The Magic of Self

How Python inserts self into methods

Sebastiaan Zeeff — PyGrunn X, 2021

Who am I?

- **Sebastiaan Zeeff** (35)
- Software Engineer & Codesmith @ **Ordina Pythoneers**
- **Python Discord**
- Volunteer for **EuroPython**

"From day one, there was deep magic hiding in some places, designed to quietly help users."

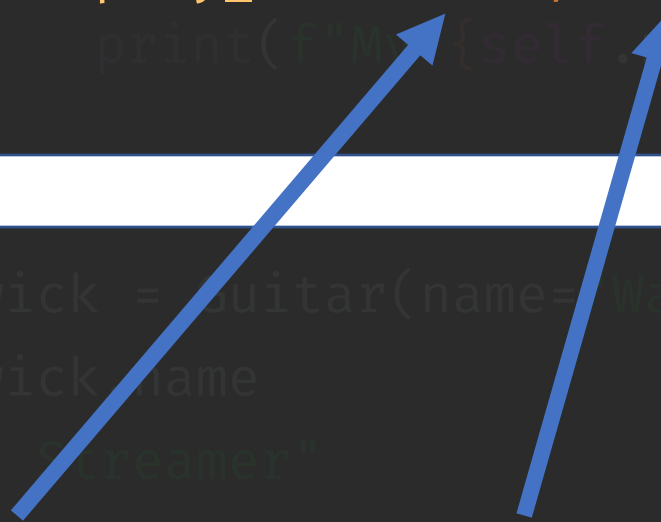
— Guido van Rossum, on Twitter.

Part one — What is the magic of self?

```python
class Guitar:
    def __init__(self, name: str) -> None:
        self.name = name

    def play_note(self, note: str) -> None:
        print(f"My {self.name} plays the note {note!r}")

```

```
>>> warwick = Guitar(name="Warwick Streamer")
>>> warwick.name
"Warwick Streamer"
>>> warwick.play_note("C#")
My Warwick Streamer plays the note 'C#'
>>>
```

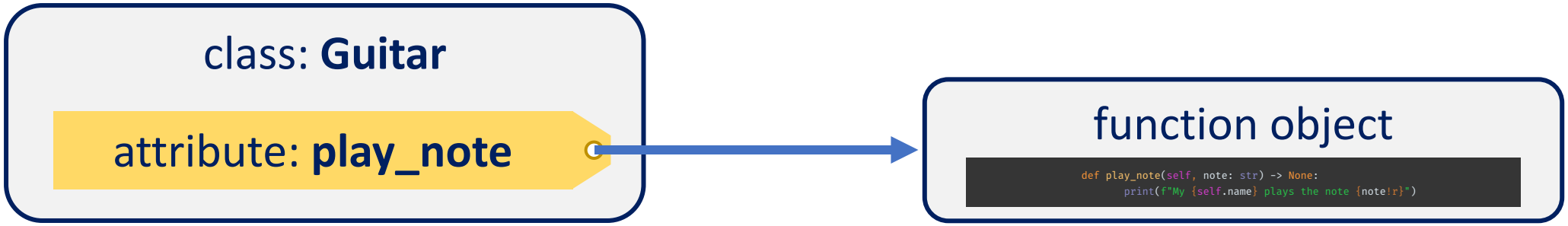
```
class Guitar:
    def __init__(self, name: str) -> None:
        self.name = name

    def play_note(self, note: str) -> None:
        print(f"My {self.name} plays the note {note!r}")

```



```
>>> warwick = Guitar(name="Warwick Streamer")
>>> warwick.name
"Warwick Streamer"
>>> warwick.play_note("C#")
My Warwick Streamer plays the note 'C#'
>>>
```

Part two — Methods in Python

```python
class Guitar:
    def __init__(self, name: str) -> None:
        self.name = name

    def play_note(self, note: str) -> None:
        print(f"My {self.name} plays the note {note!r}")

```



- The function object is still (mostly) a **regular function object.**
- We've bound a **class attribute** to that function object.

Part three — Accessing methods

```python
class Guitar:
    def __init__(self, name: str) -> None:
        self.name = name

    def play_note(self, note: str) -> None:
        print(f"My {self.name} plays the note {note!r}")

```

```
>>> Guitar.play_note
<function Guitar.play_note at 0x00000v=dQw4w9WgXcQ>

>>> warwick = Guitar(name="Warwick Streamer")
>>> warwick.play_note
<bound method Guitar.play_note of Guitar('Warwick Streamer')>

>>>
```

Part four — Descriptors

The descriptor protocol

- Descriptors can customize attribute look-up, assignment, and deletion.

- They do that by implementing special ('dunder') methods:
  - The `__get__` method customizes look-up:
  - The `__set__` method customizes assignment:
  - The `__delete__` method customizes deletion:

```
warwick.play_note
```

```
warwick.play_note = "value"
```

```
del warwick.play_note
```

- Functions are descriptors that implement a `__get__` method.

Part five — Implementing a descriptor

```python
class Guitar:
    def __init__(self, name: str) -> None: ...
    def play_note(self, note: str) -> None: ...

    is_my_favourite = FavouriteDescriptor()

warwick = Guitar(name="Warwick Streamer")
print(warwick.is_my_favourite)  # prints True
```

```python
class Guitar:
    def __init__(self, name: str) -> None: ...
    def play_note(self, note: str) -> None: ...

    is_my_favourite = FavouriteDescriptor()

fender = Guitar(name="Fender Jazz Bass Deluxe")
print(fender.is_my_favourite)  # prints False
```

```python
class Guitar:
    def __init__(self, name: str) -> None: ...
    def play_note(self, note: str) -> None: ...

    is_my_favourite = FavouriteDescriptor()

fender = Guitar(name="Fender Jazz Bass Deluxe")
print(fender.is_my_favourite)  # prints False
```

```python
class FavouriteDescriptor:
    def __get__(self, instance, owner) -> bool | FavouriteDescriptor:
        if instance is None:
            return self

        return instance.name == "Warwick Streamer"
```

```python
class Guitar:
    def __init__(self, name: str) -> None: ...
    def play_note(self, note: str) -> None: ...

    is_my_favourite = FavouriteDescriptor()

fender = Guitar(name="Fender Jazz Bass Deluxe")
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```

```
>>> warwick = Guitar(name="Warwick Streamer")
>>> warwick.is_my_favourite
True
```

```python
class Guitar:
    def __init__(self, name: str) -> None: ...
    def play_note(self, note: str) -> None: ...

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class FavouriteDescriptor:
    def __get__(self, instance, owner) -> bool | FavouriteDescriptor:
        if instance is None:
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        return instance.name == "Warwick Streamer"
```

```
>>> fender = Guitar(name="Fender Jazz Bass Deluxe")
>>> fender.is_my_favourite
False
```

```python
class Guitar:
    def __init__(self, name: str) -> None: ...
    def play_note(self, note: str) -> None: ...

    is_my_favourite = FavouriteDescriptor()

fender = Guitar(name="Fender Jazz Bass Deluxe")
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```python
class FavouriteDescriptor:
    def __get__(self, instance, owner) -> bool | FavouriteDescriptor:
        if instance is None:
            return self

        return instance.name == "Warwick Streamer"
```

```
>>> Guitar.is_my_favourite
<FavouriteDescriptor object at 0x0000A1BFD314433>
```

Part six — The __get__ method of a function

```python
# Pseudo-implementation of function's __get__
# Remember: self refers to the function itself!
class function:
    def __get__(self, instance, owner):
        if instance is None:
            return self

        return PyMethod(self, instance)
```

```
>>> Guitar.play_note
<function Guitar.play_note at 0x00000v=dQw4w9WgXcQ>

>>> Guitar.play_note.__get__(None, Guitar)
<function Guitar.play_note at 0x00000v=dQw4w9WgXcQ>

>>>
```

```python
# Pseudo-implementation of function's __get__
# Remember: self refers to the function itself!
class function:
    def __get__(self, instance, owner):
        if instance is None:
            return self

        return PyMethod(self, instance)
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```
>>> warwick = Guitar(name="Warwick Streamer")
>>> warwick.play_note
<bound method Guitar.play_note of Guitar('Warwick Streamer')>

>>> Guitar.play_note.__get__(warwick, Guitar)
<bound method Guitar.play_note of Guitar('Warwick Streamer')>
```

Part seven — Other built-in descriptors

Other built-in descriptors

- The classmethod descriptor binds the class, not the instance, to the function.

```
1 class Guitar:
2     @classmethod
3     def print_class_name(cls) -> None:
4         print(f"The name of the class: {cls.__name__!r}")
5
6
7
8
```

Other built-in descriptors

- The classmethod descriptor binds the class, not the instance, to the function.
- The staticmethod descriptor returns the function as-is, not binding anything.

```
1 class Guitar:
2     @staticmethod
3     def my_static_method() -> None:
4         print("I know no bounds!")
5
6
7
8
```

Other built-in descriptors

- The classmethod descriptor binds the class, not the instance, to the function.
- The staticmethod descriptor returns the function as-is, not binding anything.
- The property descriptor allows you to easily create getters/setters/deleters.

```
1 class Guitar:
2     @property
3     def price(self) -> float:
4         return self._price
5 
6     @price.setter
7     def price(self, new_price: float) -> None:
8         self._price = new_price
```

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- Descriptors allow you to customize how attributes work.
- Python's functions implement the descriptor protocol to create bound methods.

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- Python's functions implement the descriptor protocol to create bound methods.

Not covered, but also important:

- The `__set__` and `__delete__` descriptor methods.
- The difference between data and non-data descriptors.
- The `__set_name__` method, often used in descriptors.

Epilogue: On magic

“I'm writing a book on magic”, I explain, and I'm asked, “Real magic?” By real magic people mean miracles, thaumaturgical acts, and supernatural powers. “No”, I answer: “Conjuring tricks, not real magic”. Real magic, in other words, refers to the magic that is not real, while the magic that is real, that can actually be done, is not real magic.”

— **Lee Siegal** in **Net of Magic: Wonders and deceptions in India**

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