Compositing the Control Role

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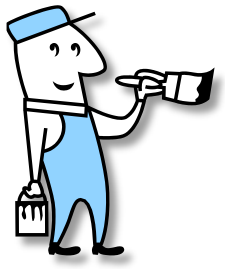
Deception of the Composite Element

- Composite design pattern leads to oversimplification
  - Add one class to the diagram to contain leaf elements and we're done
  - In practice such composite element may become very complicated
    - It receives many responsibilities
- Better approach is to refine classes
  - There could be more than one composite element
    - Separate multiple responsibilities into distinct composite elements
  - There could be more kinds of leaf elements

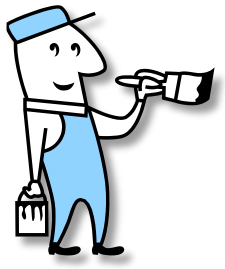
House Painters Example



1 house = 4 days

Total: 20 days

House Painters Example



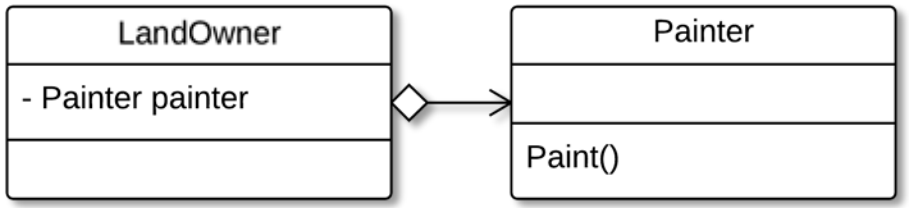
1 house = 4 days

1 house = 5 days

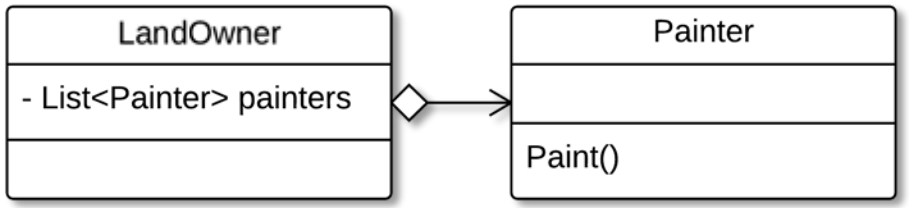
$$T = \frac{5houses}{\frac{1}{4\,days/house} + \frac{1}{5\,days/house}} = \frac{100}{9}\,days$$

Total ~11 days 1 hr

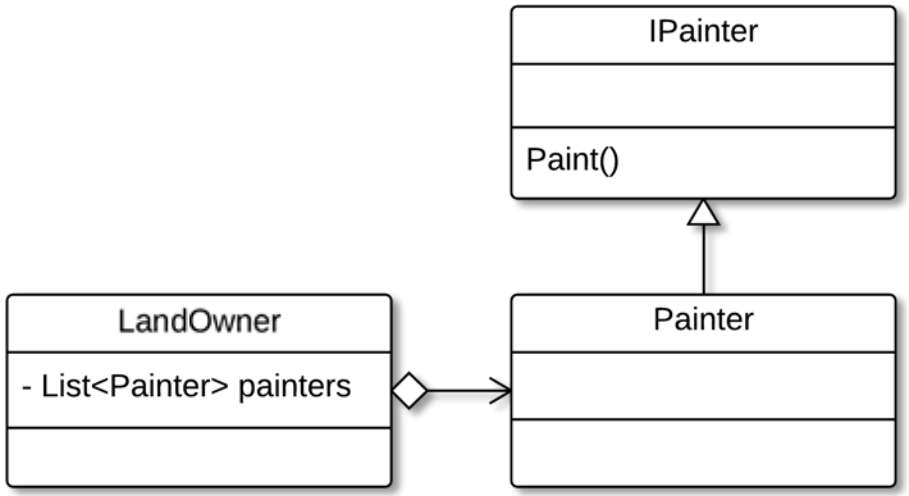
House Painters Class Diagram



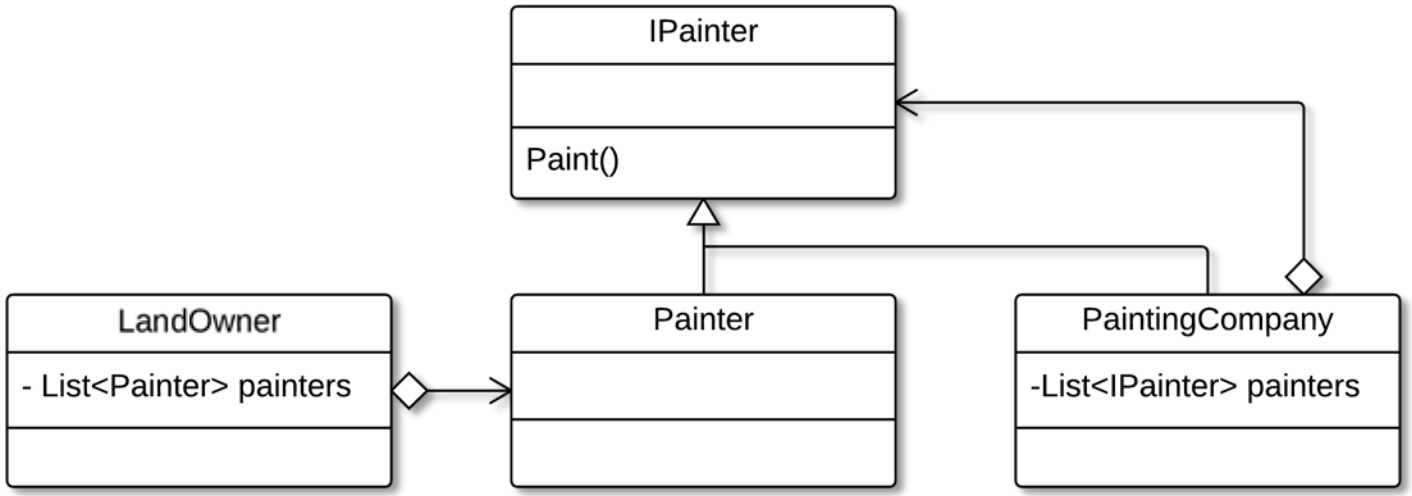
House Painters Class Diagram



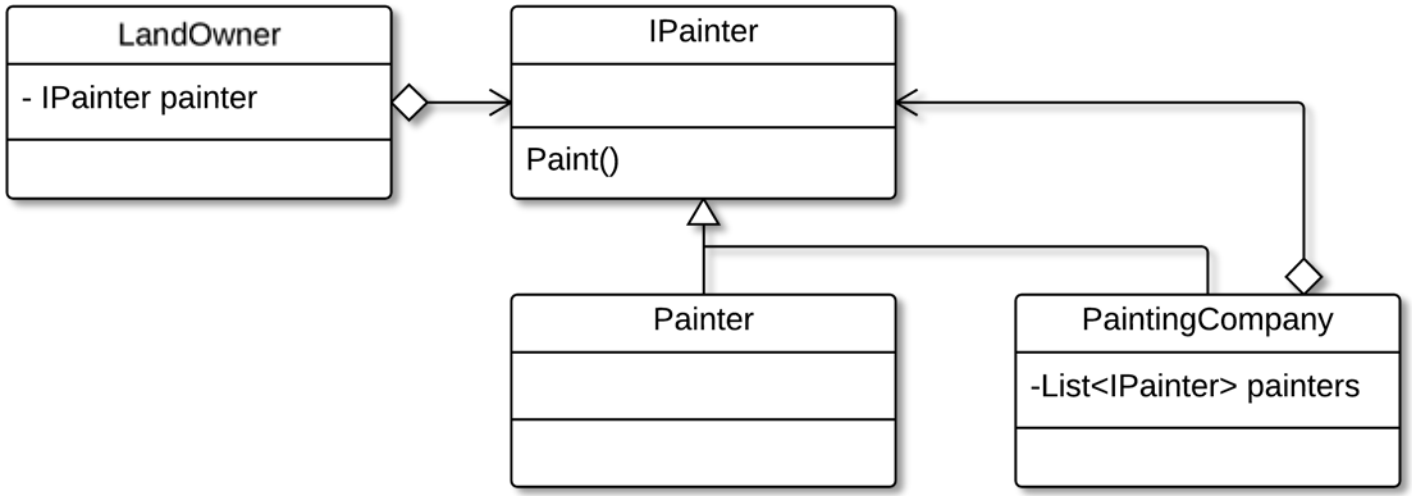
House Painters Class Diagram



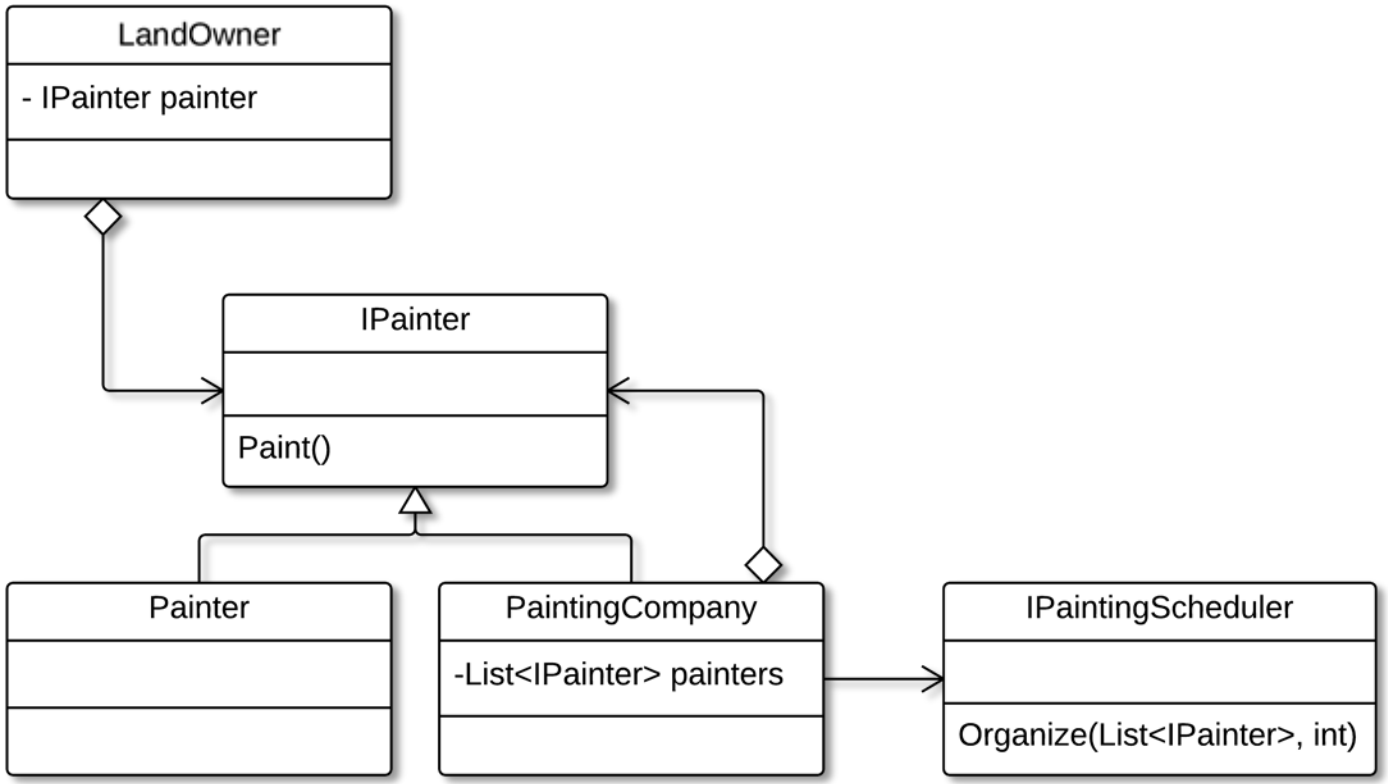
House Painters Class Diagram



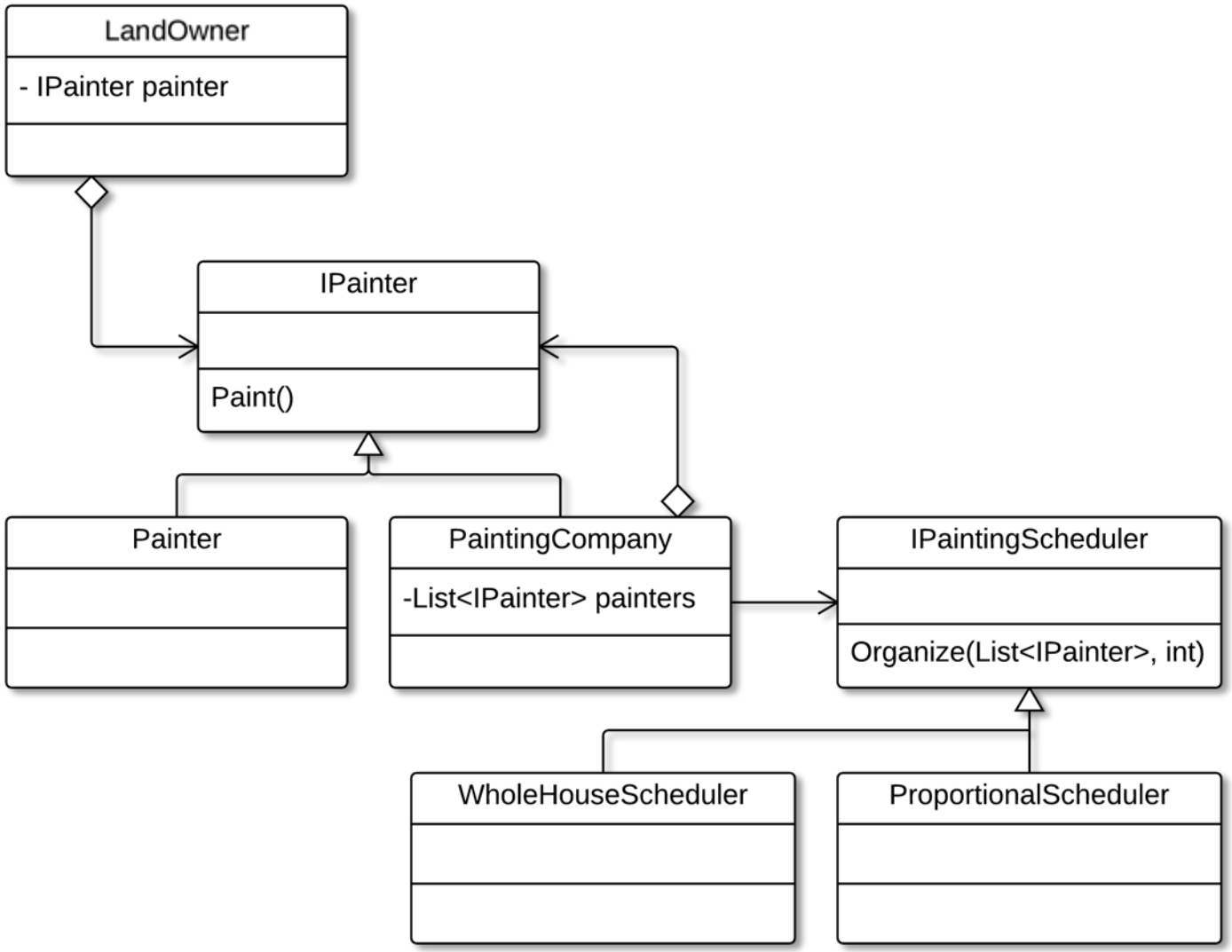
House Painters Class Diagram



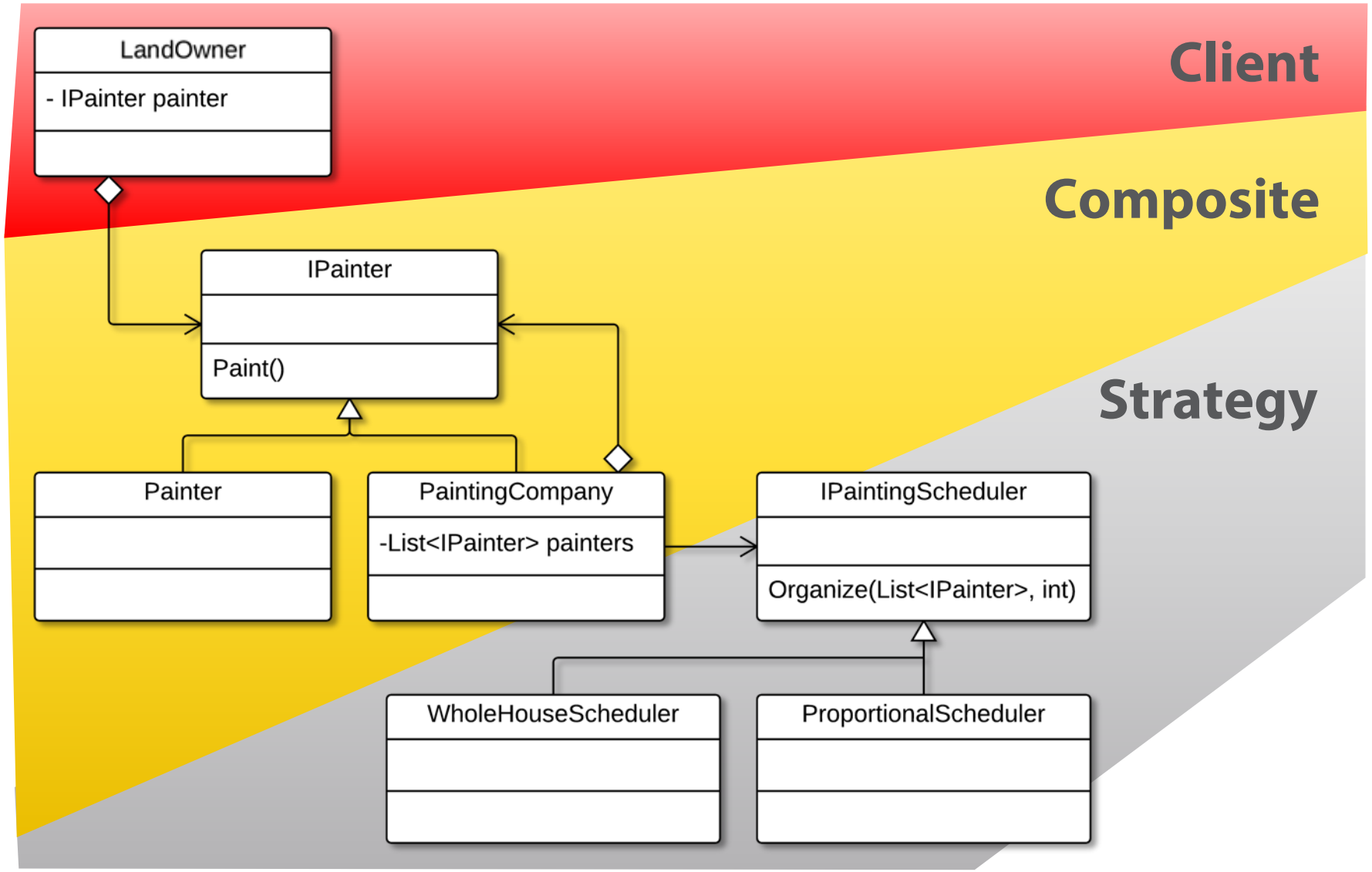
House Painters Class Diagram



House Painters Class Diagram



House Painters Class Diagram



Command-Query Separation Principle

- Definition
  - Command modifies the object
  - Query returns a value
- Command-Query Separation Principle (CQS)
  - Command method modifies the object without returning value
  - Query method returns a value without modifying the object
- Consequences
  - We should not invoke the command method multiple times
    - This is because the object will be modified every time
  - We are safe invoking the query method multiple times
    - This is because we know that the object was not modified in any of the operations

CQS and Composite

- Most common case of the command method
  - Delegate the call to all contained elements
- Problems with the query method
  - Every contained element returns a value
  - Composite object must somehow aggregate the results into a single result of the same type
- Query method returns a number
  - Take minimum, maximum, sum, average, etc.
- Query method returns a complex object
  - Select an element with minimum/maximum value of certain attribute
  - Weighted sum of element results based on special numeric attribute
  - Custom aggregation function that produces a single object

Composite with CQS in Practice

- Cost of applying the Composite design pattern
  - Easy to compose commands in general
  - Harder to compose queries in general
  - Composite is still applicable to both commands and queries
- One well-known counter-example
  - Map-reduce design pattern implemented as Composite
  - Such operation is a query by definition
  - Often, suitable reduce function is available
  - Map-reduce can then be implemented as Composite

Summary

- House painters example
  - Client became complex and inflexible
  - Composite element pulled the complexity out from the client
  - Business rules were pulled out into a strategy
- Lessons learned about the Composite design pattern
  - Pattern comes last to the picture
  - Orchestration and related logic pulled out from the client
- Composite can be applied to CQS