Patterns in Software Engineering

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Lecture 5

GoF Design Patterns – Behavioral

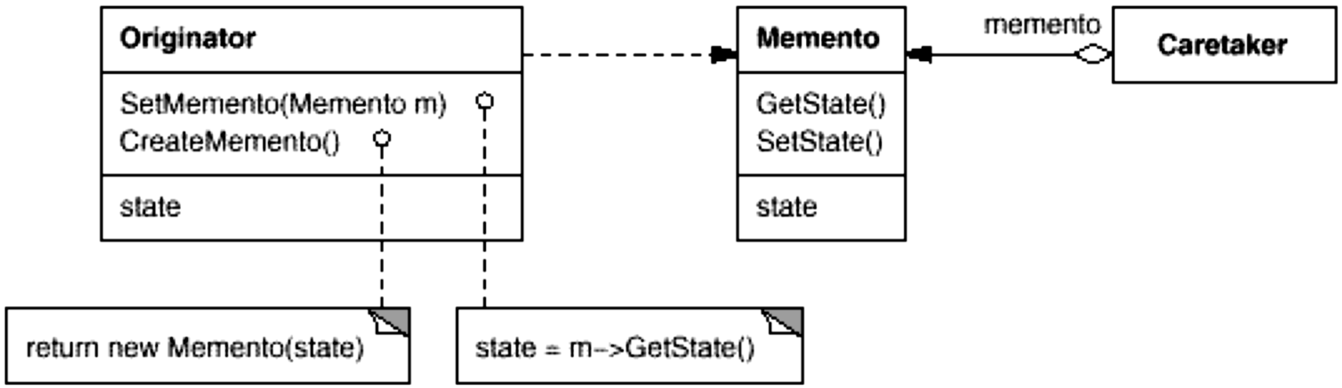
Part 2

Memento

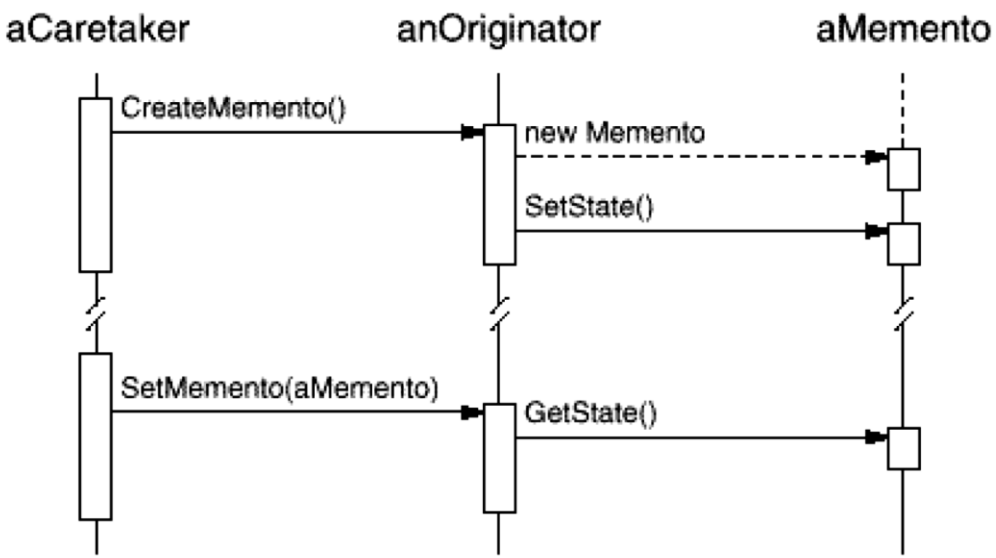
- Intent:
  - Without violating encapsulation, capture and externalize an object's internal state so that the object can be restored to this state later.

- Applicability:
  - Use the Memento pattern when
    - a snapshot of (some portion of) an object's state must be saved so that it can be restored to that state later, *and*
    - a direct interface to obtaining the state would expose implementation details and break the object's encapsulation.

Memento: Structure



Memento: Collaboration



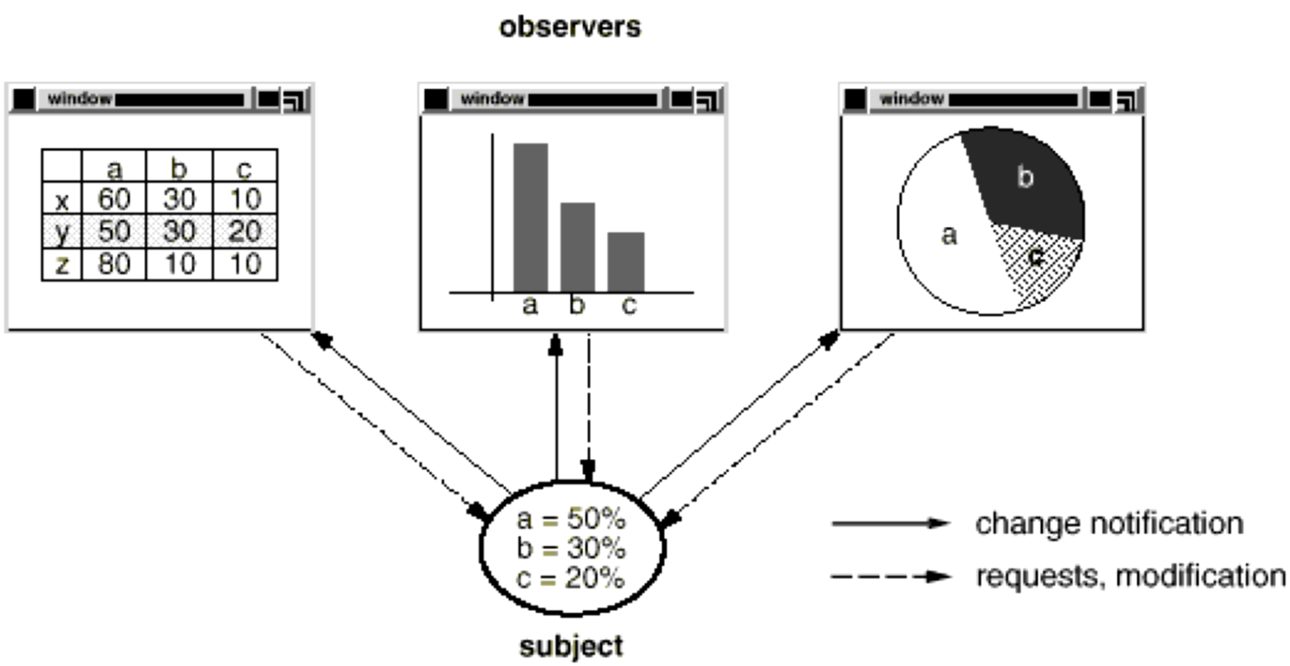
Memento: Consequences

- ✓ *Preserving encapsulation boundaries.* The pattern shields other objects from potentially complex Originator internals.
- ✓ *It simplifies Originator.* Having clients manage the state they ask for simplifies Originator and keeps clients from having to notify originators when they're done.

- ✗ *Using mementos might be expensive.* Mementos might incur considerable overhead if Originator must copy large amounts of information to store in the memento or if clients create and return many mementos.
- ✗ *Defining narrow and wide interfaces.* It may be difficult in some languages to ensure that only the originator can access the memento's state.
- ✗ *Hidden costs in caring for mementos.*

Observer

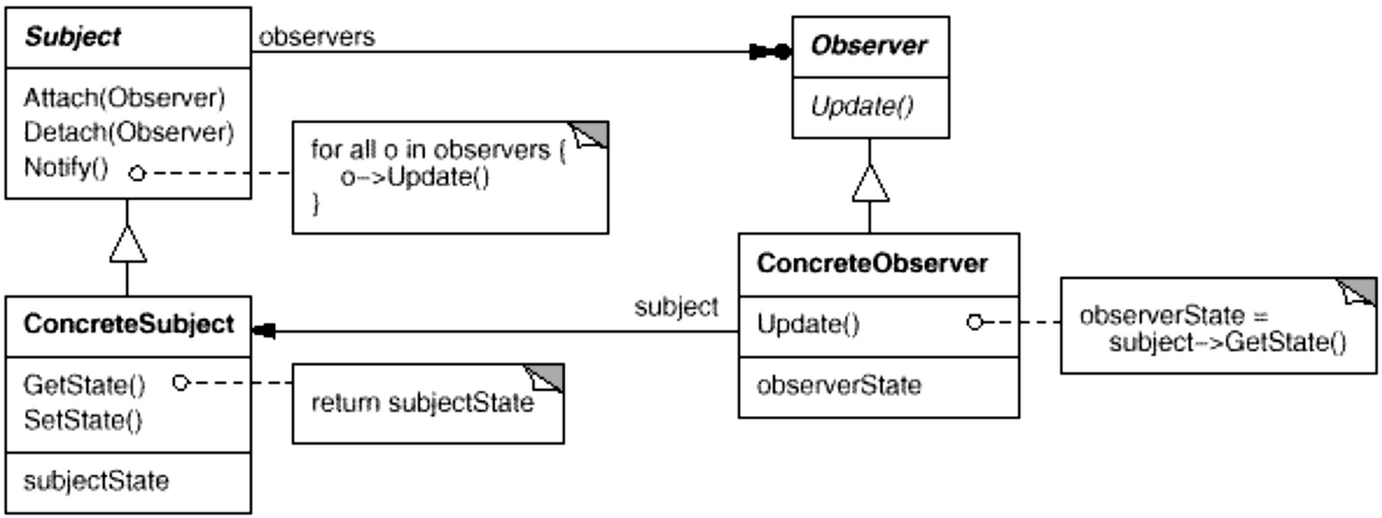
- Intent:
  - Define a one-to-many dependency between objects so that when one object changes state, all its dependents are notified and updated automatically.



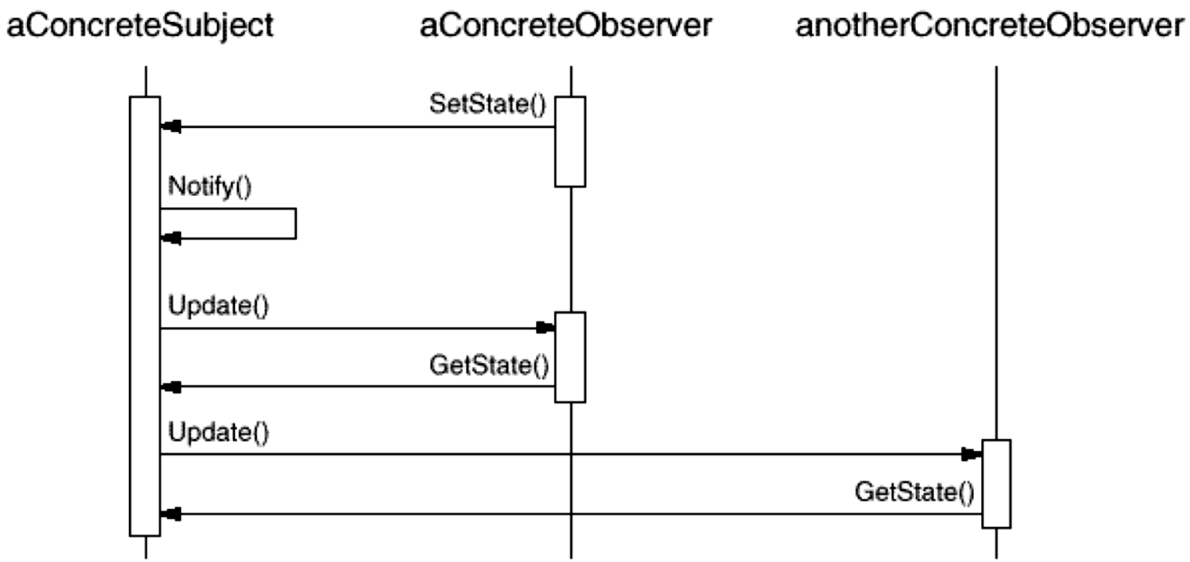
Observer: Applicability

- Use the Observer pattern when
  - an abstraction has two aspects, one dependent on the other. Encapsulating these aspects in separate objects lets you vary and reuse them independently.
  - a change to one object requires changing others, and you don't know how many objects need to be changed.
  - an object should be able to notify other objects without making assumptions about who these objects are. In other words, you don't want these objects tightly coupled.

Observer: Structure



Observer: Collaboration



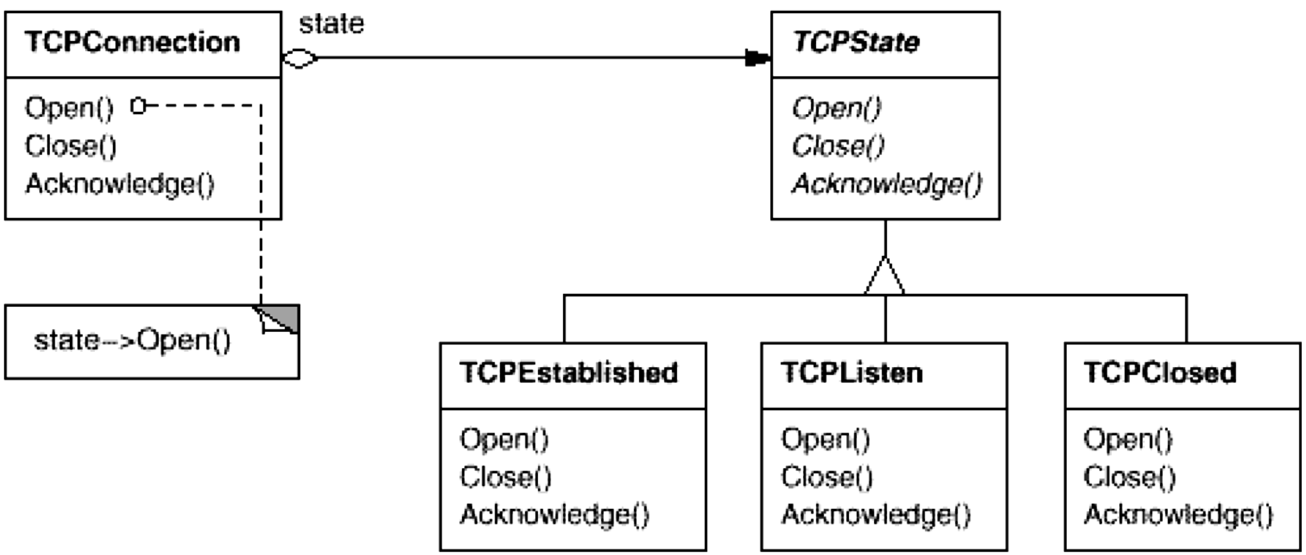
Observer: Consequences

- ✓ *Abstract coupling between Subject and Observer.*
- ✓ *Support for broadcast communication.* The notification is broadcast automatically to all interested objects that subscribed to it.

- ✗ *Unexpected updates.* Because observers have no knowledge of each other's presence, they can be blind to the ultimate cost of changing the subject.
  - ✗ A seemingly innocuous operation on the subject may cause a cascade of updates to observers and their dependent objects.

State

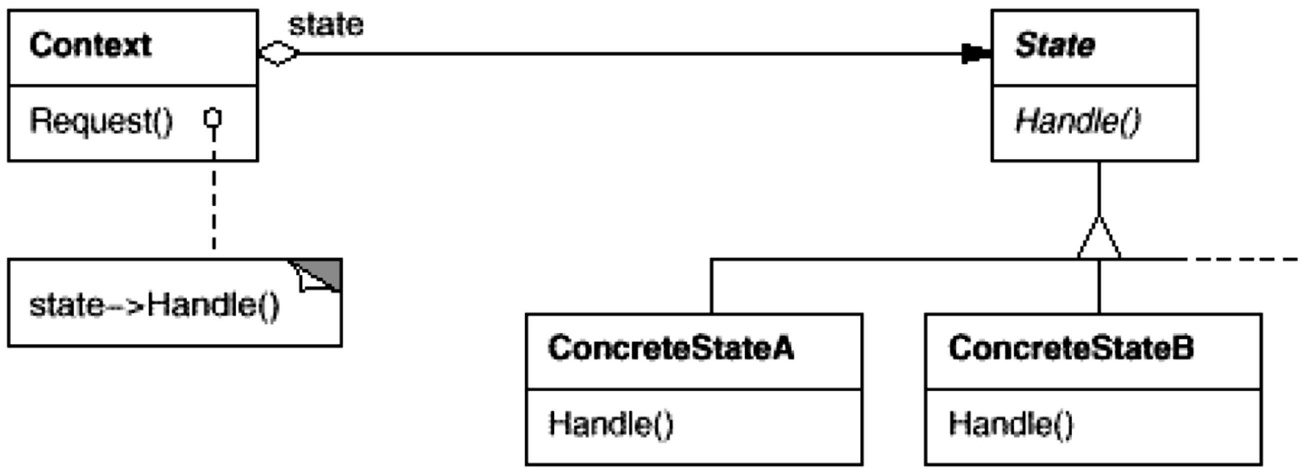
- Intent:
  - Allow an object to alter its behavior when its internal state changes. The object will appear to change its class.



State: Applicability

- Use the State pattern when
  - An object's behavior depends on its state, and it must change its behavior at run-time depending on that state.
  - Operations have large, multipart conditional statements that depend on the object's state.

State: Structure

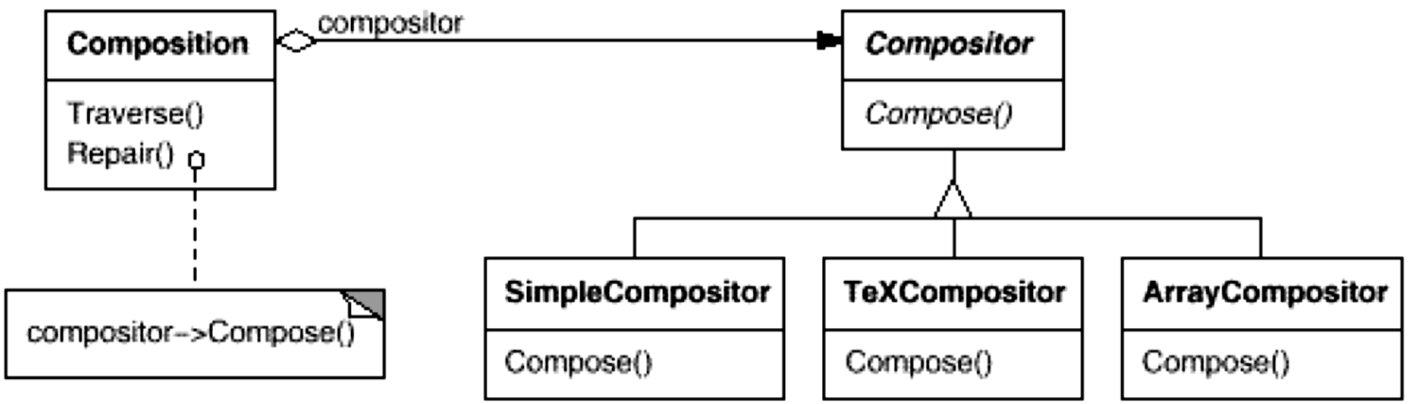


State: Consequences

- ✓ *It localizes state-specific behavior and partitions behavior for different states.* New states and transitions can be added easily by defining new subclasses.
- ✓ *It makes state transitions explicit.*
- ✓ *State objects can be shared.*

Strategy

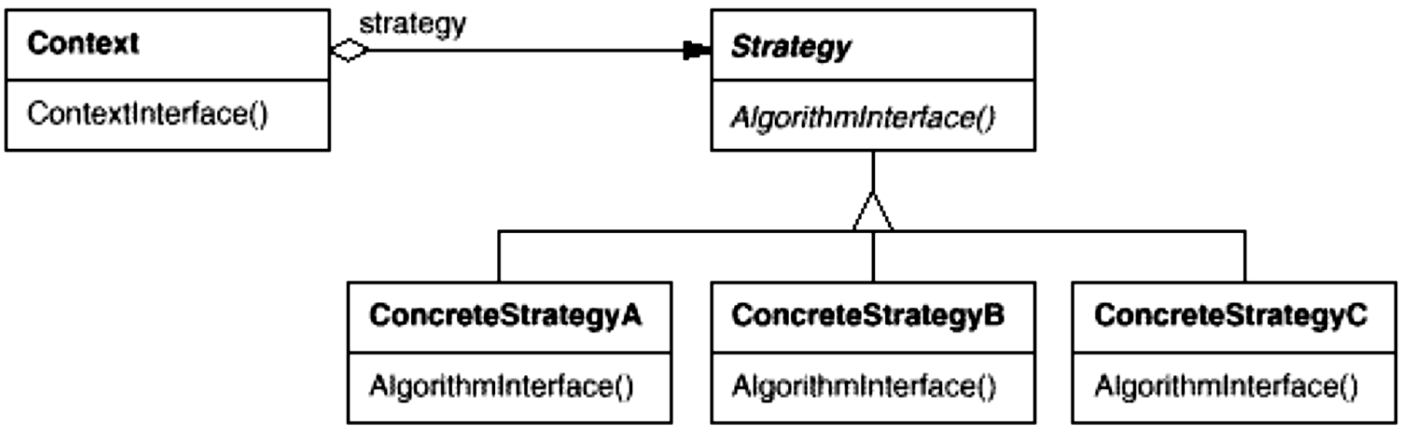
- Intent:
  - Define a family of algorithms, encapsulate each one, and make them interchangeable. Strategy lets the algorithm vary independently from clients that use it.



Strategy: Applicability

- Use the Strategy pattern when
  - many related classes differ only in their behavior. Strategies provide a way to configure a class with one of many behaviors.
  - you need different variants of an algorithm. For example, you might define algorithms reflecting different space/time trade-offs.
  - an algorithm uses data that clients shouldn't know about. Use the Strategy pattern to avoid exposing complex, algorithm-specific data structures.
  - a class defines many behaviors, and these appear as multiple conditional statements in its operations.

Strategy: Structure



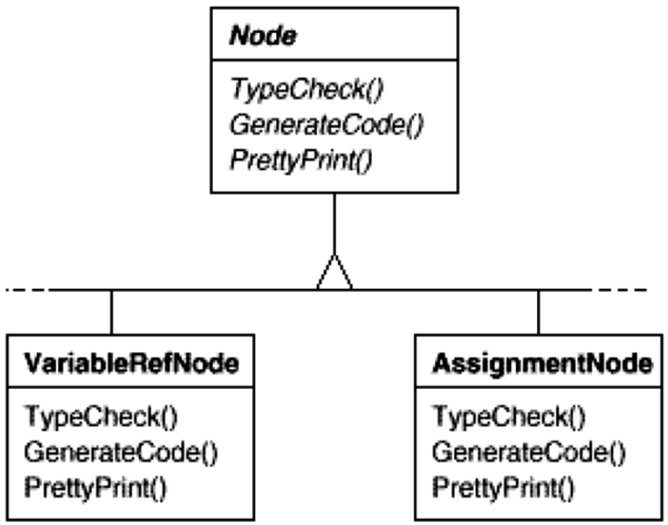
Strategy: Consequences

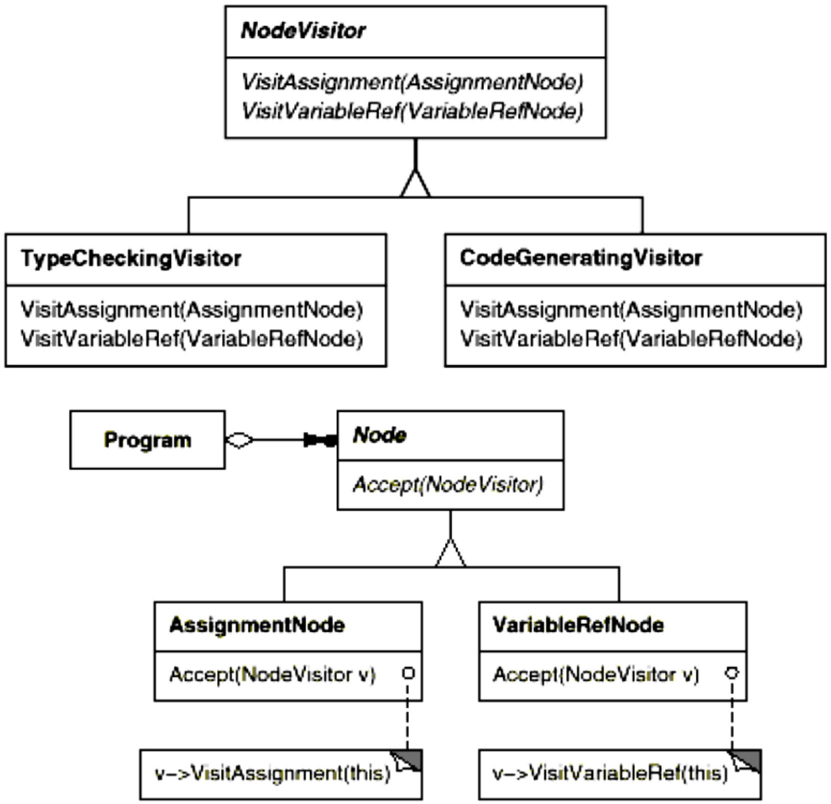
- ✓ *Families of related algorithms.*
- ✓ *An alternative to subclassing.*
- ✓ *Strategies eliminate conditional statements.*
- ✓ *A choice of implementations.* Strategies can provide different implementations of the *same* behavior. The client can choose among strategies with different time and space trade-offs.

- ✗ *Clients must be aware of different Strategies.*
- ✗ *Communication overhead between Strategy and Context.*
- ✗ *Increased number of objects.*

Visitor

- Intent:
  - Represent an operation to be performed on the elements of an object structure; lets you define a new operation without changing the classes of the elements on which it operates.

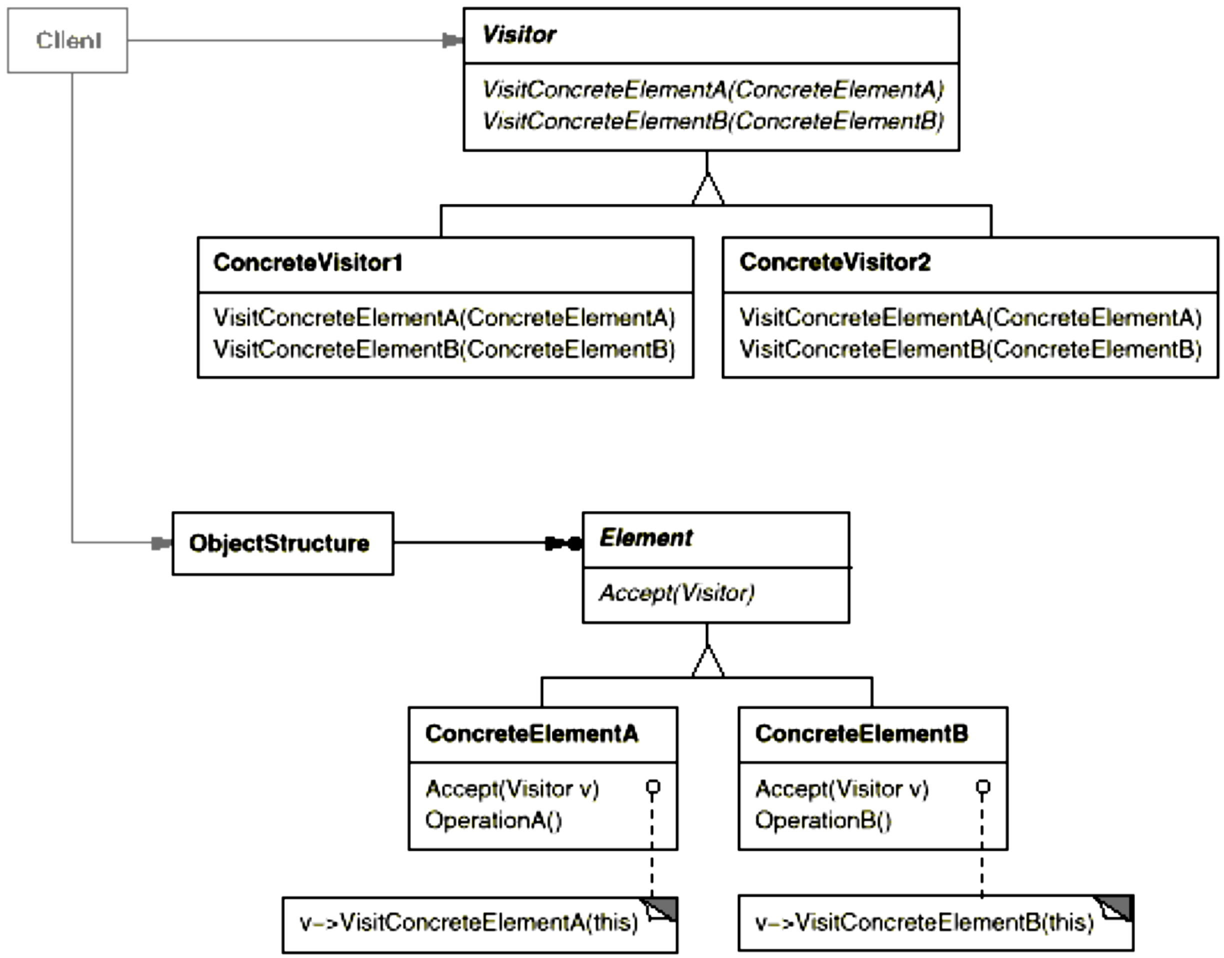




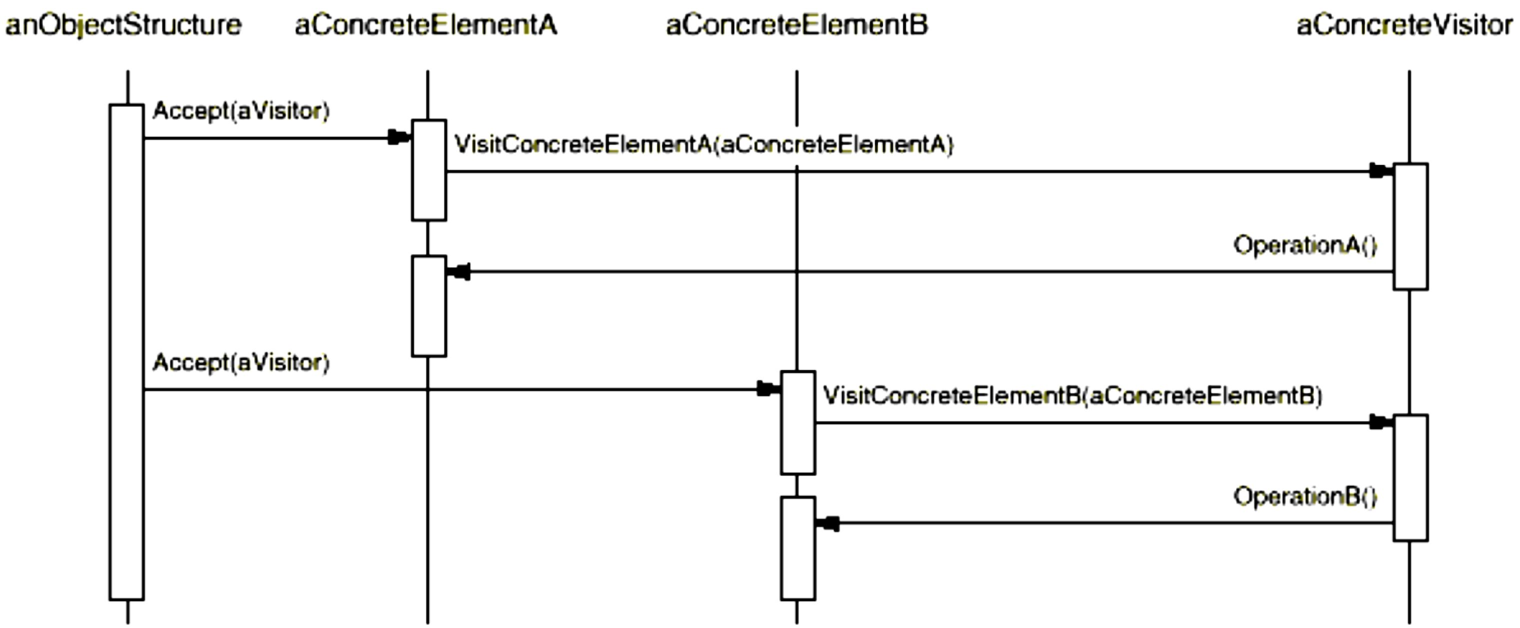
Visitor: Applicability

- Use the Visitor pattern when
  - an object structure contains many classes of objects with differing interfaces, and you want to perform operations on these objects that depend on their concrete classes.
  - many distinct and unrelated operations need to be performed on objects in an object structure, and you want to avoid "polluting" their classes with these operations.
  - the classes defining the object structure rarely change, but you often want to define new operations over the structure.

Visitor: Structure



Visitor: Collaborations



Visitor: Consequences

- ✓ *Visitor makes adding new operations easy.*
- ✓ *A visitor gathers related operations and separates unrelated ones.*

- ✗ *Adding new ConcreteElement classes is hard.*
- ✗ *Breaking encapsulation.* The pattern often forces you to provide public operations that access an element's internal state, which may compromise its encapsulation.

Reference

- Gamma, E., Helm, R., Johnson, R., and Vlissides, J., *Design Patterns: Elements of Reusable Object-oriented Software.* Addison-Wesley, 1995.