DESIGN PATTERNS IN C#

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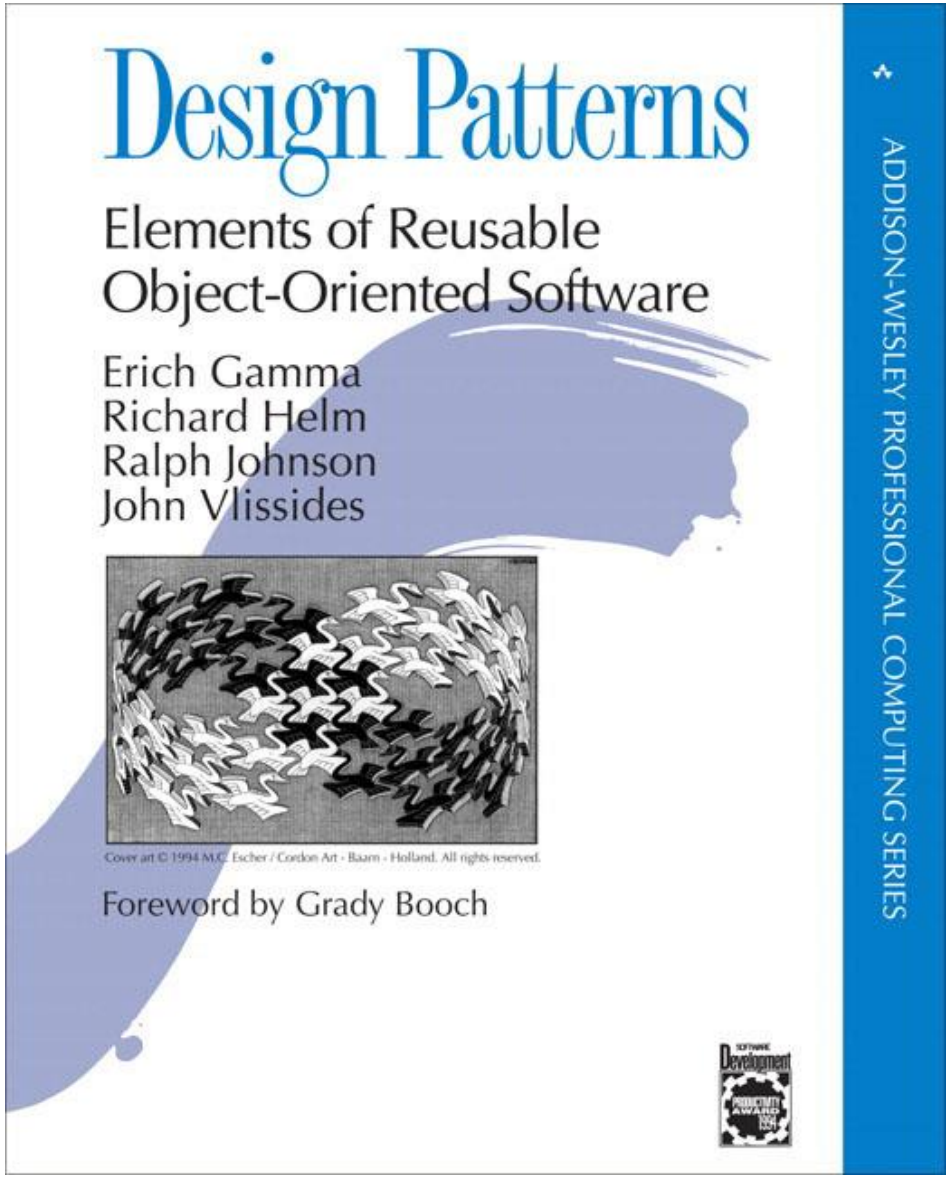
PEAK IT 002 - an AgileHub Event
13 october 2019

DESIGN PATTERNS – THE BOOK

- Published in 1994
- Gang of Four (GoF) = the authors
- You might need to read it twice ☺



WHAT ARE DESIGN PATTERNS?

- A design pattern is a recommended “recipe” to use in case of a certain problem
- Design patterns are:
  - independent of the programming language
  - simple, elegant & object-oriented solutions to a problem
  - not the first solution you would try (intuitively), because they were developed and evolved in time, to offer more flexibility and reusability
  - generally accepted by developers and used in programming

- Repo: https://github.com/nadiacomanici/git-PeakIT-002-DesignPatterns

WHY USE THEM?

- Proven solutions, that work
- No need to reinvent the wheel, just use the well-known solution for your problem
- Common vocabulary for developers, easier to communicate and understand the needed solution
- Offer flexibility and reusability of code
- Make future changes more easier
- Object-oriented solutions

SO WHICH ARE THEY?

Scope	Creational	Structural	Behavioral
Class - relationships between classes (static + compile time)	Factory Method	**Adapter**	Interpreter
			Template Method
Object - relationship between objects (dynamic + runtime)	**Abstract Factory**	Bridge	Chain of Responsibility
	Builder	Composite	Command
	Prototype	Decorator	Iterator
	Singleton	**Façade**	Mediator
		Flyweight	Memento
		Proxy	Observer
			State
			Strategy
			Visitor

STRUCTURAL DESIGN PATTERNS

1. ADAPTER

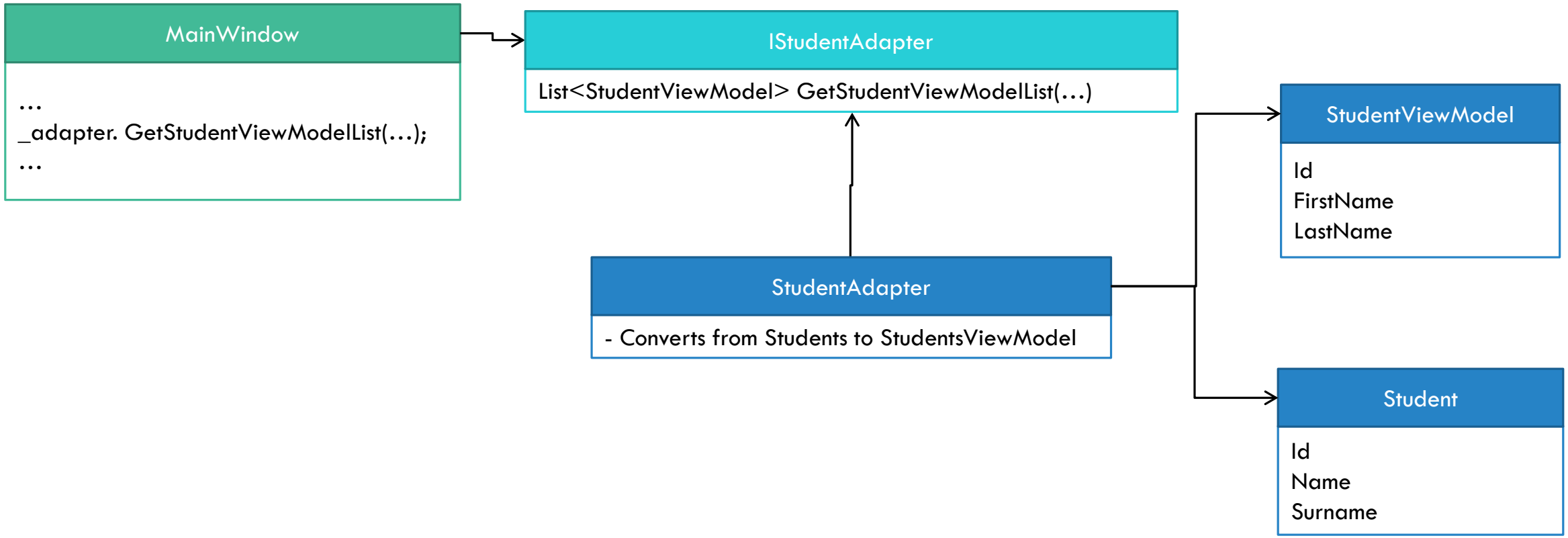
ADAPTER – WHAT DOES IT DO?

- “Convert the interface of a class into another interface clients expect. Adapter lets classes work together that couldn't otherwise because of incompatible interfaces.” (GoF)

ADAPTER – WHEN TO USE

- When you need to use a class T, but the interface of T is not the expected one
  - Interface = public data (properties, fields, methods)
  - And you don't have control/rights over the T class, to change its interface
  - Example: Model mapped over database table has different structure than the model used in UI
- Create a reusable class, that wraps over existing or future classes, that might not have compatible interfaces
- To create wrappers for a framework class that doesn't implement the interface expected by the domain.

ADAPTER – DIAGRAM – STUDENT



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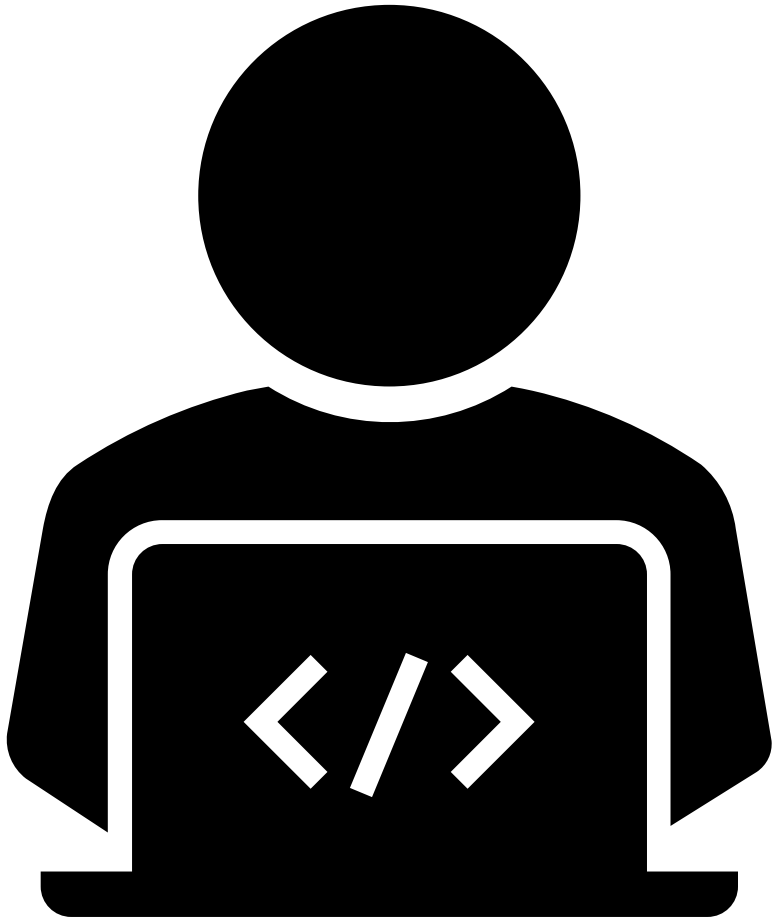
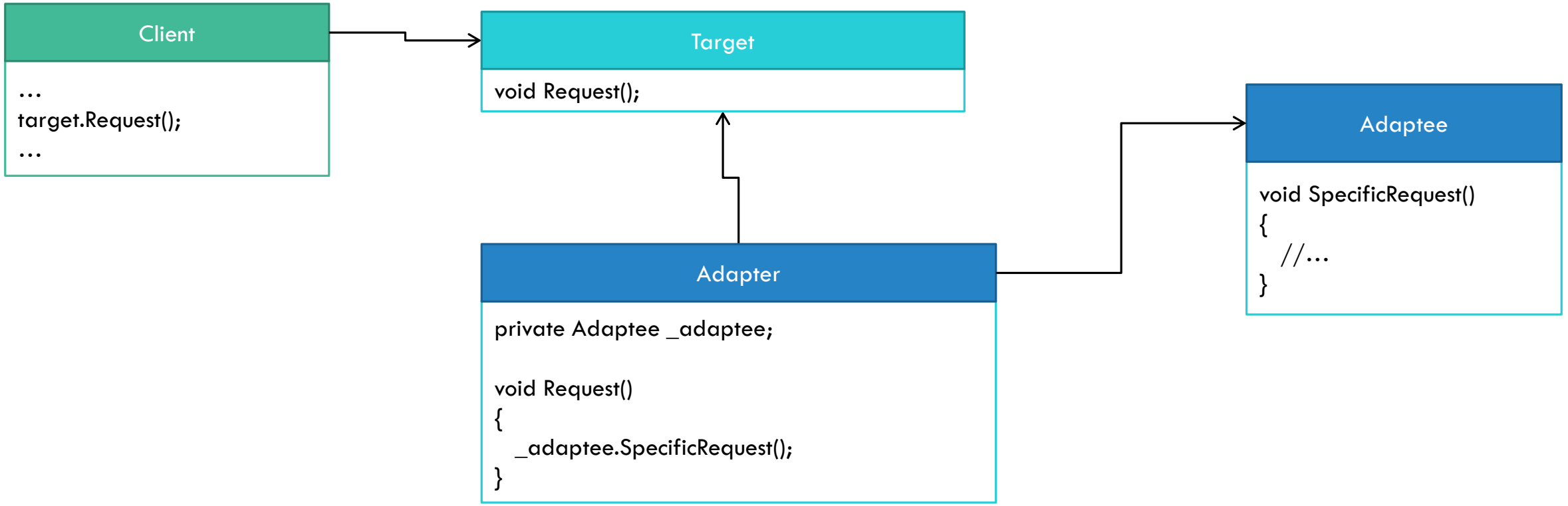
Adapter - Student



ADAPTER – DIAGRAM



Q&A
ADAPTER

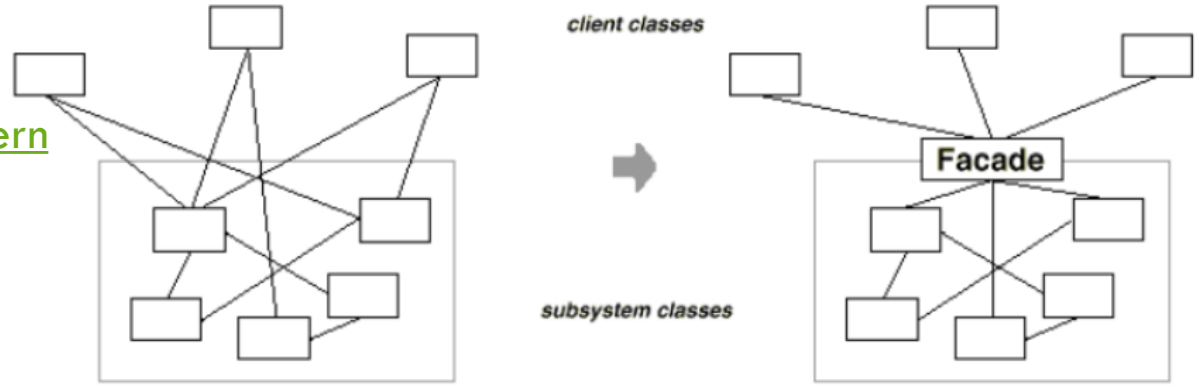
2. FACADE

FACADE – WHAT DOES IT DO?

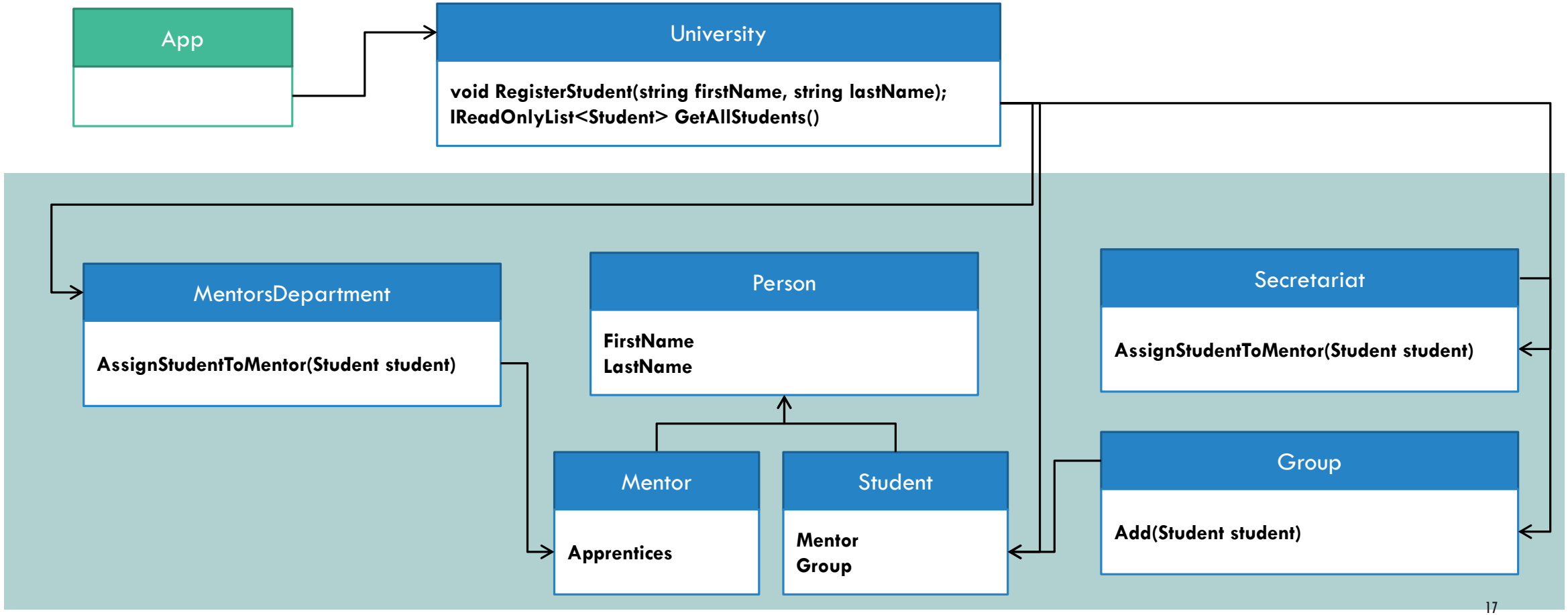
- “Provide a unified interface to a set of interfaces in a subsystem. Facade defines a higher-level interface that makes the subsystem easier to use.” (GoF)

FACADE – WHEN TO USE

- Provide a simplified interface for a complex system, from which you need only part of it, for a certain purpose
- Expose multiple systems under a single interface
- Wrap poorly designed systems in a better designed one
- More:
  - https://refactoring.guru/design-patterns/facade
  - https://www.dofactory.com/net/facade-design-pattern



FACADE – DIAGRAM – UNIVERSITY



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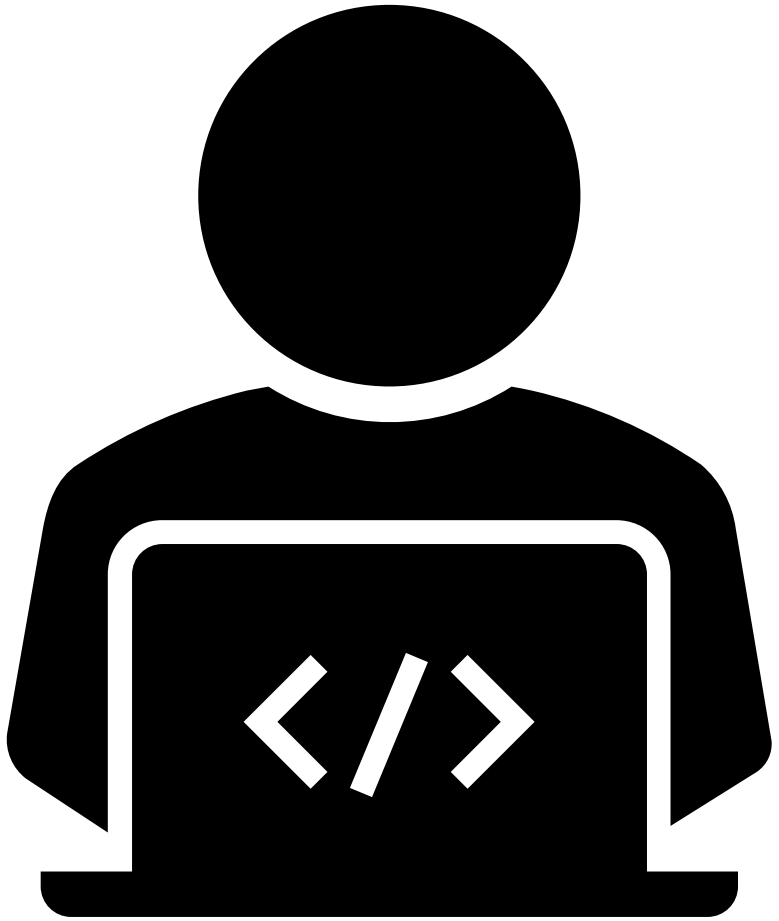
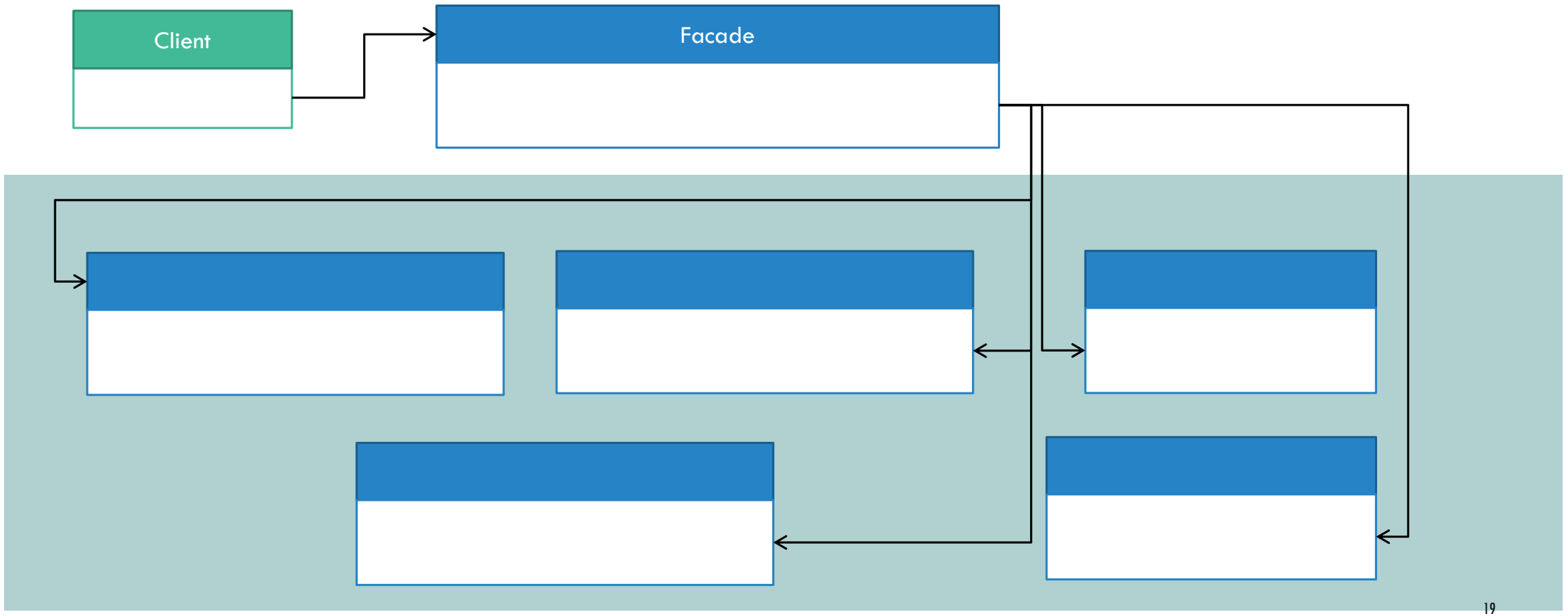
Facade - University



FACADE – DIAGRAM



FACADE – ADVANTAGES

- Simplified interface, hides implementation details and connections between elements inside subsystem
- You might already used it, but not know it has a name
- “Hides” legacy implementation / naming

FACADE – DISADVANTAGES

- Can have “God” classes (see Single Responsibility Principle)

Q&A
FACADE

CREATIONAL DESIGN PATTERNS

CREATIONAL DESIGN PATTERNS

- They encapsulate knowledge about which concrete class the system is using
- The hide how instances of these classes are created and put together
- You have flexibility over the structure and functionality

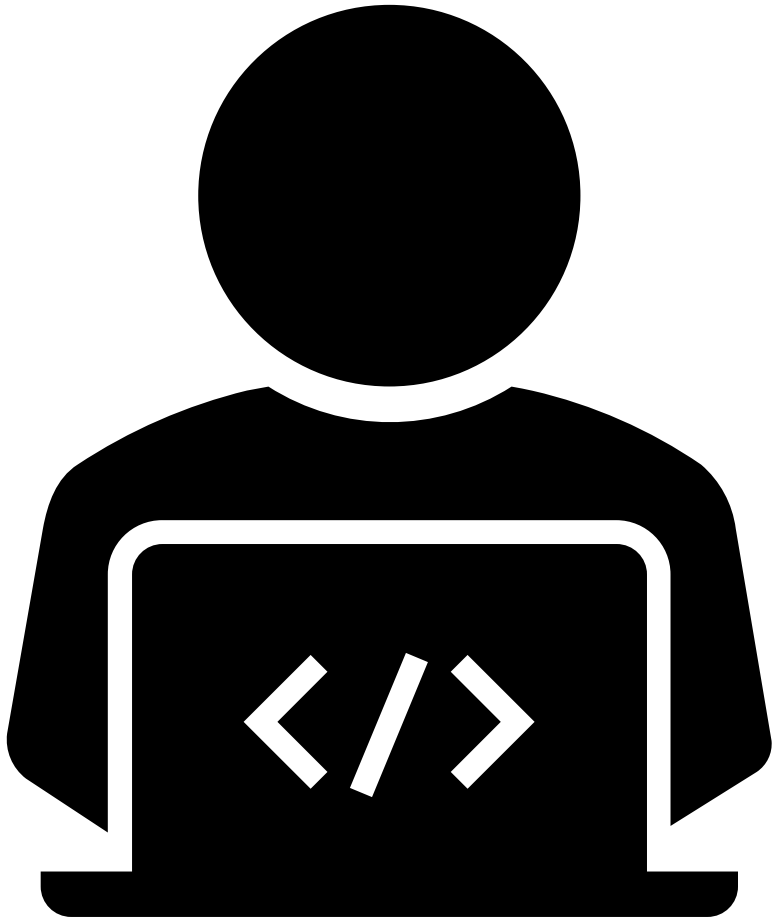
3. ABSTRACT FACTORY

ABSTRACT FACTORY – WHAT DOES IT DO?

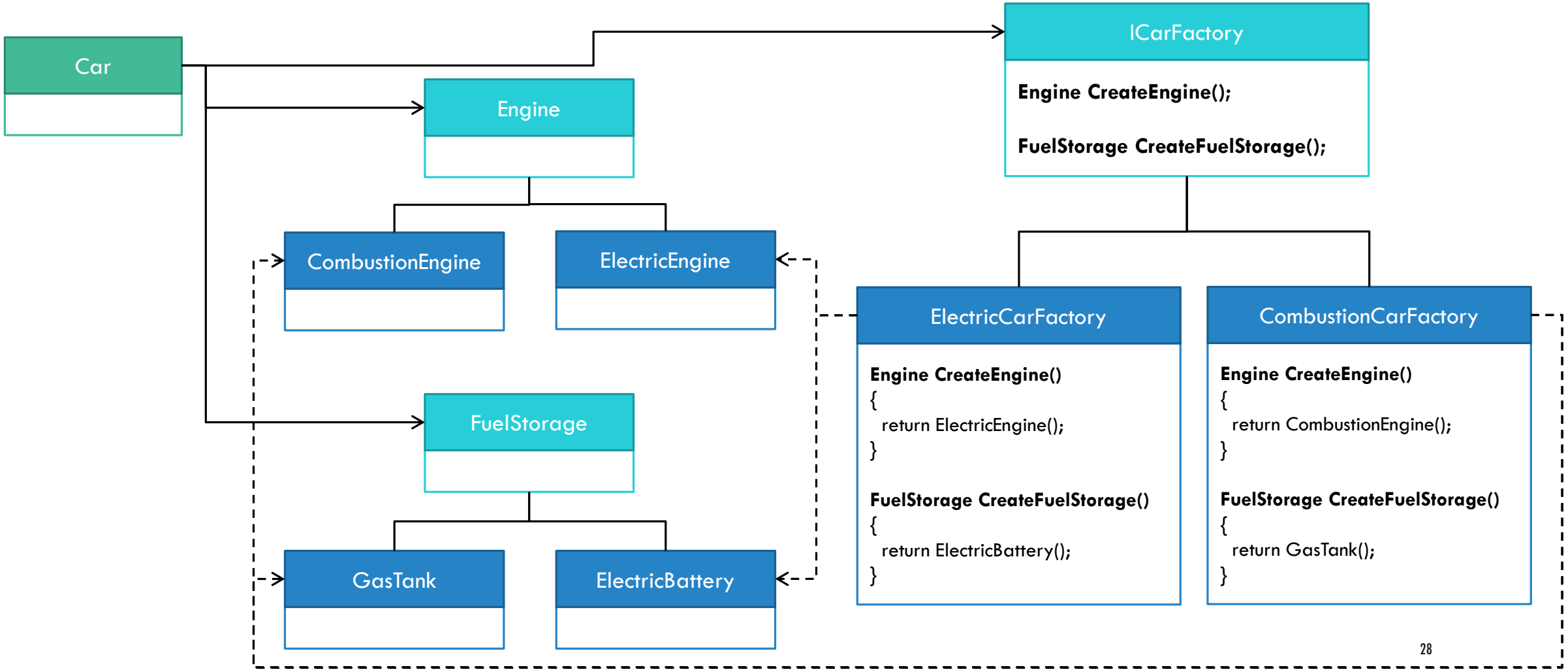
- "Provide an interface for creating families of related or dependent objects without specifying their concrete classes" (GoF)

DEMO

AbstractFactory – Cars



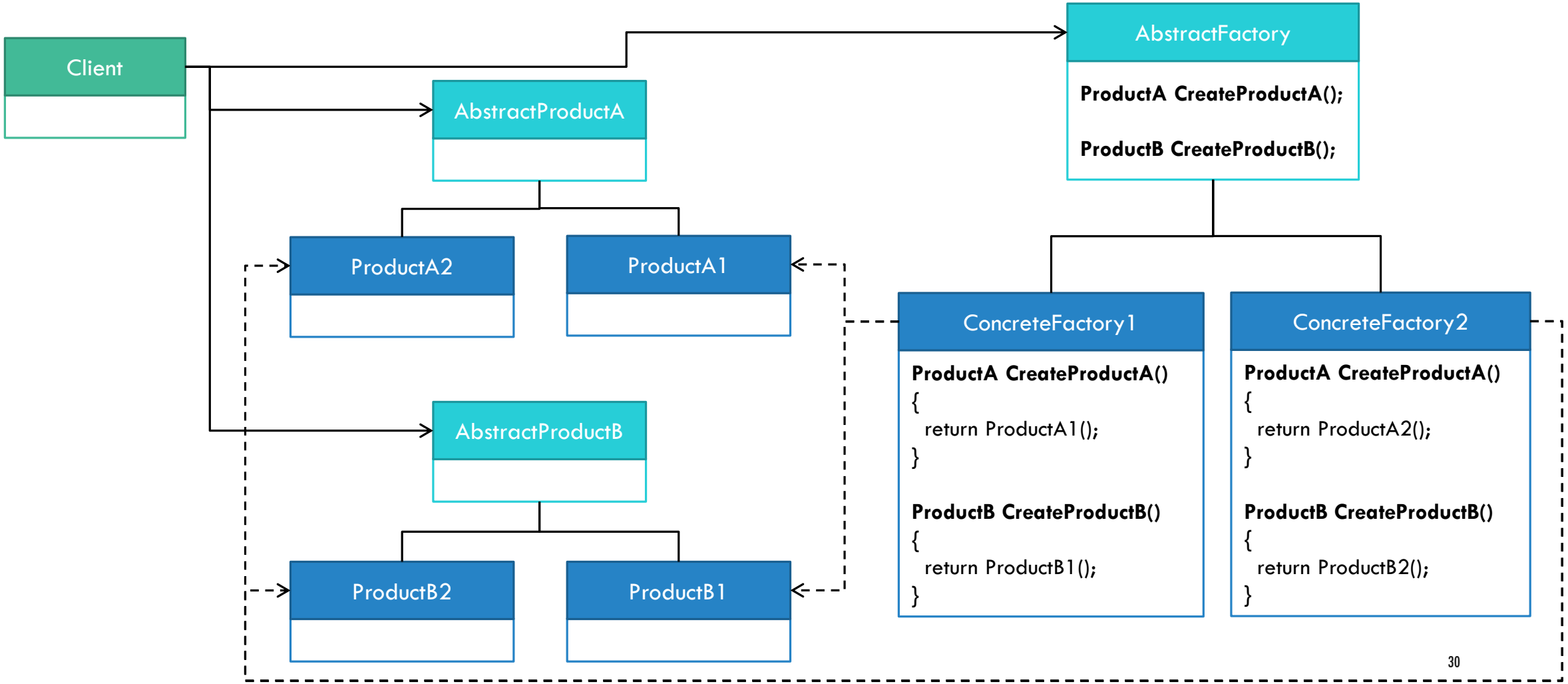
ABSTRACT FACTORY – DIAGRAM – CAR DEMO



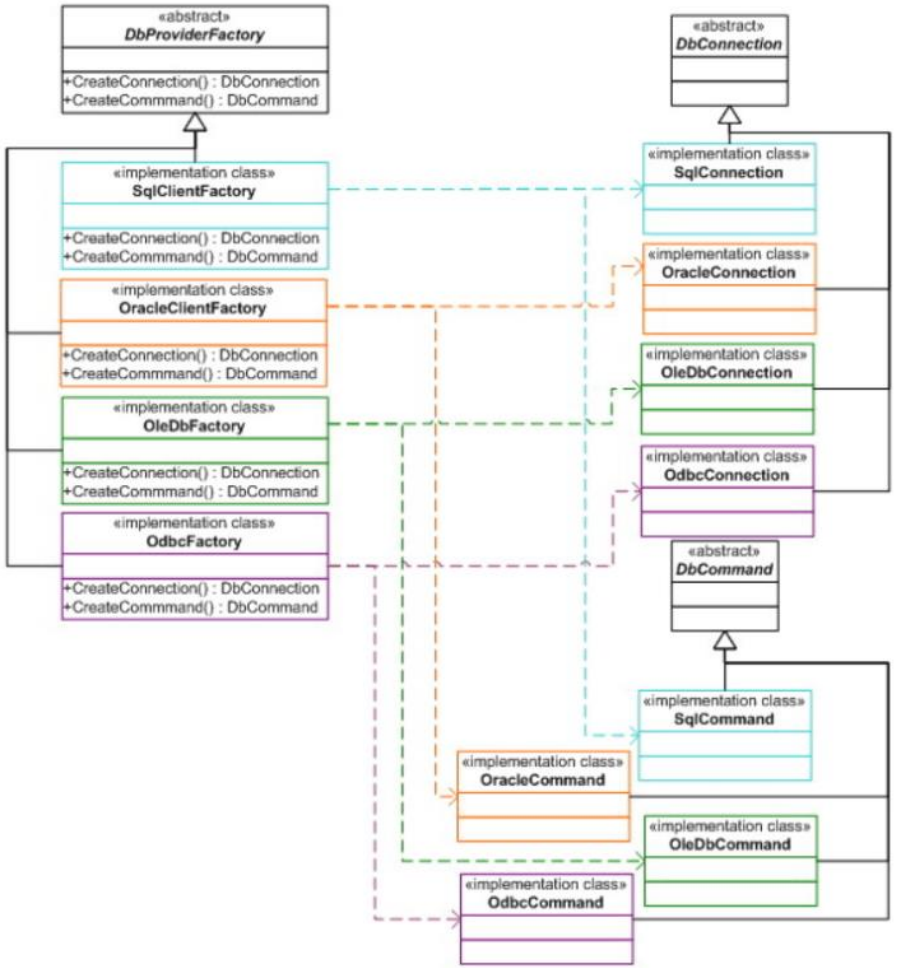
ABSTRACT FACTORY – WHEN TO USE?

- For a system that should use one of multiple families of objects
- A family of objects or a combination of objects are designed to work together and you should enforce this constraint
- The system just needs to use the objects, without knowing how they are created, stored or represented internally
- The system uses only the interface, not the implementation

ABSTRACT FACTORY – DIAGRAM



ABSTRACT FACTORY – USAGE – ADO.NET



ABSTRACT FACTORY – NOTES

- Abstract Factory in .NET Framework:
  - https://visualstudiomagazine.com/articles/2011/01/27/the-factory-pattern-in-net-part-3.aspx
  - Examples: ADO.NET, WindsorCastle, nHibernate

- More examples:
  - https://www.dofactory.com/net/abstract-factory-design-pattern
  - http://www.exceptionlesscode.com/abstract-factory-pattern-with-examples/

ABSTRACT FACTORY – ADVANTAGES

- Easy to create families of classes that should work only together (and enforce this constraint)
- Easy to replace one family with another
- The concrete classes are hidden from the client
- It enables architectures like Dependency Injection

ABSTRACT FACTORY – DISADVANTAGES

- Adding a new object to the family of objects means adding a method in the abstract interface and this will have to be implemented in all concrete factories
- The client cannot do subclass-specific operations
- Can take longer to implement at first

Q&A
ABSTRACT FACTORY

4. SINGLETON

SINGLETON – WHAT DOES IT DO?

- "Ensure a class only has one instance, and provide a global point of access to it." (GoF)

SINGLETON – WHEN TO USE?

- There must be only one instance of the class
- The sole instance must be accessible to clients using a access point

- More:
  - https://www.dofactory.com/net/singleton-design-pattern
  - https://csharpindepth.com/articles/BeforeFieldInit
  - https://csharpindepth.com/articles/singleton

SINGLETON – DIAGRAM

Singleton

```
private static Singleton _instance;
private string _data;

private Singleton()
{
        // initialize non-static data
        _data = string.Empty;
}

public static Singleton GetInstance()
{
        if (_instance==null)
        {
                _instance = new Singleton();
        }
        return _instance;
}

public void SingletonOperation()
{
        // do something with _data
}
```

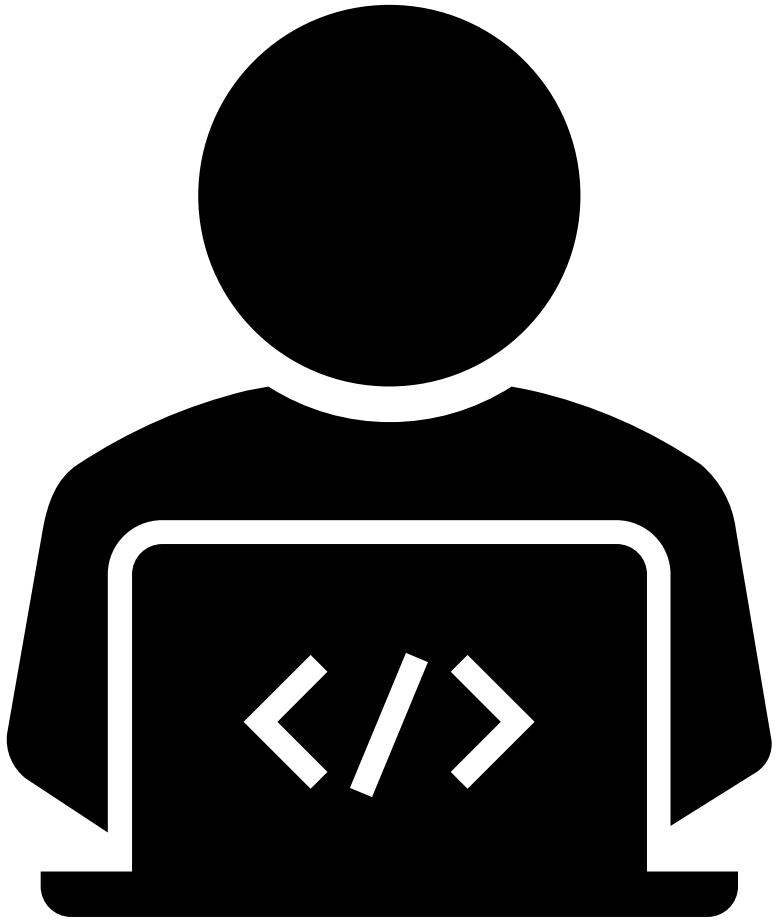
Seal Singleton class

Each Singleton should have:
- private static instance of it's own type = _instance
- public static access point = GetInstance()
- private constructor

Each Singleton can have:
- Internal non-static data

DEMO

Singleton - Logger



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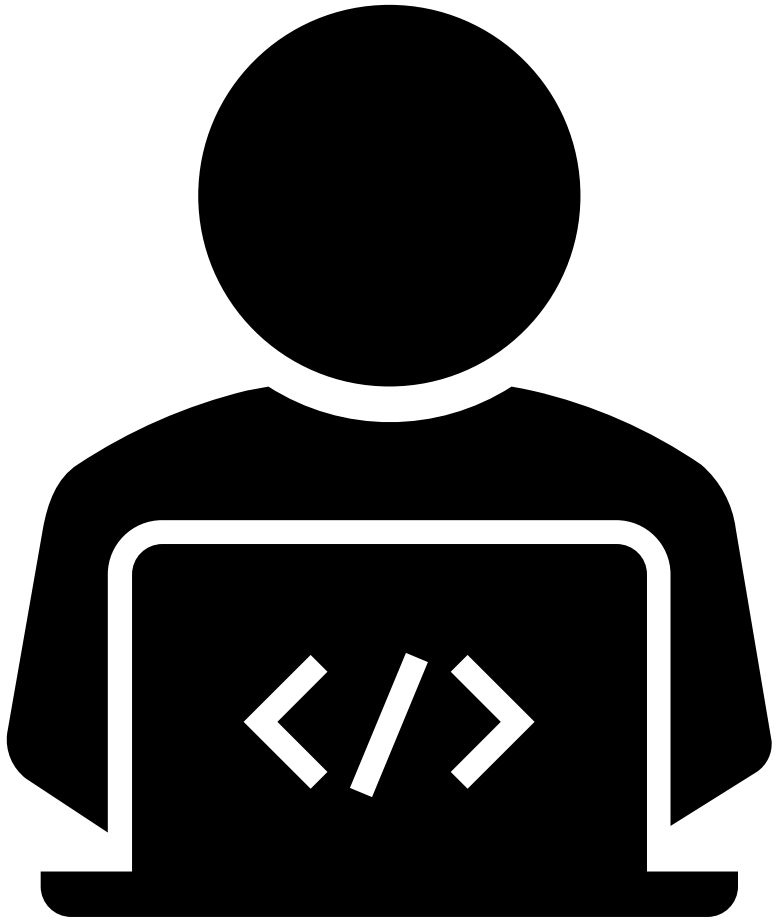
Singleton - LoggerDerived



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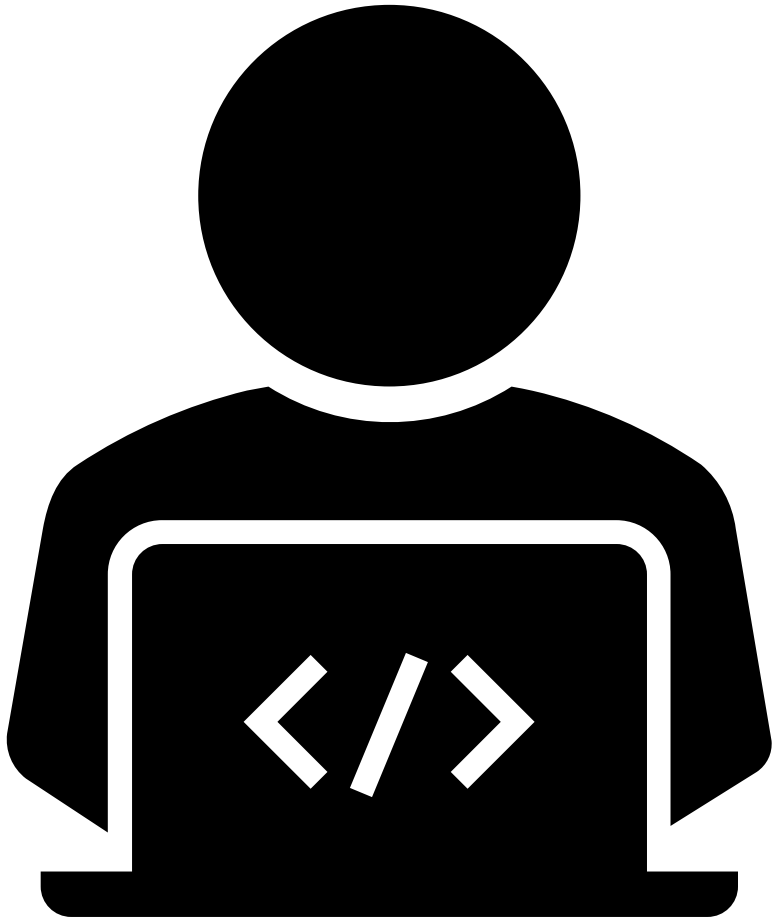
Singleton - ThreadSafeLogger



SINGLETON – ADVANTAGES

- Control over the access point
- Alternative to global variables -> global accessible
- Can use lazy loading to create the sole instance
- Can be easily adapted for multiple instances as well

SINGLETON – DISADVANTAGES

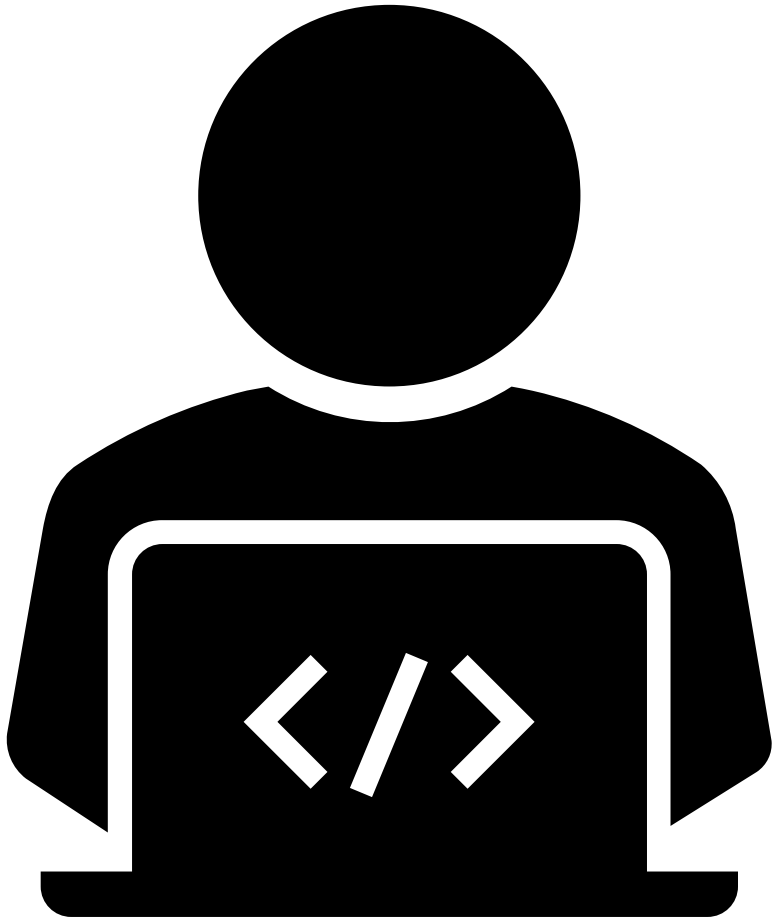
- Can be an antipattern
  - It's still "global"
  - Tendency to have multiple responsibilities
  - Tight coupling between collaborating classes
- Default implementation is not thread safe
  - Should not use in multi thread environments (e.g. ASP.NET)
- Difficult to test
  - If you call GetInstance() inside the method, instead of sending it as parameter - Static cannot be mocked
  - Try to inject the dependency as much as you can ☺
  - Use a IoC container
- Can have multiple instances, not only one
  - Make it sealed + private constructor ☺
- More:
  - https://blogs.msdn.microsoft.com/scottdensmore/2004/05/25/why-singletons-are-evil/

Q&A
SINGLETON

BEHAVIORAL DESIGN PATTERNS

DEMO

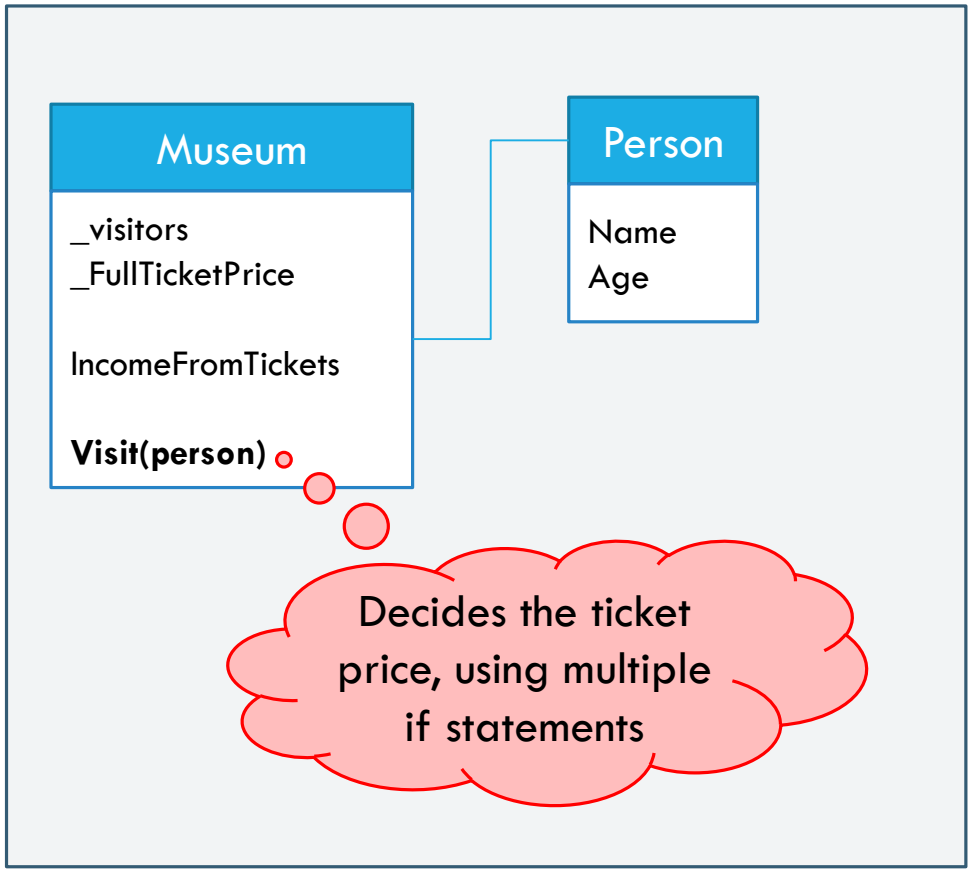
Strategy / Template Method - Museum



WHY IT ISN'T OPEN/CLOSED?

- Software entities should be:
  - **Opened for extension** = You can add new behviour
  - **Closed for modification** = You should not change the source/binary code

- Write your code so that you will be able to add new functionality without changing the existing code



HOW TO APPLY OPEN/CLOSED PRINCIPLE?

1. Use parameters
   - What is the price of a full ticket?

- **Use abstractions:**
  - Interfaces
  - Abstract clases

2. Inheritance / „Template Method" Pattern
   - Create a base class and add a method that will be implemented differently in each child class

3. Composition / „Strategy" Pattern
   - The class depends on an abstraction, that plugs in with the actual implementation

5. STRATEGY

STRATEGY – WHAT DOES IT DO?

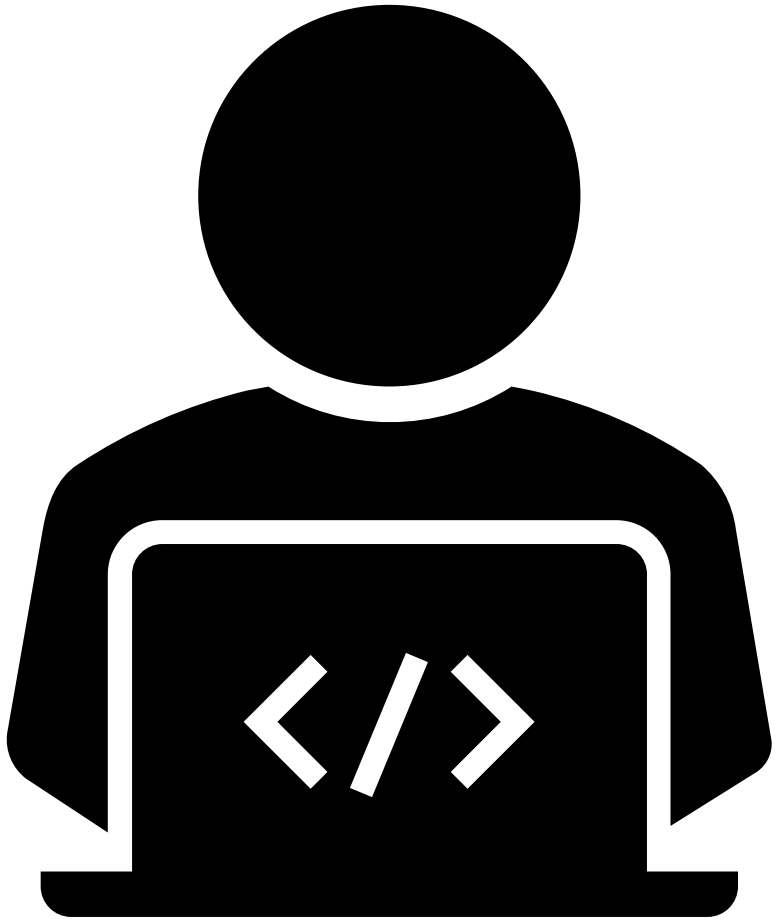
- "Define a family of algorithms, encapsulate each one, and make them interchangeable. Strategy lets the algorithm vary independently from clients that use it." (GoF)

STRATEGY – WHEN TO USE

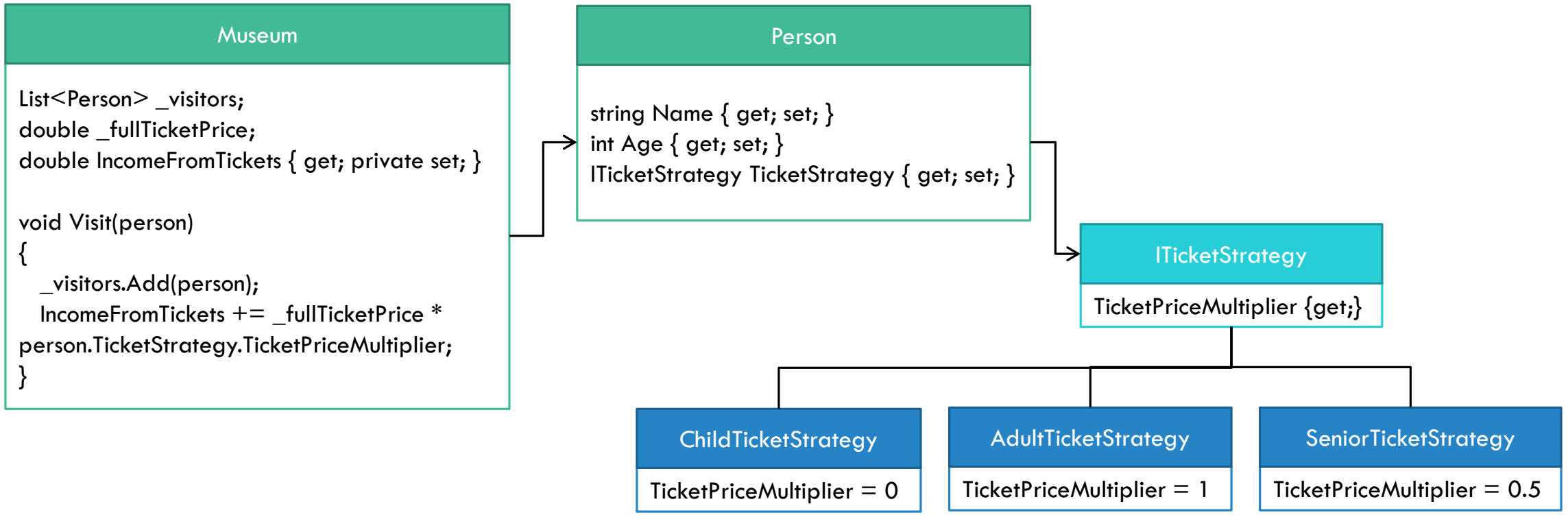
- When you have classes with similar structure, that differ only in behavior
- When you need different versions of an algorithm
  - Use list sorted by different criteria (sort by first name, sort by last name etc.)
  - Computer score based on player levels in a game (easy, medium, hard)
- When you have a class with multiple behaviors, defines using conditionals (if/switch)
  - For each condition, you should create a different strategy
- More:
  - https://www.dofactory.com/net/strategy-design-pattern

DEMO

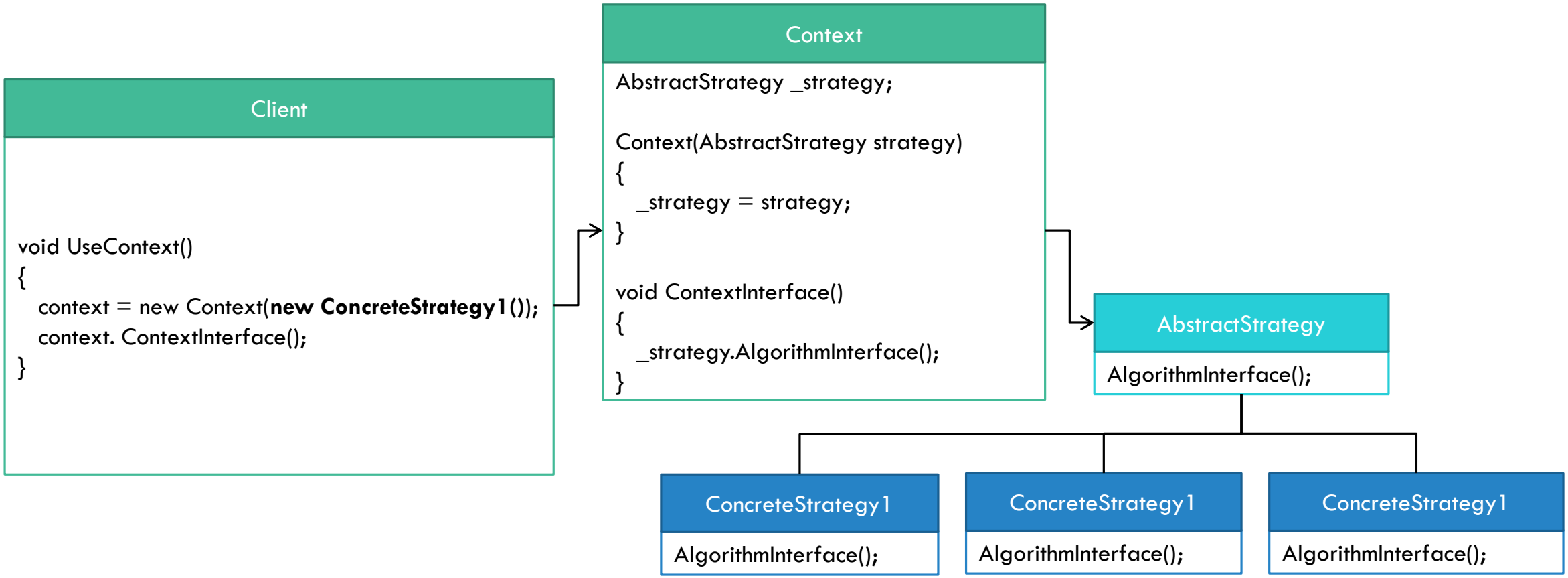
Strategy - Museum



STRATEGY – DIAGRAM – MUSEUM DEMO



STRATEGY – DIAGRAM



STRATEGY – ADVANTAGES

- Alternative to creating inheritance – can vary algorithm independent of the context
- Eliminates conditions and “god-like” methods

- Variants:
  - Can use generics: Context<ConcreteStrategy1>
  - Can have default behavior in “AbstractStrategy”

STRATEGY – DISADVANTAGES

- The client has to know the available strategies that he can use
- Increased number of classes

Q&A STRATEGY

6. TEMPLATE METHOD

TEMPLATE METHOD – WHAT DOES IT DO?

- “Define the skeleton of an algorithm in an operation, deferring some steps to subclasses. Template Method lets subclasses redefine certain steps of an algorithm without changing the algorithm's structure” (GoF)

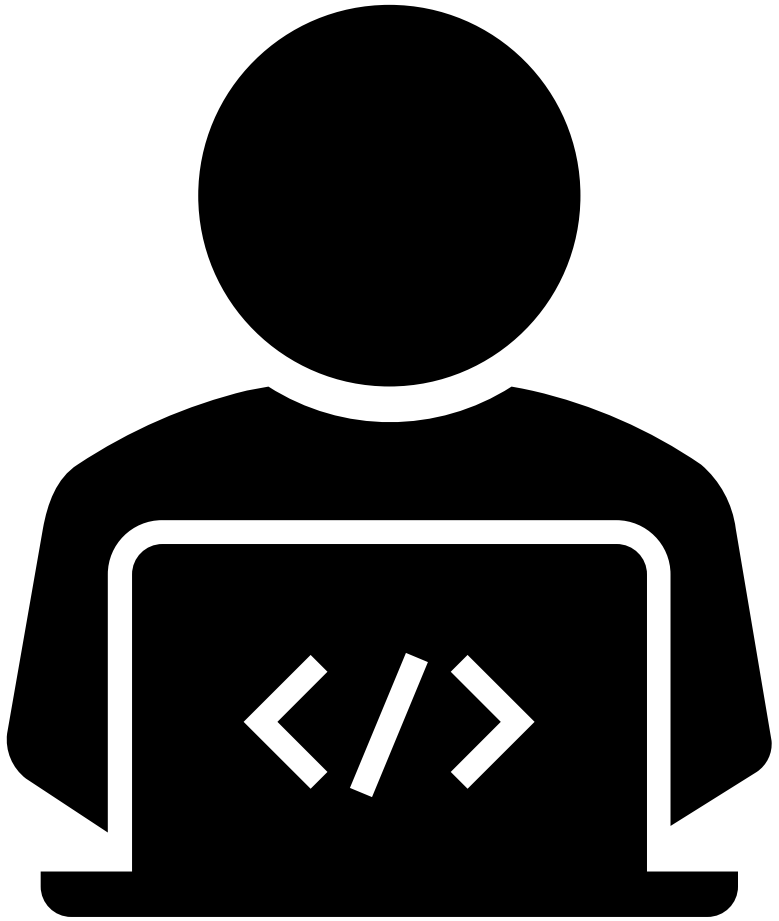
TEMPLATE METHOD – WHEN TO USE

- When you have an algorithm, defined using certain steps, at least one of the steps is abstract and the child classes implement only these steps
- When you have an algorithm that has:
  - invariant steps (same operations in same order)
  - varied behavior of some steps (different values for each kind of behavior)

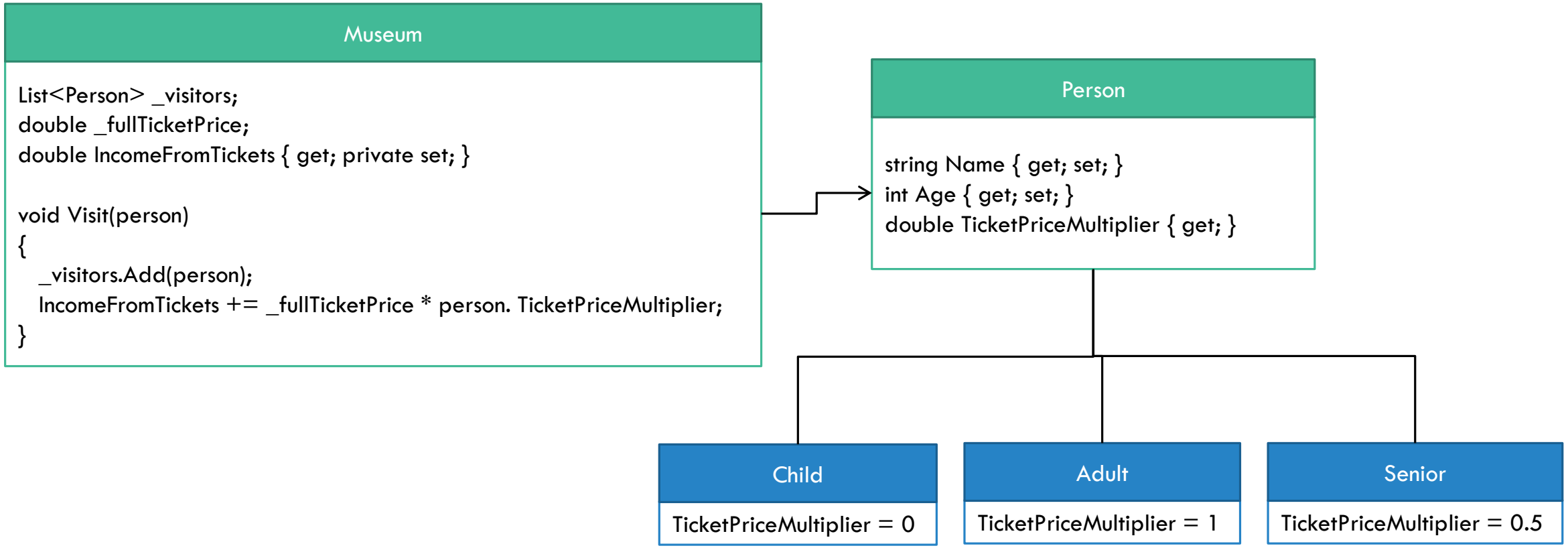
- More:
  - https://www.dofactory.com/net/template-method-design-pattern

DEMO

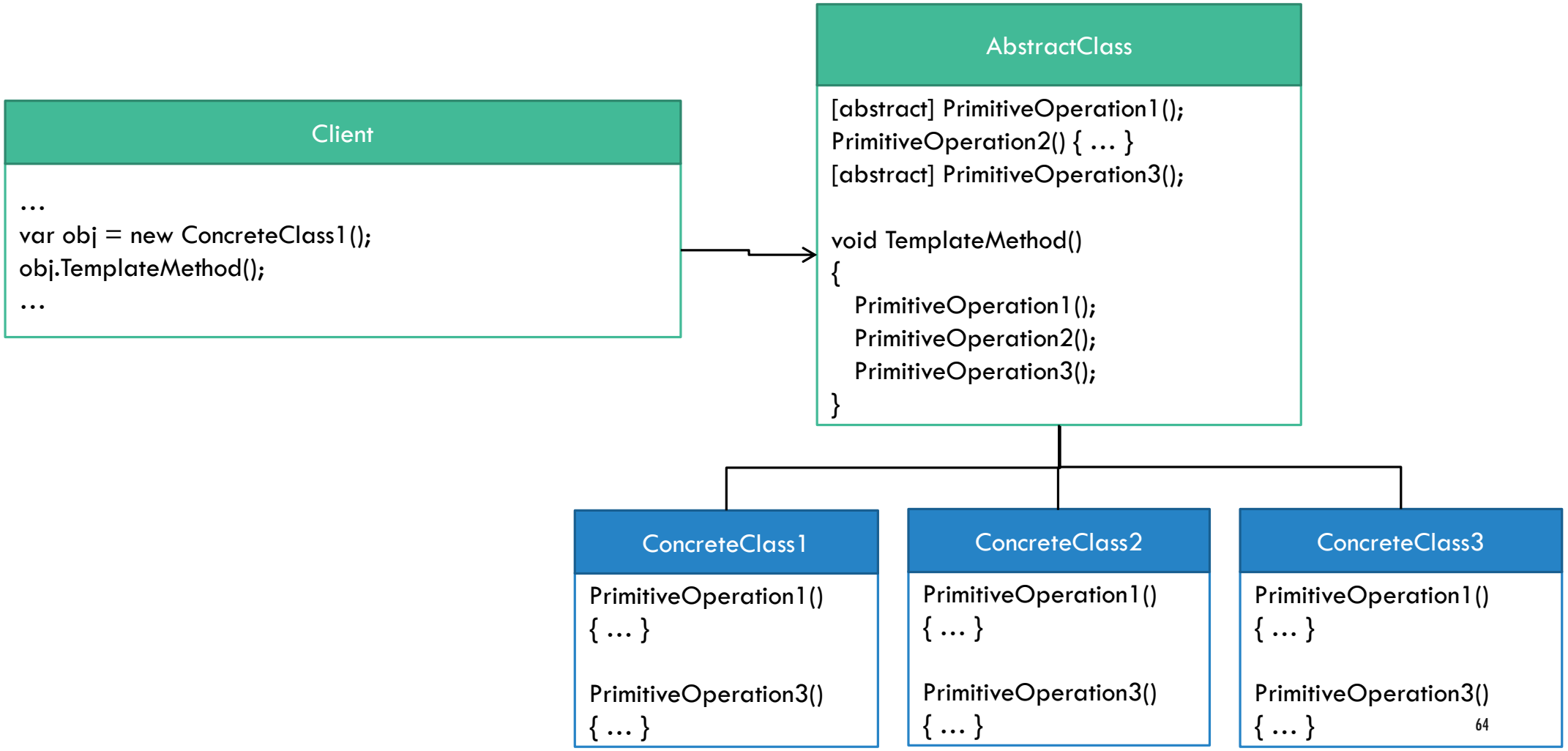
Template Method - Museum



TEMPLATE METHOD – DIAGRAM – MUSEUM DEMO



TEMPLATE METHOD – DIAGRAM



TEMPLATE METHOD - ADVANTAGES

- Encourages code reuse
- Inverted control structure: the Hollywood principle ("Don’t call us, we'll call you“)
- Alternative to composition

TEMPLATE METHOD - DISADVANTAGES

- You need to know how to separate correctly the invariant parts of the code, from the parts that vary

Q&A
TEMPLATE METHOD

QUESTIONS

Contact: nadi_comanici@yahoo.com

FEEDBACK

http://bit.ly/peak-it-2019-feedback