Structural Patterns

Software Modeling

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2024-I

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Outline

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Basic Concepts

- **Intent**: Describe how objects are connected to each other. These patterns are related to the design principles of descomposition and generalization.
- **Motivation**:
  - **Problem**: A system should be independent of how its objects and products are created, composed, and represented.
  - **Solution**: Encapsulate the knowledge of which concrete classes are involved in creating the objects and let the system use that knowledge.

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Bridge Concepts

- When there is a **very large class**, this pattern lets **split** it into two separate hierarchies based on *abstraction* and *implementation*.
- Also, it helps when you want to combine two different but **related classes**, and you want to keep them independent.
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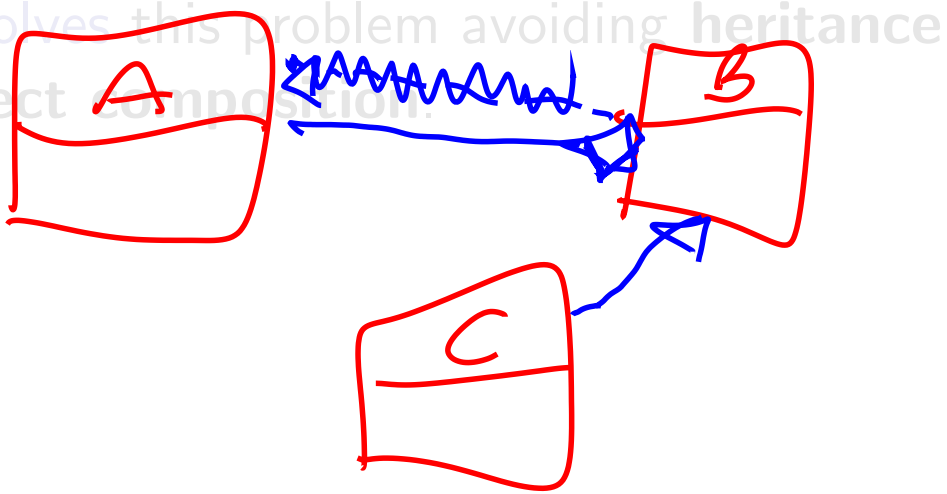

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Bridge Classes Structure

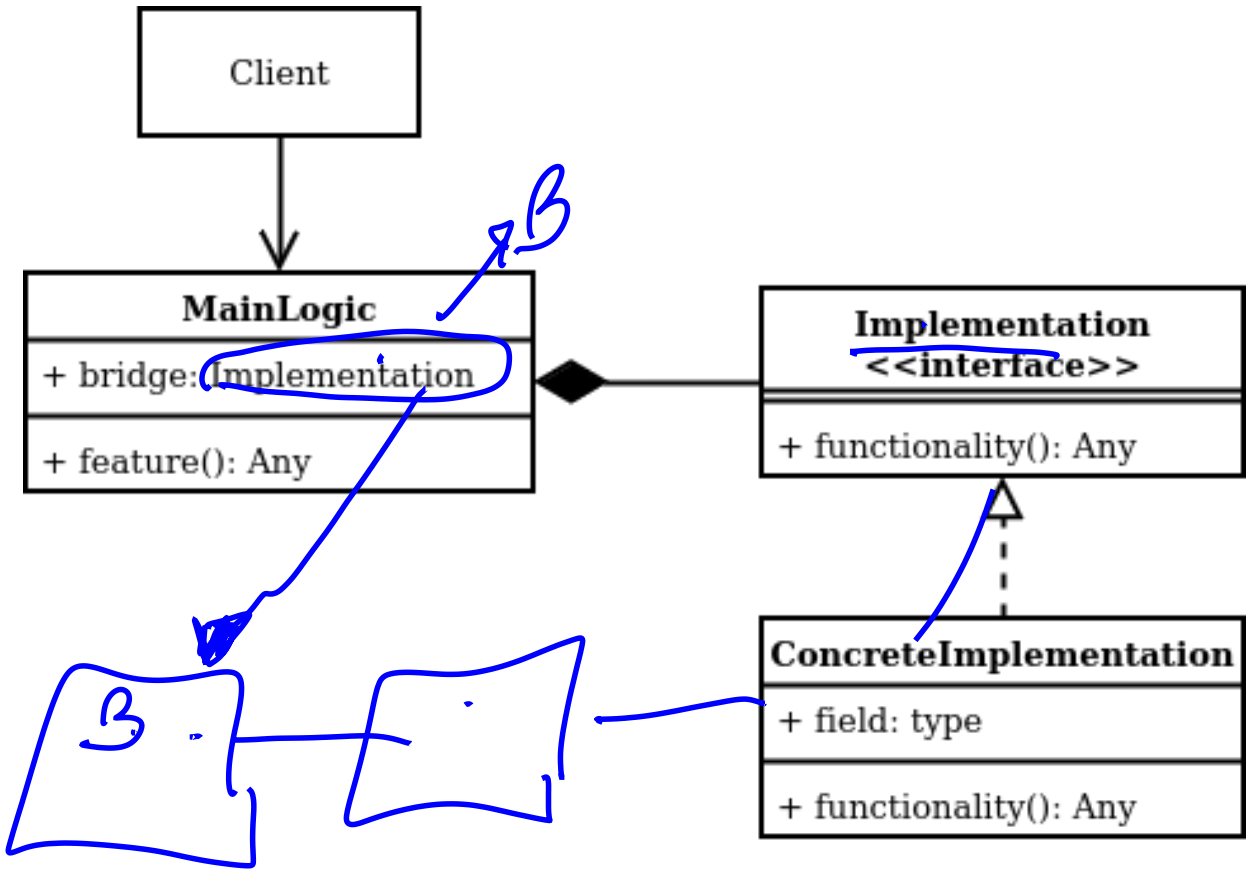

Figure: Bridge Pattern Class Diagram

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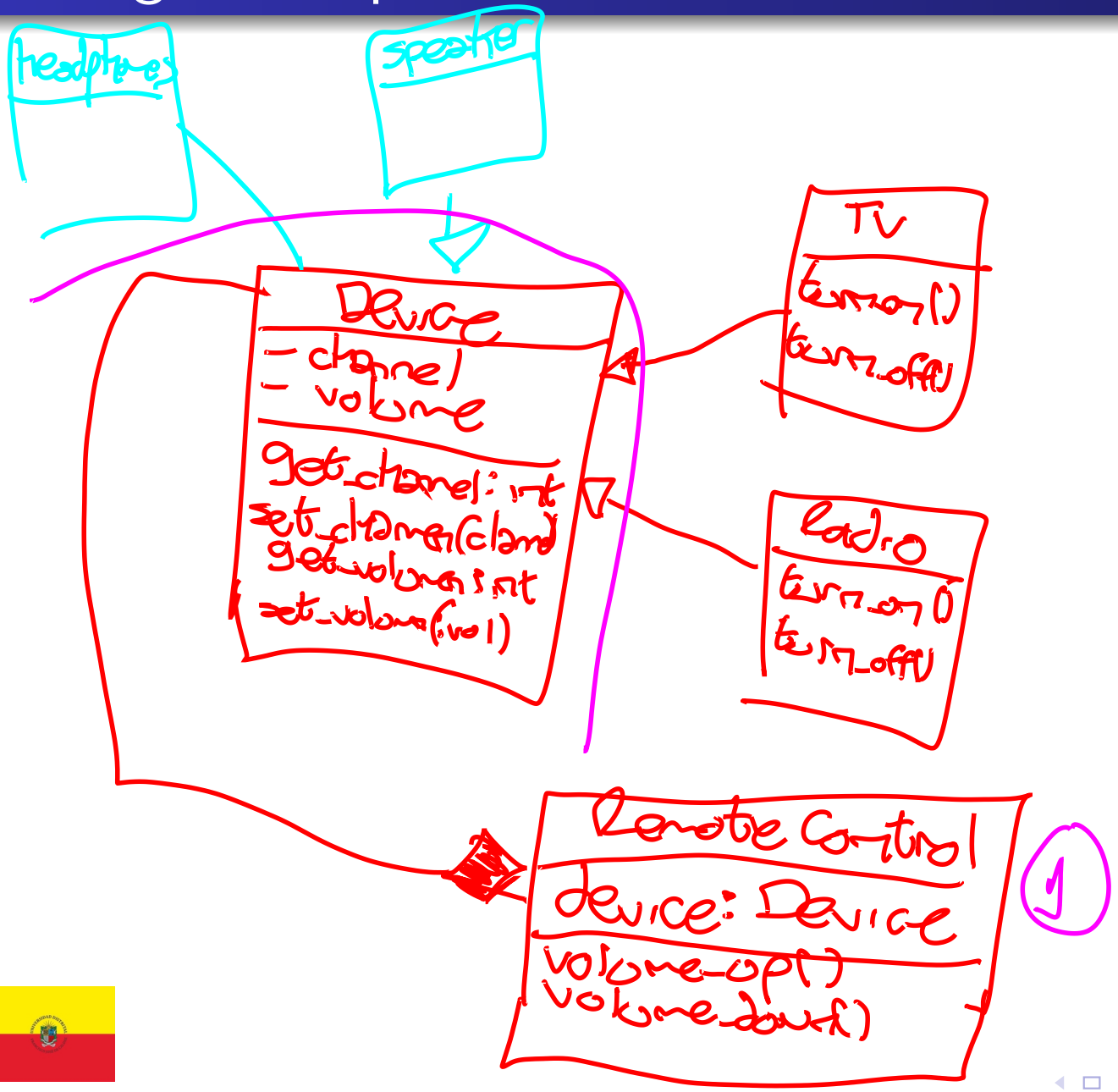
Bridge Example: Remote Controls



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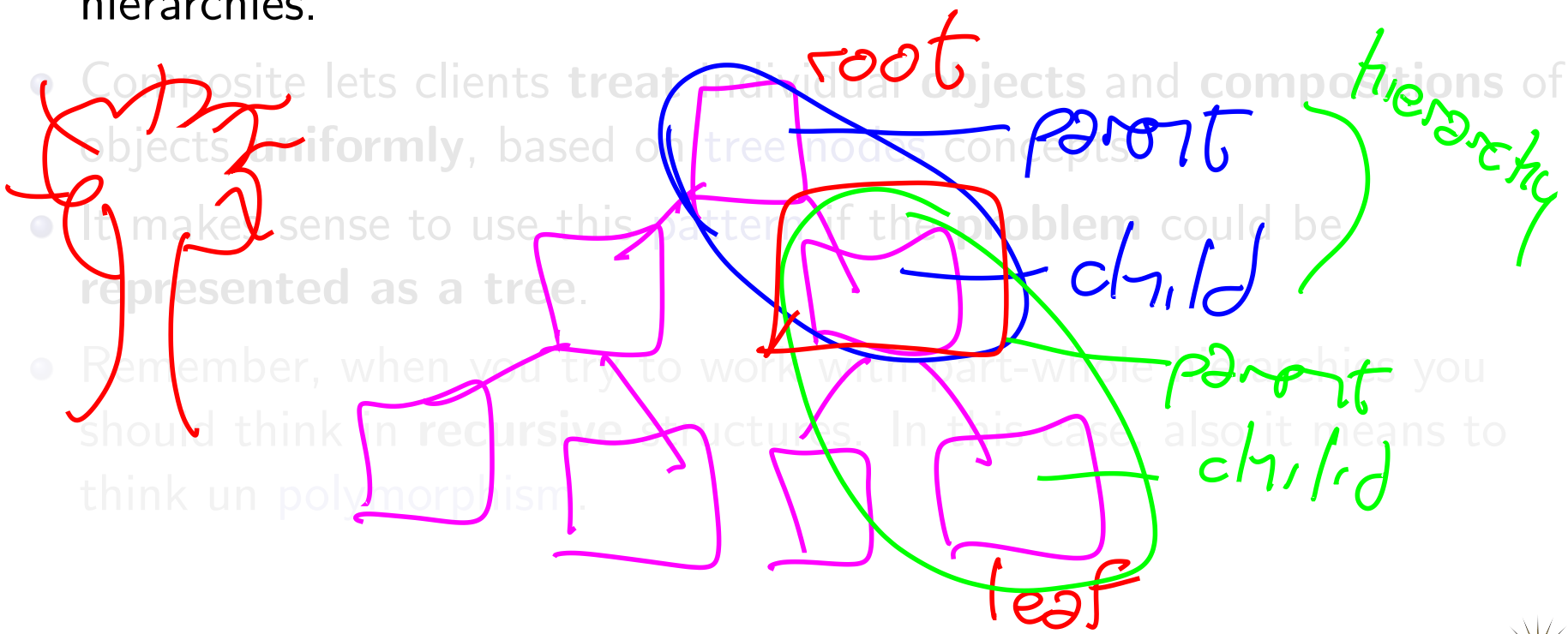
Composite Concepts

- Compose objects into **tree structures** to represent part-whole hierarchies.



- Composite lets clients **treat individual objects** and **compositions** of objects **uniformly**, based on tree nodes concepts.
- It make sense to use this pattern if the **problem** could be **represented as a tree**.
- Remember, when you try to work with part-whole hierarchies you should think in **recursive** structures. In this case also it means to think un polymorphism.

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Composite Classes Structure

Looks like the russian dolls, the *matryoshka*.

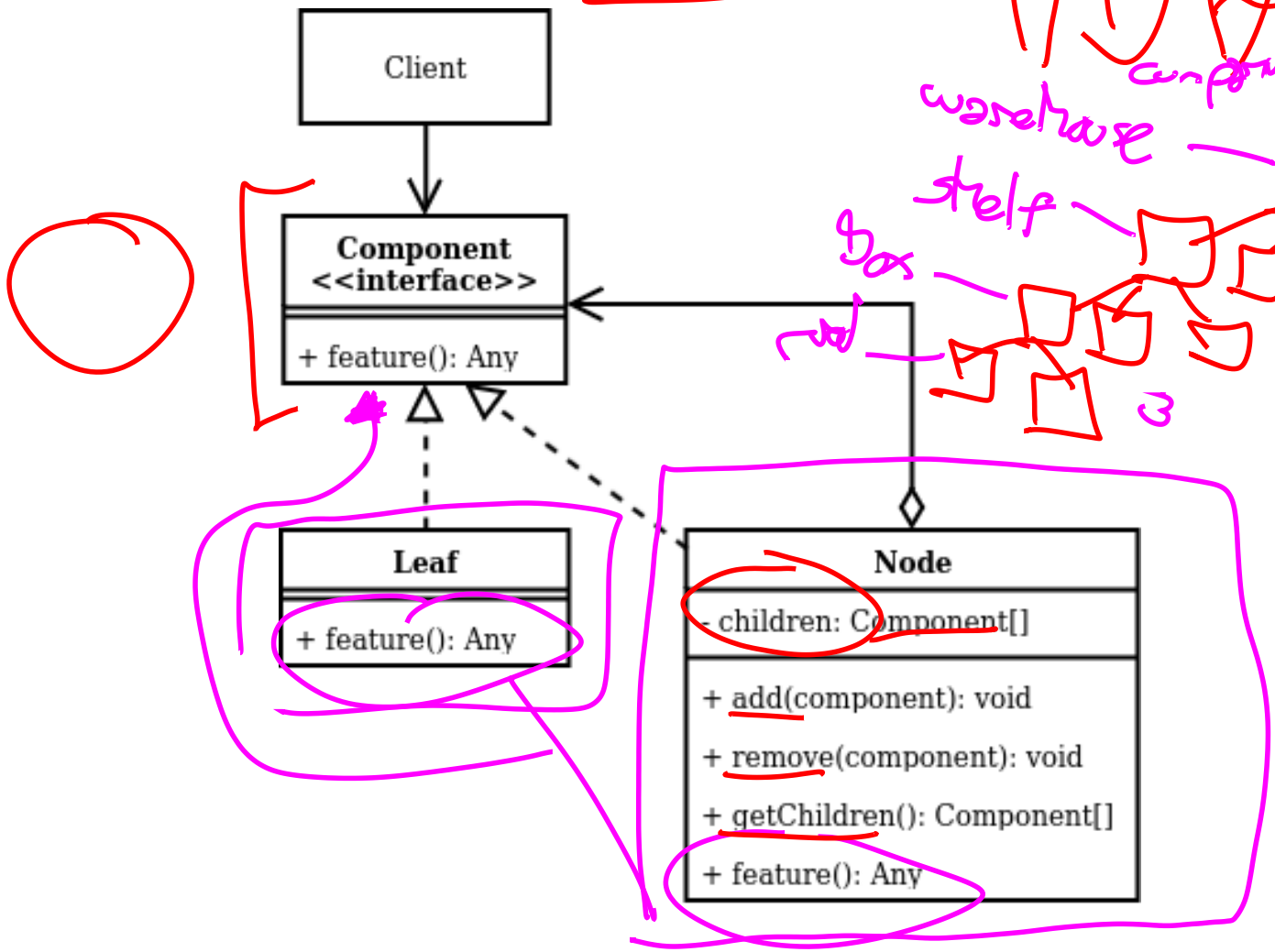
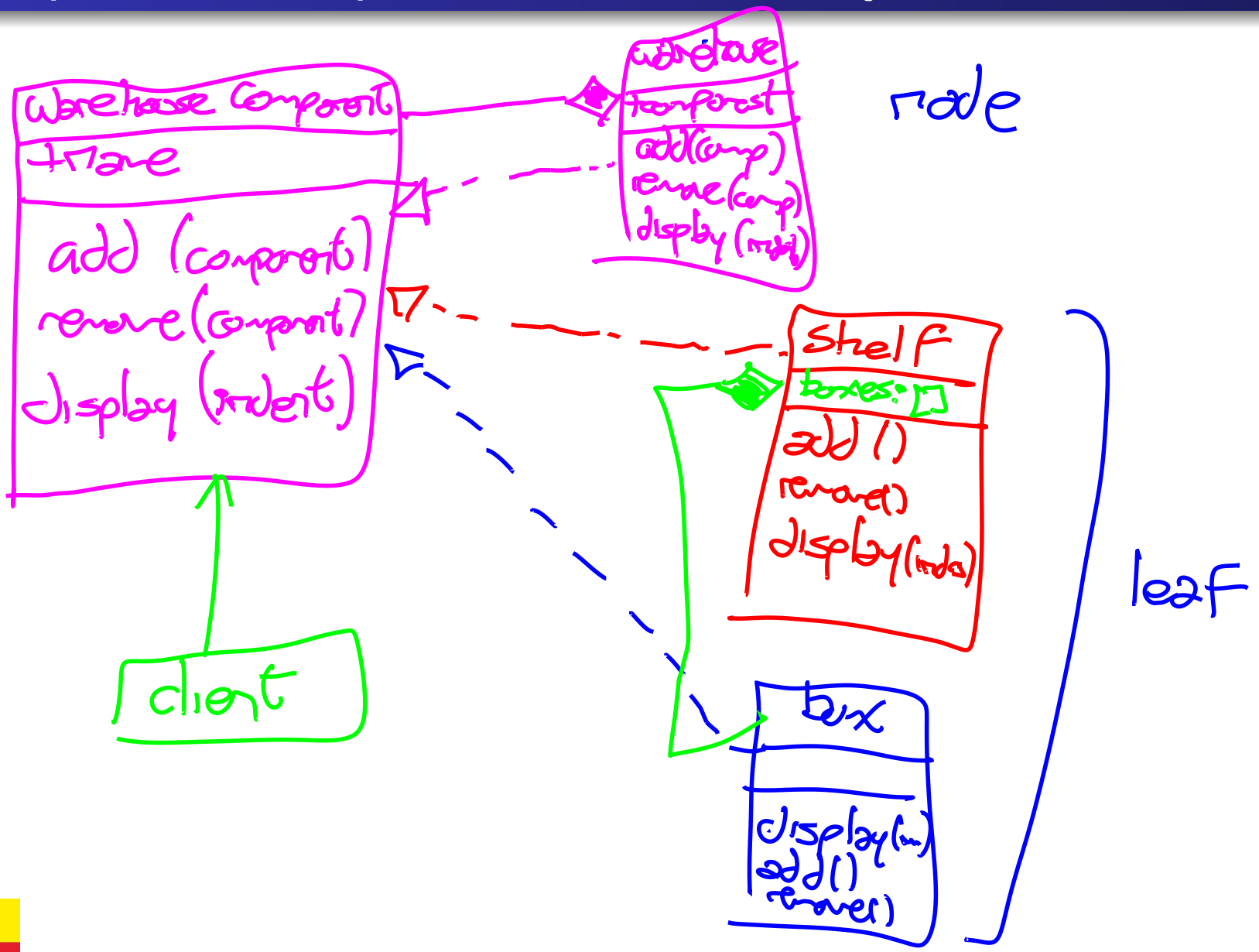


Figure: Composite Pattern Class Diagram

Composite Example: Amazon Delivery Warehouse



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Proxy Concepts

- This pattern lets to provide a **substitute** for an object. In this way, access could be controlled.
- It is useful when you want to **add a level of indirection** to control access to an object. Is is like a add middle layer without affect previous logic.
- Also, it is useful when you want to **reduce memory** used in a service, similar to think in *cache memory*.
- In some cases, this pattern lets **add additional logic** (like *logging* or *security*) to an existing logic **without** change original class.

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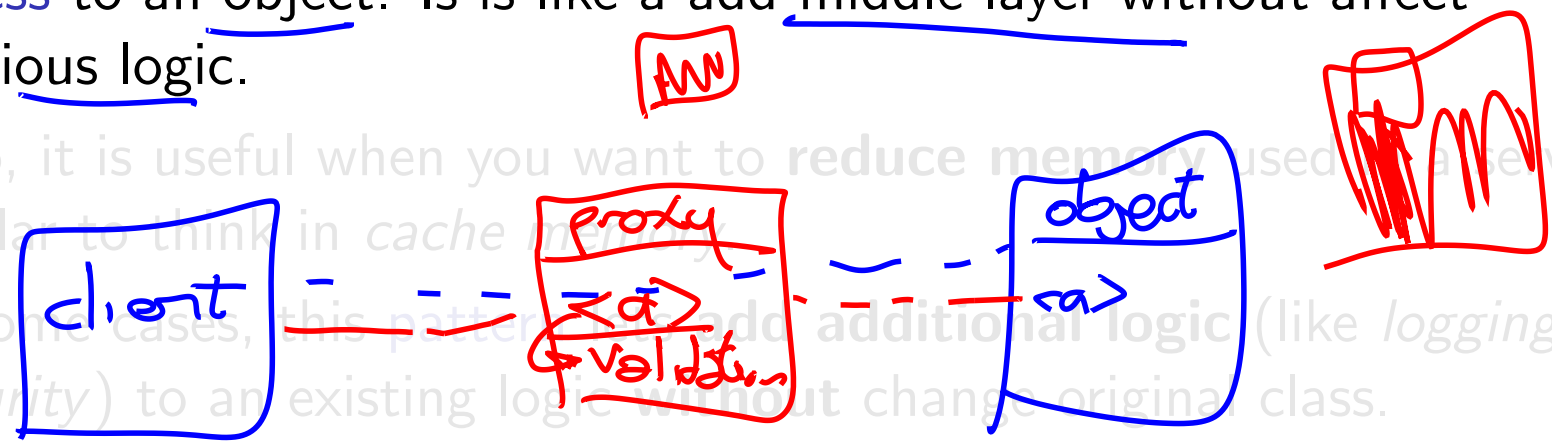

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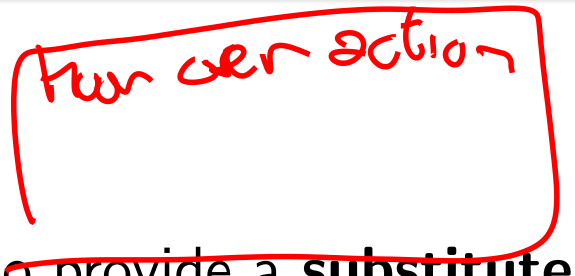

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Proxy Classes Structure

Do you remember Mini Me from *Austin Powers*?

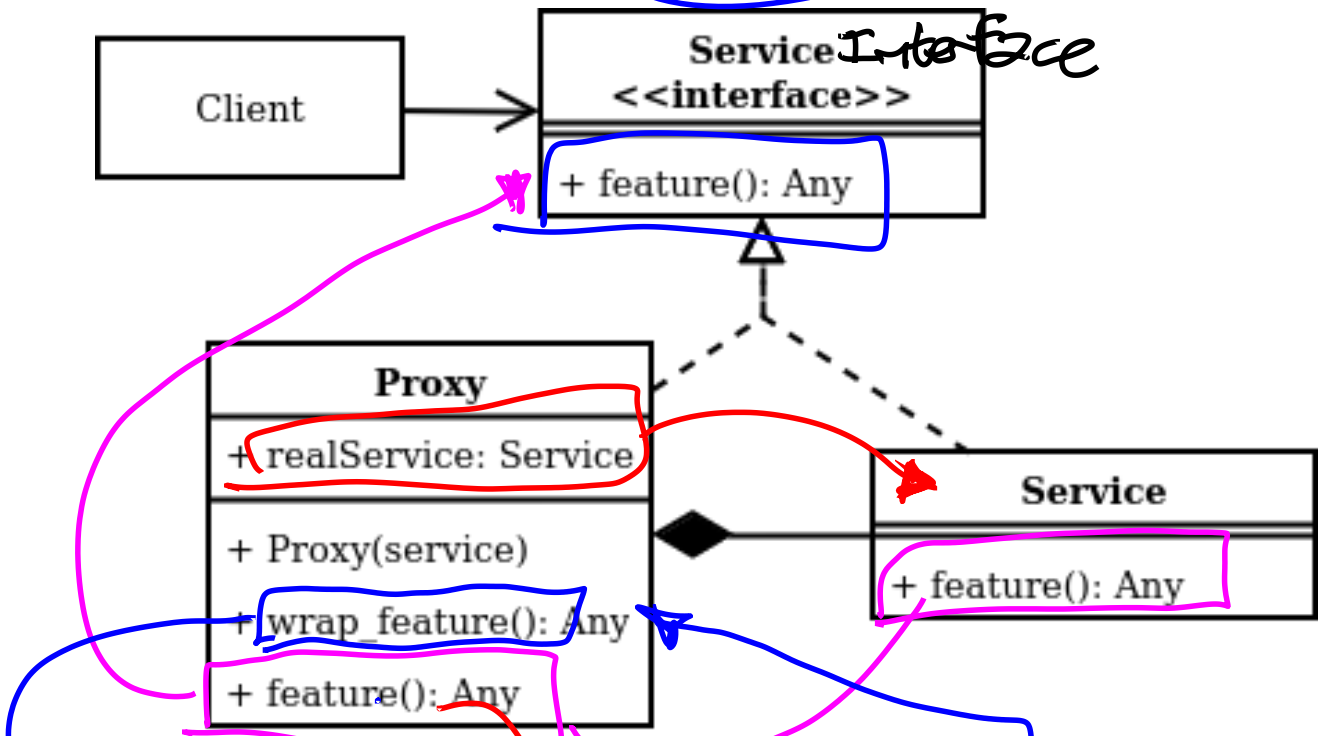
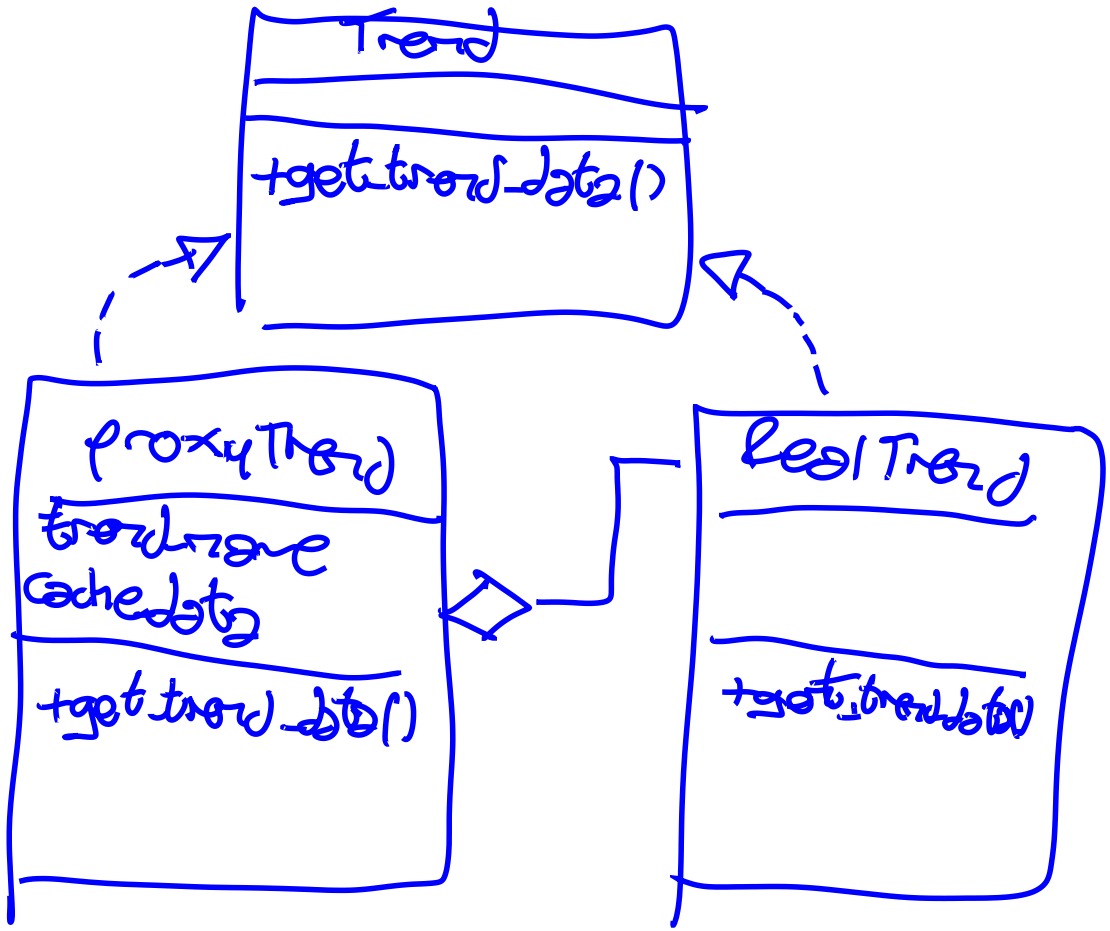


Figure: Proxy Class Diagram

Proxy Example: Cache Trends on a Social Networks



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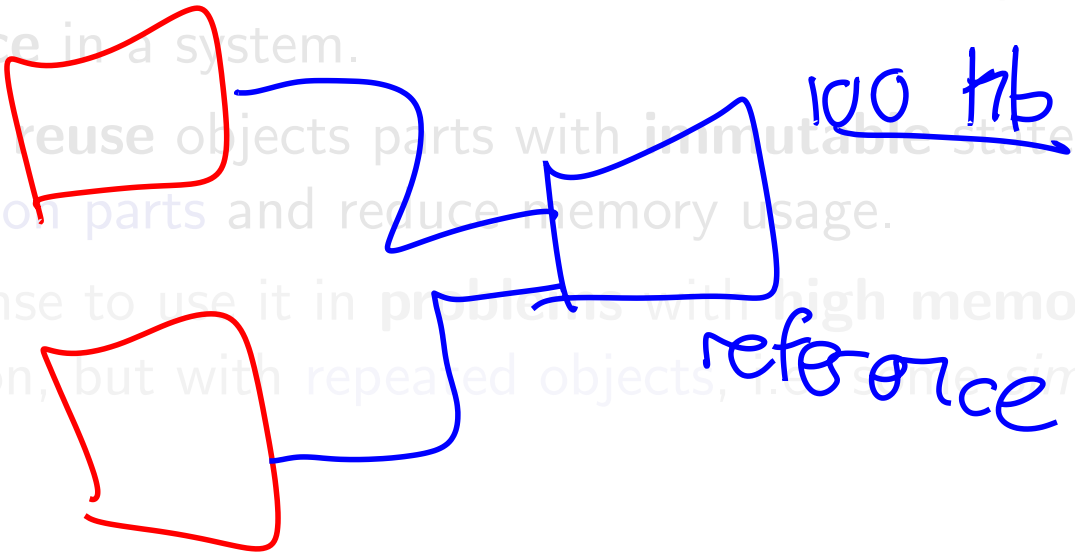
Flyweight Concepts

- This pattern lets you use **sharing** to support large numbers of fine-grained objects efficiently.
- It is useful when you want to **reduce memory usage** and **increase performance** in a system.
- The idea to **reuse** objects parts with **immutable** state. This lets share common parts and reduce memory usage.
- It makes sense to use it in **problems** with **high memory** RAM comsumption, but with repeated objects, i.e. some *simulations*.



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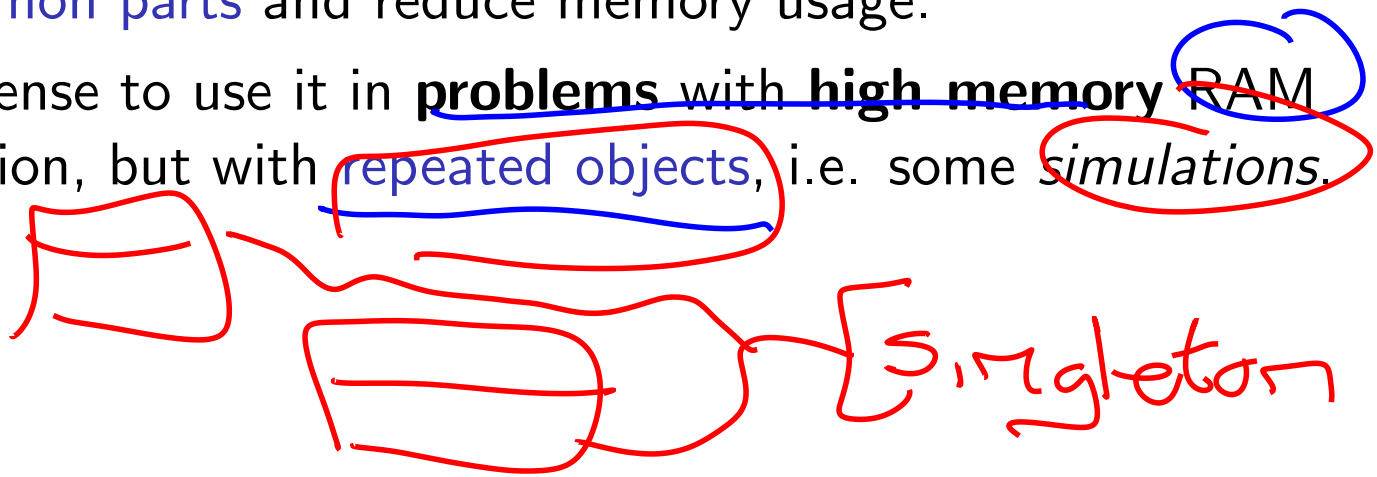

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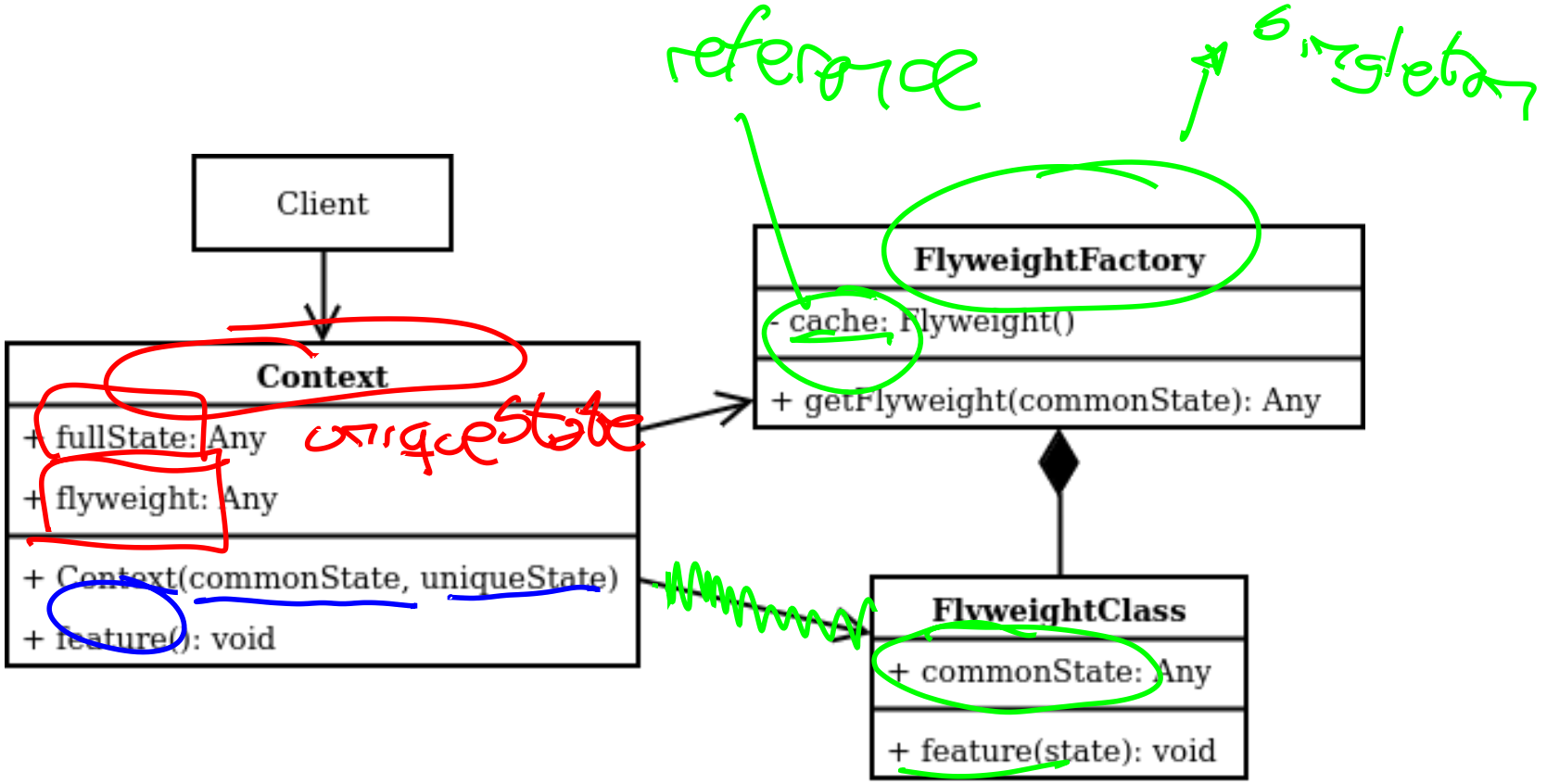

Figure: Flyweight Pattern Class Diagram

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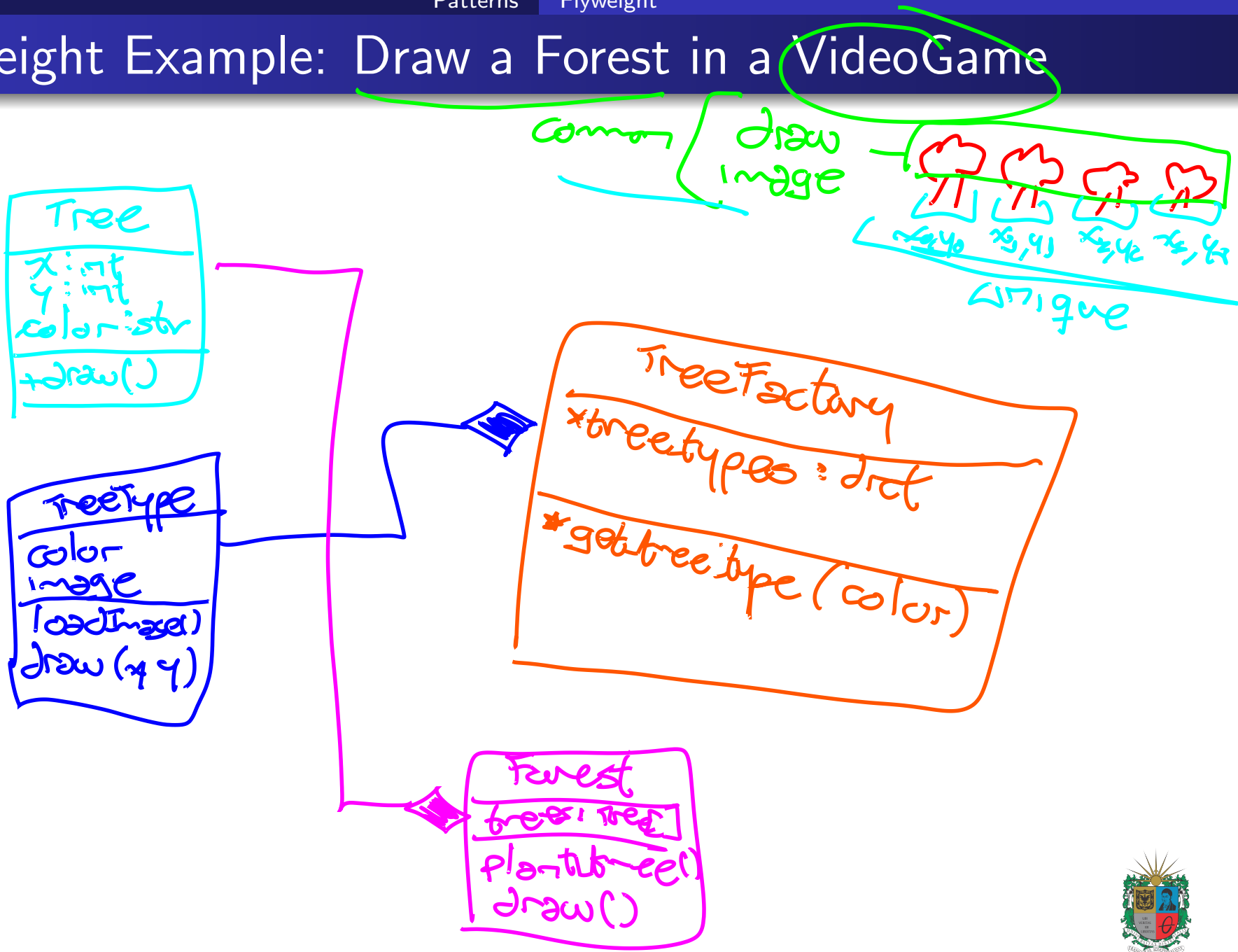
Flyweight Example: Draw a Forest in a VideoGame



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Decorator Concepts

- This pattern lets you **attach** additional functionalities to an object **dynamically**.
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Decorator Classes Structure

It is like Dr. Strange and his **Cloak of Levitation**.

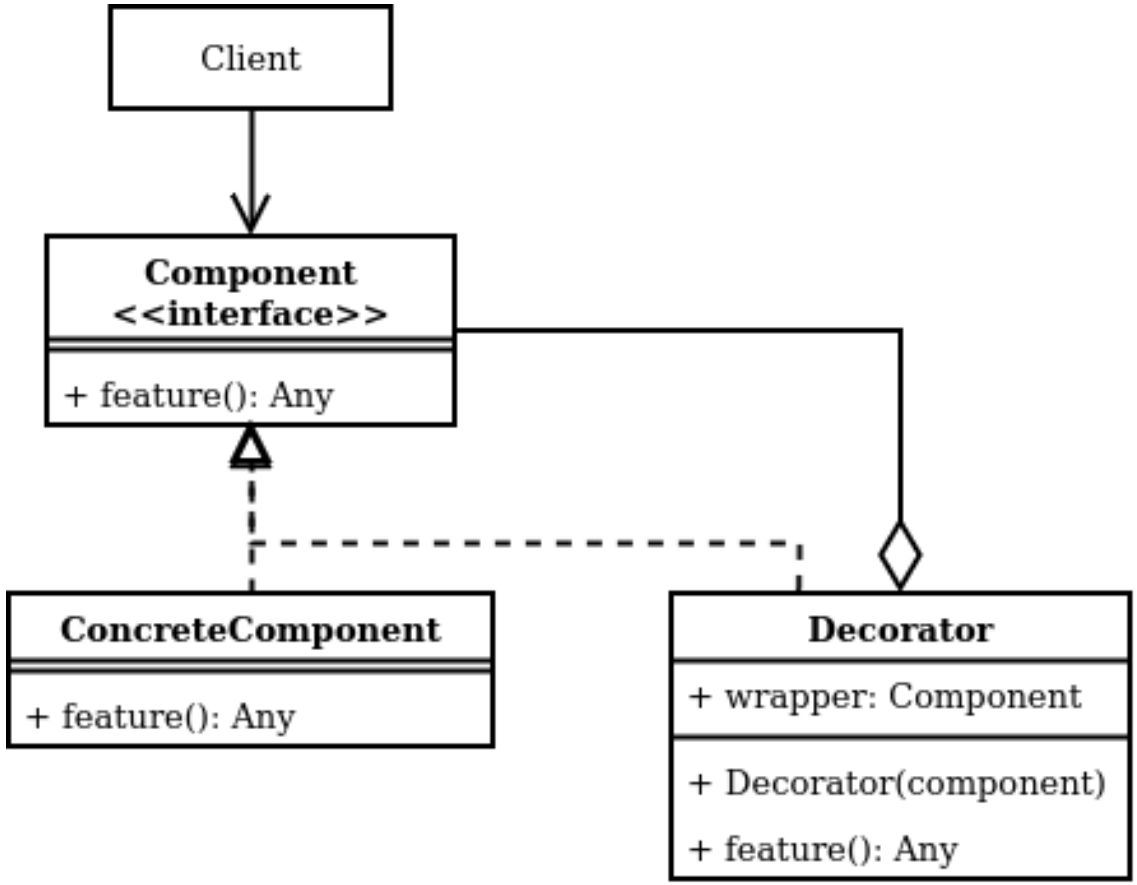

Figure: Decorator Pattern Class Diagram

Decorator Example: Monitoring an Application

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Adapter Concepts

- This pattern is pretty simple, it just attempts to **convert** the **interface** of a class into another interface clients expects.
- It is useful when you want to **reuse** an existing class, but its **not compatible** with the rest of your code, or at least where you need it.
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Adapter Classes Structure

Now technology is based in adapters to make everything **compatible**.

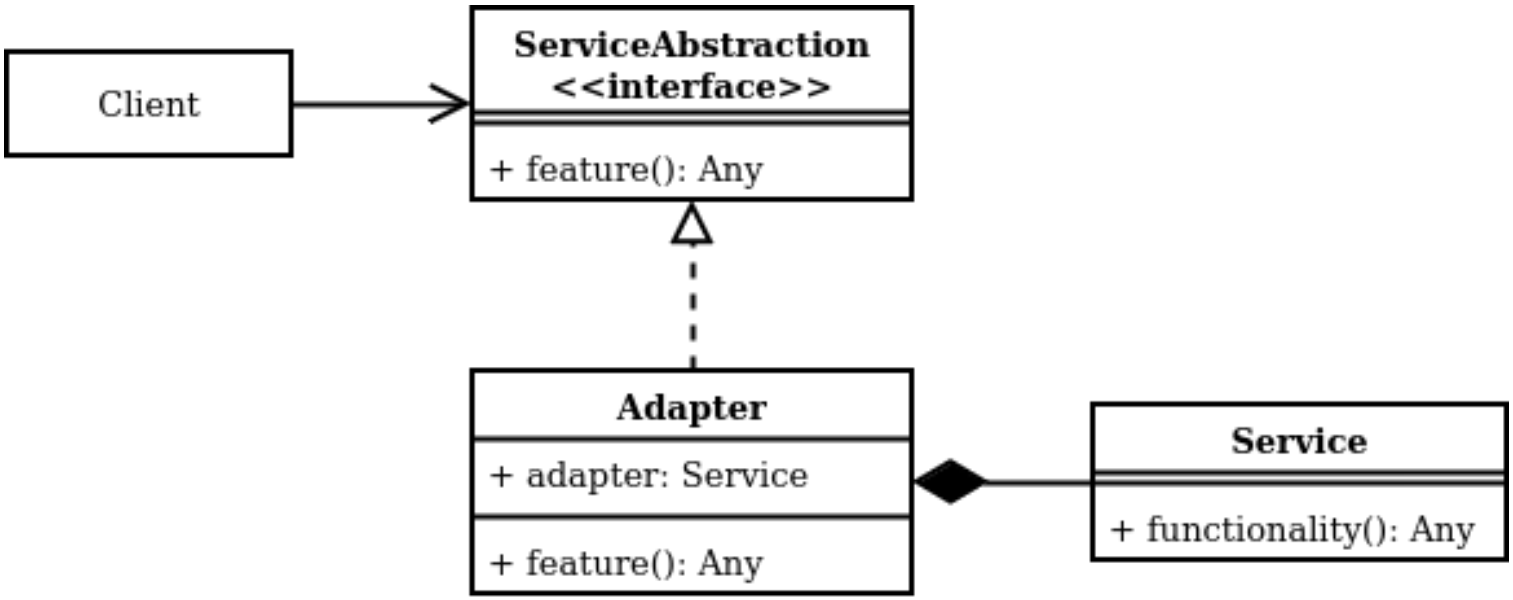

Figure: Adapter Pattern Class Diagram

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Adapter Example: Processing different File Sources

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Facade Concepts

- This pattern provides a **unified interface** to a set of classes that could be group into a subsystem.
- It is useful when you want to **define a high-level interface** that makes the subsystem **easier to use**. It means, **hide** any **complex logic** and let the client use a simple interface.
- It is normal when you want to **reduce** the **dependencies**. The **client** just **interacts** with the **facade**, and the facade interacts with the subsystem.
- You could add complexity at the subsystem and client will not be affected, it **increases flexibility**. At most, there will be more new functionalities to be exposed to the client.

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Facade Classes Structure

You are the only one who knows how to find something in your bedroom.

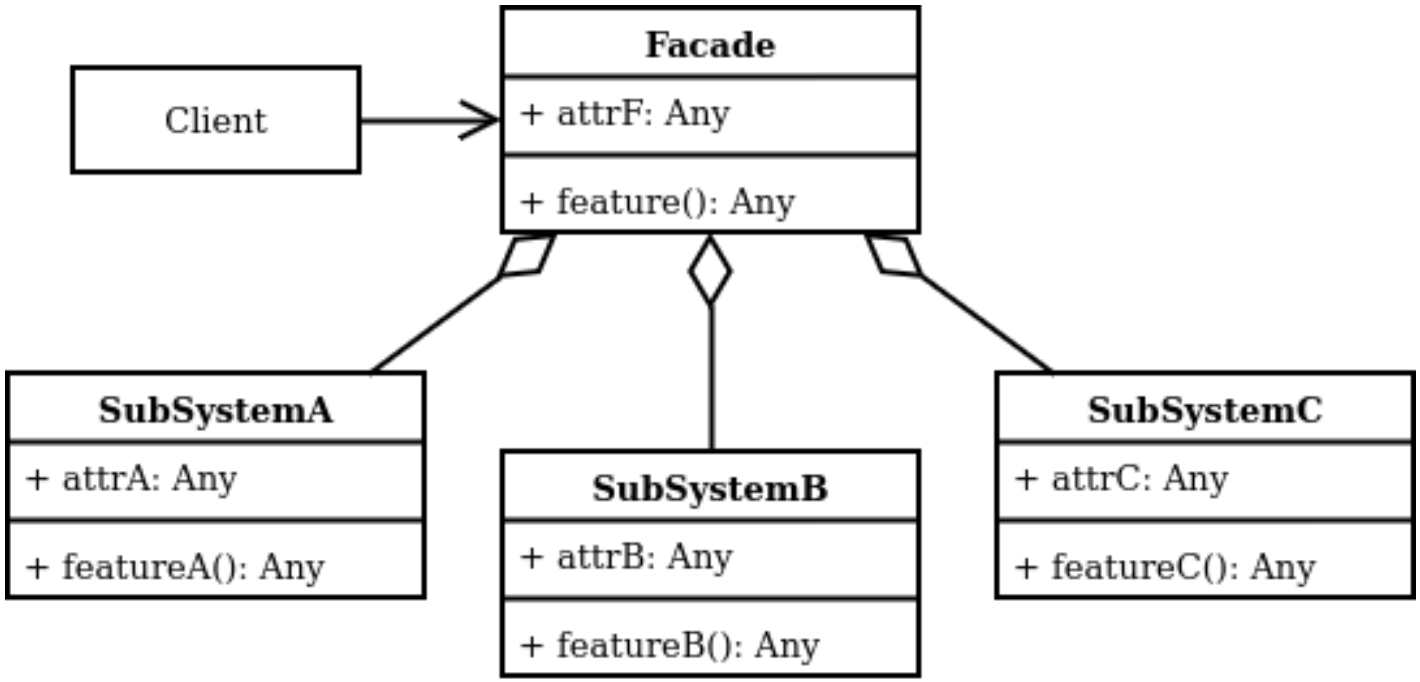

Figure: Facade Pattern Class Diagram

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Facade Example: Bank Account Management

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Conclusions

- Structural patterns are useful to **describe how objects are connected** to each other.
- They are related to the design principles of **descomposition** and **generalization**.
- You could **fit a lot of problems** with these patterns as a nice solution. However, be **careful** with the **complexity** of the solution.
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Thanks!

Questions?

Repo: *github.com/engandres/ud-public/software-modeling*