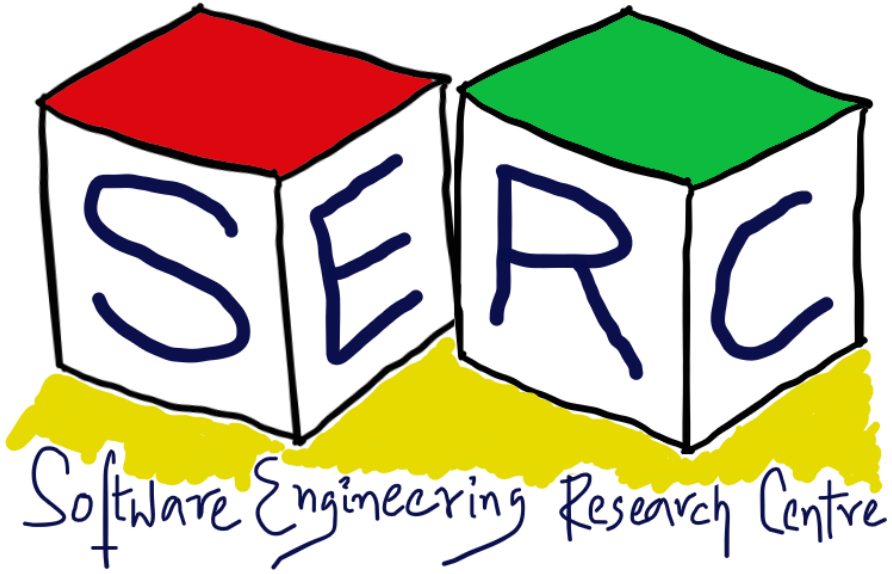
# Design Patterns

**CS6.401 Software Engineering**




Dr. Karthik Vaidhyanathan

karthik.vaidhyanathan@iiit.ac.in

https://karthikvaidhyanathan.com

INTERNATIONAL INSTITUTE OF INFORMATION TECHNOLOGY
HYDERABAD

# Acknowledgements

The materials used in this presentation have been gathered/adapted/generated from various sources as well as based on my own experiences and knowledge

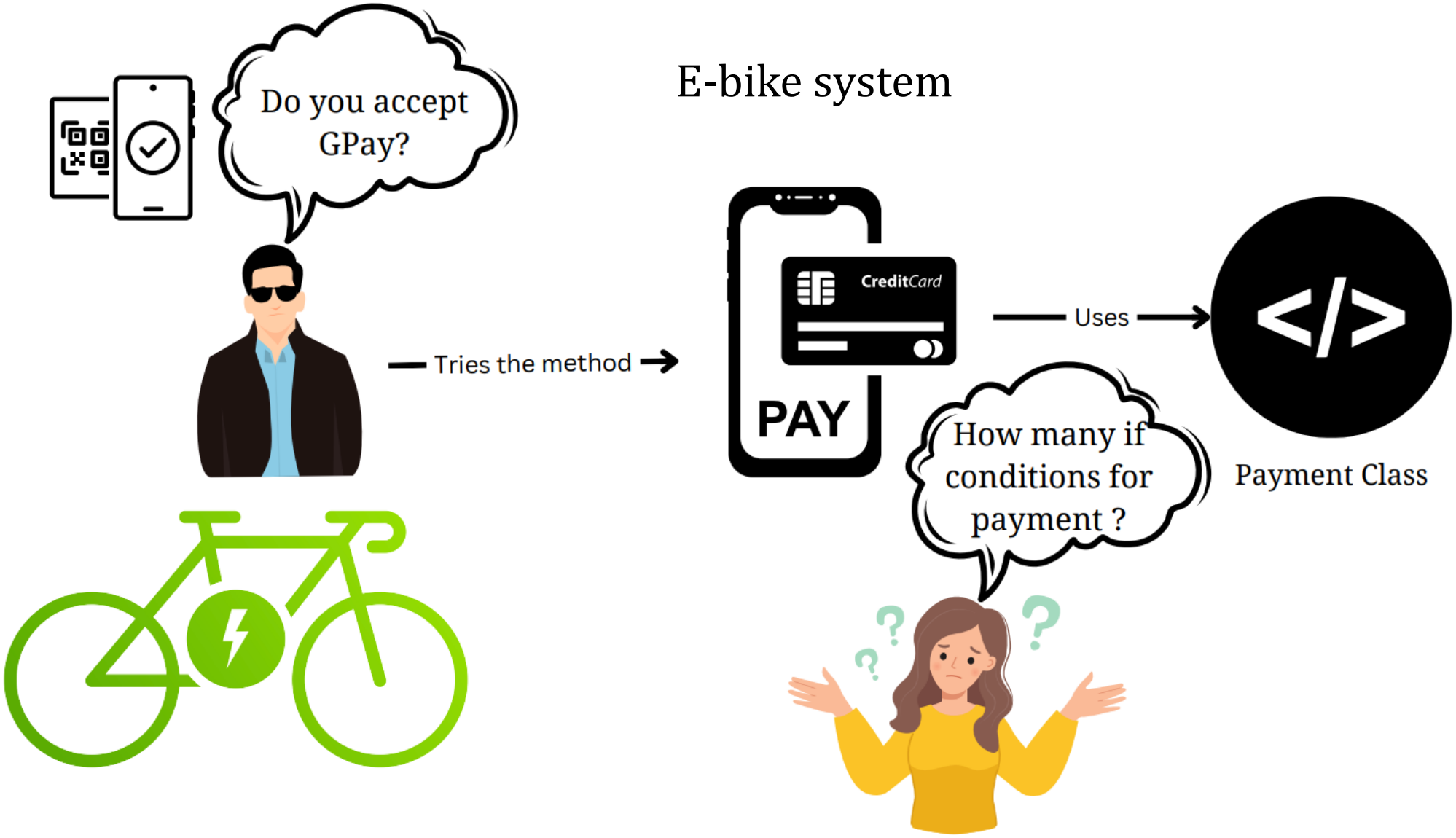
-- Karthik Vaidhyanathan

Sources:

1. **Design Patterns: Elements of Reusable Object-Oriented Software** by Erich Gamma, Richard Helm, Ralph Johnson and John Vlissides
2. **Head first Design Patterns**, Second Edition, Eric Freeman and Elisabeth Robson

# Strategies can be different: Strategy Pattern! [Behavioral]

# Meet the Strategy Pattern!



# Meet the Strategy Pattern

- What if you want to alter objects behavior at run-time?
- What if there are similar objects but the way they work is different?
- Each variety of algorithm may require its own set of data and functions

# Strategy Pattern: Documentation

**Intent**

Define a family of algorithms, encapsulate each one and ensure they are interchangeable. Strategy lets algorithm change depending on the client, who is using it

**Also Known As:** Policy

**Motivation**

- Different algorithms will be appropriate at different times
- Promotes maintainability
- Two key objects: *Context and Strategy*

Example: Think of Google maps -> selection of mode of transport

# Strategy Pattern: Documentation

**Applicability**

- Many related classes differ only in their behavior
- There is a need for different variants of an algorithm
- Algorithm might require data that client needs not know about – avoid exposing algorithm specific data structures
- Class defines many behaviors and these appear as multiple conditional statements

# Strategy Pattern: Documentation

## Structure

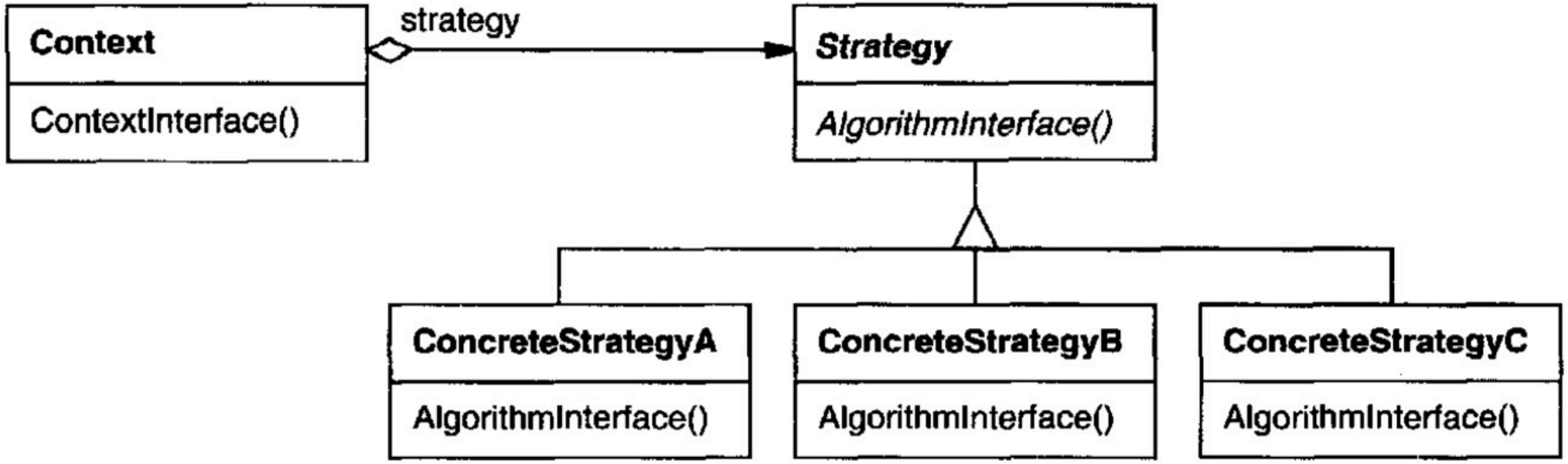



Image source: Gang of four book

# Strategy Pattern: Documentation

## Participants

### Strategy(PaymentType)

- Interface common to all algorithms. Used by context

### ConcreteStrategy (DebitCard)

- Implements algorithm using strategy interface

### Context (Booking)

- Configured with ConcreteStrategy object
- Maintains reference to a Strategy object
- Can define interface for Strategy to access data

# Strategy Pattern: Documentation

**Consequences**

- Families of related algorithms
  - Hierarchies of strategy classes define a family of algorithms or behaviors
  - Inheritance can help in factoring out common functionality

- Alternative to subclassing
  - Inheritance is another mechanism – Hard-wires context [coupling!]

- Eliminates conditional statements
  - Encapsulates behavior separately [Good solution for long method smell]

- If the number of variations are less - Don’t overcomplicate!
- Classes must be aware of different possible strategies

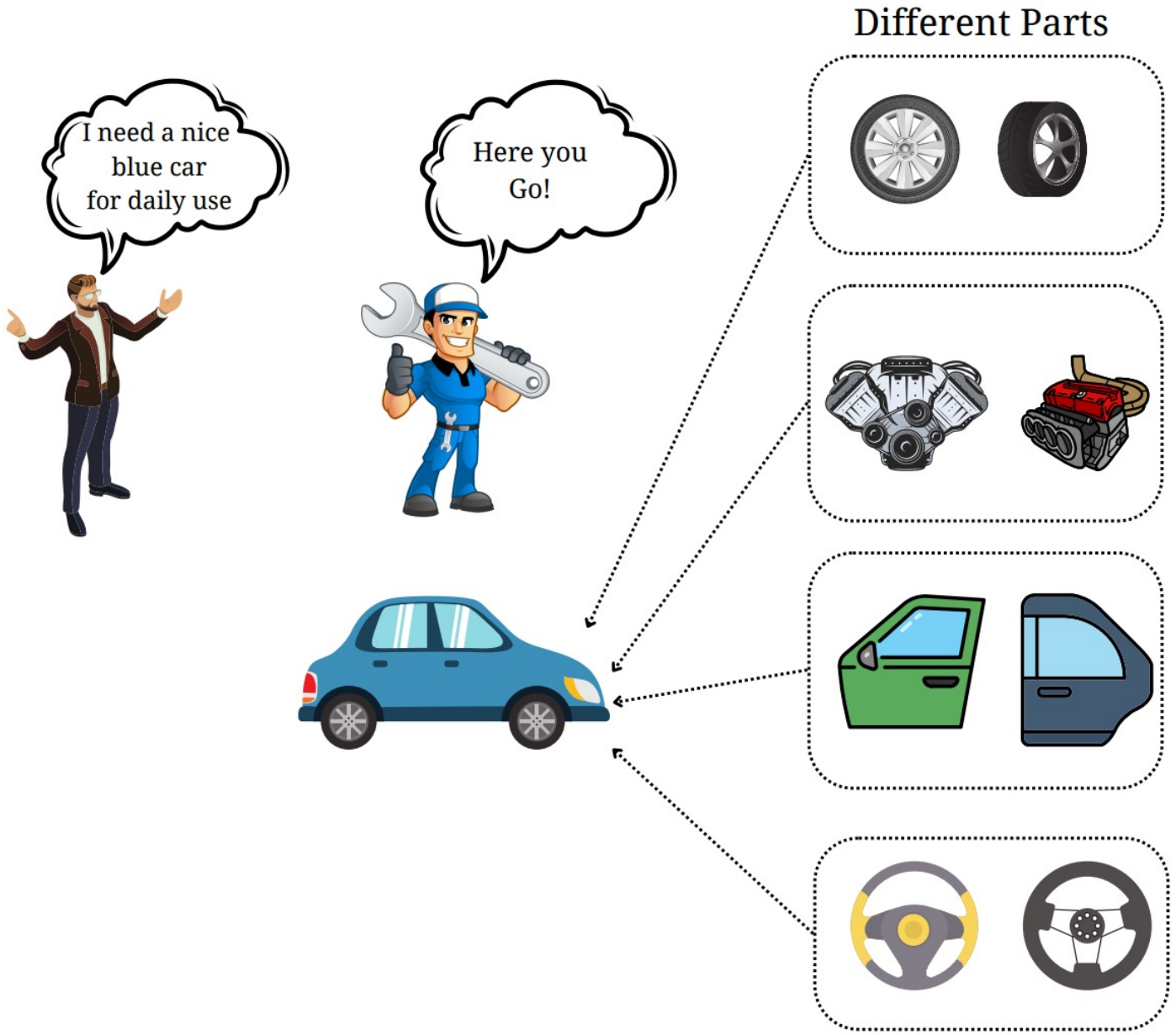
# Strategy Pattern: Documentation

**Implementation**

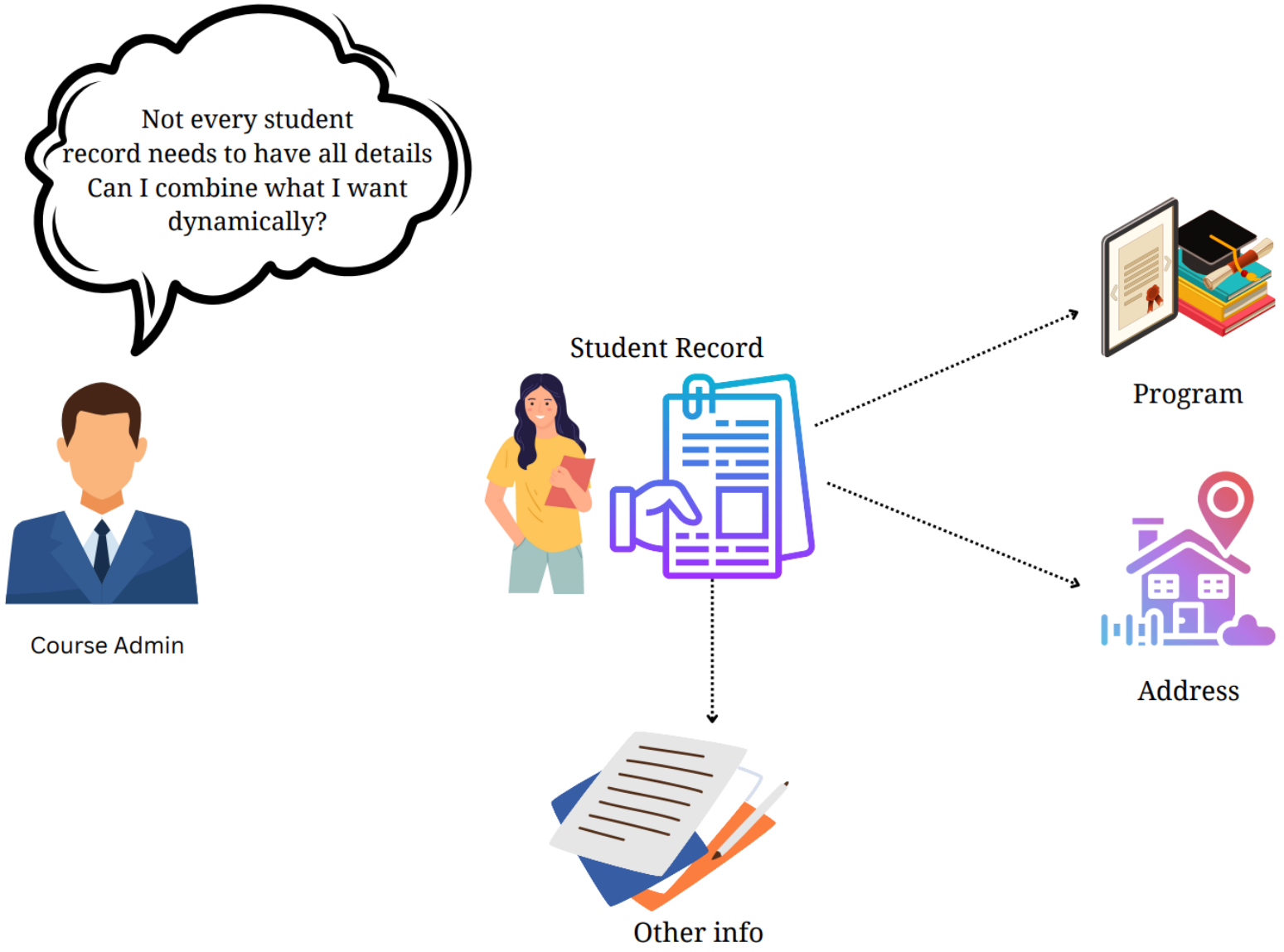
Check the source code given along: EBikePaymentStrategy

# How about building things: Builder Pattern! [Creational]

# Meet the Builder Pattern!



# Meet the Builder Pattern!




How to dynamically build the different types of student records?

# Meet the Builder Pattern

- What if there is a complex object?
- Can we avoid instantiation of a huge constructor?
- Not every time all constructor parameters are required
- Allows extraction of object construction code to separate object
- Creation of an object is just about assembling other objects step by step
- A very decoupled approach to creation

# Builder Pattern: Documentation

**Intent**

Separate construction of complex object from representation such that same construction process can result in different representations

**Also Known As:** Builder

**Motivation**

- Separate object construction from business logic
- Promote readability and understandability
- Three key objects: *Director, Builder, Product*

Example: Builder to build different types of vehicles [Each has engine, tyre, etc]

# Builder Pattern: Documentation

**Applicability**

- Algorithm for creating the object must be independent
  - Different parts may make up the object
  - Need not worry about how they are put together

- Construction of different representations of the object needs to be supported

# Builder Pattern: Documentation

## Structure

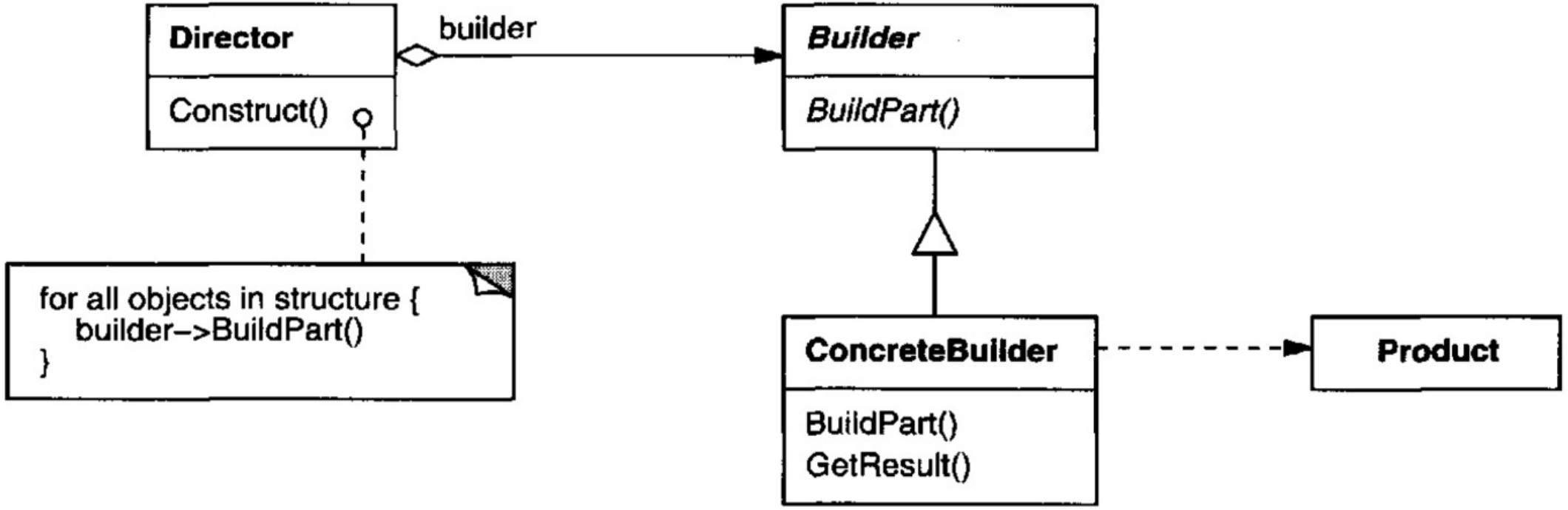



Image source: Gang of four book

# Builder Pattern: Documentation

## Participants

### Builder (StudentBuilder)

- Defines the interface for creating parts of a product object

### ConcreteBuilder (ConcreteStudentBuilder)

- Assembles the parts to create product by implementing builder interface

### Director (StudentDirector)

- Constructs an object using the builder interface

### Product (Student)

- Complex object under construction
- Includes classes that define the different parts

# Builder Pattern: Documentation

**Consequences**

- Easily vary products internal representation
  - Director gets the abstract interface to build a product
  - All that needs to be done is to define a new kind of builder

- Isolate code for representation and constructions
  - Concrete builder contains code for building a kind of product
  - Directors can reuse builders to build different variants of product

- More control over the construction process
  - Step by step approach under directors control – Focus is on the process

- The overall code complexity increases due to multiple classes
  - Benefits in the long run

# Builder Pattern: Documentation

**Implementation**

Check the source code given along: StudentRecordBuilder

# Thank You

Course website: karthikv1392.github.io/cs6401_se

Email: karthik.vaidhyanathan@iiit.ac.in
Web: https://karthikvaidhyanathan.com
Twitter: @karthi_ishere