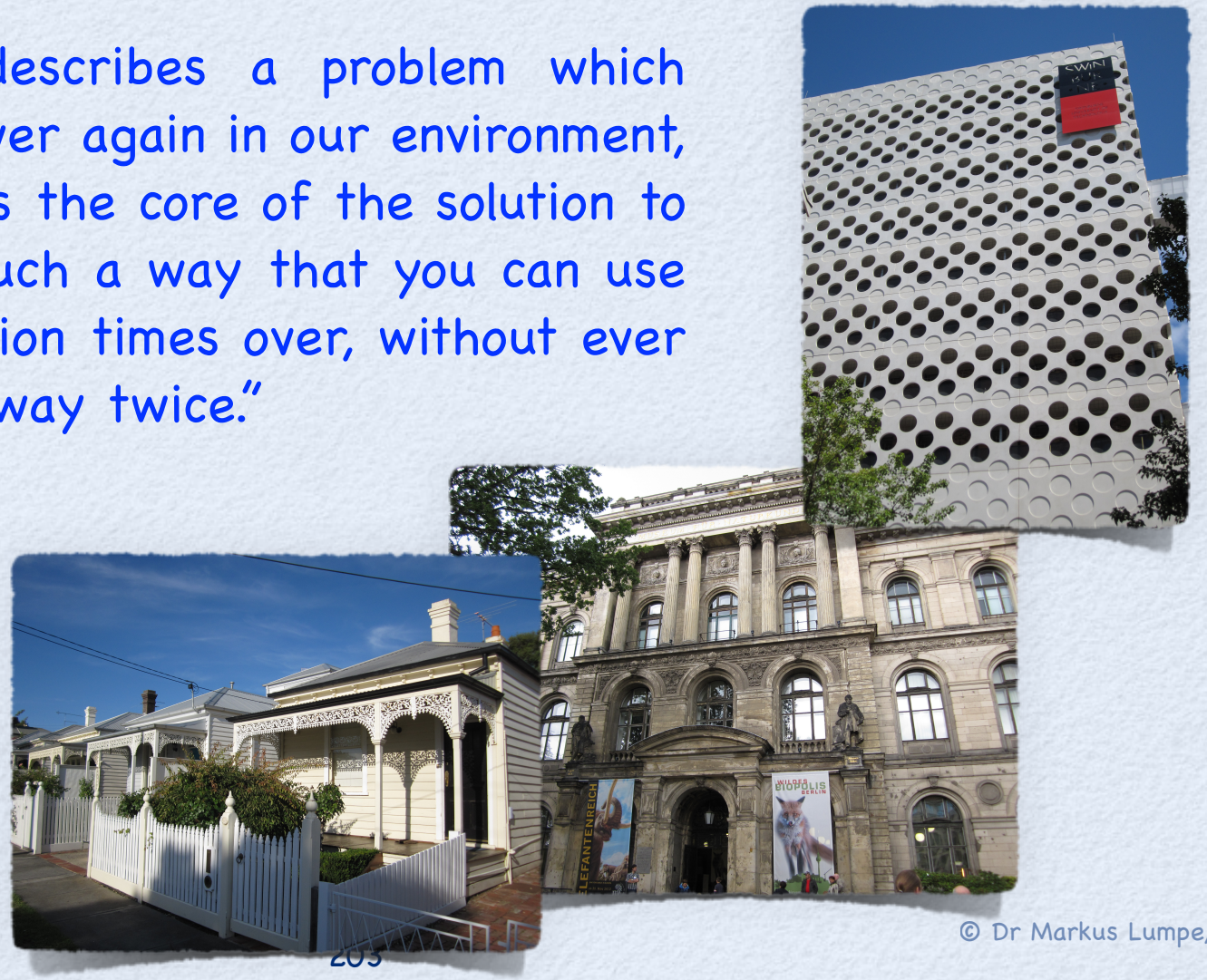
Design Pattern

What is a Design Pattern?

Christopher Alexander says:

> "... [A] pattern describes a problem which occurs over and over again in our environment, and then describes the core of the solution to that problem, in such a way that you can use this solution a million times over, without ever doing it the same way twice."



Essential Design Pattern Elements

A pattern has four essential elements:

- The pattern name that we use to describe a design problem,
- The problem that describes when to apply the pattern,
- The solution that describes the elements that make up the design, and
- The consequences that are the results and trade-offs of applying the pattern.

Design Patterns Are Not About Design

- Design patterns are not about designs such as linked lists and hash tables that can be encoded in classes and reused as is.
- Design patterns are not complex, domain-specific designs for an entire application or subsystem.
- Design patterns are descriptions of communicating objects and classes that are customized to solve a general design problem in a particular context.

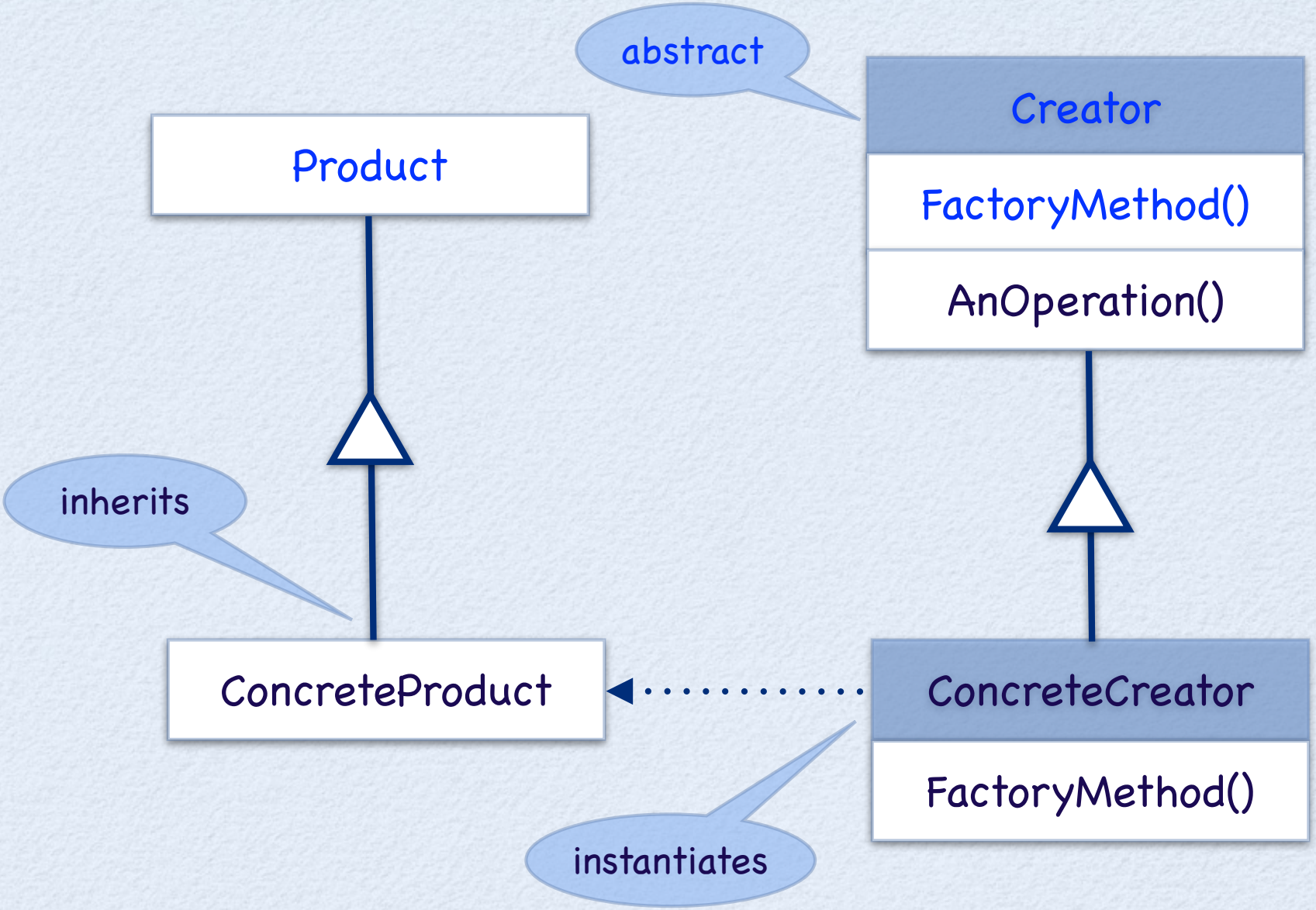
Creational Patterns

- Creational patterns abstract the instantiation process. They help to make a system independent of how its objects are created, composed, and represented.
- Main forms:
  - Creational patterns for classes use inheritance to vary the class that is instantiated.
  - Creational patterns for objects delegate instantiation to another object.

Example: Factory Method

- Intent:
  - Define an interface for creating an object, but let subclasses decide which class to instantiate. Factory Method lets a class defer instantiation to subclasses.
- Collaborations:
  - Creator relies on its subclasses to define the factory method so that it returns an instance of the appropriate ConcreteProduct.

Structure of Factory Method



Classical Example

- A classical example of factory method is that of iterators.
- An iterator provides access to elements of a collection. A concrete iterator methods isolate the caller from knowing which class to instantiate.

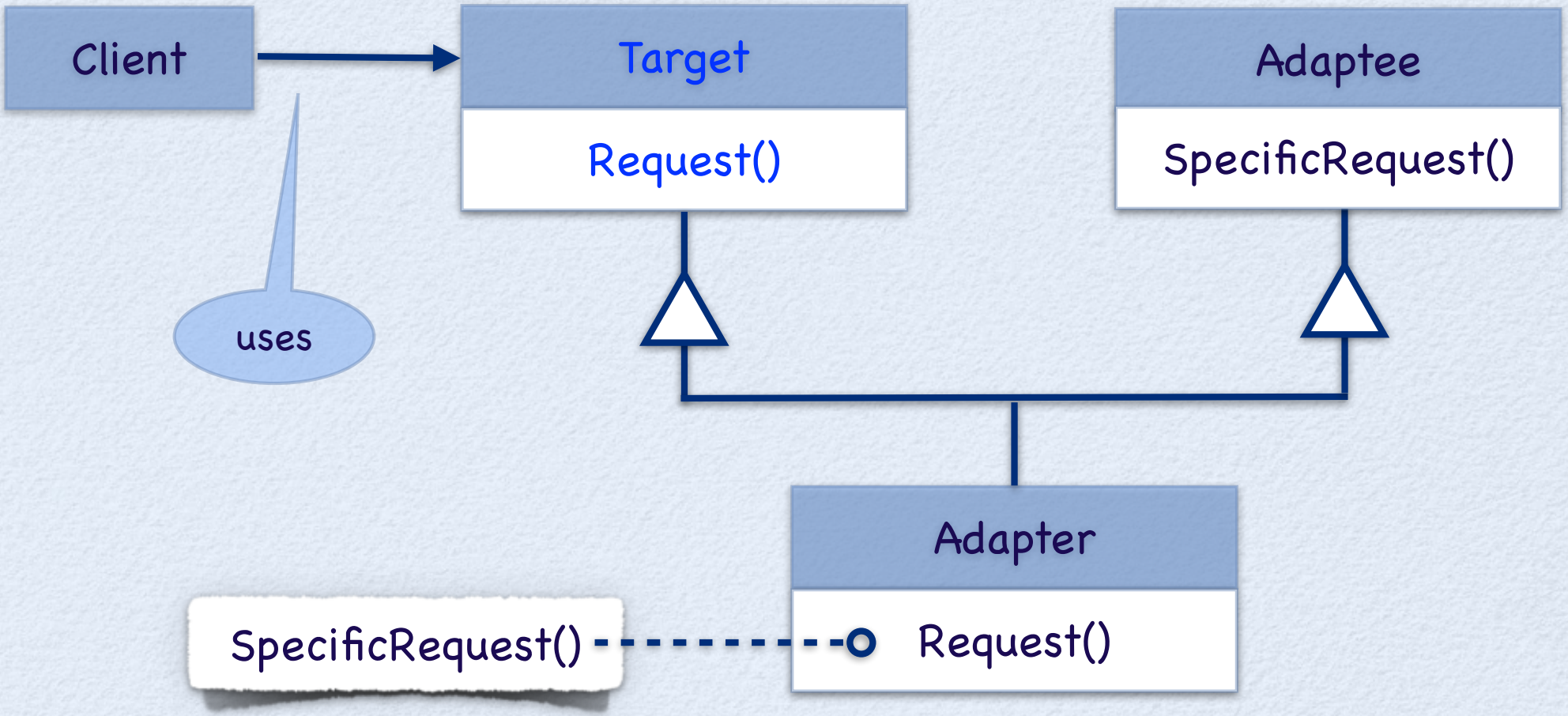
Structural Patterns

- Structural patterns are concerned with how classes and object are composed to form larger structures:
  - Structural class patterns use inheritance to compose interfaces or implementations.
  - Structural object patterns describe ways to compose objects to realize new functionality. The added flexibility of object composition comes from the ability to change the composition at runtime, which is impossible with static class composition.

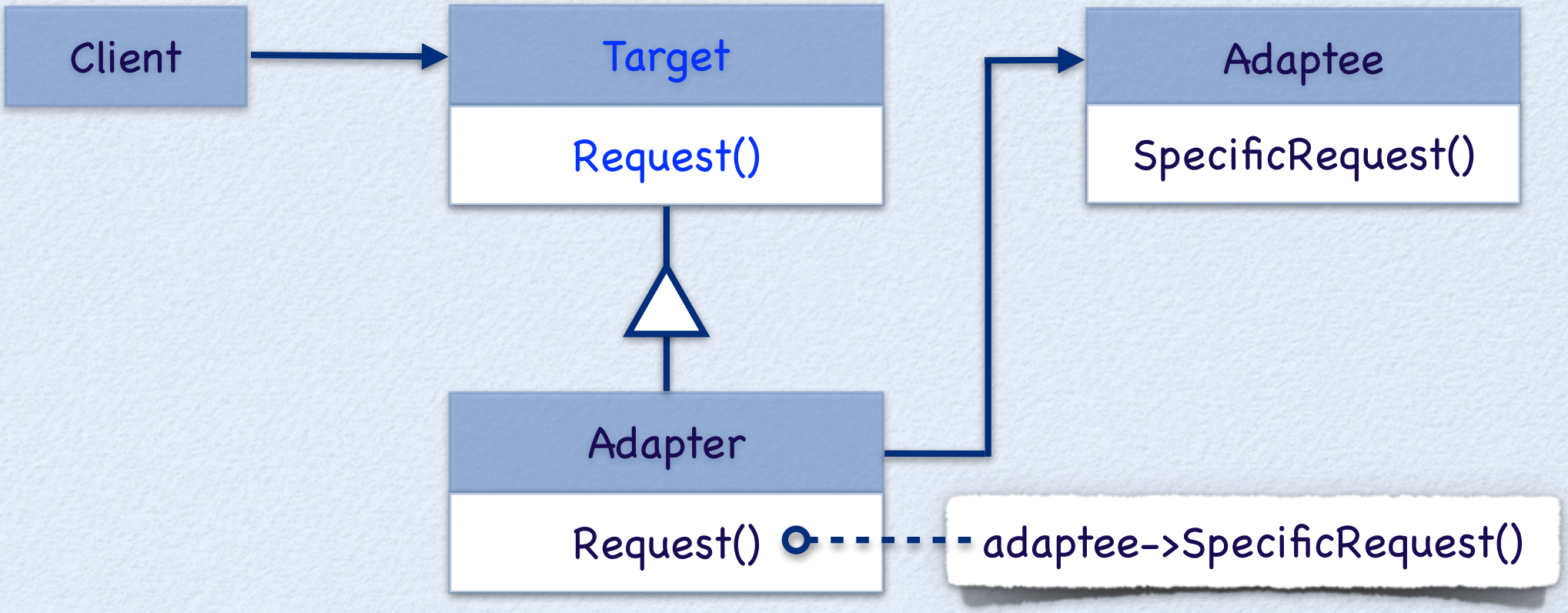
Example: Adapter

- Intent:
  - Convert the interface of a class into another interface clients expect. Adapter lets classes work together that could not otherwise because of incompatible interfaces.
- Collaborations:
  - Clients call operations on an Adapter instance. In turn, the adapter calls Adaptee operations that carry out the request.

Structure of a Class Adapter



Structure of an Object Adapter



Behavioral Patterns

- Behavioral patterns are concerned with algorithms and the assignment of responsibilities between classes and objects:
  - Behavioral class patterns use inheritance to distribute behavior between classes.
  - Behavioral object patterns object composition rather than inheritance. Some describe how a group of peer objects cooperate to perform a task that no single object can carry out by itself.
- The classic example of a behavioral pattern is Model-View-Controller (MVC), where all views of the model are notified whenever the model's state changes.

Example: Iterator

- Intent:
  - Provide a way to access the elements of n aggregate object sequentially without exposing its underlying representation.
- Collaborations:
  - A ConcreteIterator keeps track of the current object in the aggregate and can compute the succeeding object in the traversal.

Structure of Iterator