



# Lecture 10: Builder Pattern

## IN710: Object-Oriented Systems Development

### Semester One, 2020

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Thursday, 19 March

# LECTURE 09: ADAPTER PATTERN RECAP

- ▶ Design pattern 05: adapter pattern
  - ▶ Definition
  - ▶ Problem/solution
  - ▶ Real world analogy
  - ▶ UML & implementation
  - ▶ Pros & cons

# LECTURE 10: BUILDER PATTERN TOPICS

- ▶ Design pattern 06: builder pattern
  - ▶ Definition
  - ▶ Problem/solution
  - ▶ UML & implementation
  - ▶ Applicability
  - ▶ Pros & cons

# BUILDER PATTERN: GoF

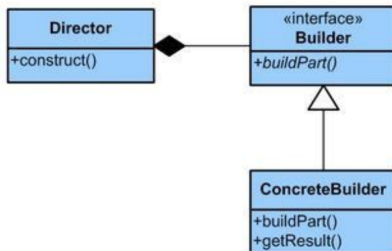
## ► GoF definition & UML

### Builder

**Type:** Creational

**What it is:**

Separate the construction of a complex object from its representing so that the same construction process can create different representations.



# BUILDER PATTERN: DEFINITION

- ▶ Creational pattern
- ▶ Separates the construction of a complex object from its representation
- ▶ The same construction process can create different representations

# BUILDER PATTERN: PROBLEM

## ► Building a house

```
class House:
    def __init__(self, num_rooms, num_doors, num_windows,
                  has_garage, has_garden, has_swimming_pool):
        self.num_rooms = num_rooms
        self.num_doors = num_doors
        self.num_windows = num_windows
        self.has_garage = has_garage
        self.has_garden = has_garden
        self.has_swimming_pool = has_swimming_pool

def main():
    house = House(4, 8, 20, False, True, True)

if __name__ == '__main__':
    main()
```

# BUILDER PATTERN: SOLUTION

## ► HouseBuilder class

```
class HouseBuilder(Builder):
    def __init__(self):
        self.reset()

    def reset(self):
        self._product = House()

    @property
    def product(self):
        product = self._product
        self.reset()
        return product

    def set_num_rooms(self, num_rooms):
        pass

    def set_num_doors(self, num_doors):
        pass

    def set_num_windows(self, num_windows):
        pass

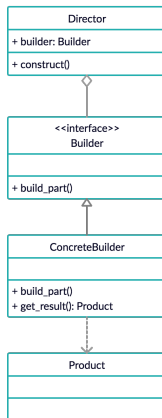
    def set_has_garage(self, has_garage):
        pass

    def set_has_garden(self, has_garden):
        pass

    def set_has_swimming_pool(self, has_swimming_pool):
        pass
```

# BUILDER PATTERN: UML

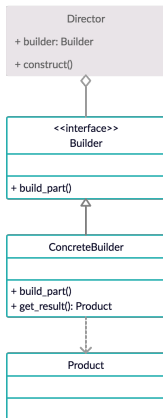
- Consider the following UML diagram:





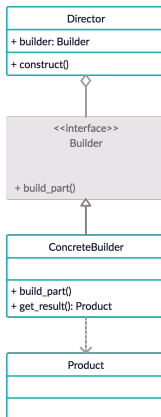
# BUILDER PATTERN: UML

- ▶ Director class
- ▶ Doesn't create the product class
- ▶ Refers to the builder interface class for creating the parts of a complex object



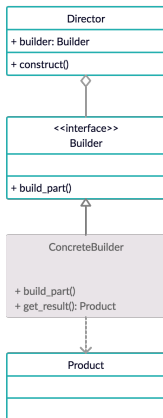
# BUILDER PATTERN: UML

## ► Builder interface class



# BUILDER PATTERN: UML

- ConcreteBuilder class
- Implements the builder interface class by creating the product object



# BUILDER PATTERN: IMPLEMENTATION

```
from abc import ABC, abstractmethod, abstractproperty

class Builder(ABC):
    @abstractproperty
    def product(self):
        pass

    @abstractmethod
    def set_first_name(self, first_name):
        pass

    @abstractmethod
    def set_last_name(self, last_name):
        pass

    @abstractmethod
    def set_email_address(self, email_address):
        pass

    @abstractmethod
    def set_phone_number(self, phone_number):
        pass
```

# BUILDER PATTERN: IMPLEMENTATION

```
class PersonBuilder(Builder):
    def __init__(self):
        self.reset()

    def reset(self):
        self._product = Person()

    @property
    def product(self):
        product = self._product
        self.reset()
        return product

    def set_first_name(self, first_name):
        self._product.add(f'First_name:_{first_name}')

    def set_last_name(self, last_name):
        self._product.add(f'Last_name:_{last_name}')

    def set_email_address(self, email_address):
        self._product.add(f'Email_address:_{email_address}')

    def set_phone_number(self, phone_number):
        self._product.add(f'Phone_number:_{phone_number}')
```

# BUILDER PATTERN: IMPLEMENTATION

```
class Person:
    def __init__(self):
        self.details = {}

    def add(self, detail):
        self.details.append(detail)

    def display_details(self):
        for d in self.details:
            print(d)

class Director:
    def __init__(self):
        self.__builder = None

    @property
    def builder(self):
        return self.__builder

    @builder.setter
    def builder(self, builder):
        self.__builder = builder

    def build_person_details(self):
        self.builder.set_first_name('John')
        self.builder.set_last_name('Doe')
        self.builder.set_email_address('johndoe@gmail.com')
        self.builder.set_phone_number('0271234567')
```

# BUILDER PATTERN: IMPLEMENTATION

## ► Custom builder

```
def main():
    director = Director()
    person_builder = PersonBuilder()
    director.builder = person_builder

    print('Person_details:')
    director.build_person_details()
    person_builder.product.display_details()

    print('\nCustom_person_details:')
    person_builder.set_first_name('Jane')
    person_builder.set_last_name('Doe')
    person_builder.product.display_details()

if __name__ == '__main__':
    main()
```

# BUILDER PATTERN: APPLICABILITY

- ▶ Telescopic constructors
- ▶ Create different representations of the same product
- ▶ Construct composite trees or other complex objects
- ▶ Android - AlertDialog.Builder



# BUILDER PATTERN: PROS

- ▶ Constructed objects can be step-by-step, defer construction steps or run steps recursively
- ▶ When building representations of a product, the same construction code can be reused
- ▶ The construction code is isolated from the business logic

## BUILDER PATTERN: CONS

- ▶ Overall complexity of the code increases - creating multiple new classes is required
- ▶ The builder classes are required to be mutable
- ▶ Dependency injection may be less supported

# PRACTICAL

- ▶ Series of tasks covering today's lecture
- ▶ Worth 1% of your final mark for the Object-Oriented Systems Development course
- ▶ Deadline: Friday, 12 June at 5pm

## REMINDER: EXAM 02

- ▶ Series of tasks covering lectures 05-08
- ▶ Worth 6% of your final mark for the Object-Oriented Systems Development course
- ▶ Deadline: Today at 5pm

# LECTURE 11: STATE PATTERN TOPICS

- ▶ Design pattern 07: state pattern
  - ▶ Definition
  - ▶ Problem/solution
  - ▶ Real world analogy
  - ▶ UML & implementation
  - ▶ Pros & cons