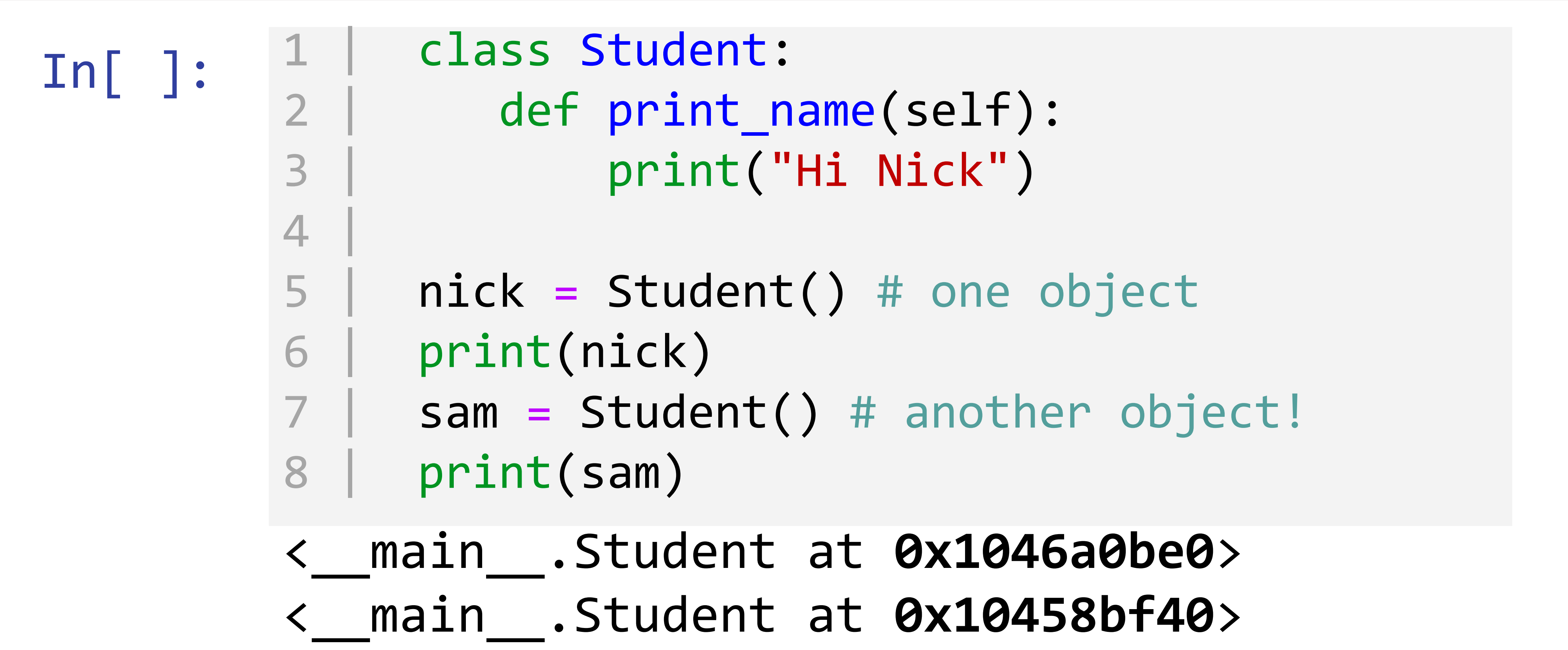
nick = Student() # one object
print(nick)
sam = Student() # another object!
print(sam)
```

Two objects



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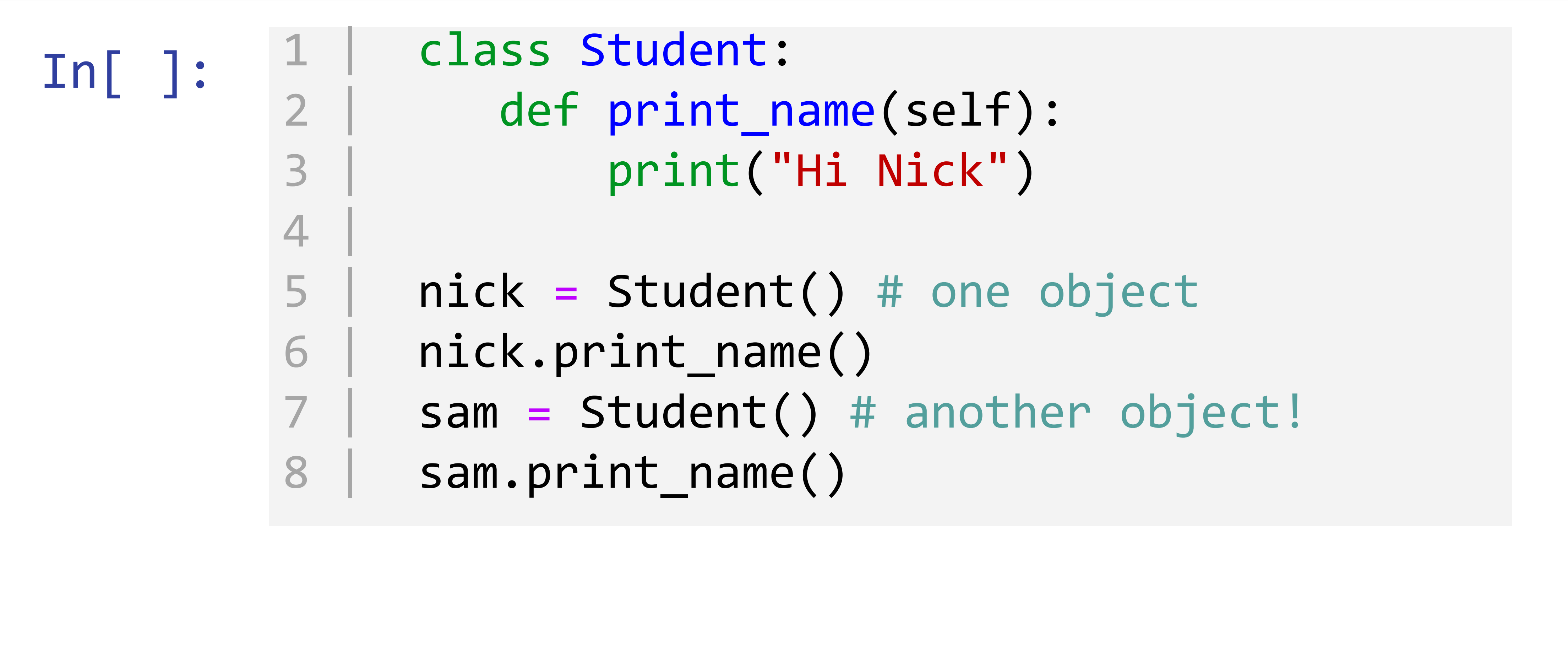
Two objects



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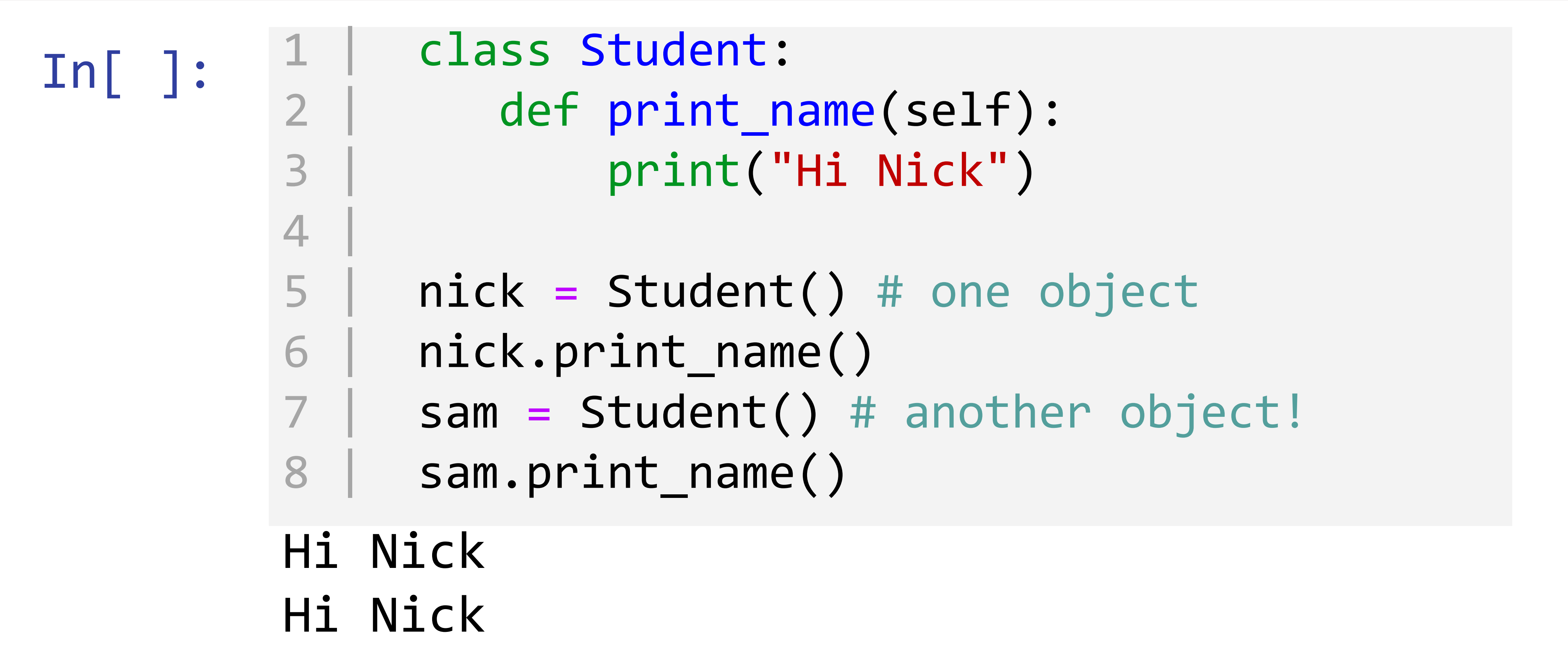
Problem!



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nick = Student() # one object
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sam = Student() # another object!
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```

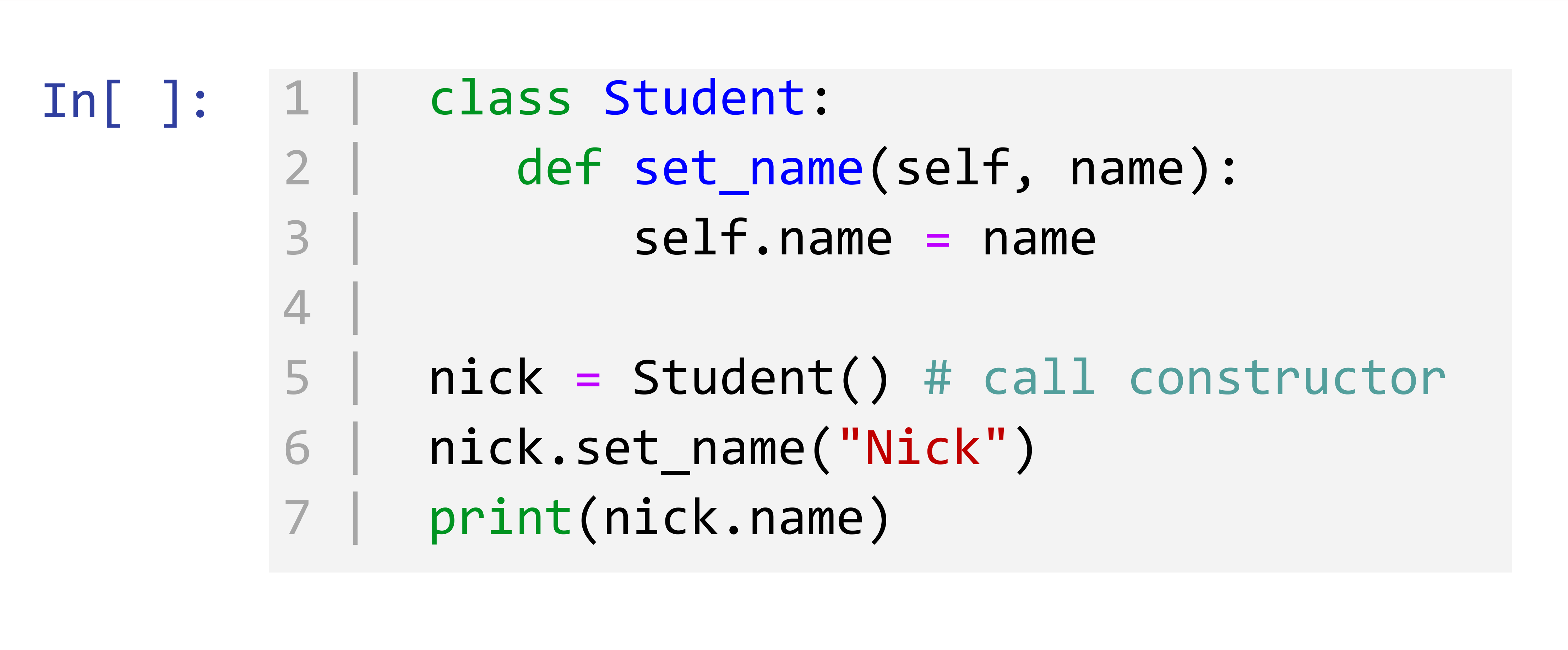
```
Hi Nick
Hi Nick
```

'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

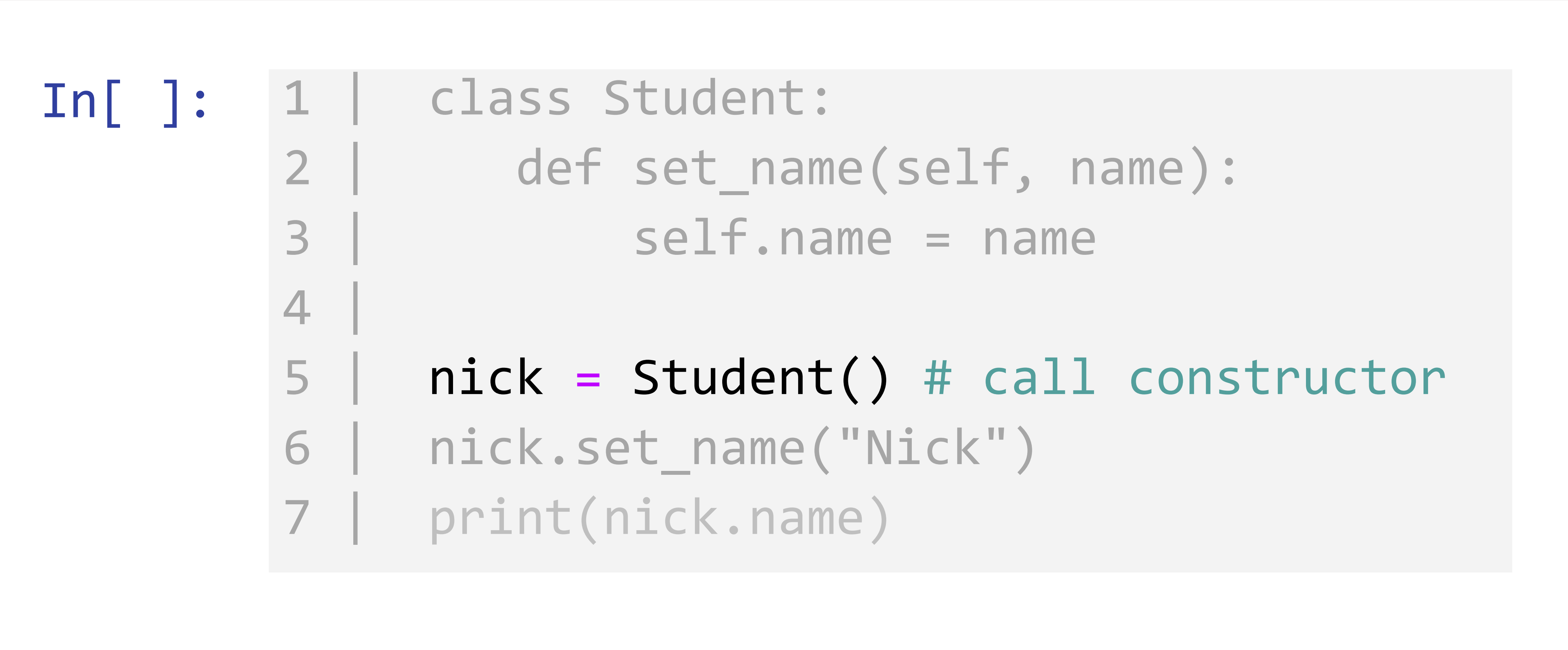


In[ ]:

```python
class Student:
    def set_name(self, name):
        self.name = name

nick = Student() # call constructor
nick.set_name("Nick")
print(nick.name)
```

Self



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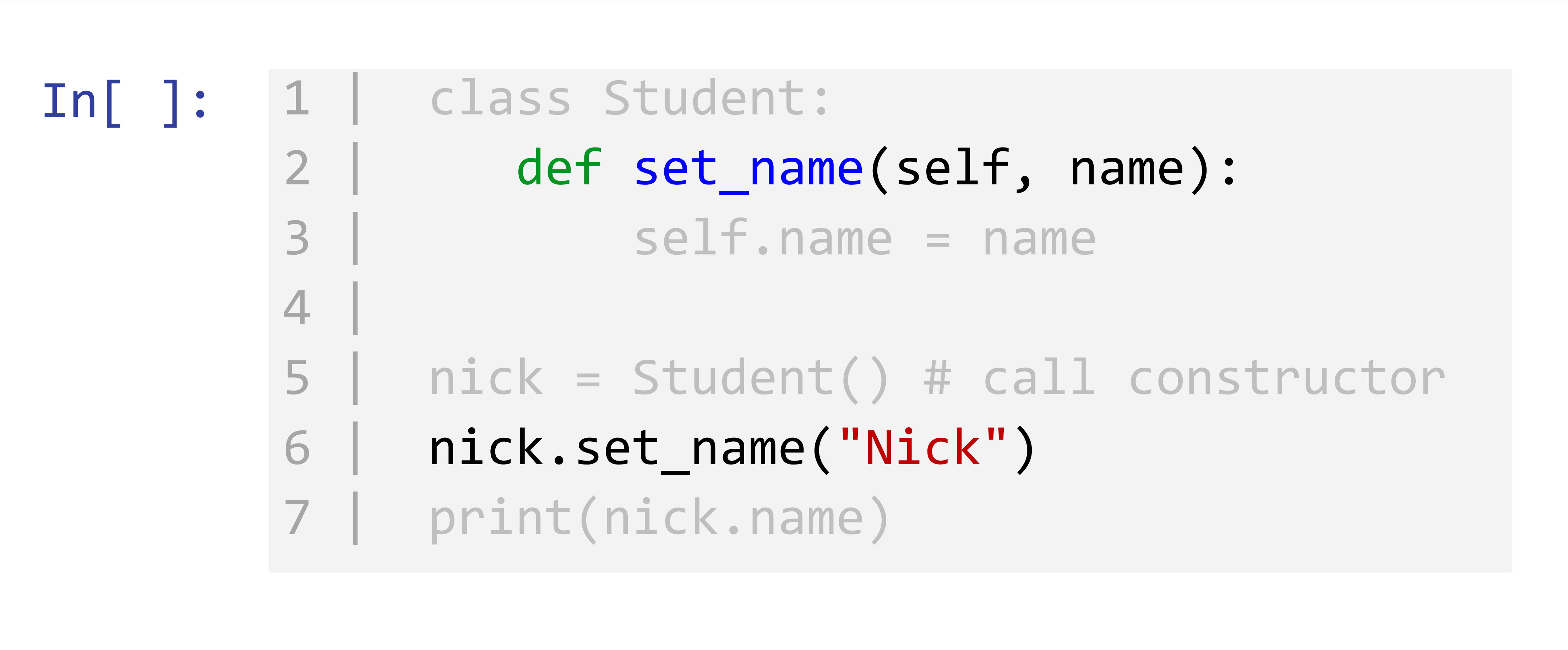

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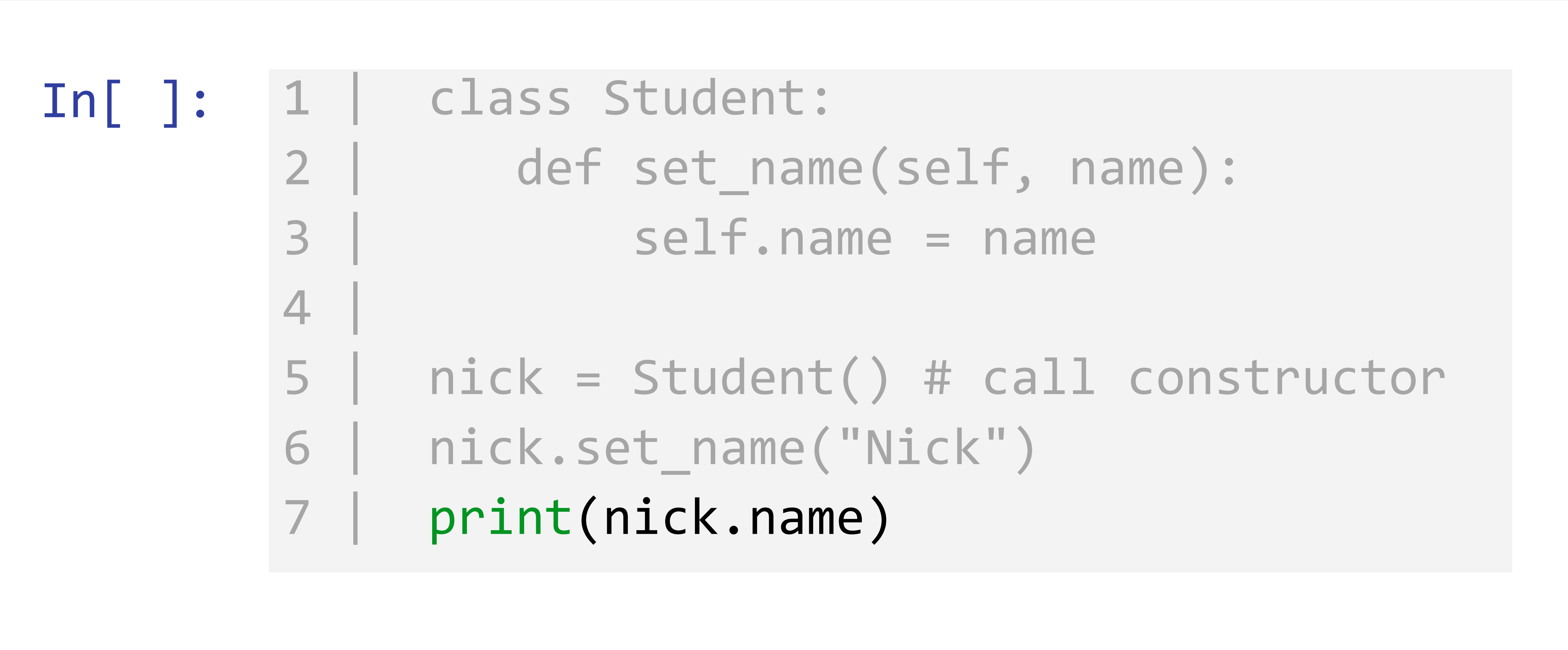
Self



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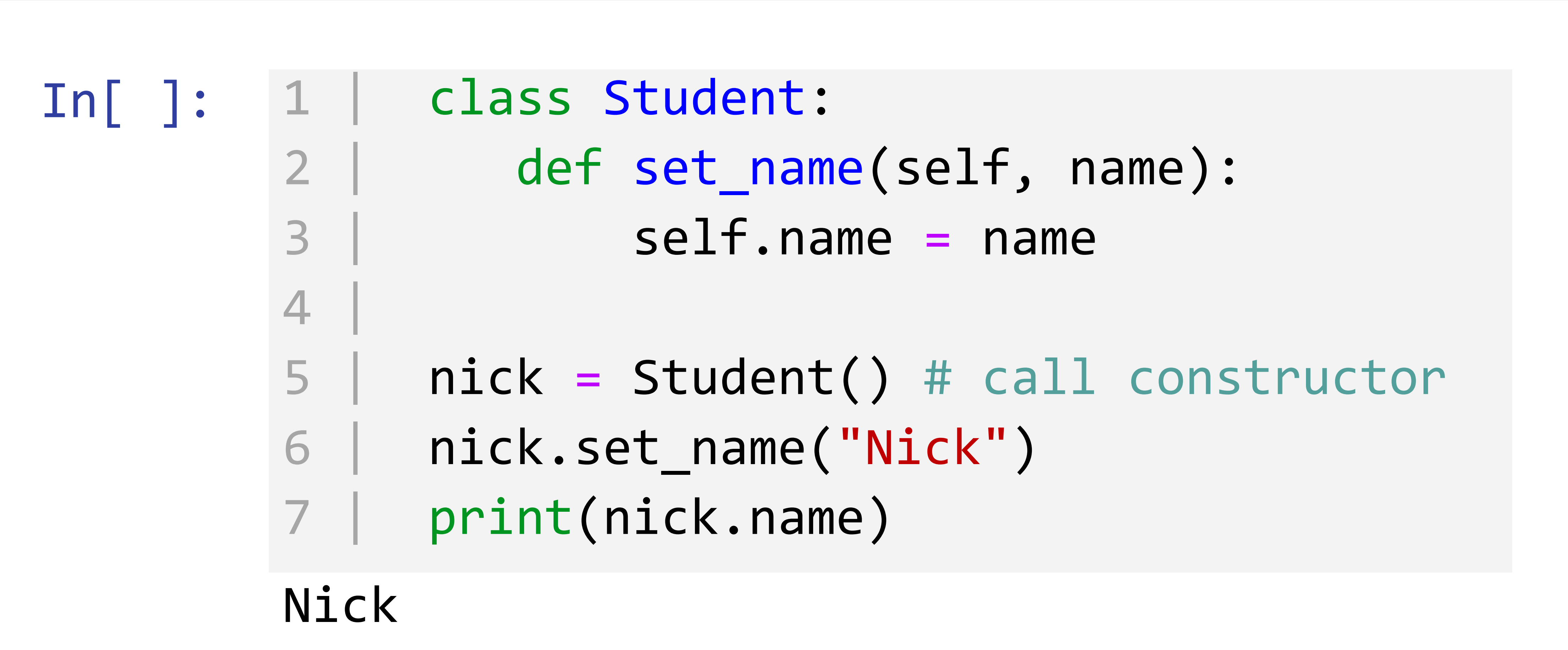

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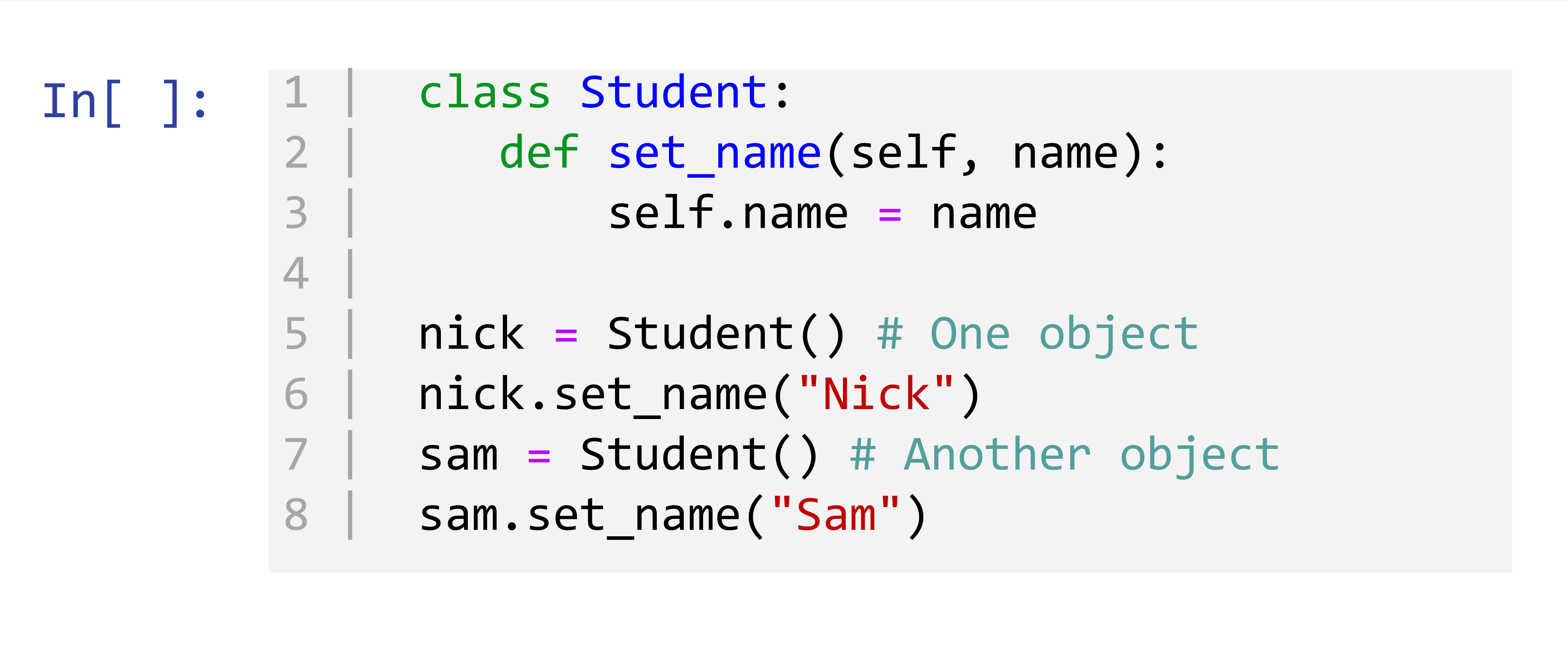
print(nick.name)
```

```
Nick
```

Self - unique values



```
class Student:
    def set_name(self, name):
        self.name = name

nick = Student() # One object
nick.set_name("Nick")
sam = Student() # Another object
sam.set_name("Sam")
```

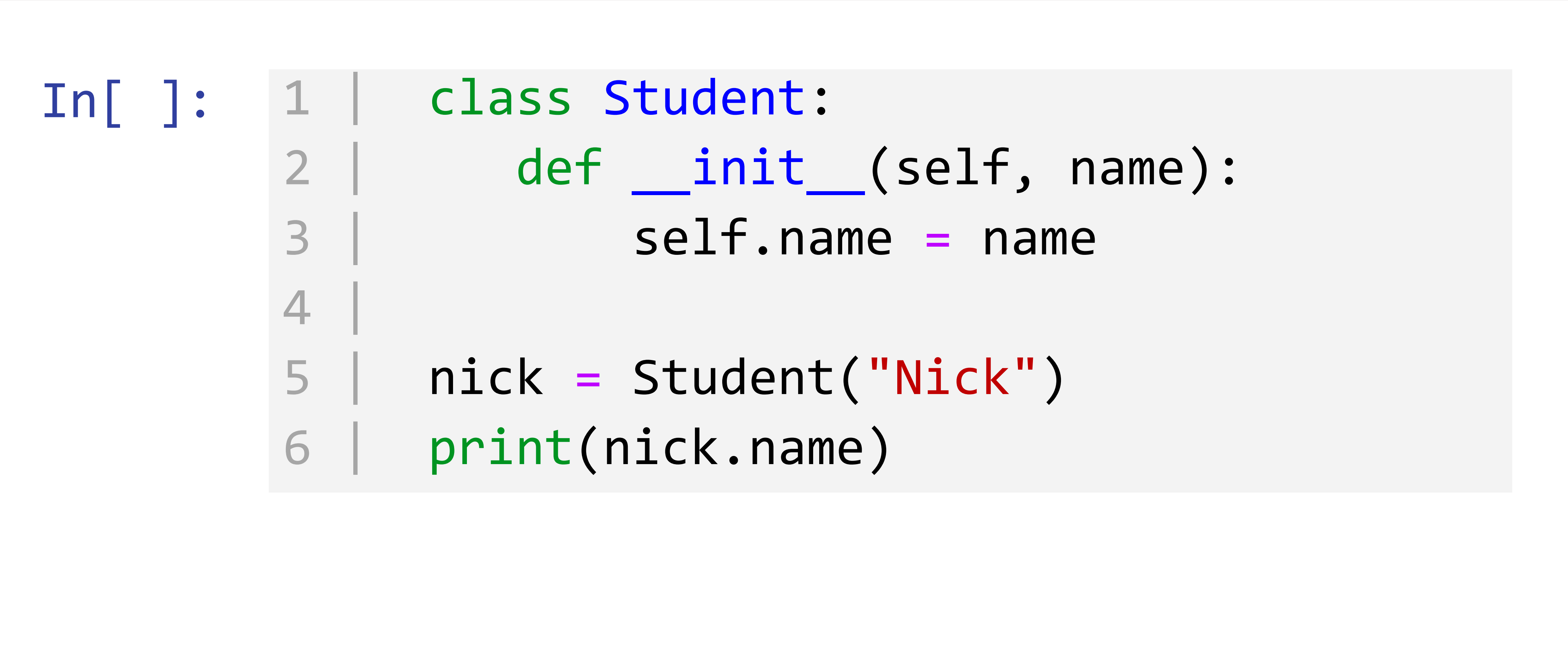
__init__() constructor

Constructor

- A constructor is a method which has the same name as the class.

- In Python, we can use the dunder method (**d**ouble **under**score) __init__() to refer to the constructor. Dunder methods are called by the **Python interpreter**. It **init**ialises 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__()



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class Student:
    def __init__(self, name):
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nick = Student("Nick")
print(nick.name)
```
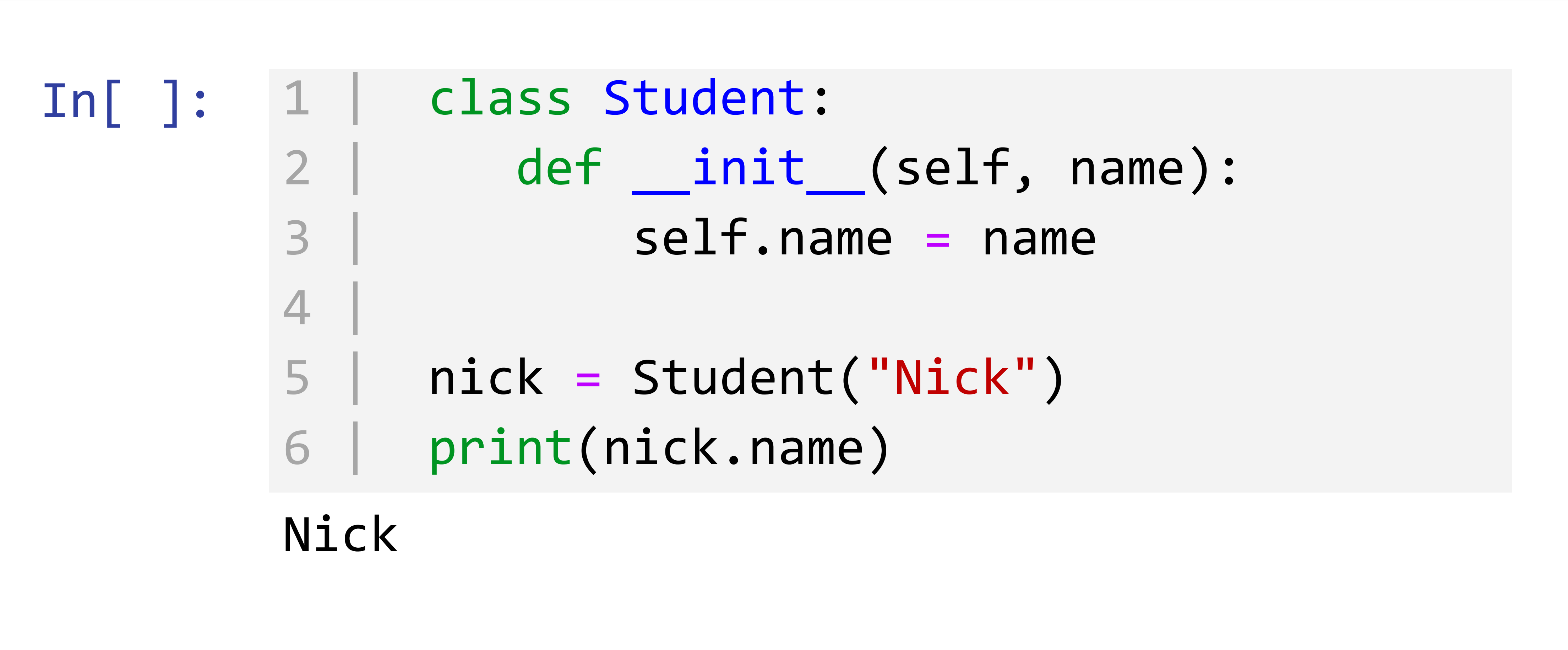

__init__()



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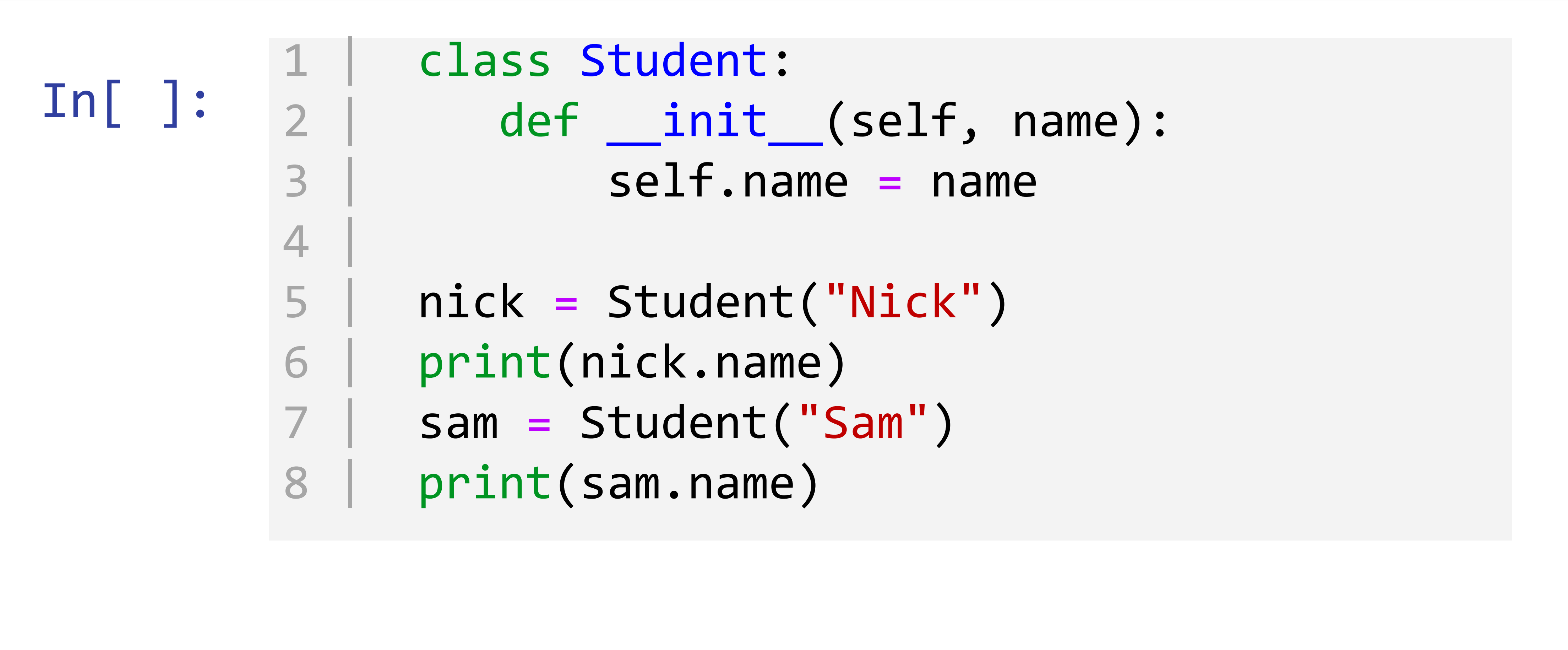
nick = Student("Nick")
print(nick.name)
```

```
Nick
```

Two objects



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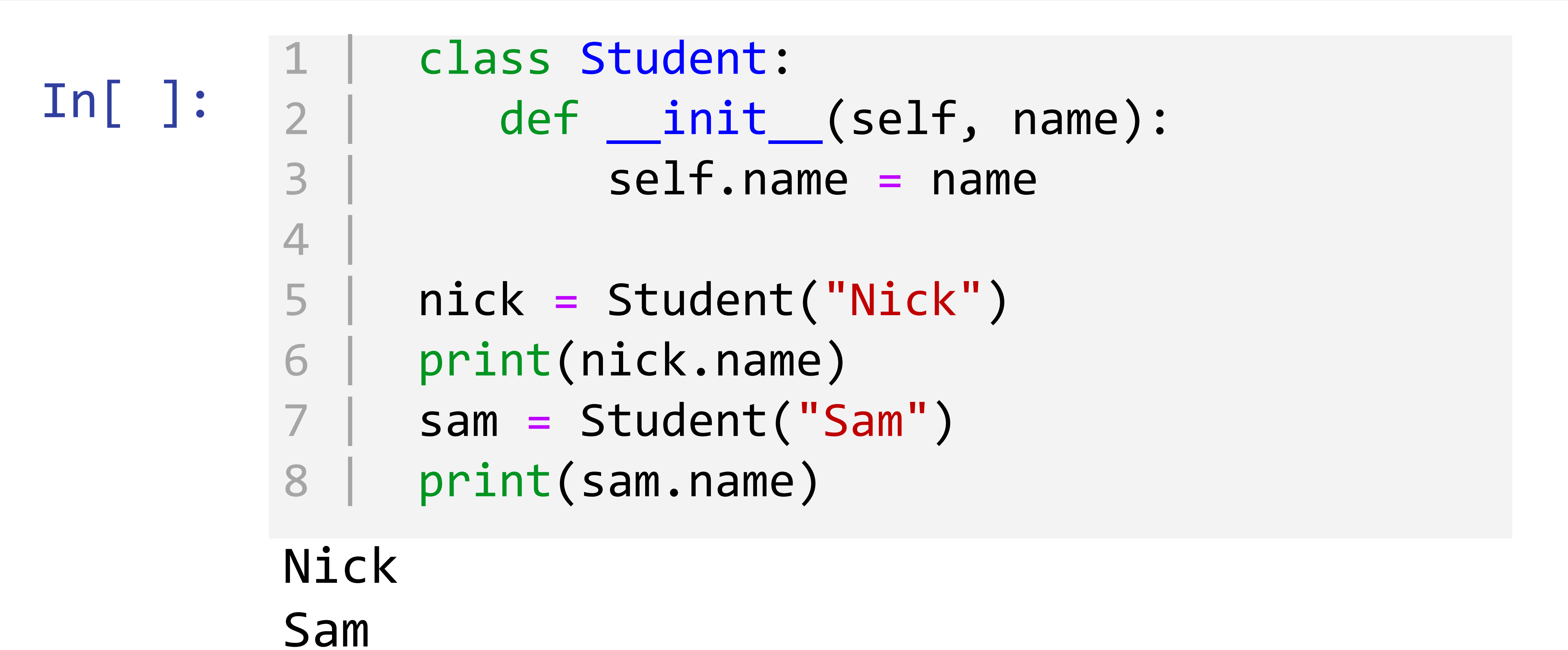
Two objects



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```

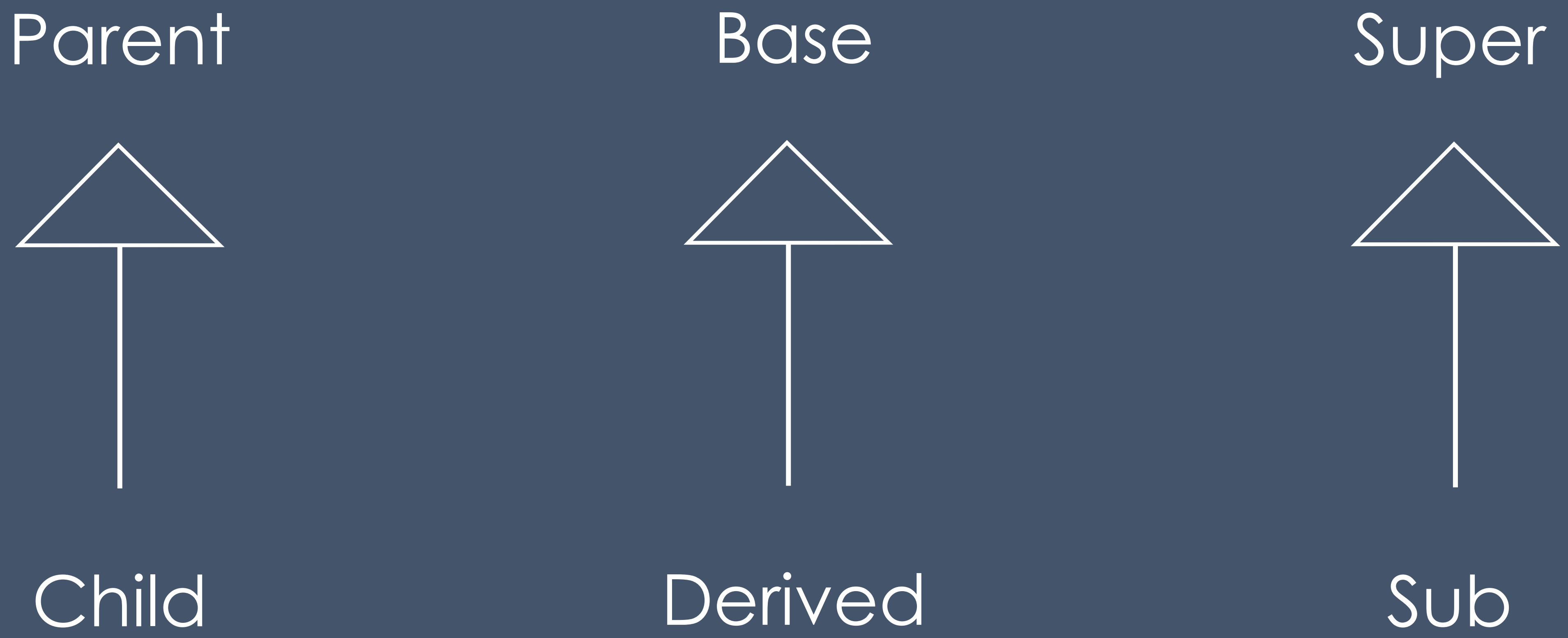
```
Nick
Sam
```

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

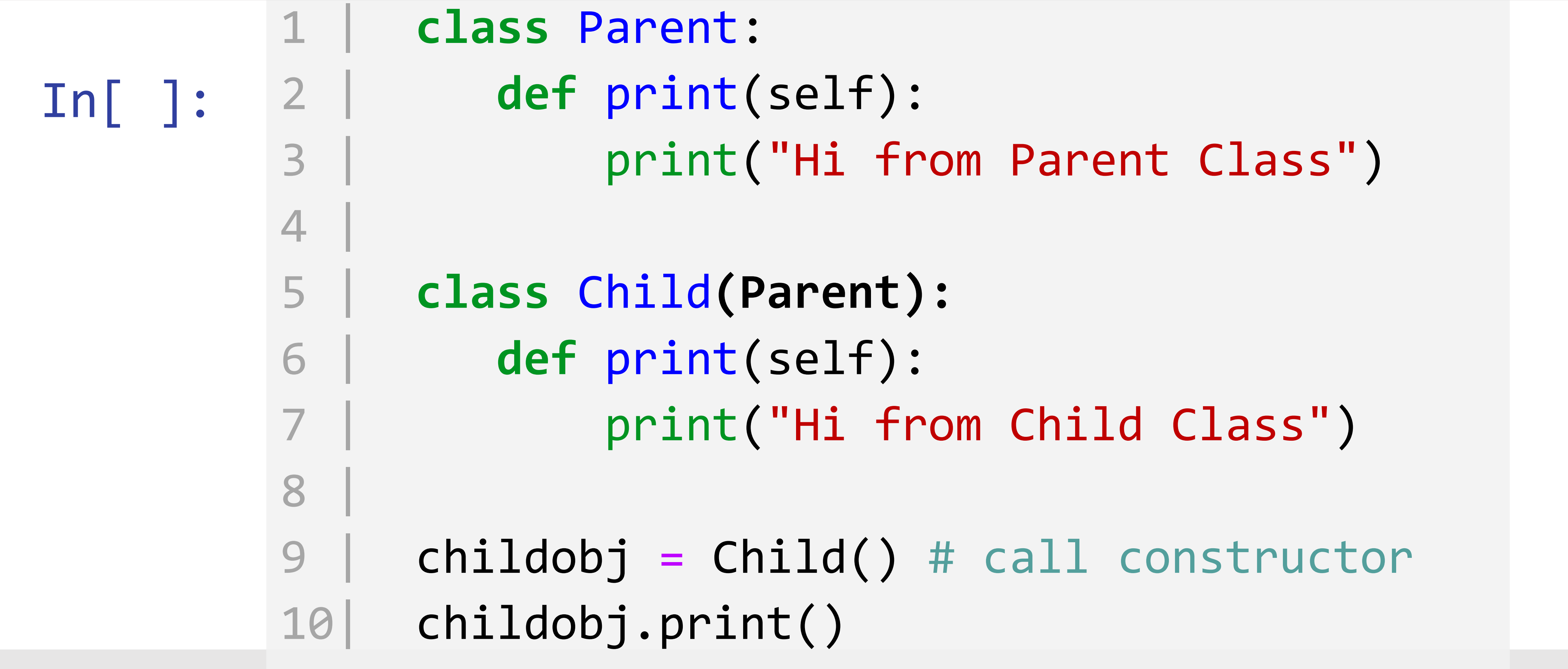
Super

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



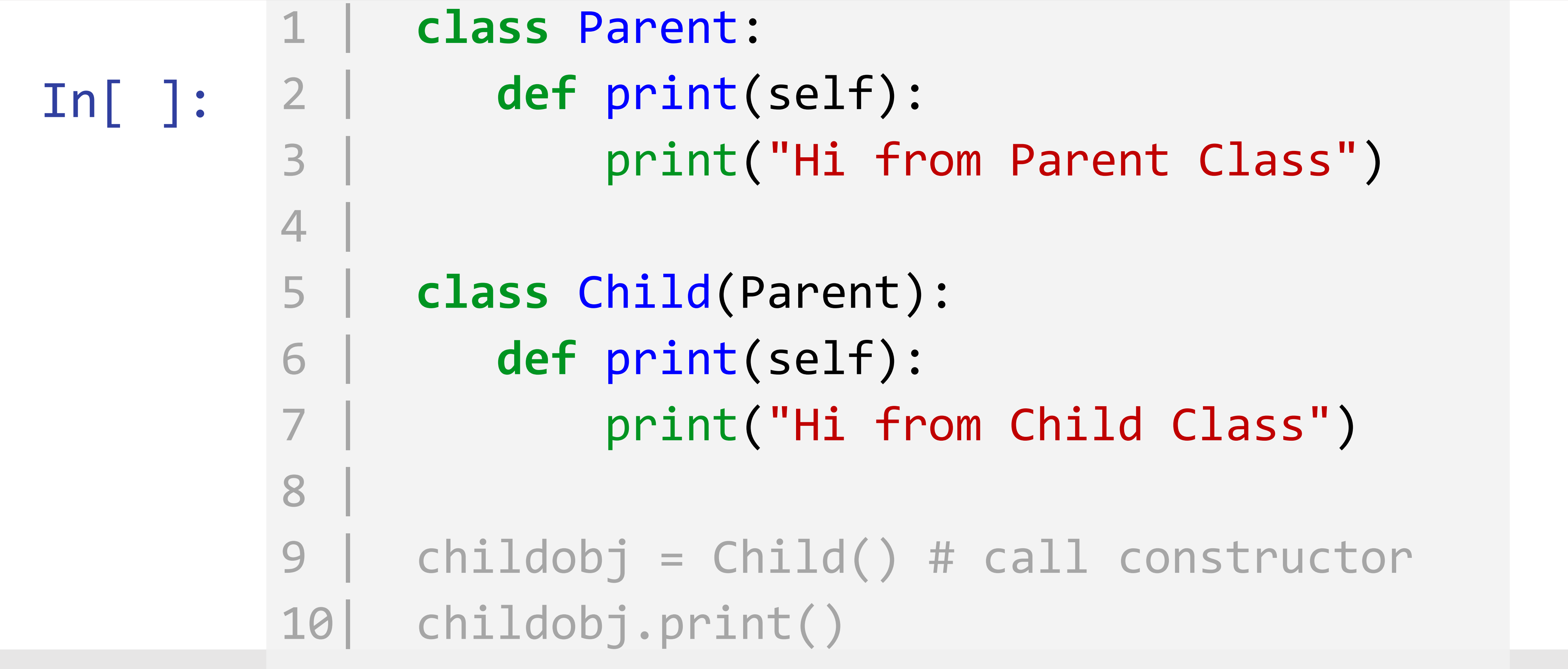
In[ ]:

```python
class Parent:
    def print(self):
        print("Hi from Parent Class")

class Child(Parent):
    def print(self):
        print("Hi from Child Class")

childobj = Child() # call constructor
childobj.print()
```

Inheritance



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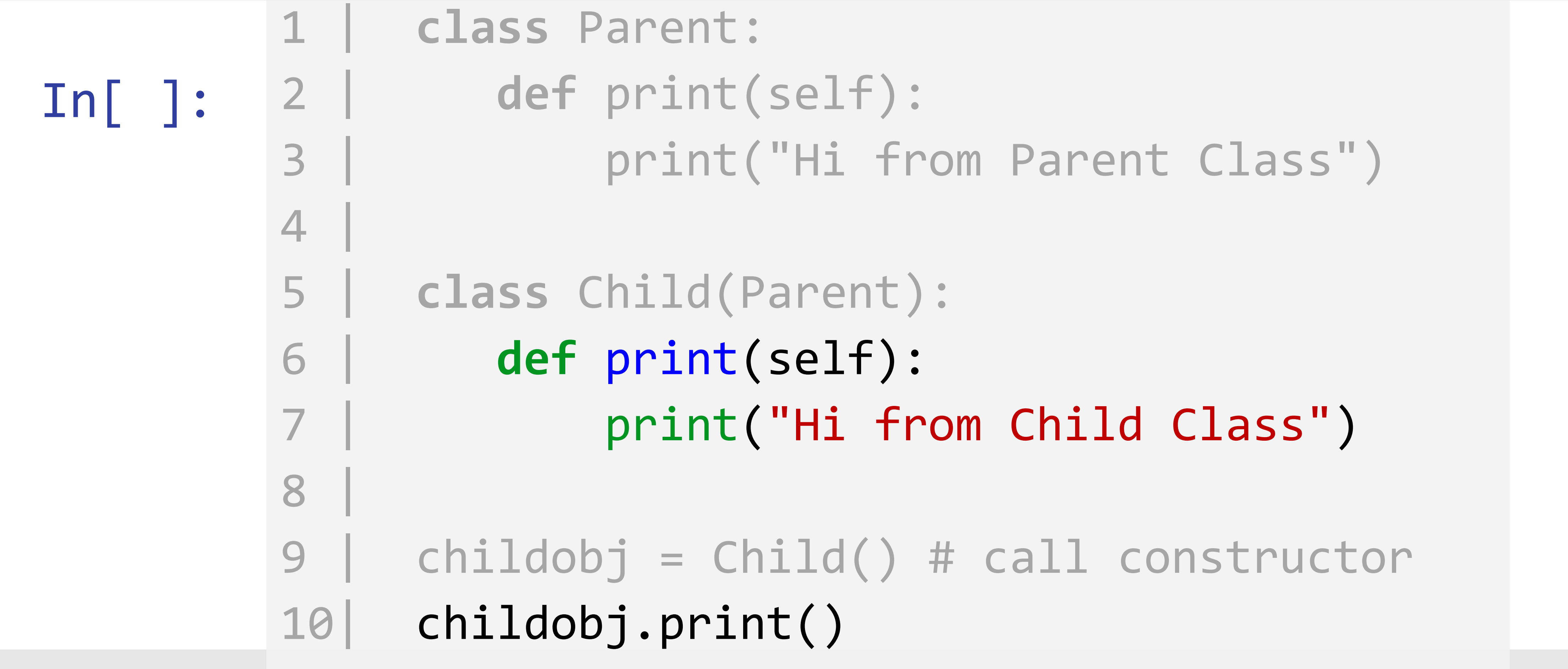

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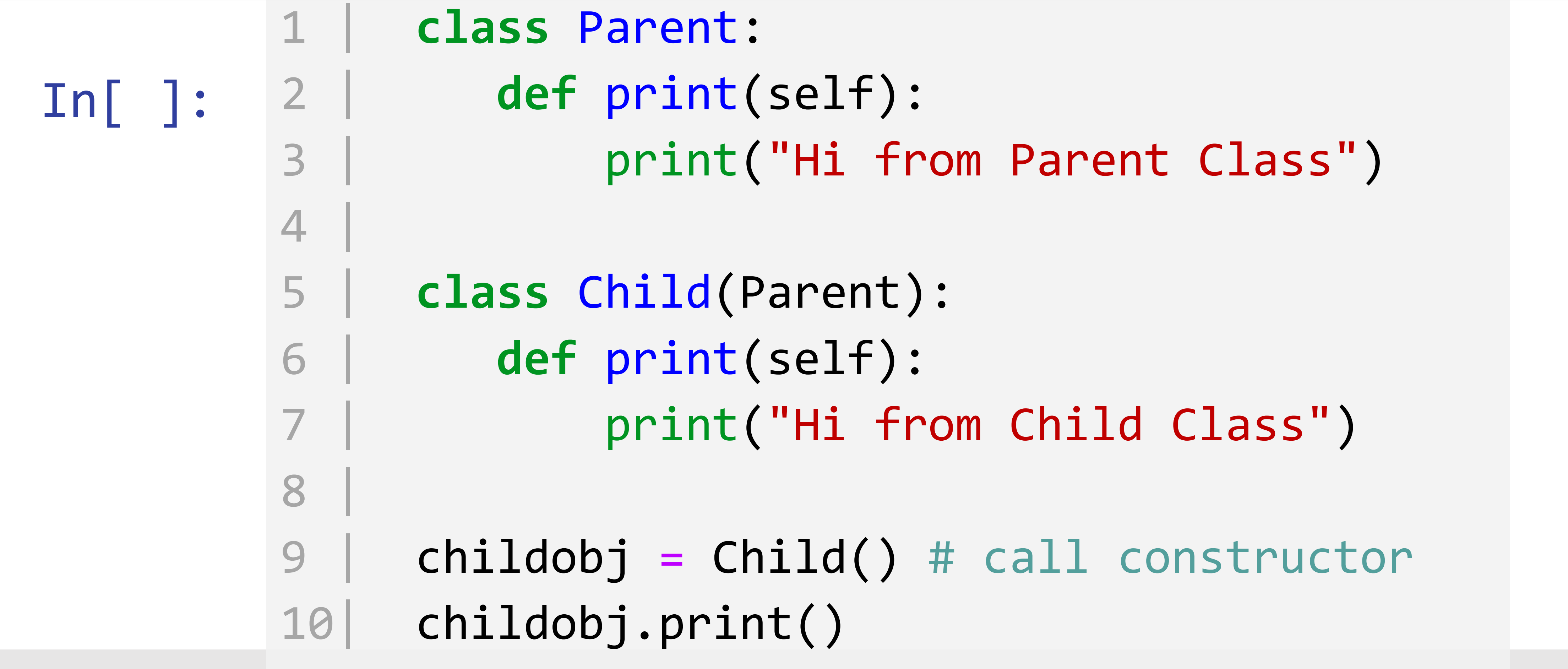

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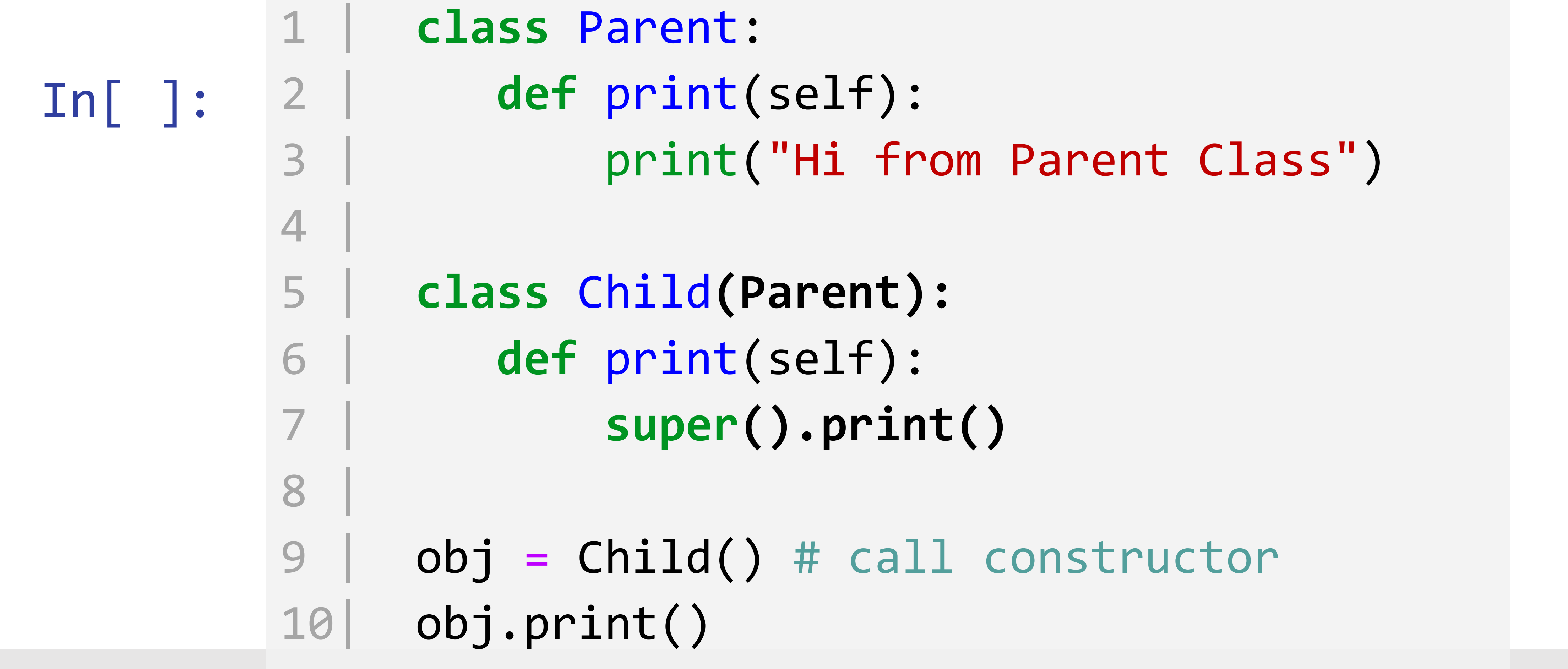
'super()' reference

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()



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class Child(Parent):
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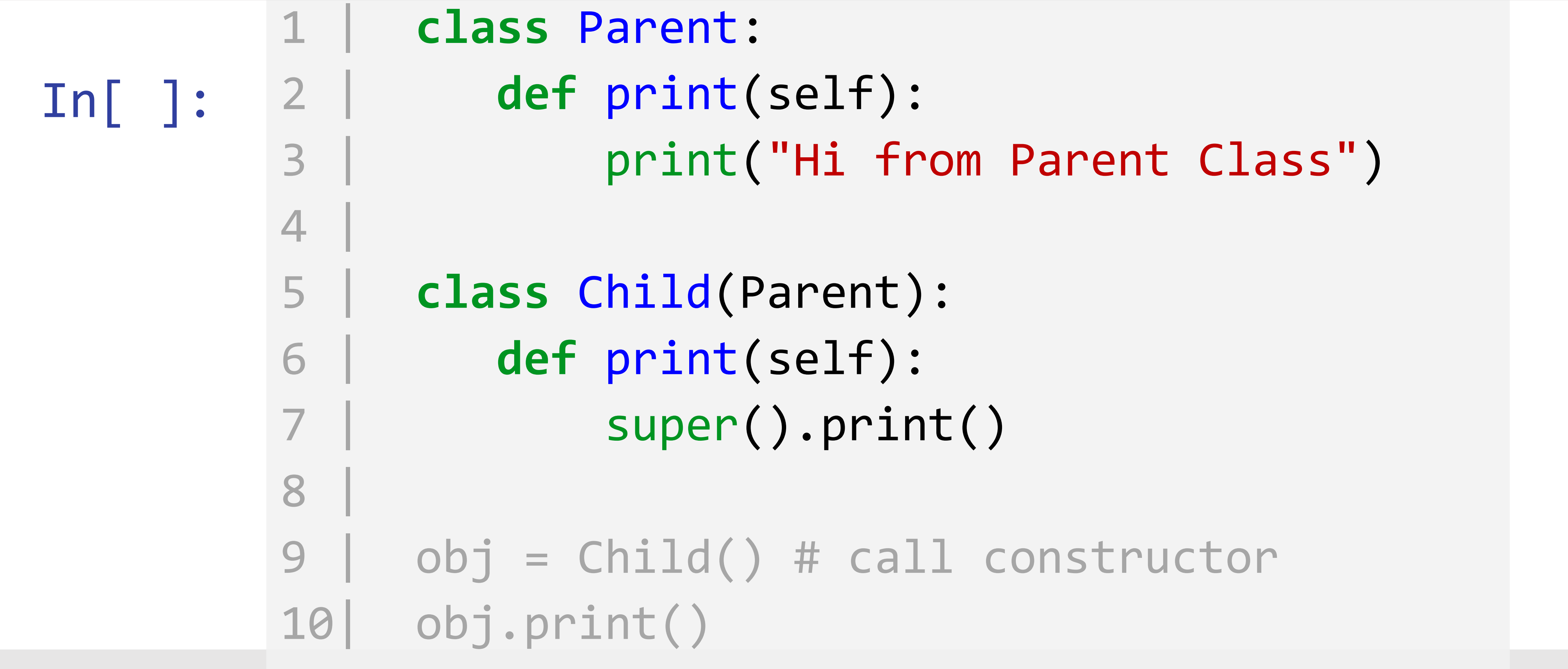
```

super()



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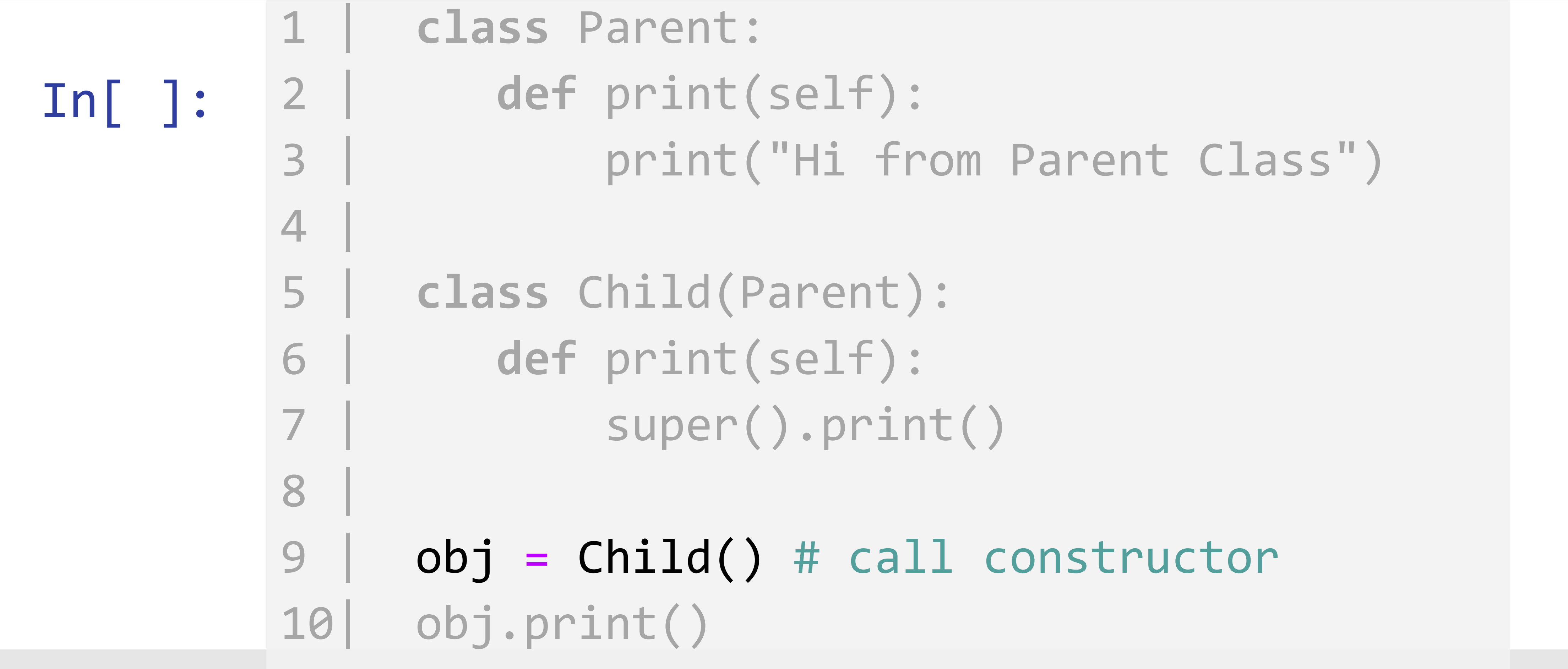
super()



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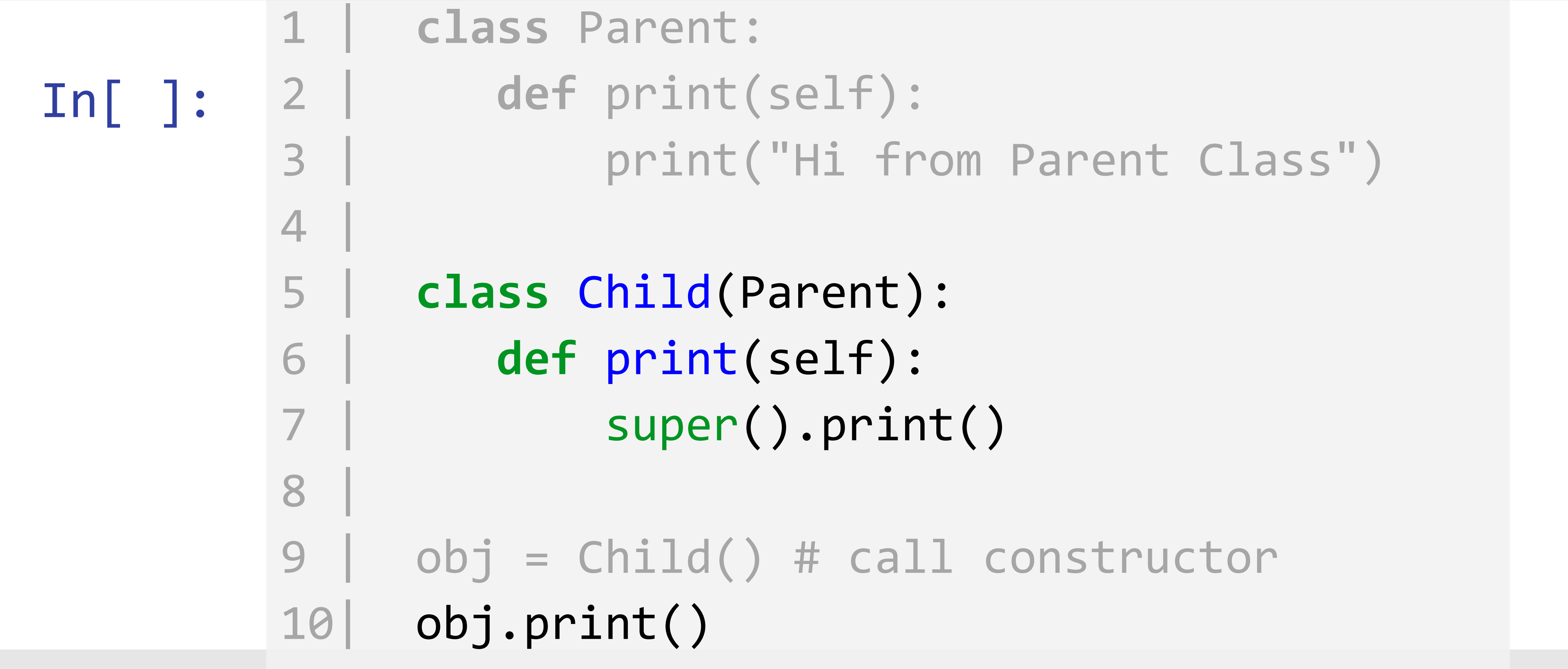

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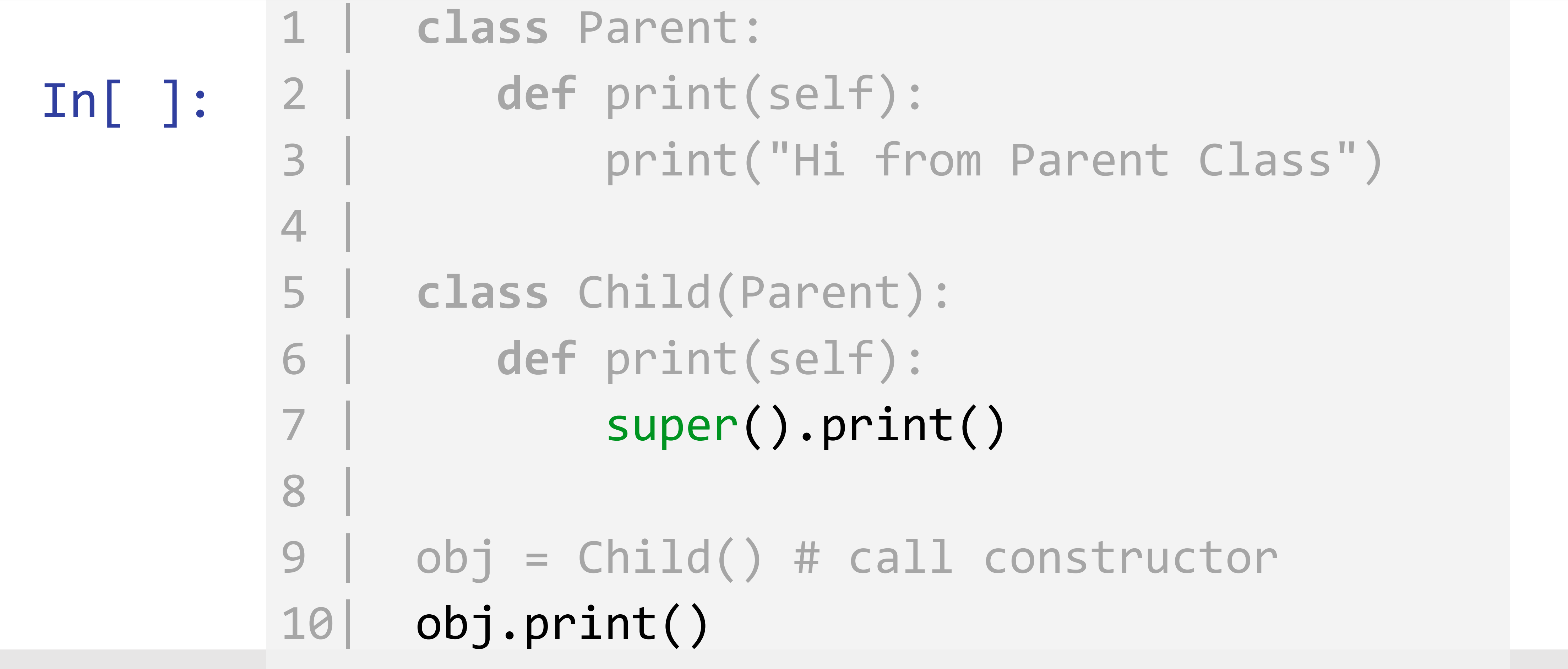

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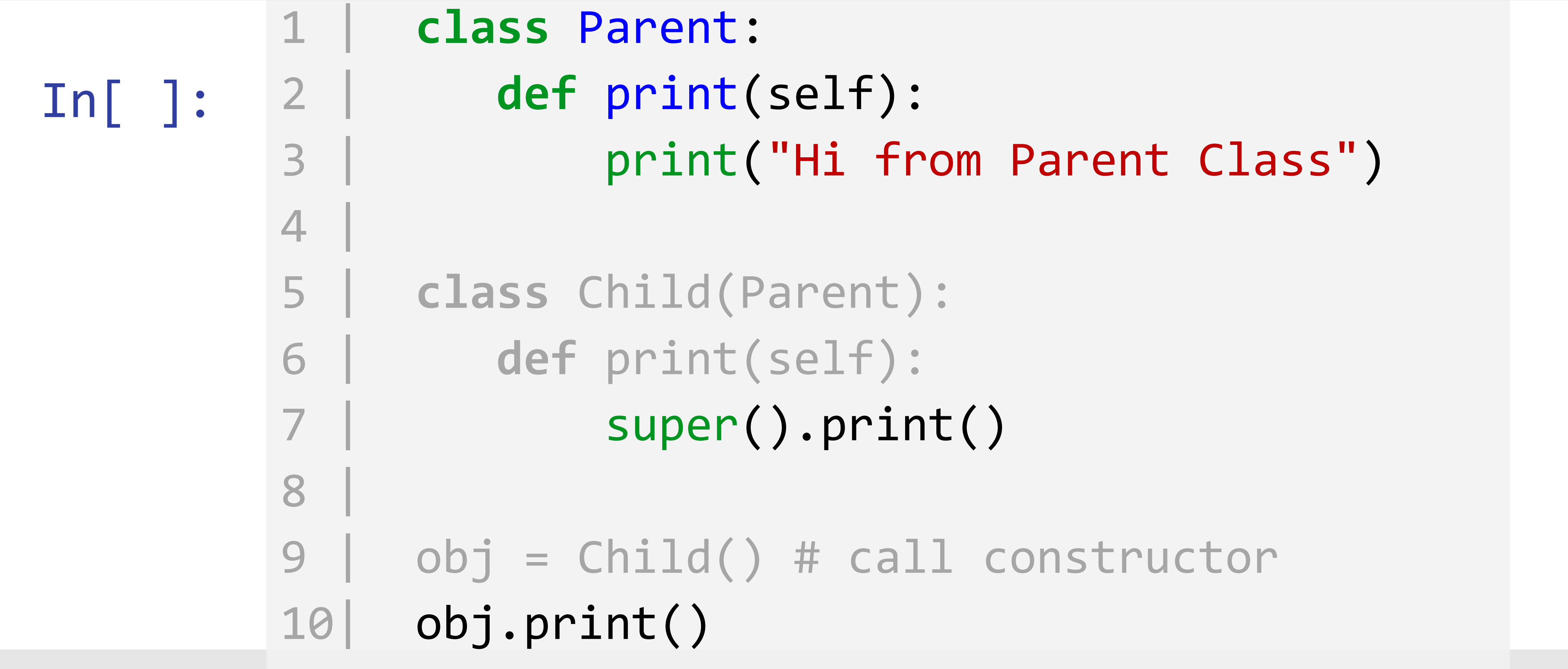

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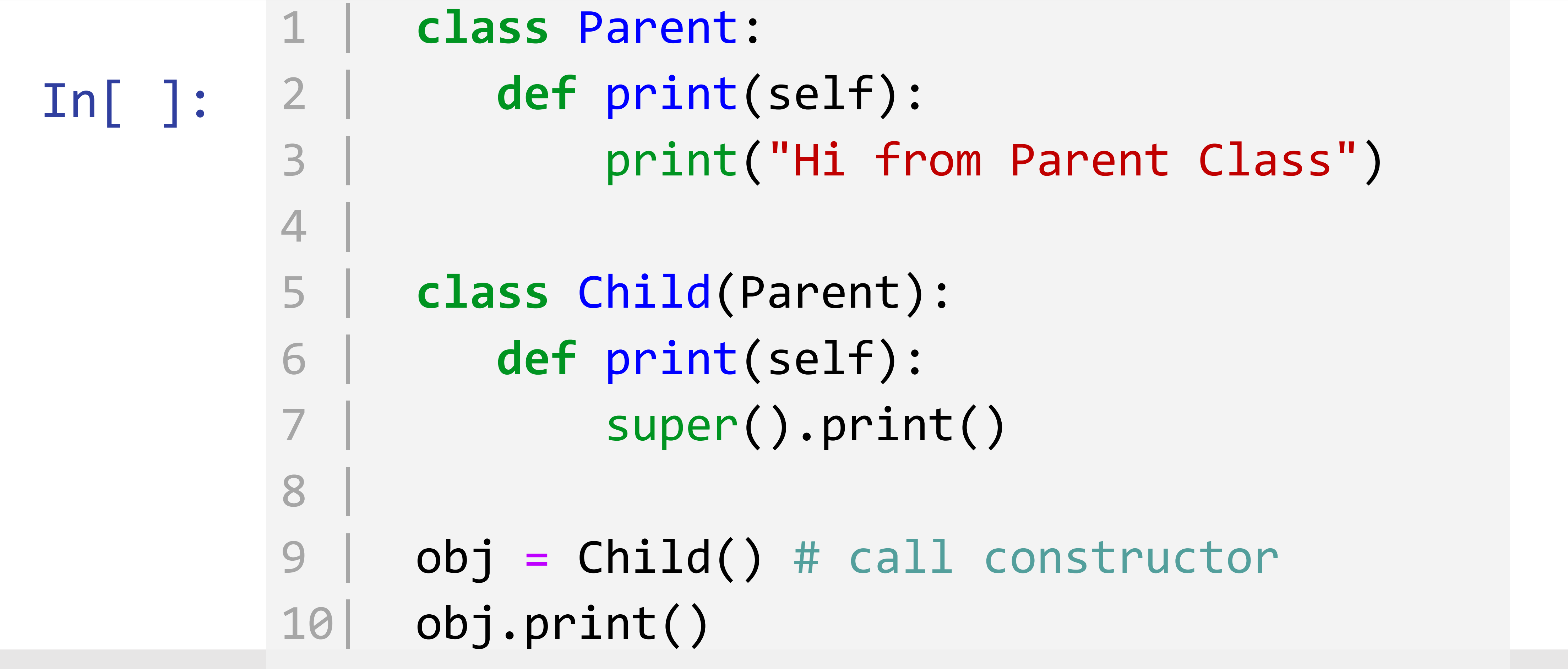

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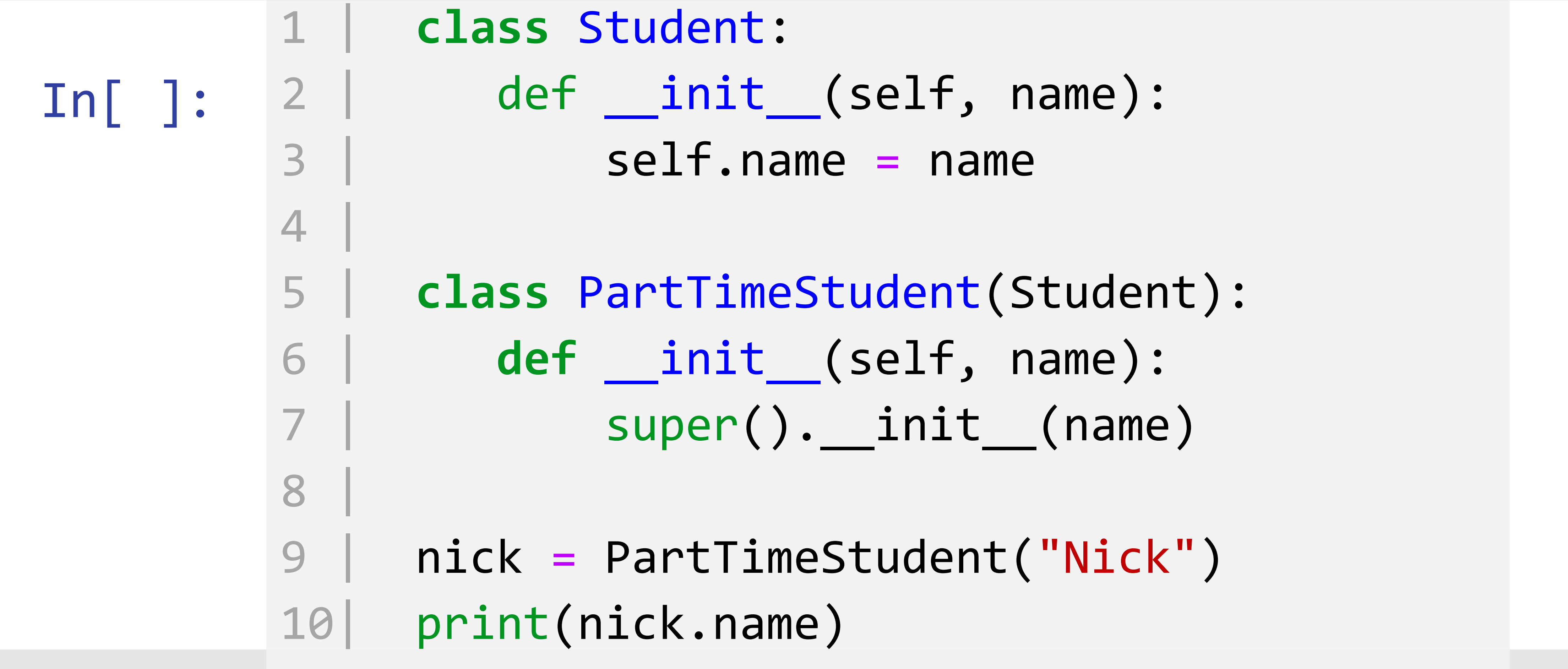
Inheritance extension

Inheritance



```python
class Student:
    def __init__(self, name):
        self.name = name

class PartTimeStudent(Student):
    def __init__(self, name):
        super().__init__(name)

nick = PartTimeStudent("Nick")
print(nick.name)
```

Inheritance

In[ ]:

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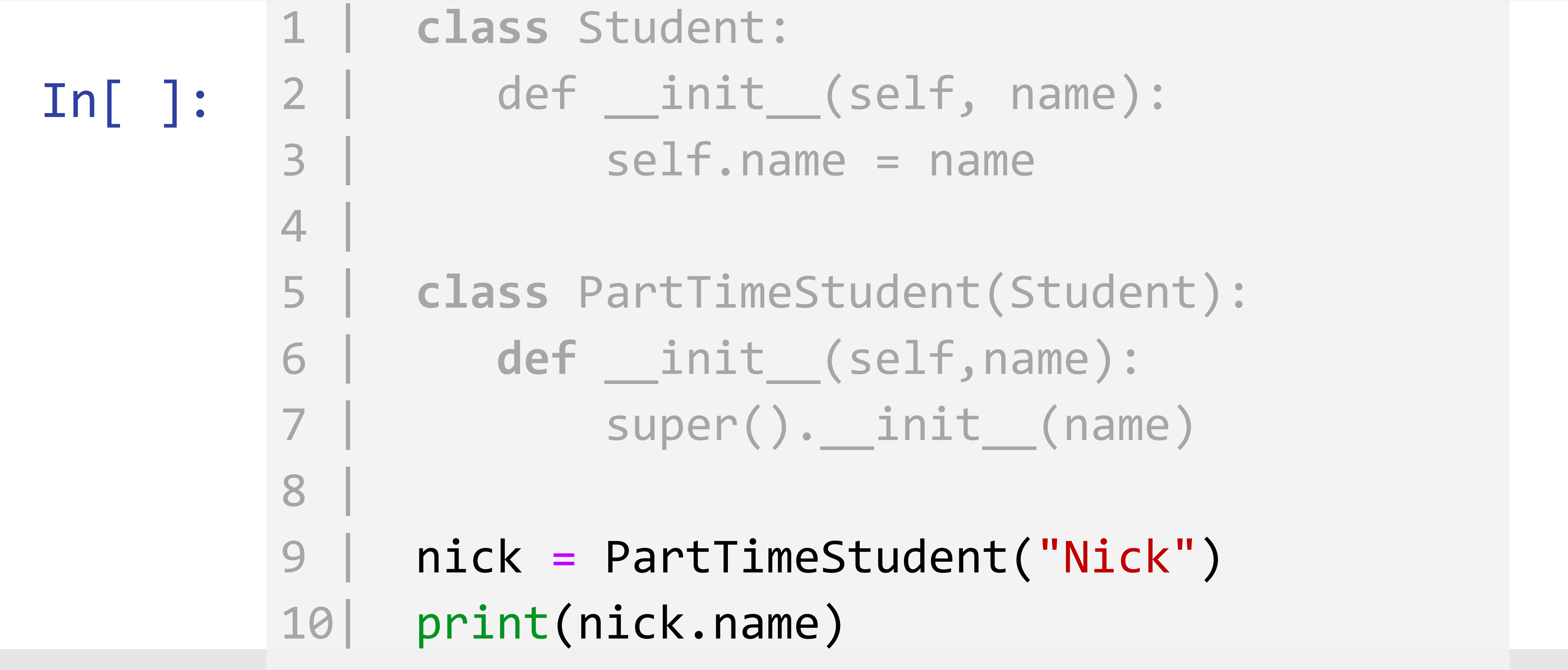
Inheritance



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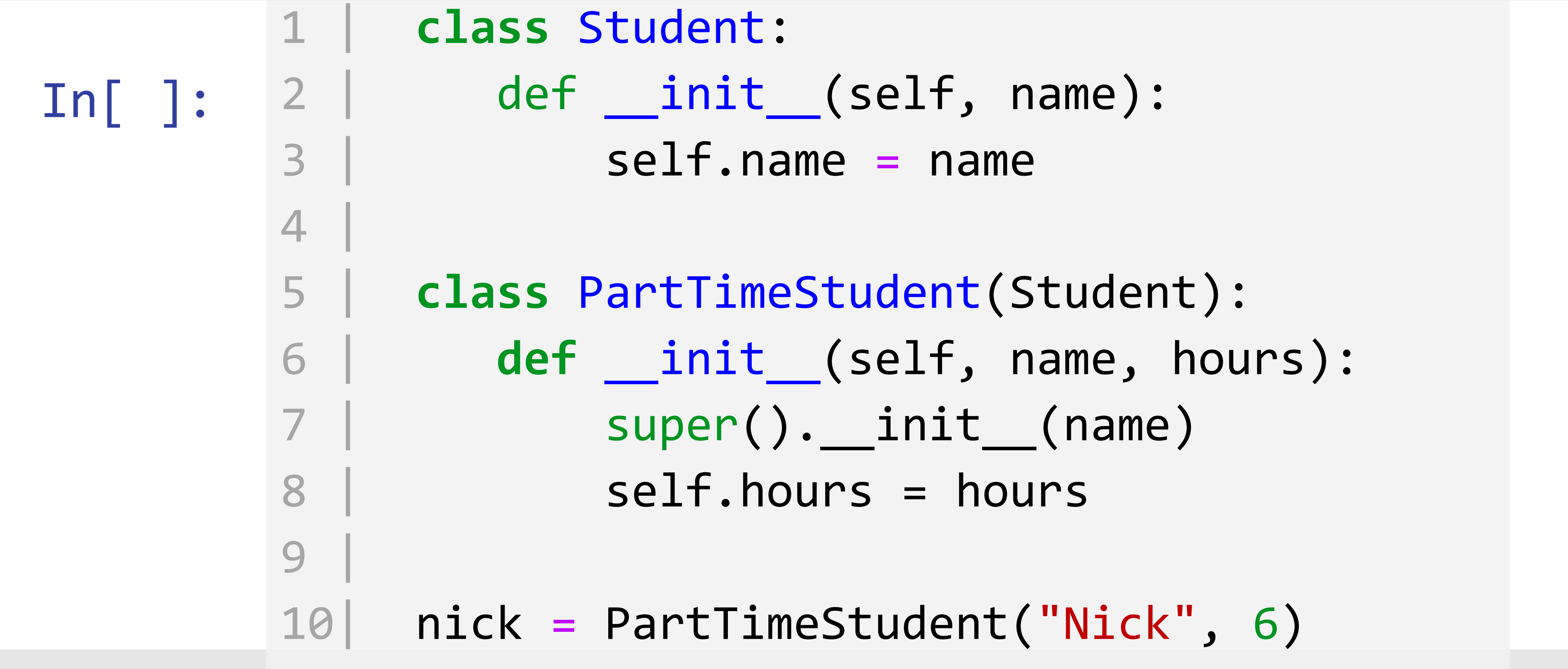
Inheritance



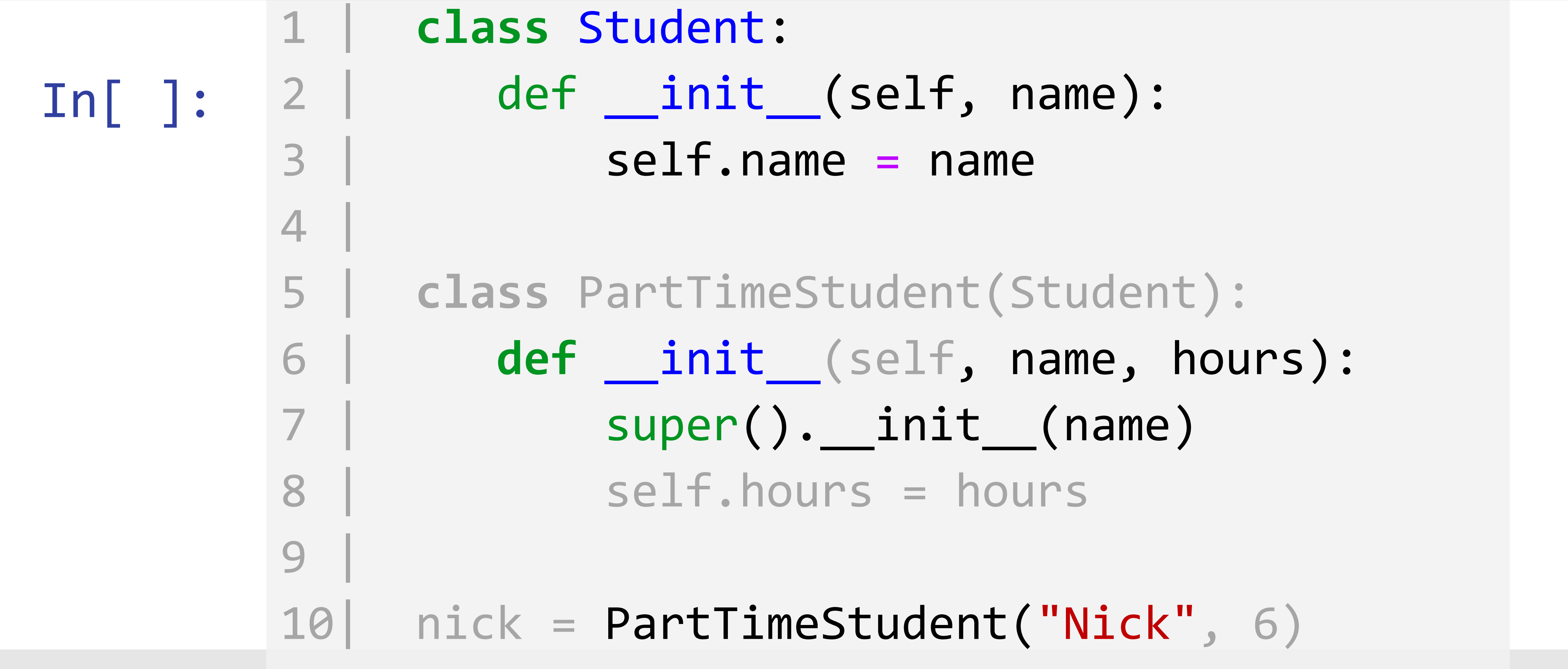
In[ ]:

```
class Student:
    def __init__(self, name):
        self.name = name

class PartTimeStudent(Student):
    def __init__(self, name, hours):
        super().__init__(name)
        self.hours = hours

nick = PartTimeStudent("Nick", 6)
```

Inheritance



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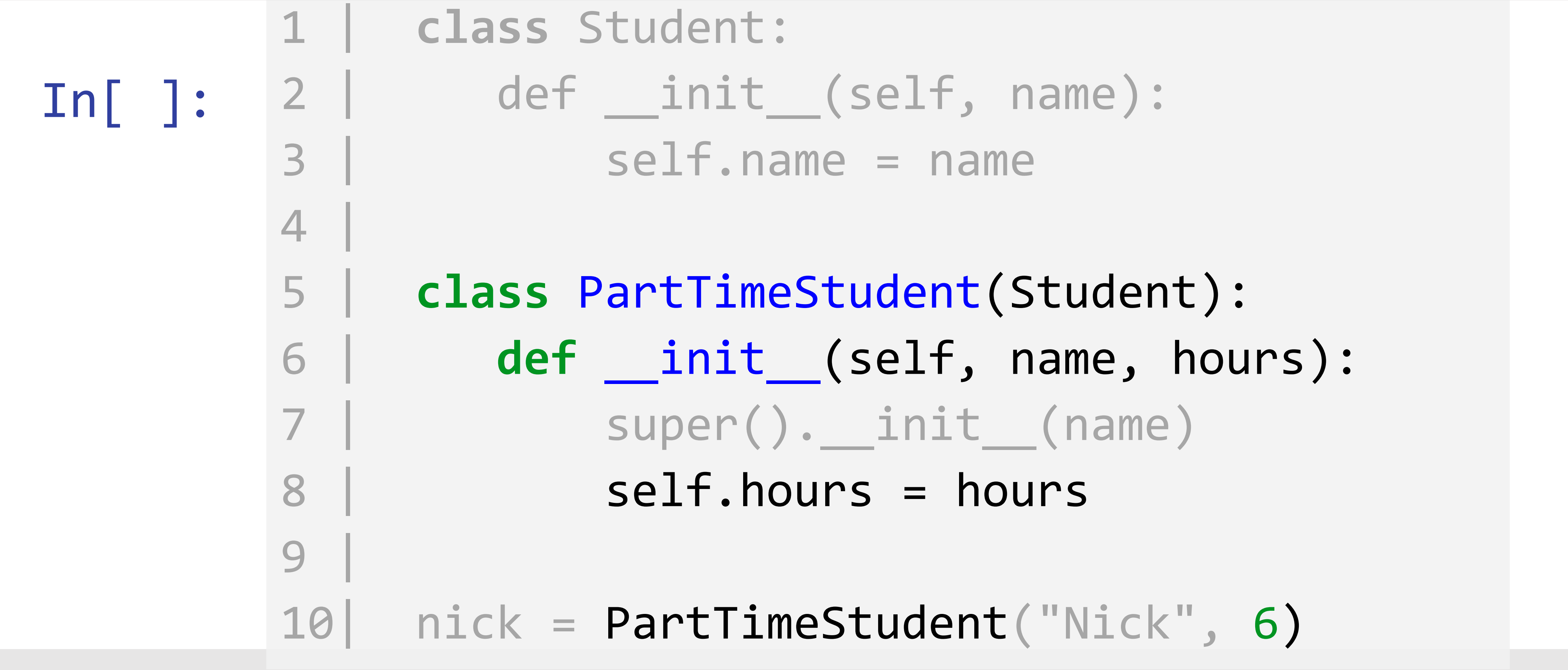
Inheritance



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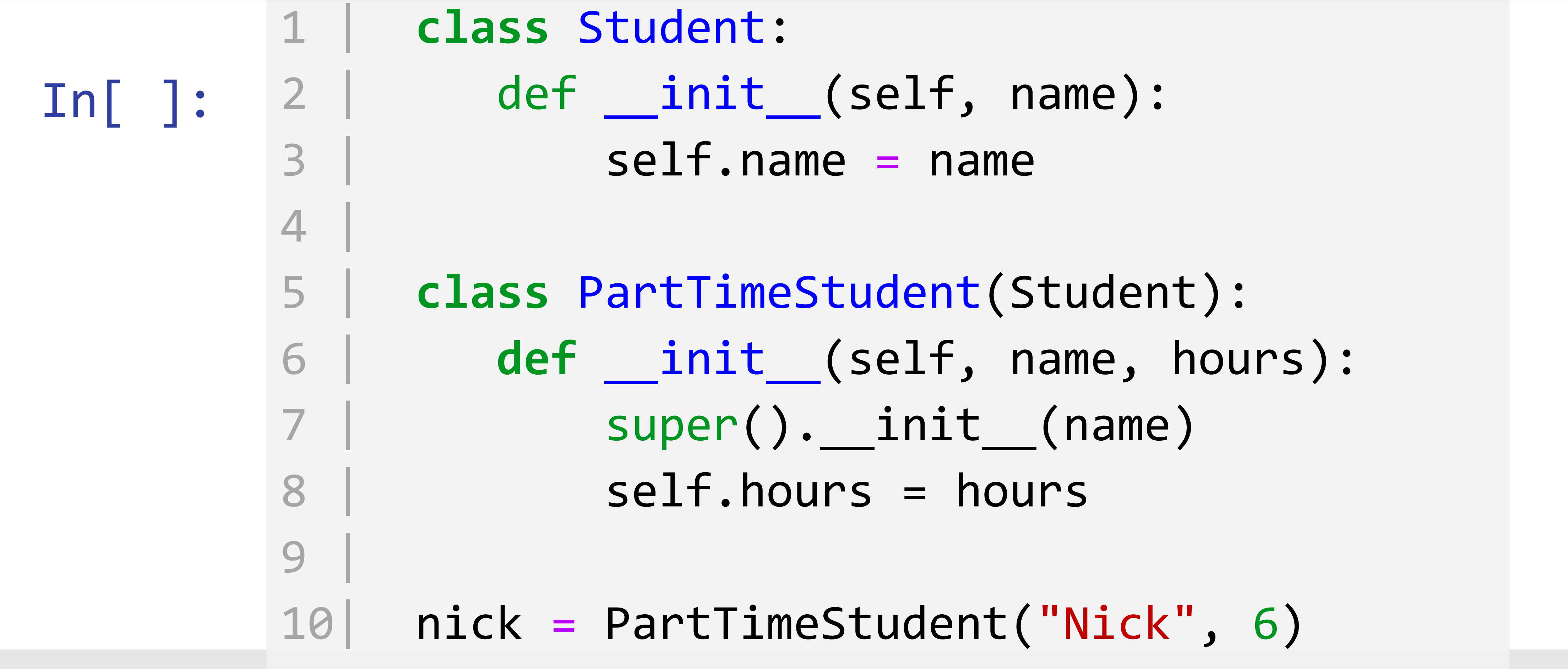
    def __init__(self, name, hours):
        super().__init__(name)
        self.hours = hours

nick = PartTimeStudent("Nick", 6)
```

Inheritance



In[ ]:

```python
class Student:
    def __init__(self, name):
        self.name = name

class PartTimeStudent(Student):
    def __init__(self, name, hours):
        super().__init__(name)
        self.hours = hours

nick = PartTimeStudent("Nick", 6)
```