



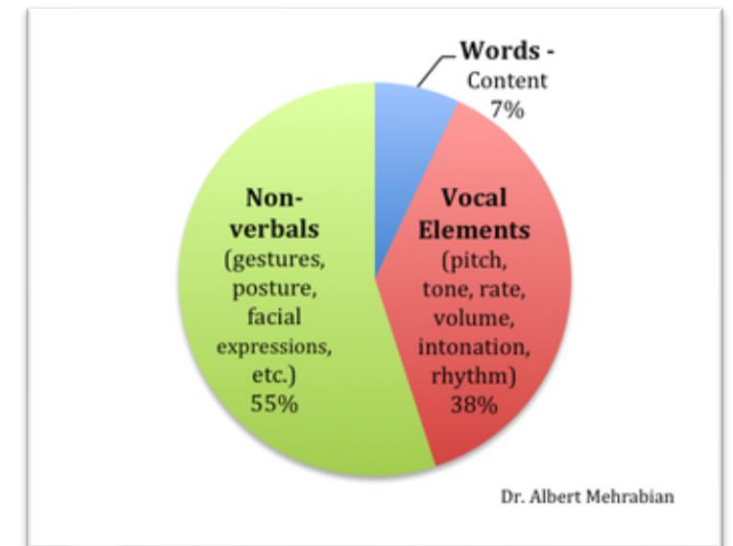
DESIGN PATTERNS IN C#

PART 1: CREATIONAL PATTERNS

Trainer: Nadia Comanici

LET'S HAVE AN INTERACTIVE COURSE 😊

1. Please check your microphone, I encourage you to ask questions. A lot of them.
2. You can raise hand (or use non-verbal gestures) from the “Participant” window
 - We also have a “Chat” window, but I don’t see that all the time, so I might miss the questions. So, raise hand or unmute + ask question
3. If you have a video camera, please turn it on
 - Even if you have a bad hair day or you are in your pijamas 😊
 - Communication is 7% verbal, 38% para-verbal and 55% non-verbal
4. Participate actively in the exercises
 - For each design pattern we will have a live practical exercise
 - Be a hero and ask for the remote controls in order to code
 - We will assist and help you with ideas 😊



CE ESTE AgileHub?

✓ AgileHub este un ONG din Braşov



<https://agilehub.ro/>



✓ Oferim **educație gratuită** celor care:

- Lucrează în IT sau
- Vor să înceapă o carieră în IT

CE ÎȘI DOREȘTE AgileHub?



Educație informală în IT

Profesioniști bine pregătiți

Comunitate IT activă în Brașov

Cât mai multe oportunități în IT

Cât mai mulți voluntari AgileHub

VALORILE AgileHub

INDEPENDENȚA

- Trainerii și participanții vin pe cont propriu, fără a promova vreo firmă
- Nimeni nu reprezintă interesele nici unei firme
- La începutul cursului, când ne prezentăm, spunem care e rolul și experiența noastră, fără a specifica firma la care lucrăm

EDUCAȚIA GRATUITĂ

- Cursurile sunt gratuite pentru toți participanții

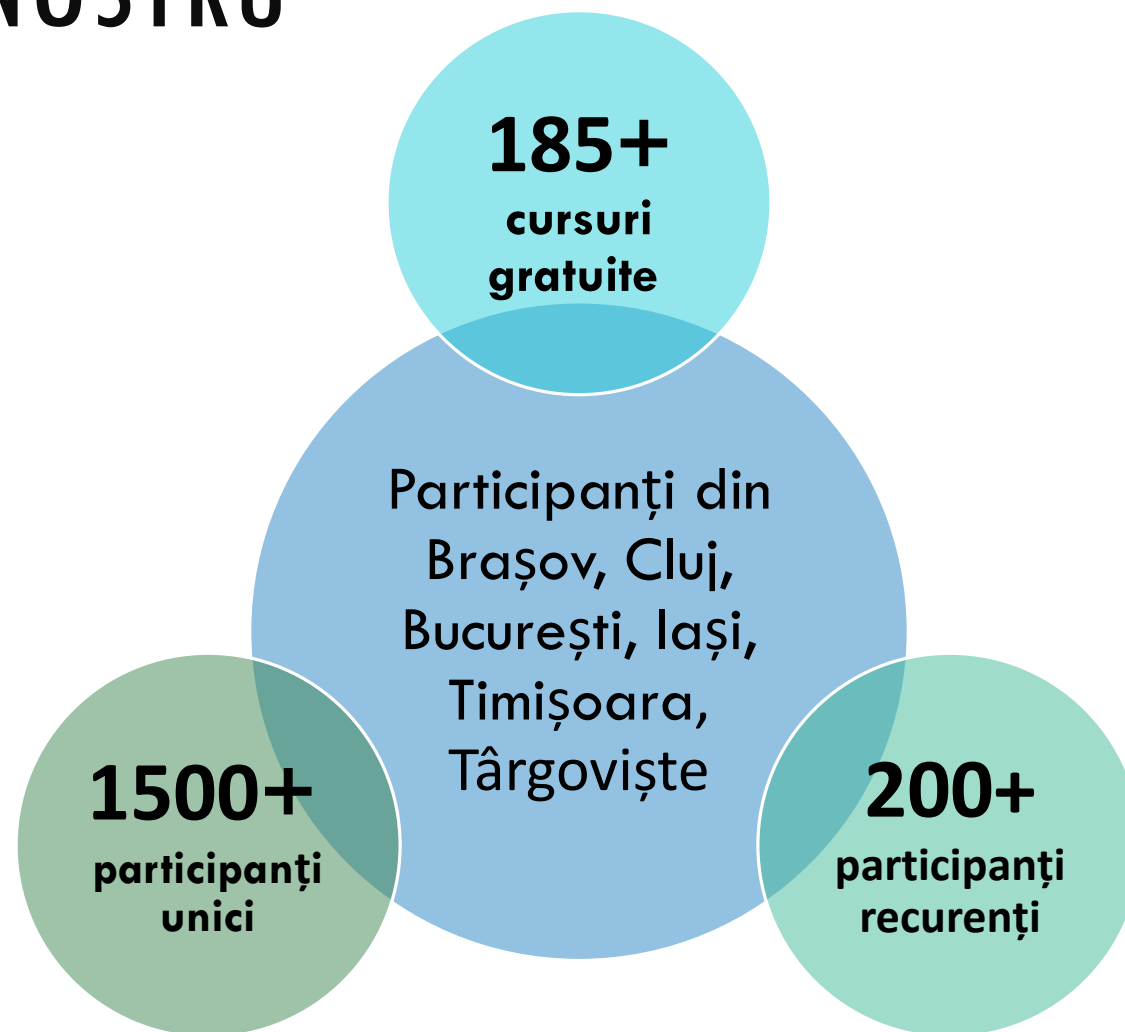
VOLUNTARIATUL

- Toți trainerii sunt voluntari

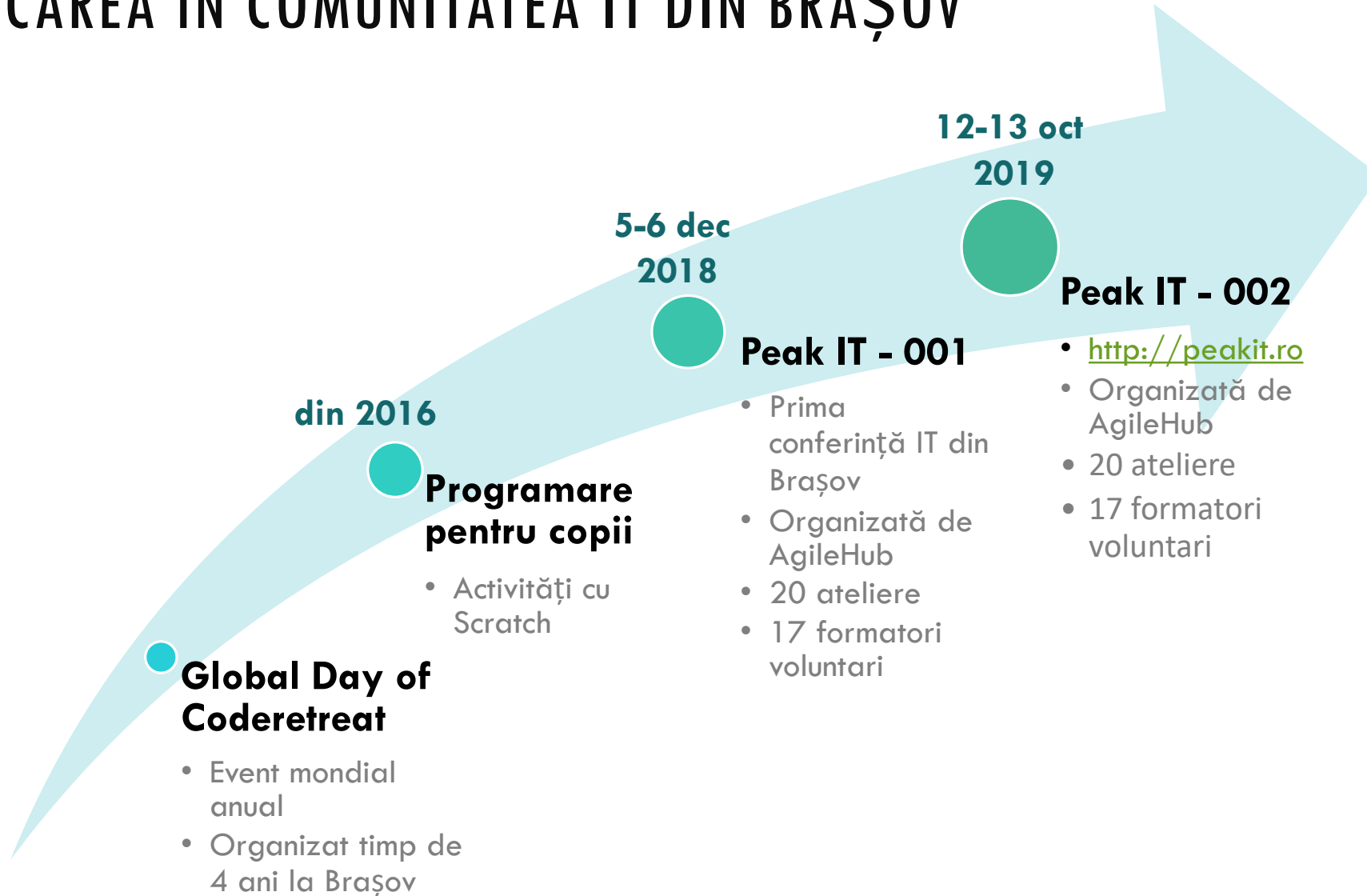
ÎMPĂRTĂȘIREA EXPERIENȚEI PROPRII

- Majoritatea formatorilor **NU** sunt traineri profesioniști
- Formatorii lucrează în IT și au multă experiență practică în domeniul pe care îl predau

IMPACTUL NOSTRU



IMPLICAREA ÎN COMUNITATEA IT DIN BRAȘOV



CUM PUTEȚI CONTRIBUI?

Spuneți-ne cum vi s-a părut

- Formularul online de feedback de la finalul cursului
- Recomandare si pe <https://www.facebook.com/agilehub>

Împărtășiți și aplicați informațiile de la curs

- Dacă v-a plăcut cursul, când se va mai ține, recomandați-l și altora

Recomandați prietenilor și colegilor

- Urmăriți-ne cursurile pe pagina de [Facebook](#)
- Dacă vedeți un curs interesant pentru un amic, share-uiți cu el postarea

Deveniți voluntar AgileHub

- Pentru cursuri
- Pentru activități organizatorice
- contact@agilehub.ro

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- Asociația AgileHub
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Direcționați 2% din impozit

- Găsiți formularul 230 online [aici](#)

LET'S GET TO KNOW EACH OTHER

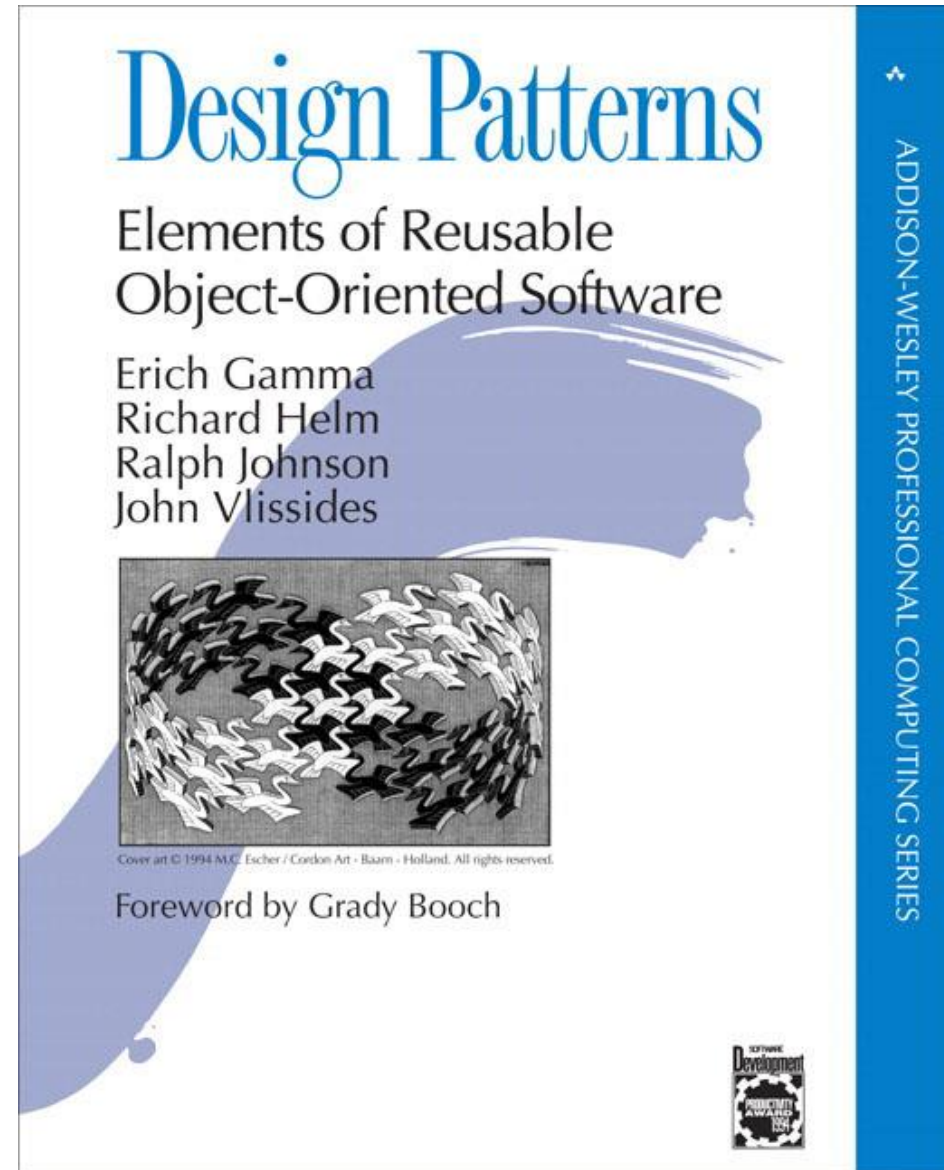
- What's your name?
- What is your experience level?
- Which are your expectations for this workshop?

POLL



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

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

CREATIONAL DESIGN PATTERNS

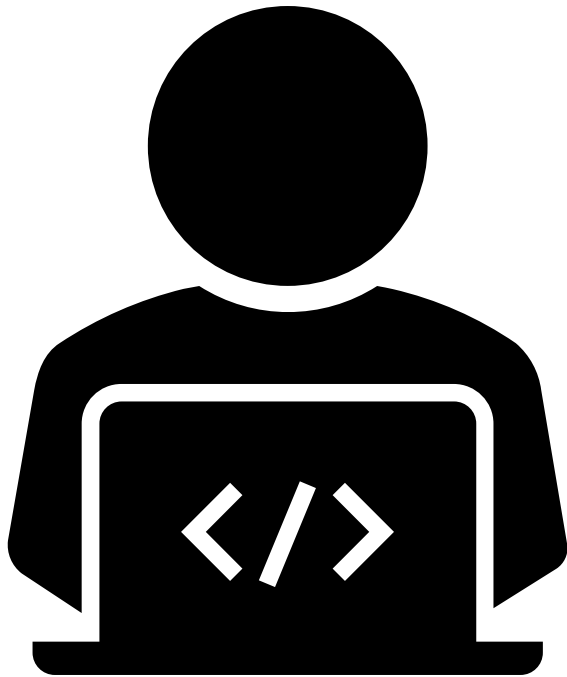
CREATIONAL DESIGN PATTERNS

- They encapsulate knowledge about which concrete class the system is using
- They hide how instances of these classes are created and put together
- You have flexibility over the structure and functionality
- Code: https://github.com/nadiacomnici/DesignPatterns-Creational/tree/2020_04_26_AgileHub

1. ABSTRACT FACTORY

ABSTRACT FACTORY — WHAT DOES IT DO?

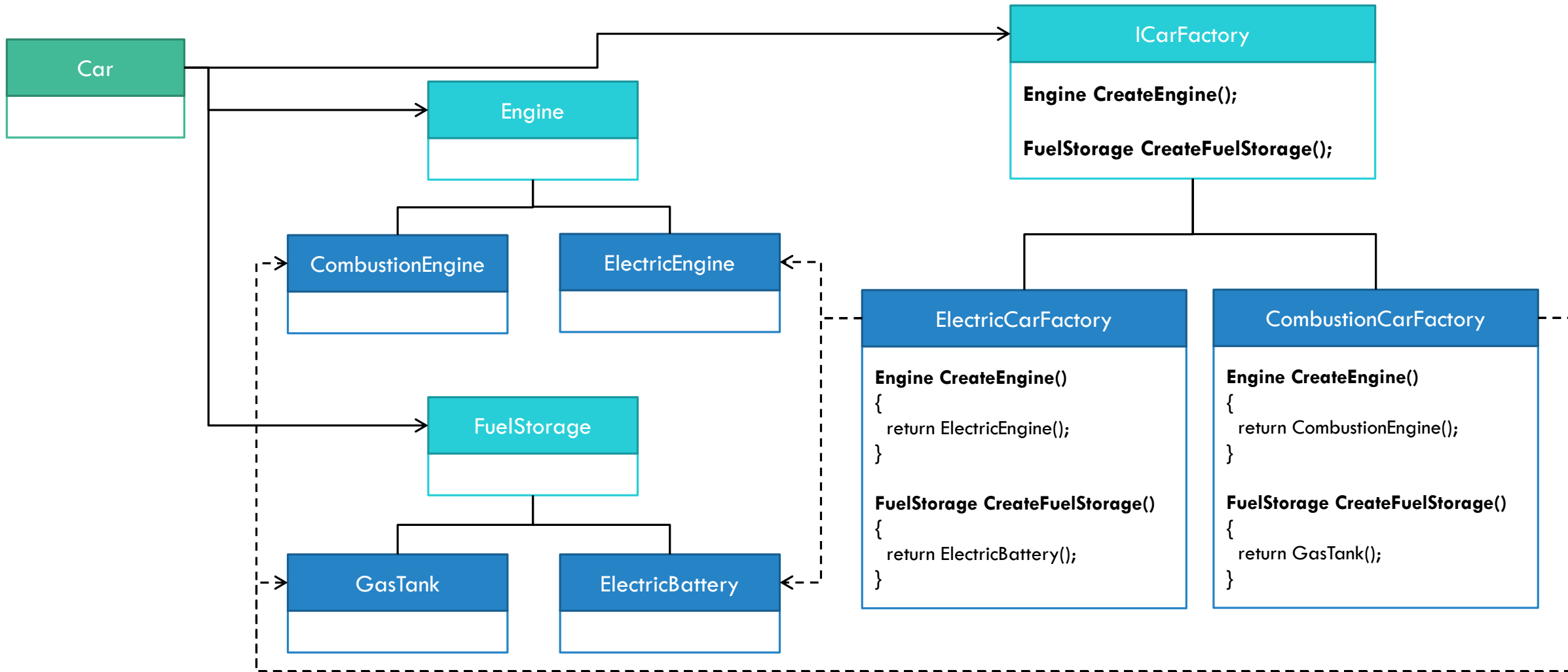
- “Provide an interface for creating families of related or dependent objects without specifying their concrete classes” (GoF)



DEMO

AbstractFactory – Cars

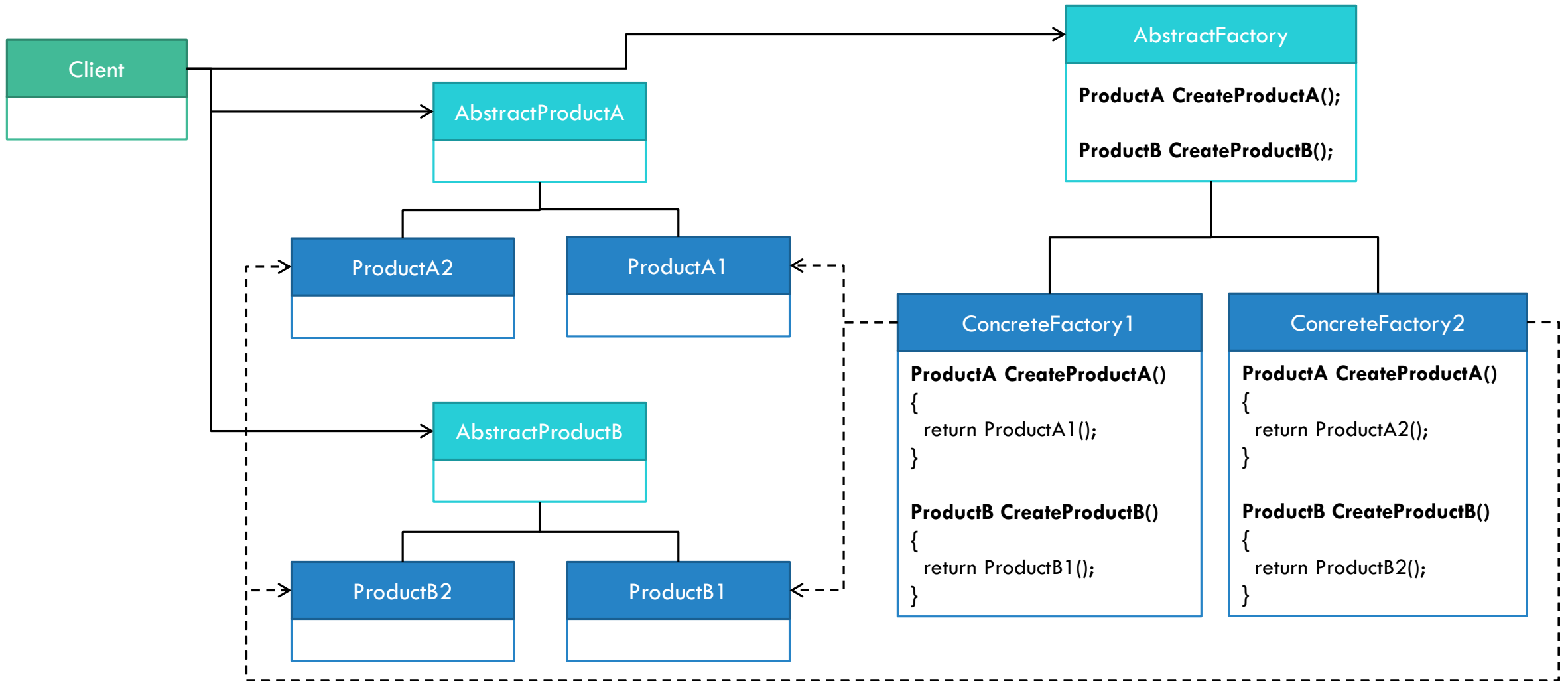
ABSTRACT FACTORY — DIAGRAM — CAR DEMO

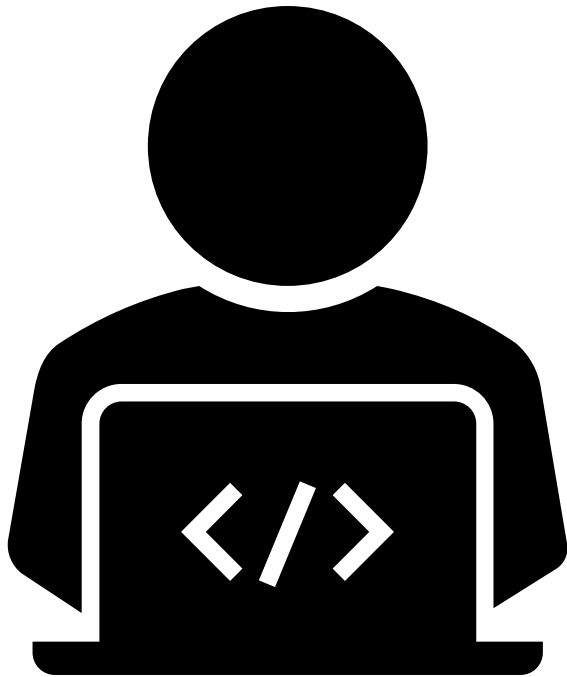


ABSTRACT FACTORY — WHEN TO USE?

- 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

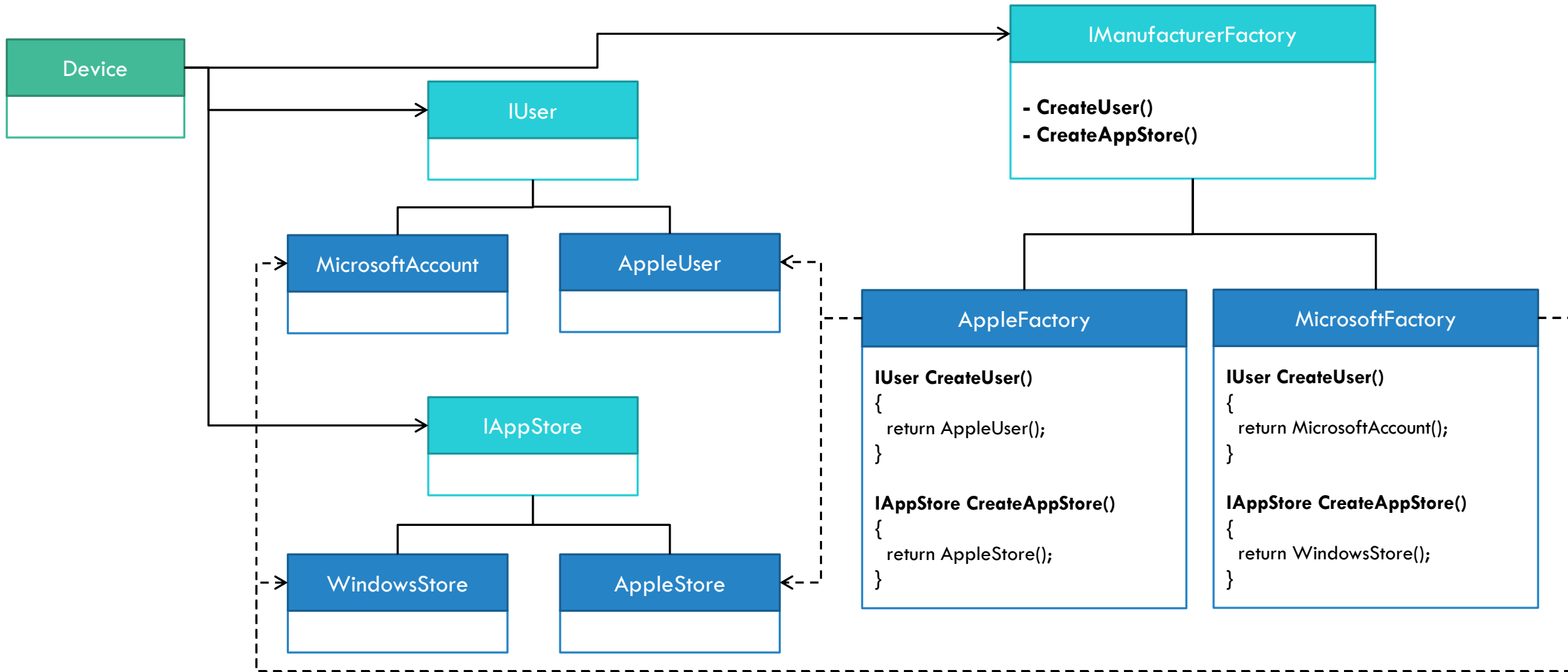




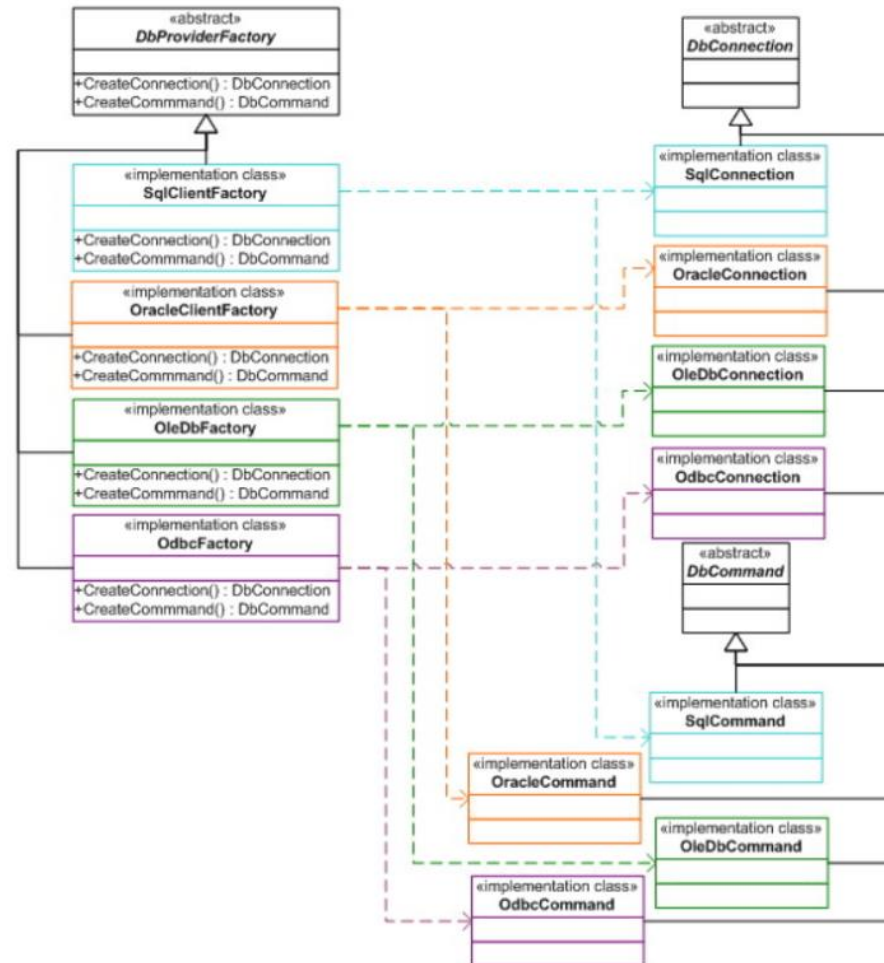
DEMO

AbstractFactory – Operating Systems

ABSTRACT FACTORY — DIAGRAM — OS DEMO



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



2. FACTORY METHOD

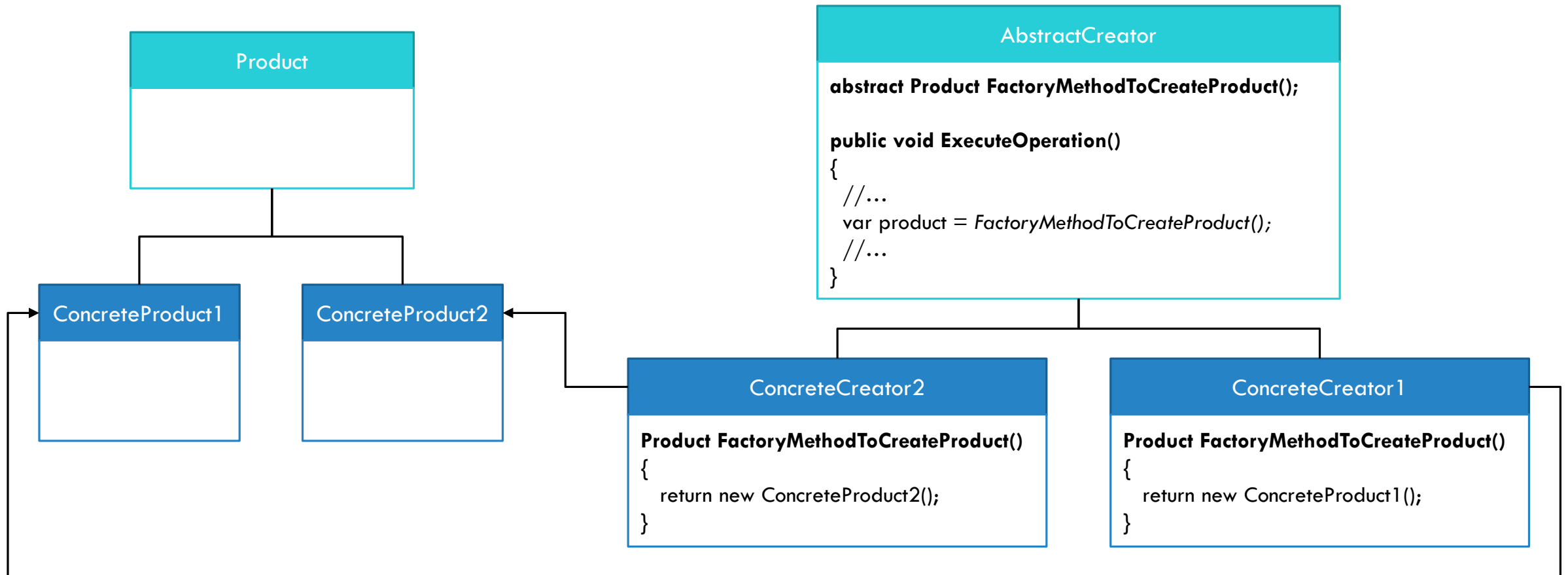
FACTORY METHOD — WHAT DOES IT DO?

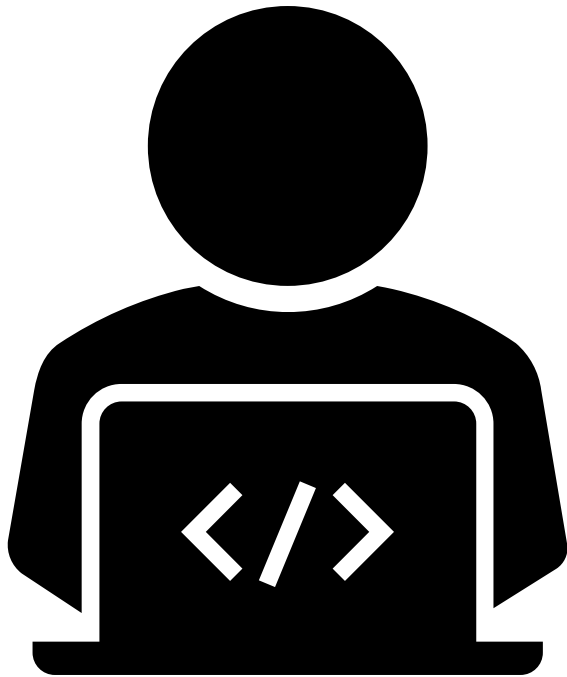
- “Define an interface for creating an object, but let subclasses decide which class to instantiate. Factory Method lets a class defer instantiation to subclasses” (GoF)

FACTORY METHOD — WHEN TO USE?

- A class can't anticipate the class of objects it must create.
- A class wants its subclasses to specify the objects it creates.
- Classes delegate responsibility to one of several helper subclasses, and you want to localize the knowledge of which helper subclass is the delegate

FACTORY METHOD — DIAGRAM

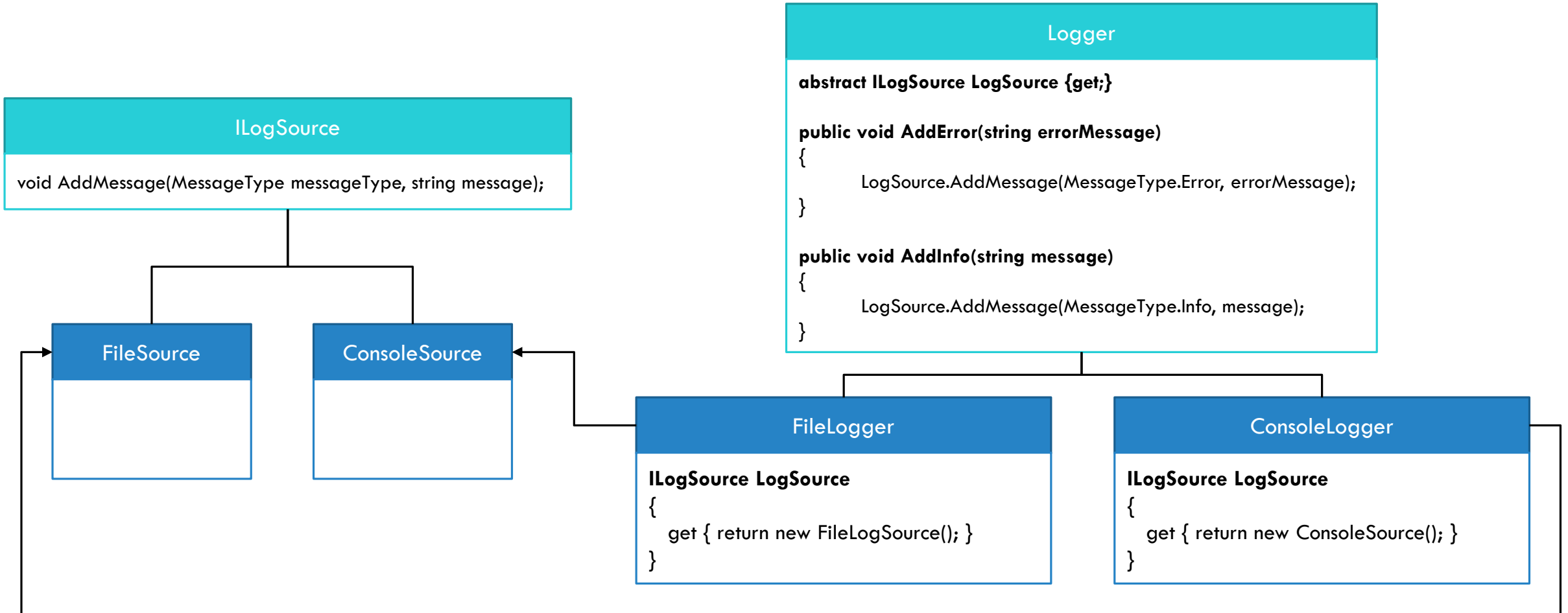




DEMO

Factory Method – Logger

FACTORY METHOD — DIAGRAM — LOGGER DEMO



FACTORY METHOD - ADVANTAGES

- Can easily add another implementation
- Connects parallel hierarchies of classes

FACTORY METHOD - VARIETY

- The FactoryMethod can return a new instance each time or it can use lazy loading, to load the instance at first request and return the same instance

```
public abstract class Logger
{
    4 references
    protected abstract LogSource LogSource { get; }

    2 references
    public void AddError(string errorMessage)
    {
        LogSource.AddMessage(MessageType.Error, errorMessage);
    }

    1 reference
    public void AddInfo(string message)
    {
        LogSource.AddMessage(MessageType.Info, message);
    }
}
```

```
public class ConsoleLogger : Logger
{
    4 references
    protected override LogSource LogSource
    {
        get
        {
            return new ConsoleLogSource();
        }
    }
}
```

```
public class FileLogger : Logger
{
    private readonly string _fullFilePath;
    private FileLogSource _fileLogSource;

    0 references
    public FileLogger(string fullFilePath)
    {
        _fullFilePath = fullFilePath;
    }

    4 references
    protected override LogSource LogSource
    {
        get
        {
            if (_fileLogSource == null)
            {
                _fileLogSource = new FileLogSource(_fullFilePath);
            }
            return _fileLogSource;
        }
    }
}
```

FACTORY METHOD - VARIETY

- The FactoryMethod can have a default implementation in the base class or not
- The Creator can create the product based on a parameter

```
public class VehicleCreator
{
    1 reference
    public IVehicle GetVehicle(int numberOfWheels)
    {
        switch (numberOfWheels)
        {
            case 1:
                return new UniCycle();
            case 2:
                return new Bicycle();
            case 3:
                return new Tricycle();
            case 4:
                return new Car();
            default:
                throw new ArgumentException("Invalid number of wheels");
        }
    }
}
```

```
var vehicleCreator = new VehicleCreator();
for (int i = 1; i <= 4; i++)
{
    var vehicle = vehicleCreator.GetVehicle(i);
    vehicle.Accelerate();
    vehicle.Stop();
}
```

FACTORY METHOD - NOTES

- Factory Method inside .NET Framework
 - Example: WebRequest
 - [http://aspalliance.com/1751 Exemplifying the Factory Method Pattern inside the NET Framework.3](http://aspalliance.com/1751)
- More samples:
 - https://sourcemaking.com/design_patterns/factory_method
 - <https://www.dofactory.com/net/factory-method-design-pattern>
 - <https://exceptionnotfound.net/the-daily-design-pattern-factory-method/>

FACTORY METHOD VS ABSTRACT FACTORY

Abstract Factory	Factory Method
Uses composition	Uses inheritance
A class delegates the responsibility of object instantiation to another object	Relies on a subclass to handle the desired object instantiation.
Creates a family of related objects	Creates an object

- More: <https://dzone.com/articles/factory-method-vs-abstract>

Q&A FACTORY METHOD



3. 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> (6 ways of implementing a 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
}
```

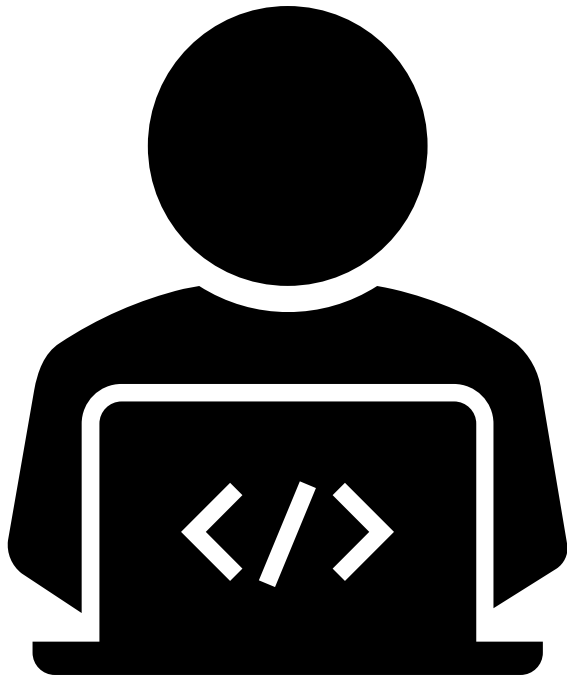
Seal Singleton class

Each Singleton should have:

- private static instance of it's own type = `_instance`
- public static access point = `GetInstance()`
- private constructor

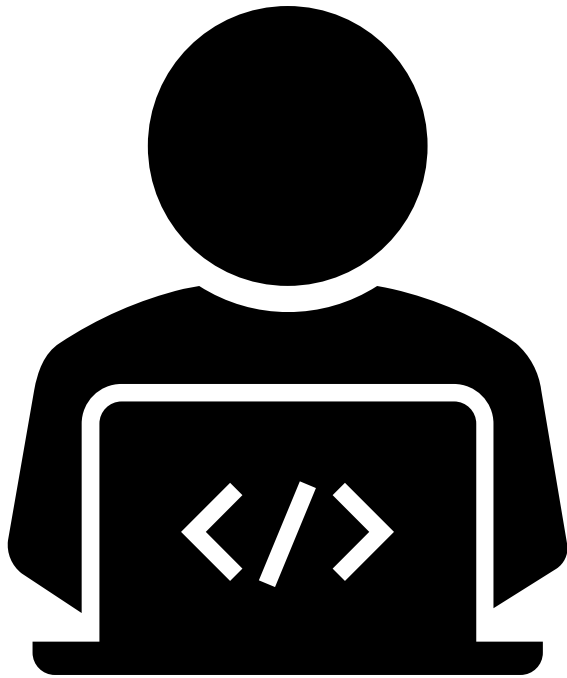
Each Singleton can have:

- Internal non-static data



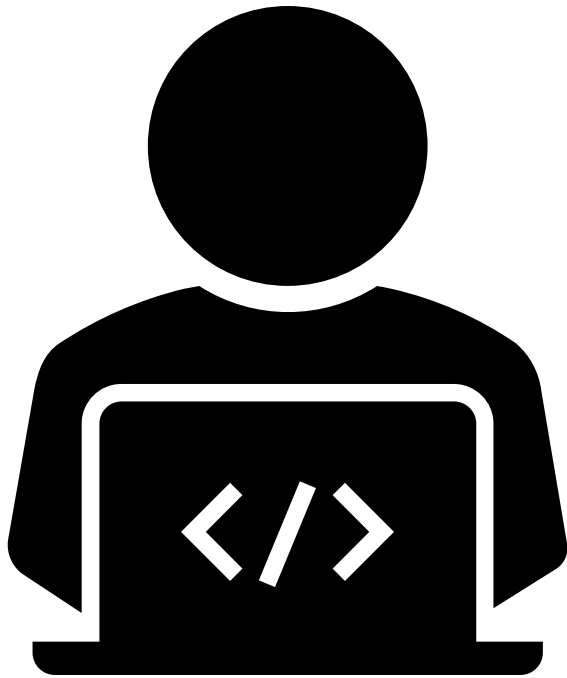
DEMO

Singleton - Logger



DEMO

Singleton - LoggerDerived



DEMO

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



4. PROTOTYPE

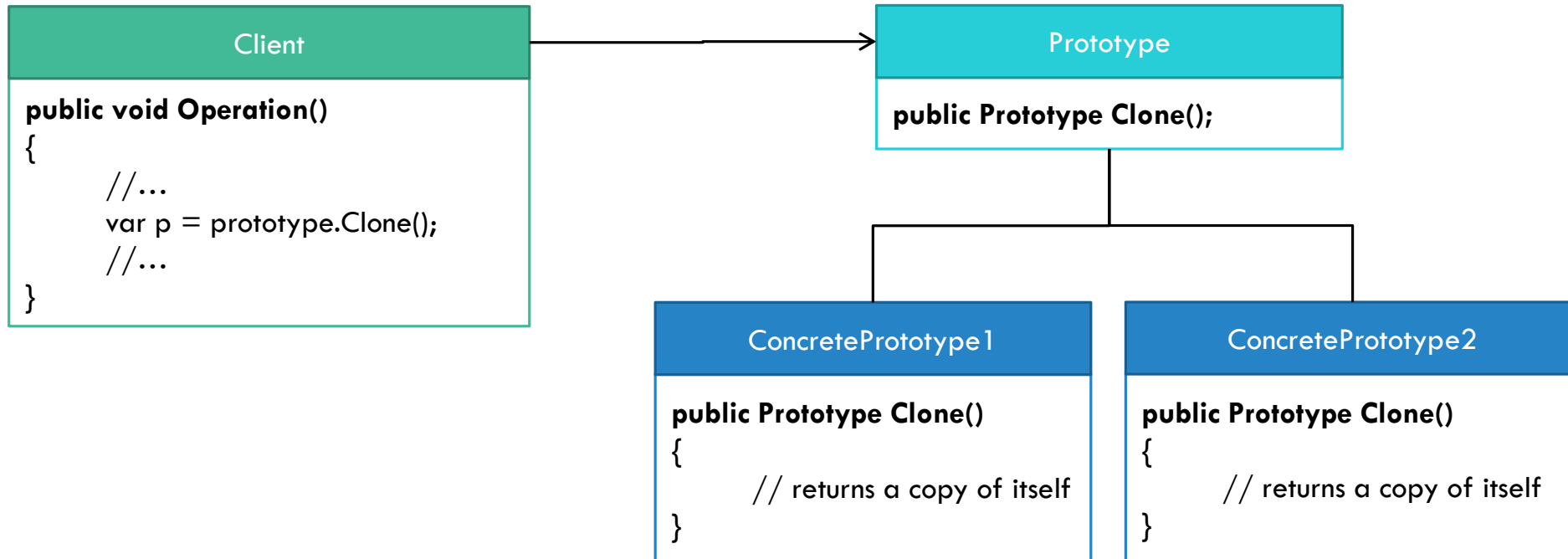
PROTOTYPE — WHAT DOES IT DO?

- “Specify the kinds of objects to create using a prototypical instance, and create new objects by copying this prototype.” (GoF)

PROTOTYPE — WHEN TO USE?

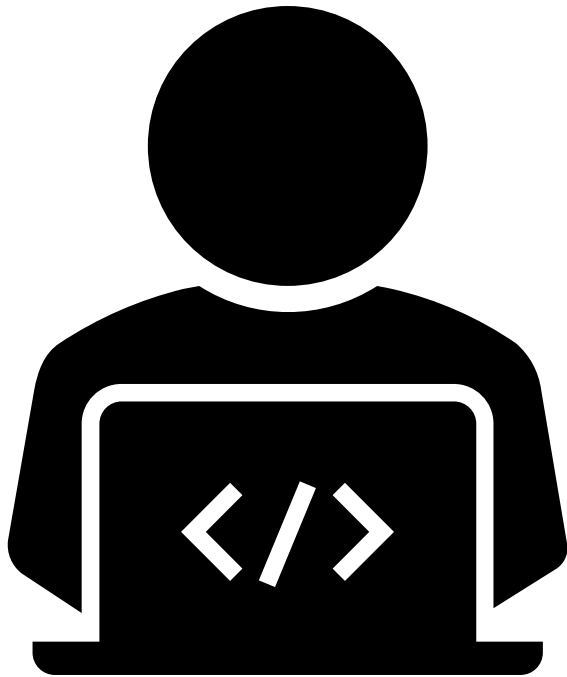
- To clone one or multiple objects that are created after a costly operation, like
 - Database call
 - Apply algorithm
 - Get response from webpage
- The cloned objects are very similar to the prototype object
- It's faster to clone than to create a new object
- When the classes to instantiate are specified at runtime
- More:
 - <https://www.dofactory.com/net/prototype-design-pattern>

PROTOTYPE — DIAGRAM



PROTOTYPE — IN .NET FRAMEWORK

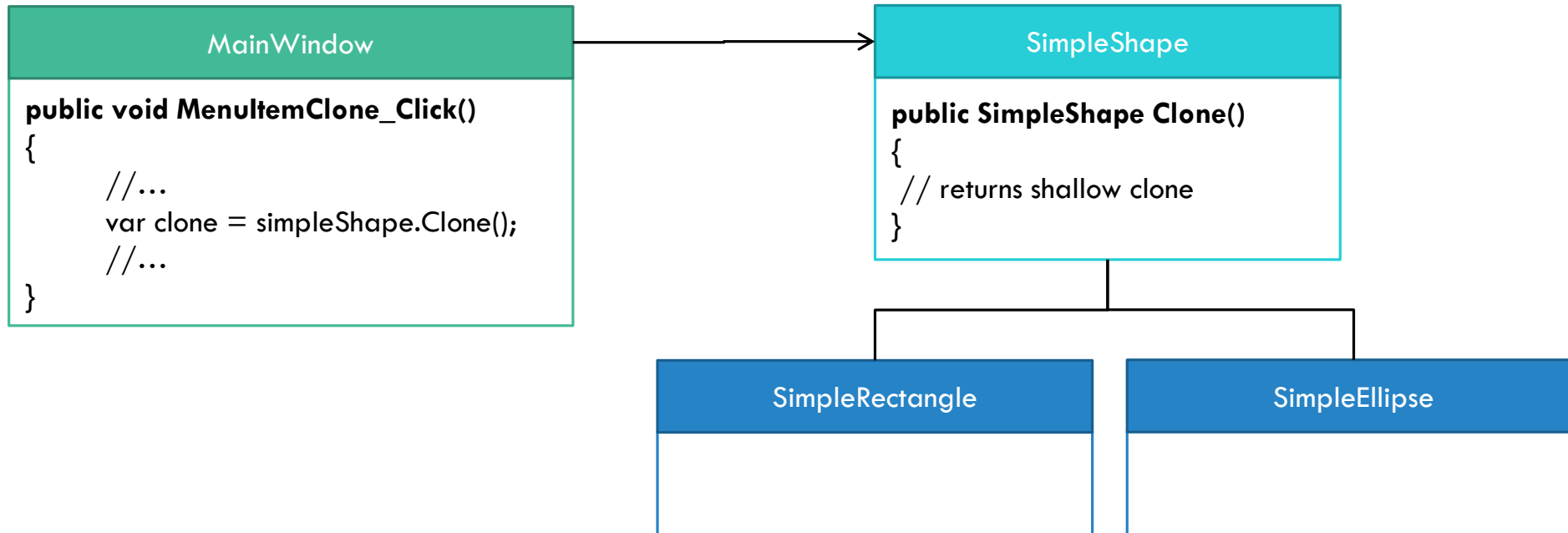
- You can use `ICloneable`



DEMO

Prototype - Shapes

PROTOTYPE — DIAGRAM — SHAPES DEMO



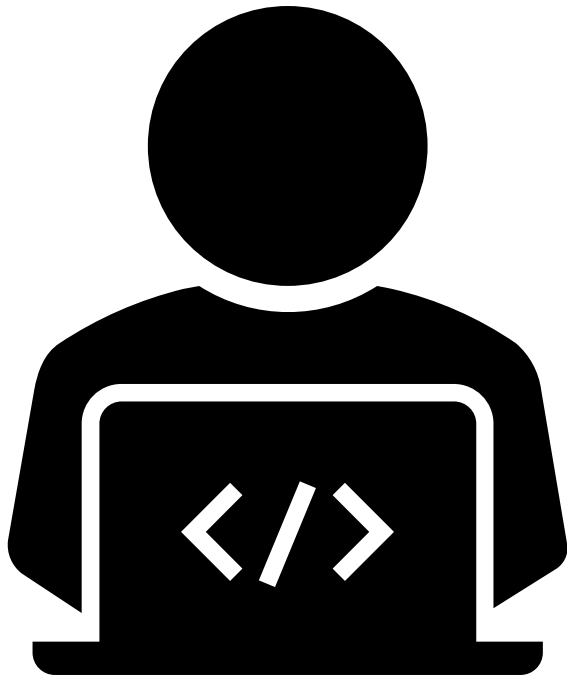
PROTOTYPE

Shallow clone	Deep clone
<ul style="list-style-type: none">- Makes copies of value-type members- Uses the same reference-type members	<ul style="list-style-type: none">- Duplicates everything (value or reference types)
<ul style="list-style-type: none">- MemberwiseClone()	<ul style="list-style-type: none">- If class is Serializable, you can use MemoryStream and BinaryFormatter

```
public object Clone()
{
    return MemberwiseClone();
}
```

```
public static T DeepClone<T>(T obj)
{
    using (var ms = new MemoryStream())
    {
        var formatter = new BinaryFormatter();
        formatter.Serialize(ms, obj);
        ms.Position = 0;

        return (T)formatter.Deserialize(ms);
    }
}
```



DEMO

Prototype - ShallowAndDeepClone

PROTOTYPE — ADVANTAGES

- Create at runtime a object by cloning an already existing one, not by creating a new one
- Can reduce the number of classes in the system
- The concrete classes are hidden from the client
- Greater flexibility in combining the objects of the system, at runtime

PROTOTYPE — DISADVANTAGES

- You might need a `PrototypeManager` to register all available prototype
- Cloning when you have circular references
 - Shallow clone vs Deep clone
- If you want the clone to have different values when it is initialized, you might need to add an `Initialize` method

Q&A PROTOTYPE



5. BUILDER

BUILDER — WHAT DOES IT DO?

- “Separate the construction of a complex object from its representation, so that the same construction process can create different representations.” (GoF)

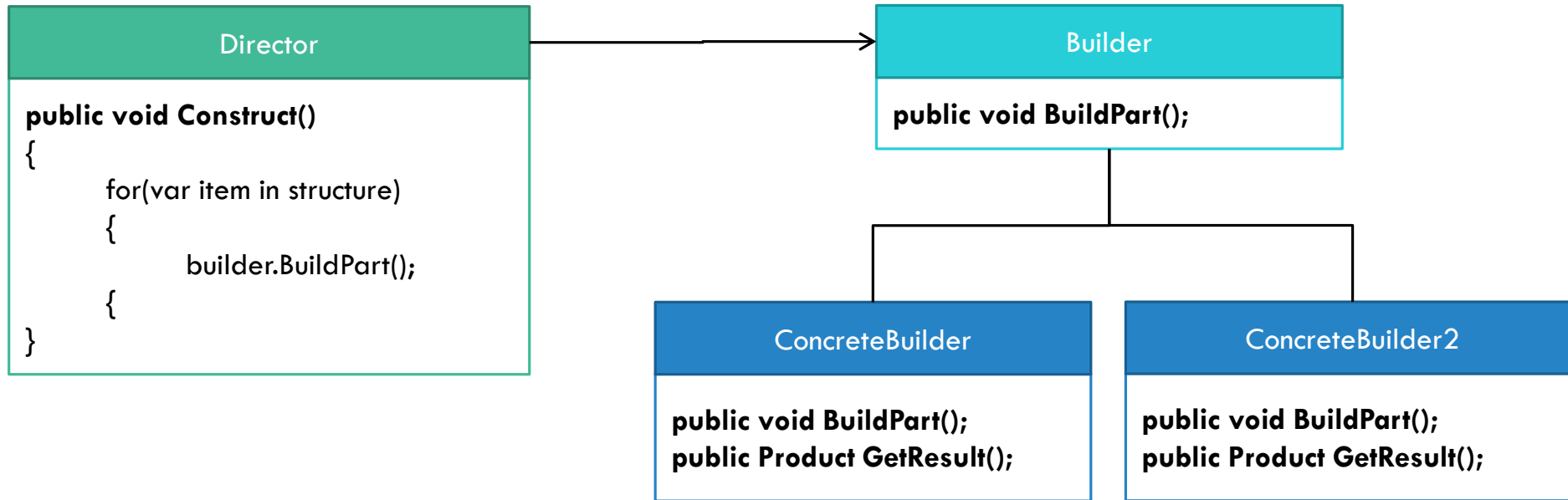
BUILDER — WHEN TO USE?

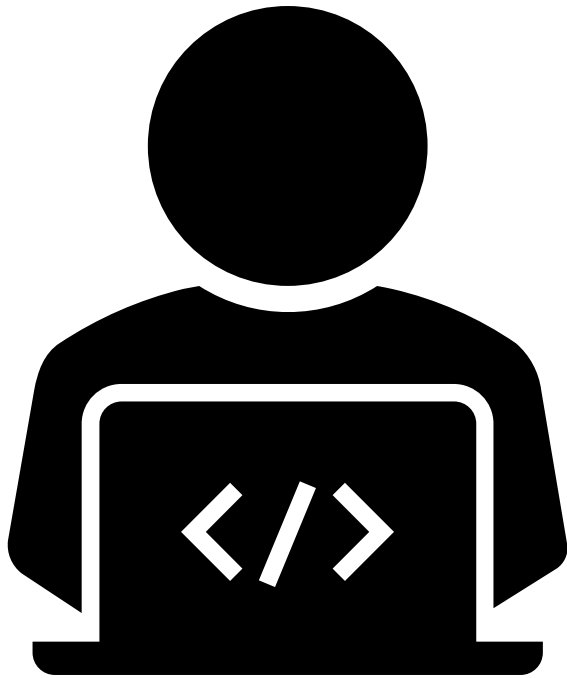
- To separate the construction of a complex object from the actual functionality
- More:
 - <https://www.dofactory.com/net/builder-design-pattern>

BUILDER — WHAT IS NOT

- StringBuilder is not a builder design pattern implementation
- Fluent Interface is not a builder implementation
 - Fluent Interfaces are semantic facades, they just improve readability, but don't actually enforce the construction of an object
 - <https://medium.com/@sawomirkowalski/design-patterns-builder-fluent-interface-and-classic-builder-d16ad3e98f6c>

BUILDER — DIAGRAM

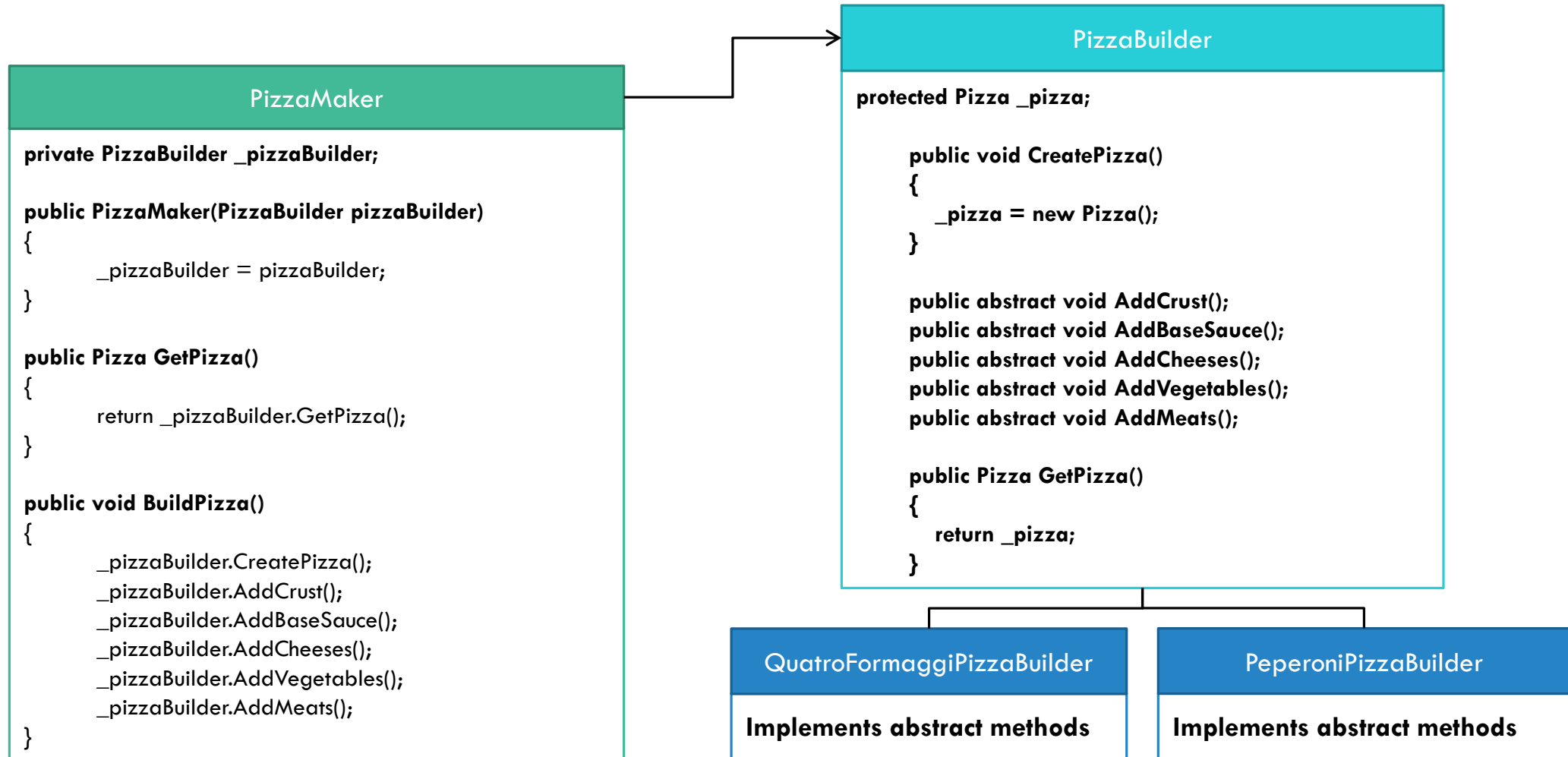




DEMO

Builder - Pizza

BUILDER — DIAGRAM — PIZZA DEMO




BUILDER — ADVANTAGES

- Hides the representation of a complex object
- Allows you to vary the internal representation and parts of an object
- Isolates the construction and the representation
 - Client's don't know about the internal representation of the products
- Enforces the steps for creating the object
 - The Director returns the object only after all the steps were done

Q&A BUILDER





Q&A

RECAP

1. Factory Method
2. Builder
3. Prototype
4. Singleton
5. Abstract Factory

FEEDBACK



<http://bit.ly/agilehub-feedback>



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Durează 2-3 minute



Feedback anonim - pentru
formator si AgileHub