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Problem Solving Programming

Design Patters

GRASP Design Principles

GRASP

- Stands for General Responsibility Assignment Software Patterns
- Guides in assigning responsibilities to collaborating objects.
- 9 GRASP patterns
  - Creator
  - Information Expert
  - Low Coupling
  - Controller
  - High Cohesion
  - Indirection
  - Polymorphism
  - Protected Variations
  - Pure Fabrication

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Responsibility

- Responsibility can be:
  - Accomplished by a single object
  - Or Collaboratively by a group of objects
- GRASP helps us in deciding which responsibility should be assigned to which object/class.
- Identify the objects and responsibilities from the problem domain, and also identify how objects interact with each other.
- Define blueprint for those objects – i.e. class with methods implementing those responsibilities.

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Creator

- Who creates an Object? Or who should create a new instance of some class?
- “Container” object creates “contained” objects.
- Decide who can be creator based on the objects association and their interaction.

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Creator Example

- Consider VideoStore and Video in that store.
- VideoStore has an aggregation association with Video. I.e, VideoStore is the container and the Video is the contained object.
- So, we can instantiate video object in VideoStore class

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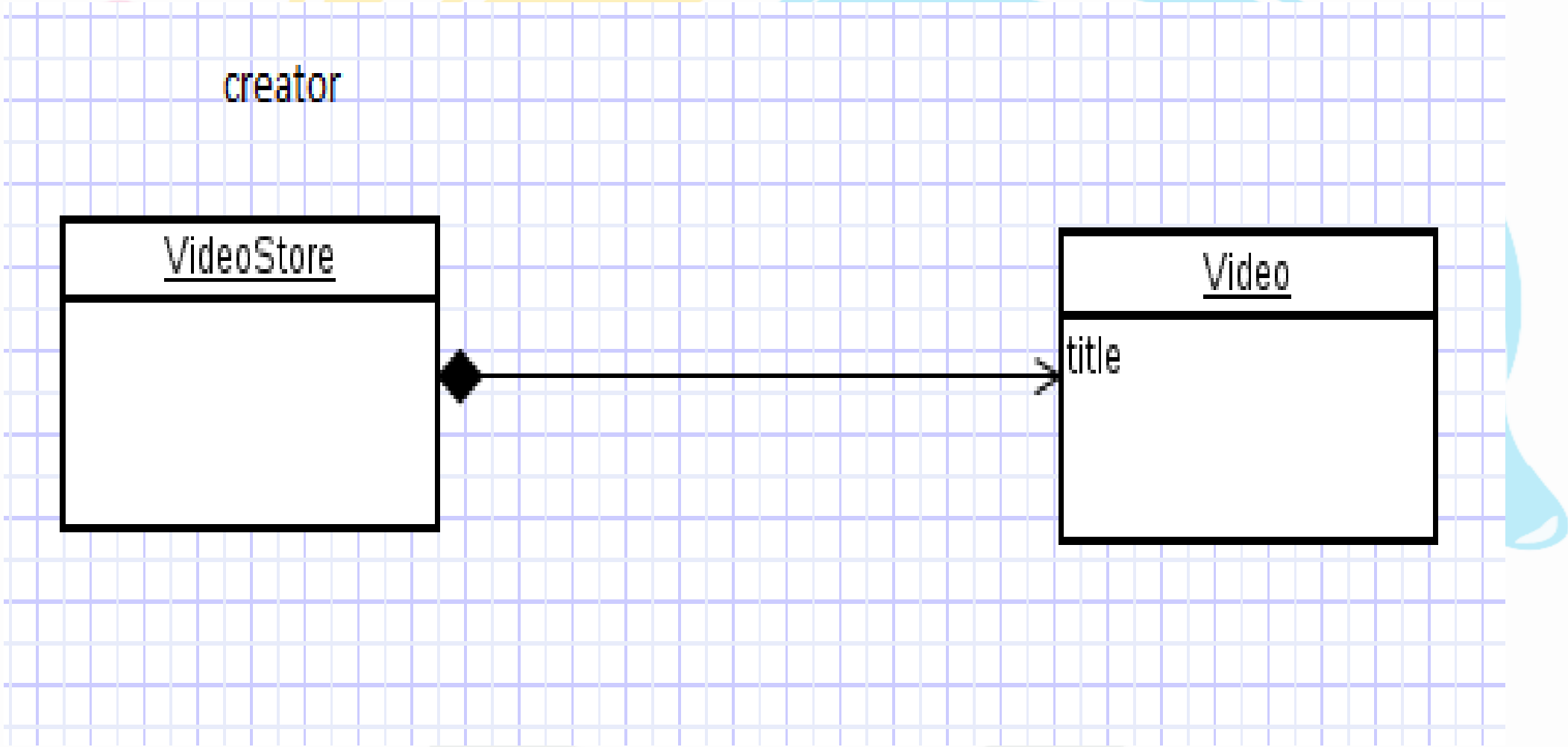
Example Diagram



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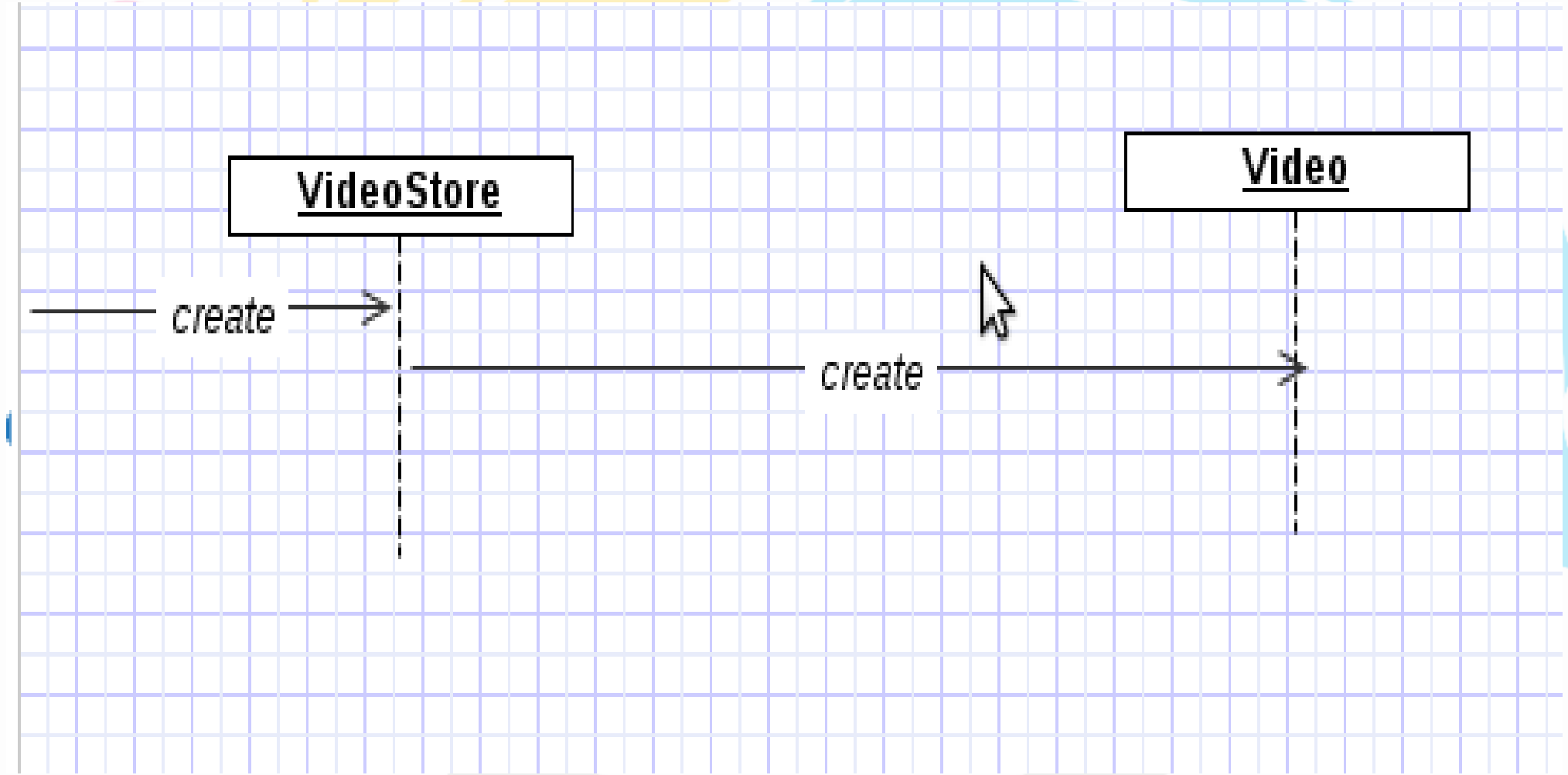
Creator Example



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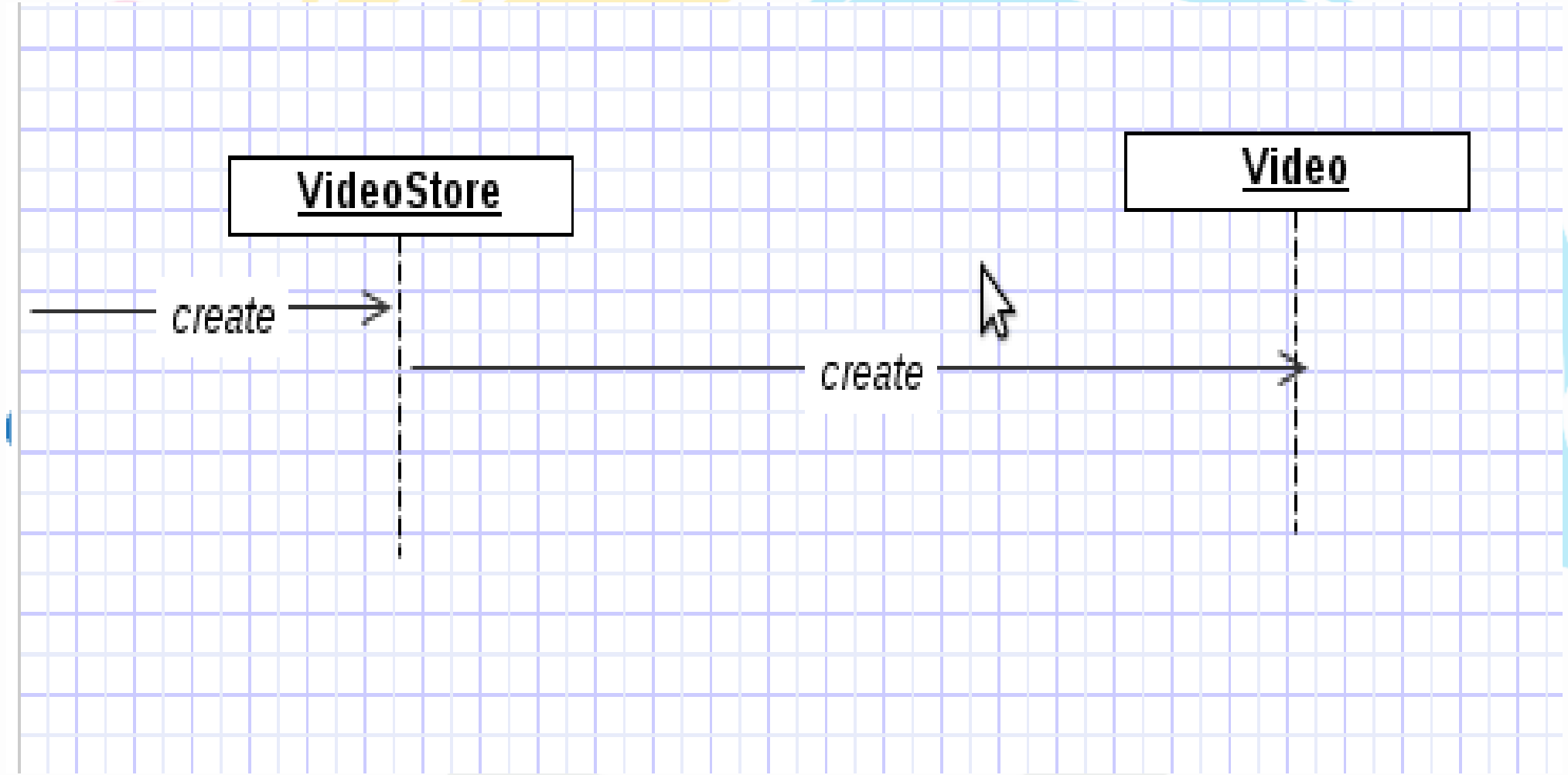
Creator Example



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Information Expert

- Given an object o, which responsibilities can be assigned to o?
- Expert principle says – assign those responsibilities to o for which o has the information to fulfill that responsibility.
- They have all the information needed to perform operations, or in some cases they collaborate with others to fulfill their responsibilities.

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Example Information Expert

- Assume we need to get all the videos of a VideoStore.
- Since VideoStore knows about all the videos, we can assign this responsibility of giving all the videos can be assigned to VideoStore class.
- VideoStore is the information expert.

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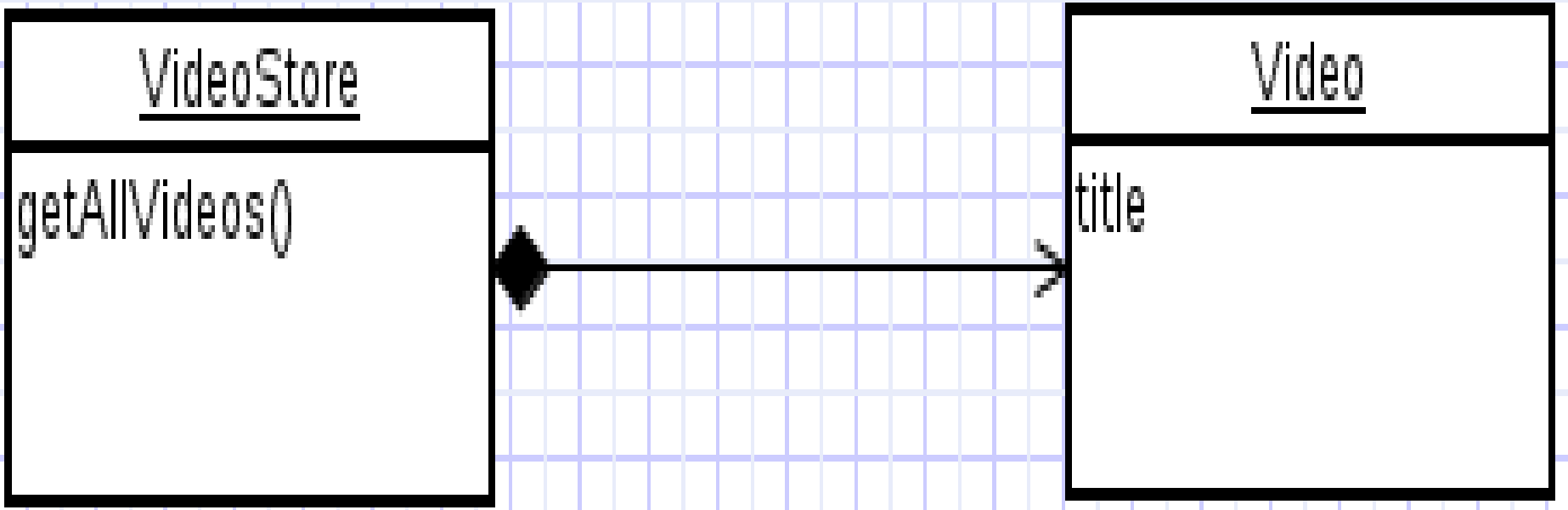
Example Expert



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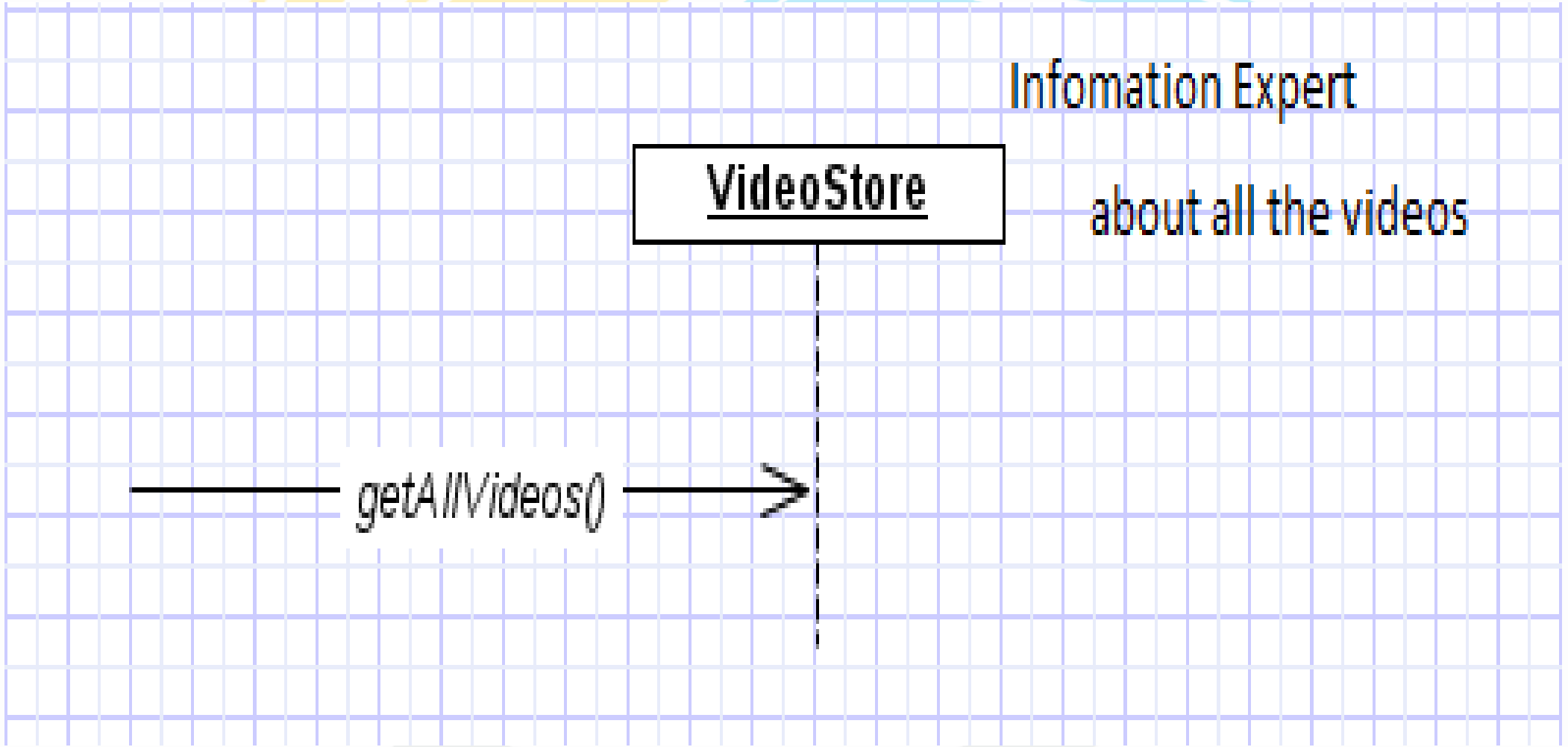
Example Expert



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Low Coupling

- How strongly the objects are connected to each other?
- Coupling – object depending on other object.
- When depended upon element changes, it affects the dependent also.
- Low Coupling – How can we reduce the impact of change in depended upon elements on dependent elements.
- Prefer low coupling – assign responsibilities so that coupling remain low.
- Minimizes the dependency hence making system maintainable, efficient and code reusable

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Low Coupling

- Two elements are coupled, if
  - One element has aggregation/composition association with another element.
  - One element implements/extends other element.

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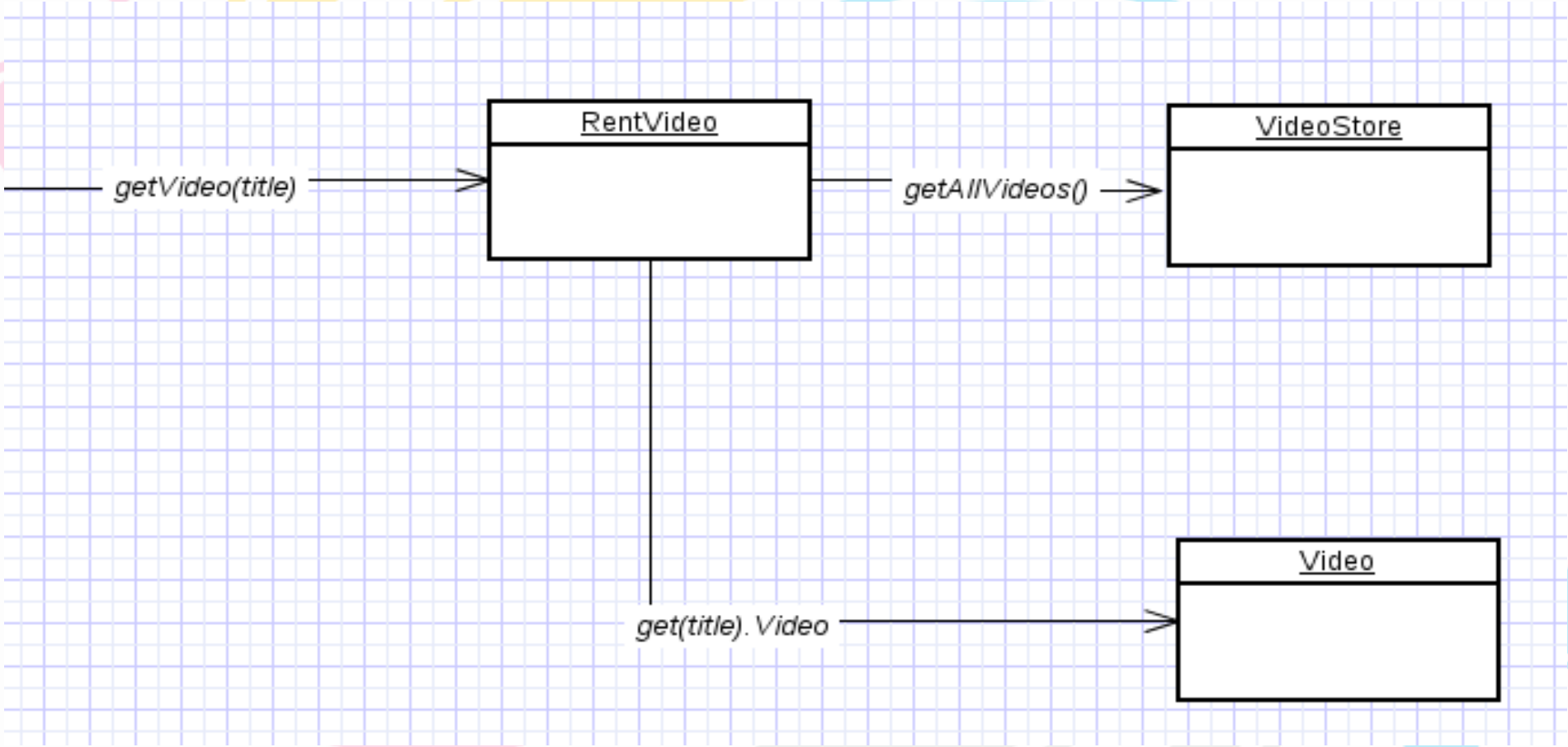
Poor Coupling Example



- Here class Rent knows about both VideoStore and Video objects. Rent is depending on both the classes.

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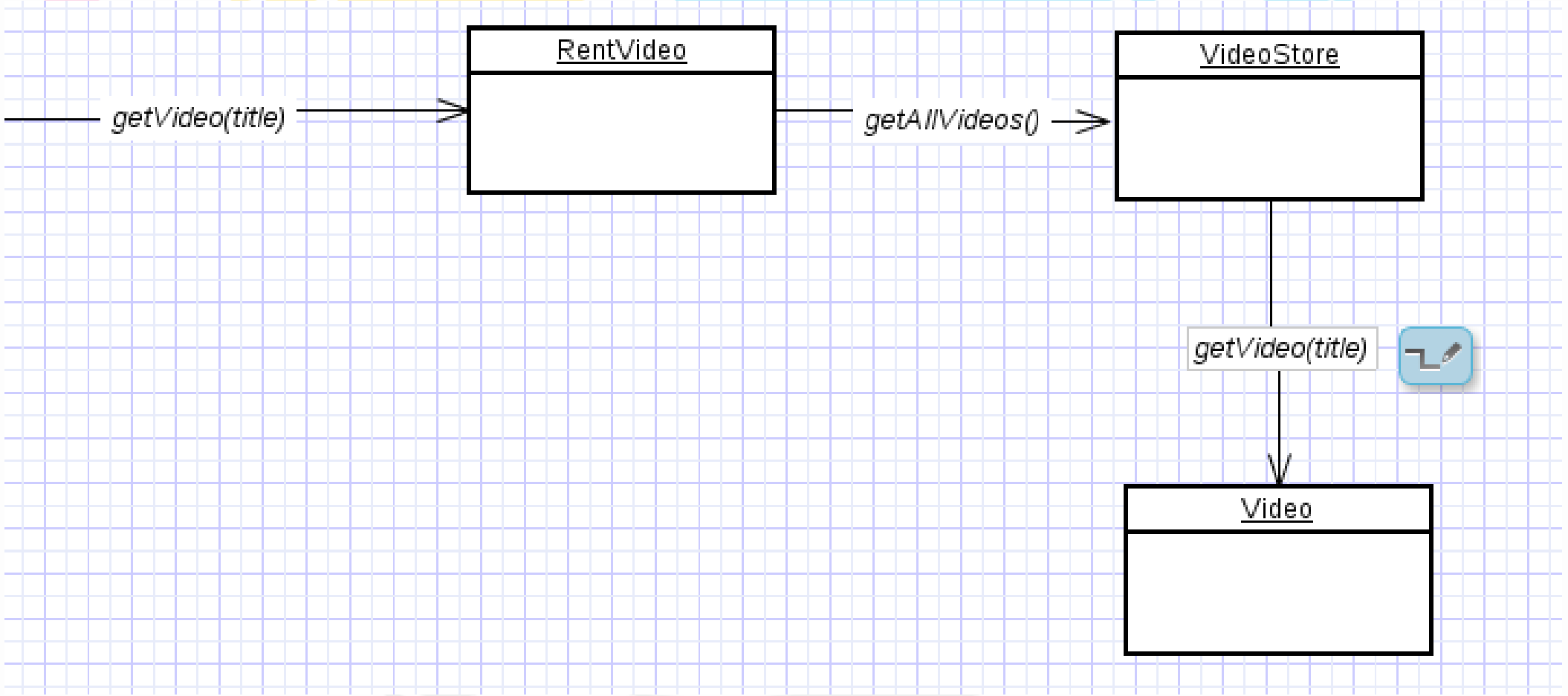
Low Coupling Example

VideoStore and Video class are coupled, and Rent is coupled with VideoStore. Thus providing low coupling.



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Controller

- Deals with how to delegate the request from the UI layer objects to domain layer objects.
- when a request comes from UI layer object, Controller pattern helps us in determining what is that first object that receive the message from the UI layer objects.
- This object is called controller object which receives request from UI layer object and then controls/coordinates with other object of the domain layer to fulfill the request.
- It delegates the work to other class and coordinates the overall activity.

Controller

- **We can make an object as Controller, if**
  - Object represents the overall system (facade controller)
  - Object represent a use case, handling a sequence of operations (session controller).
- **Benefits**
  - can reuse this controller class.
  - Can use to maintain the state of the use case.
  - Can control the sequence of the activities

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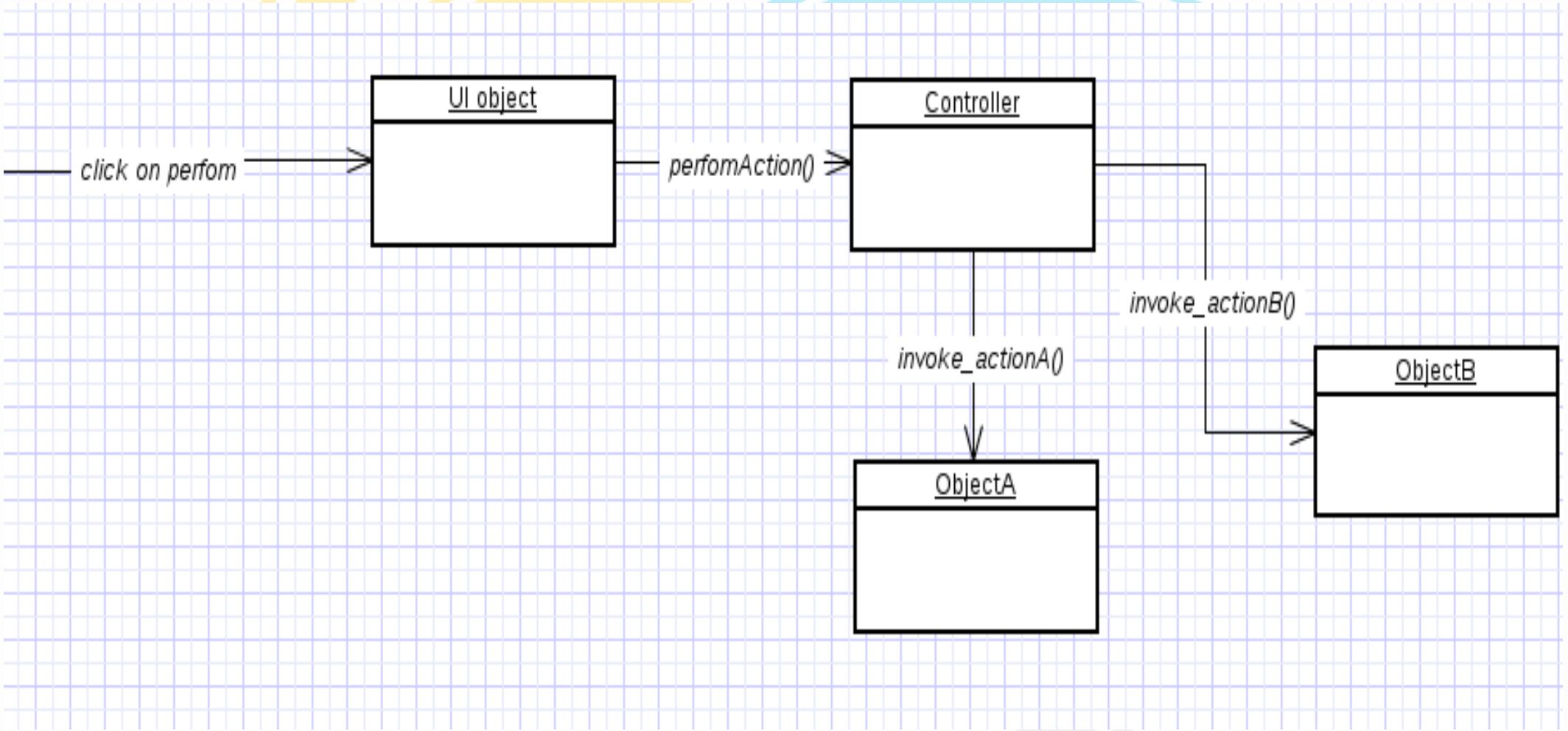
Controller Example



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Bloated Controllers

Controller class is called bloated, if

- The class is overloaded with too many responsibilities.

  Solution – Add more controllers

- Controller class also performing many tasks instead of delegating to other class.

  Solution – controller class has to delegate things to others.

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High Cohesion

- How are the operations of any element are functionally related?
- Related responsibilities in to one manageable unit.
- Prefer high cohesion
- Clearly defines the purpose of the element
- Benefits
  - Easily understandable and maintainable.
  - Code reuse
  - Low coupling

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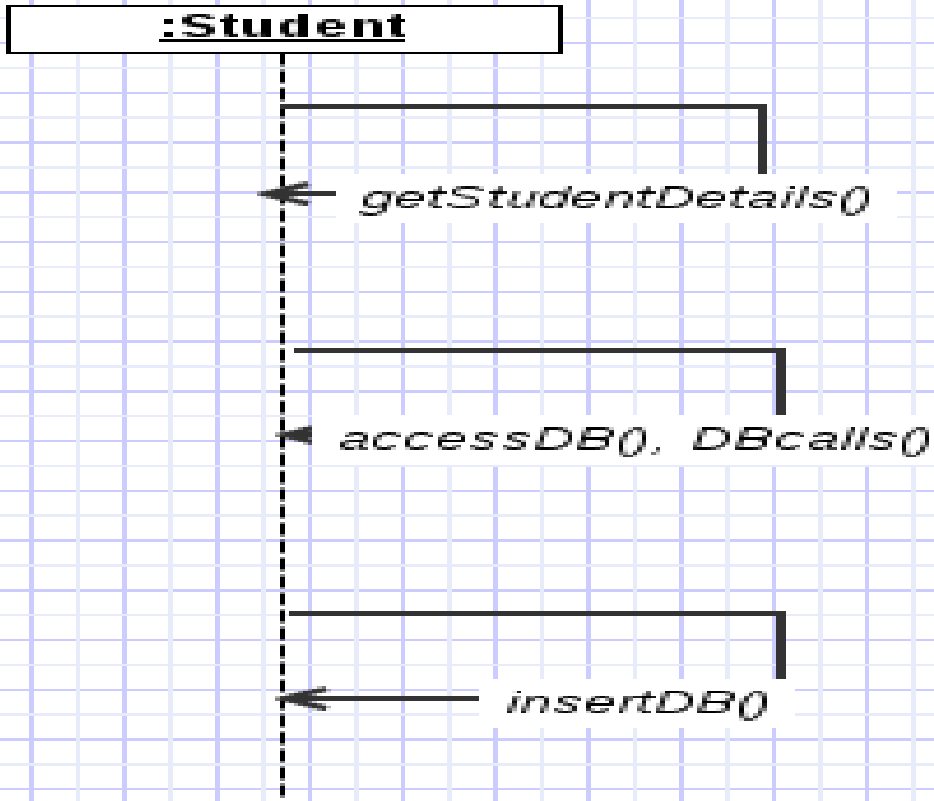
Low Cohesion Example



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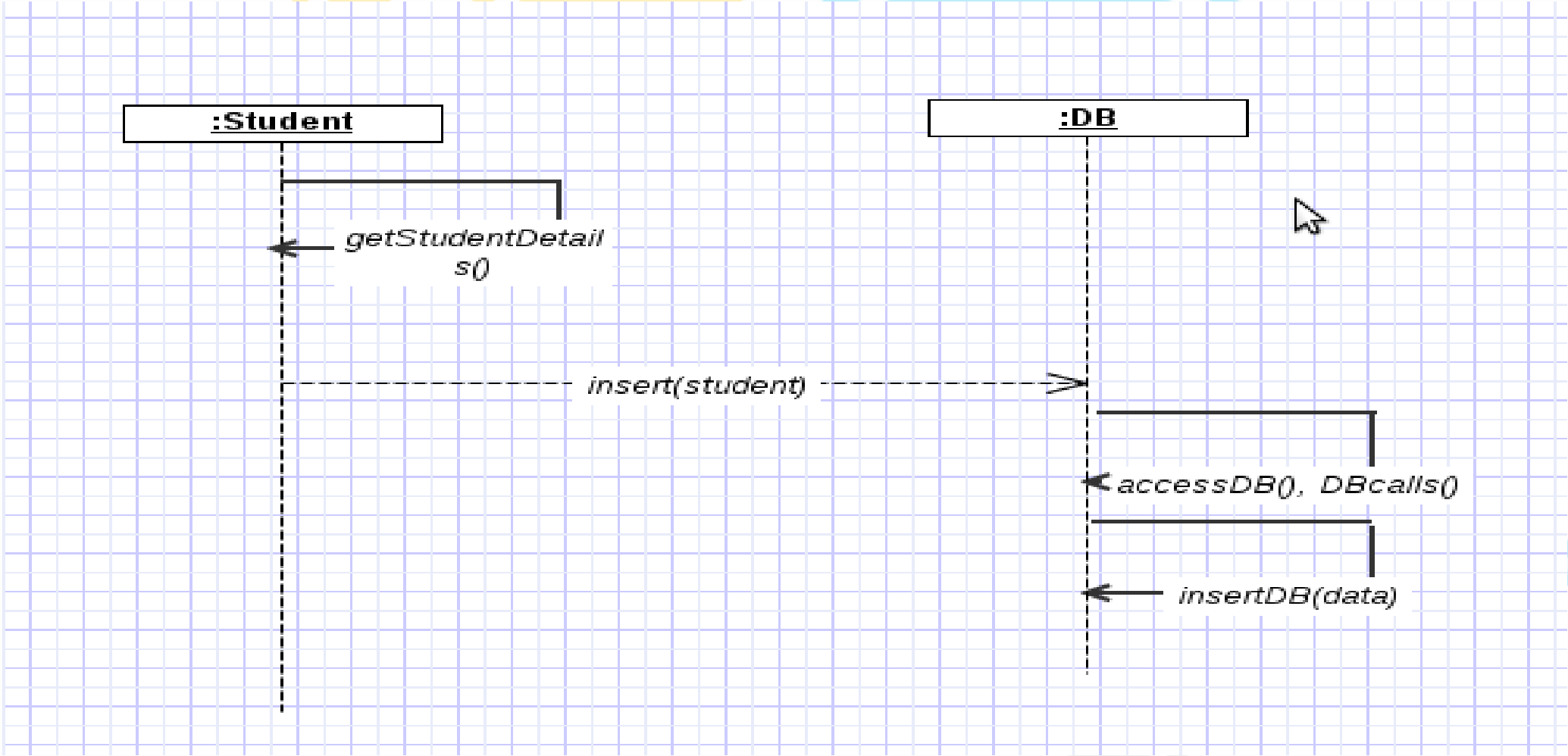
High Cohesion Example



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Polymorphism

- How to handle related but varying elements based on element type?
- Polymorphism guides us in deciding which object is responsible for handling those varying elements.
- Benefits: handling new variations will become easy.

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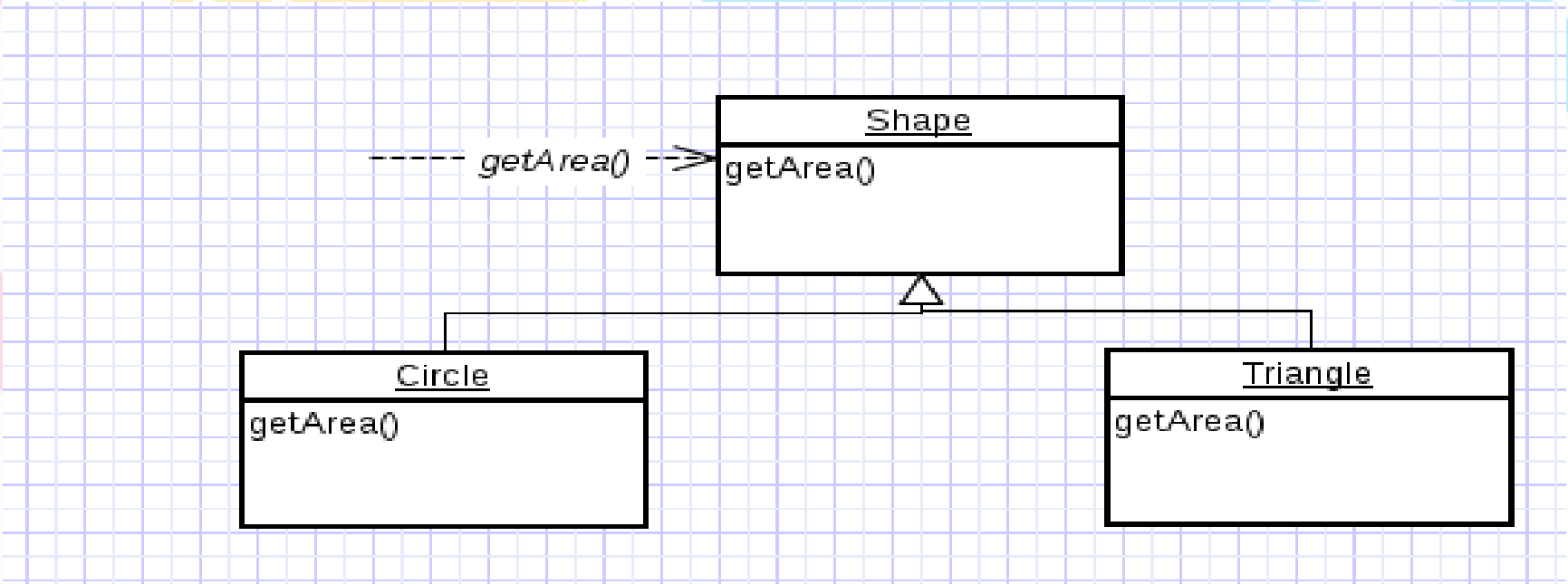
Polymorphism Example

- The getArea() varies by the type of shape, so we assign that responsibility to the subclasses.



- By sending message to the Shape object, a call will be made to the corresponding sub class object – Circle or Triangle.

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Pure Fabrication

- Fabricated class/ artificial class – assign set of related responsibilities that doesn't represent any domain object.
- Provides a highly cohesive set of activities.
- Behavioral decomposed – implements some algorithm.
- Examples: Adapter, Strategy
- Benefits: High cohesion, low coupling and can reuse this class.

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Pure Fabrication Example

- Suppose the Shape class, if we must store the shape data in a database.
- If we put this responsibility in Shape class, there will be many database related operations thus making Shape incohesive.
- So, create a fabricated class DBStore which is responsible to perform all database operations.
- Similarly logInterface which is responsible for logging information is also a good example for Pure Fabrication.

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Indirection

- How can we avoid a direct coupling between two or more elements.
- Indirection introduces an intermediate unit to communicate between the other units, so that the other units are not directly coupled.
- Benefits: low coupling
- Example: Adapter, Facade, Obserever

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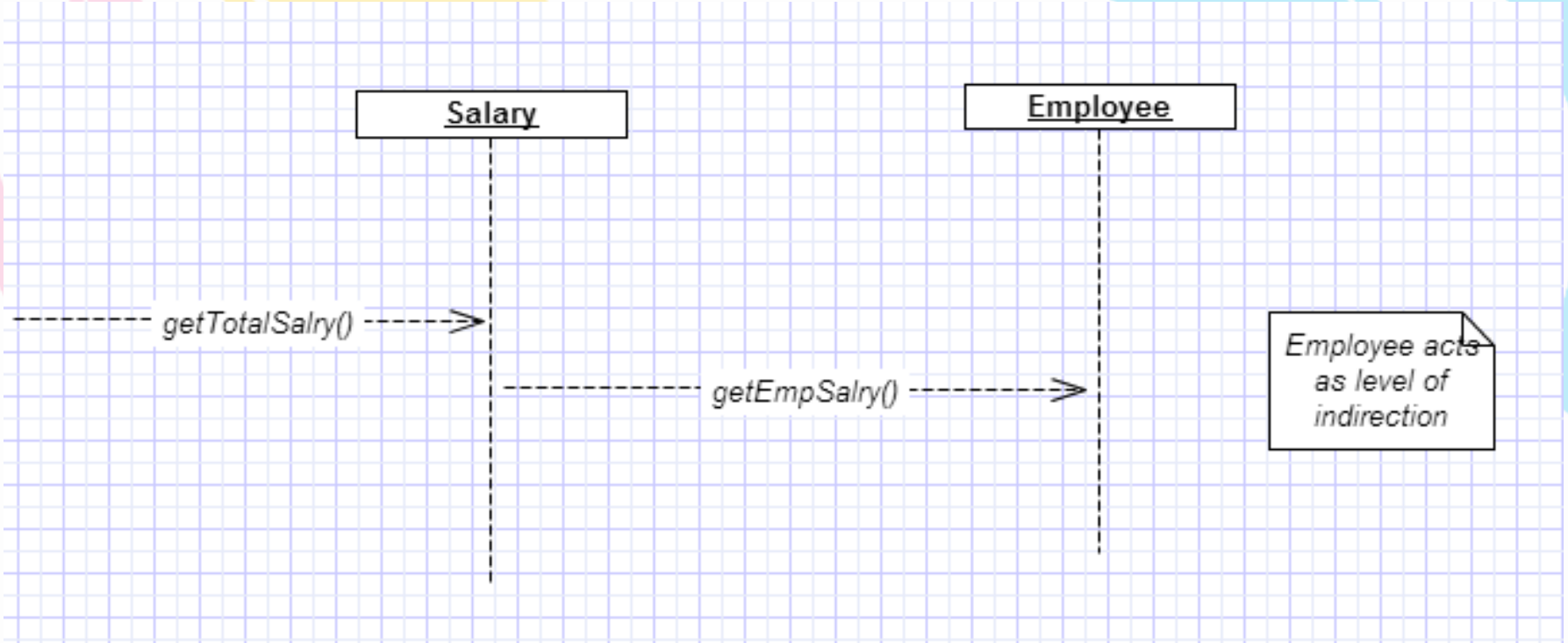
Indirection Example

- Here polymorphism illustrates indirection
- Class Employee provides a level of indirection to other units of the system.



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Protected Variations

- How to avoid impact of variations of some elements on the other elements.
- It provides a well defined interface so that the there will be no affect on other units.
- Provides flexibility and protection from variations.
- Provides more structured design.
- Example: polymorphism, data encapsulation, interfaces

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Reference

Applying UML and Patterns, Third Edition, Craig Larman

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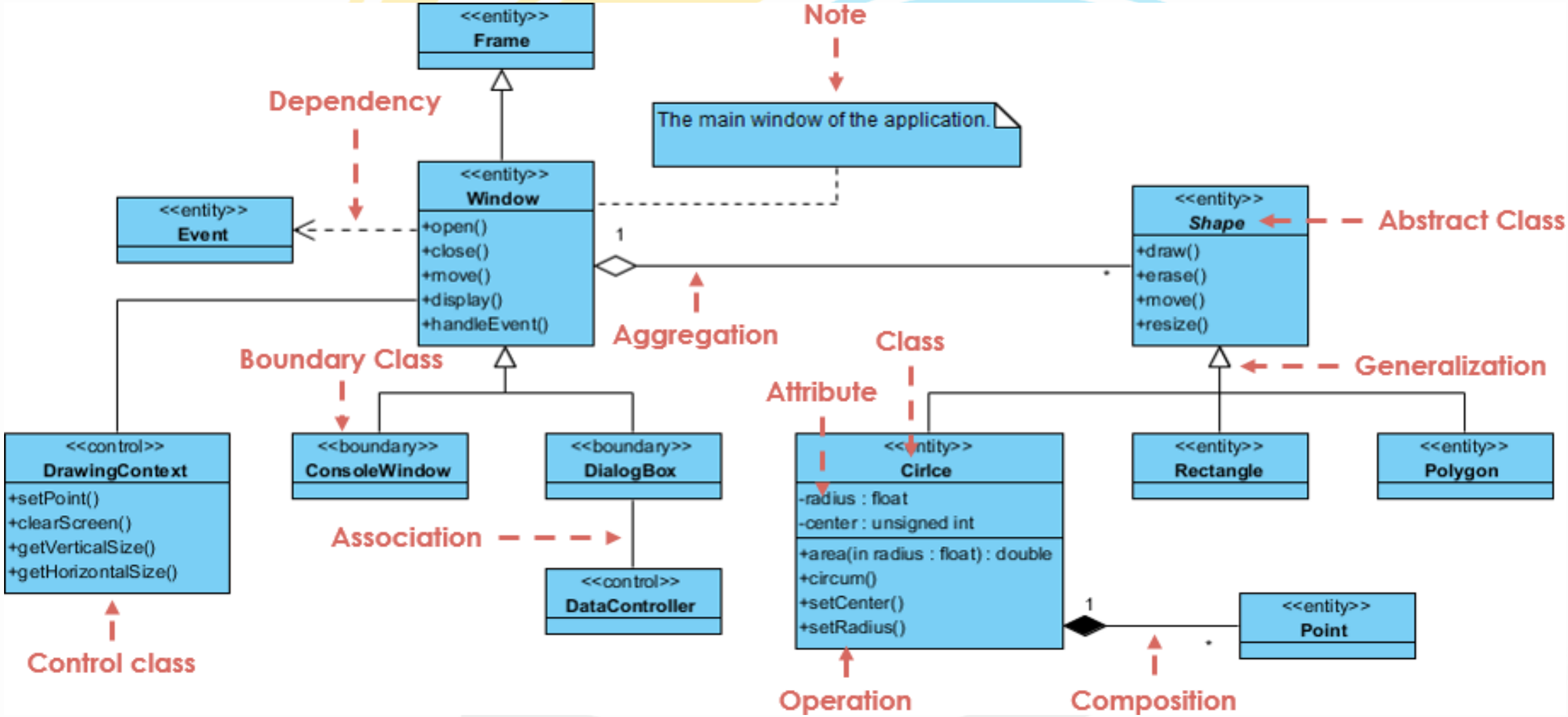
Example of UML Class Diagram



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