Behavioral Design Patterns

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Acknowledgement

The content of the following slides are partially based on the listed material as follows:

- Object-Oriented Patterns & Frameworks by Dr. Douglas C. Schmidt
- https://en.wikipedia.org/wiki/Strategy_pattern
- https://en.wikipedia.org/wiki/Observer_pattern
- https://en.wikipedia.org/wiki/Command_pattern
- https://en.wikipedia.org/wiki/Template_method_pattern
- https://en.wikipedia.org/wiki/Iterator_pattern
- https://en.wikipedia.org/wiki/Null_Object_pattern

WARNING:

Overuse of design patterns can lead to code that is downright over-engineered. Always go with the simplest solution that does the job and introduce patterns only where the need emerges.

Freeman, E., Robson, E., Bates, B., & Sierra, K. (2008). *Head first design patterns*. " O'Reilly Media, Inc."

Behavioral Design Patterns

- Strategy
- Observer
- Command
- Template Method
- Iterator
- Null Object

ยุทธศาสตร์

Strategy

Strategy: Problem

- How to independently vary algorithm from clients that use it?
- How to defer the decision about which algorithm to use until runtime?

Applicability

- when an object should be configurable with one of many algorithms,
- and all algorithms can be encapsulated,
- and one interface covers all encapsulations

Strategy: Solution

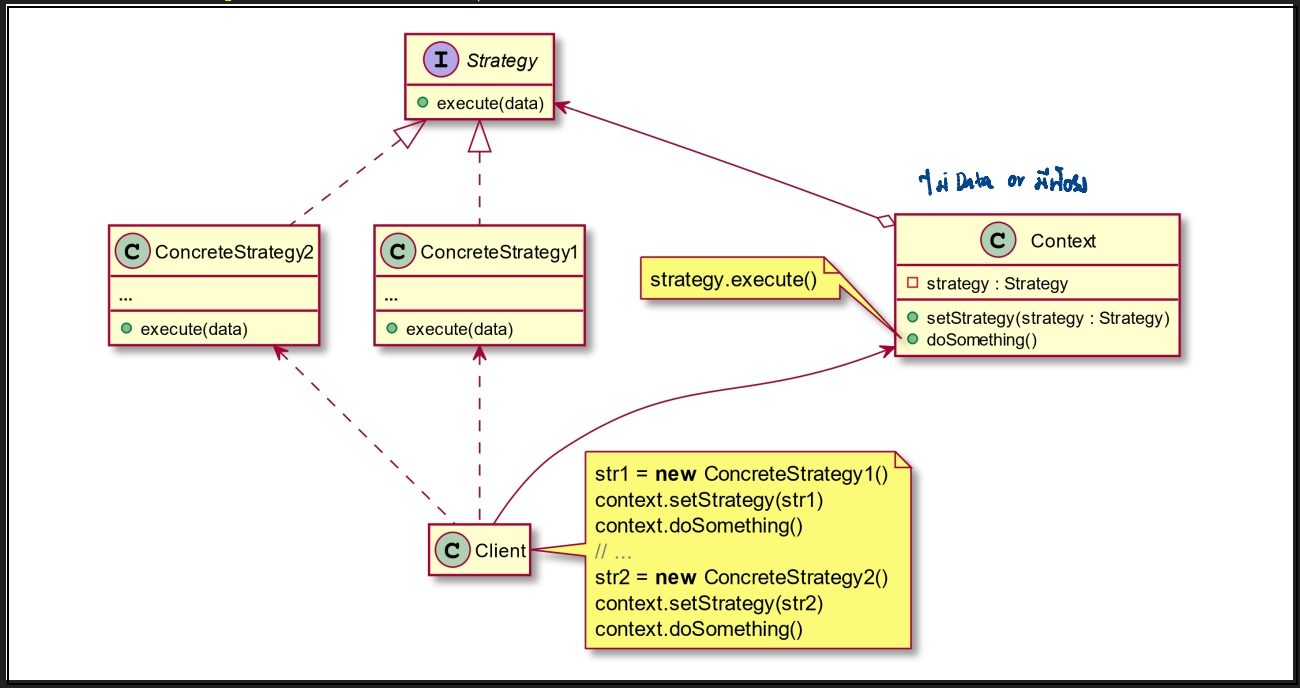
Intent

- Define a family of algorithms, encapsulate each one, & make them interchangeable to let clients & algorithms vary independently.

What solution does the Strategy design pattern describe?

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

Strategy ขยาย ก. สามารถ โดยไม่ยุ่งกับ Context / วิธีดีเกิน



Strategy: Consequences

+ Greater flexibility, reuse.
+ Can change algorithms dynamically.
– Strategy creation & communication overhead.
– Inflexible Strategy interface.
– Semantic incompatibility of multiple strategies used together.

Strategy: Examples

- Strategy (refactoring.guru)
- Strategy pattern – Wikipedia
- Strategy Design Pattern in Java - Example Tutorial – JournalDev

*ใช้เยอะ

Observer

อีกชื่อ Also known as:

บางครั้งชื่อ

Event-Subscriber, Listener

└ นิยมกว่า #ดูตัวแปรว่าใช่observer จริงมั้ย จุดสังเกตุ!

ผู้สังเกตการณ์ pub-sub

Observer: Problem

- A one-to-many dependency between objects should be defined without making the objects tightly coupled.
- It should be ensured that when one object changes state, an open-ended number of dependent objects are updated automatically.
- It should be possible that one object can notify an open-ended number of other objects.

Applicability

- An abstraction has two aspects, one dependent on the other.
- A change to one object requires changing untold others.
- An object should notify unknown other objects.

Observer: Solution

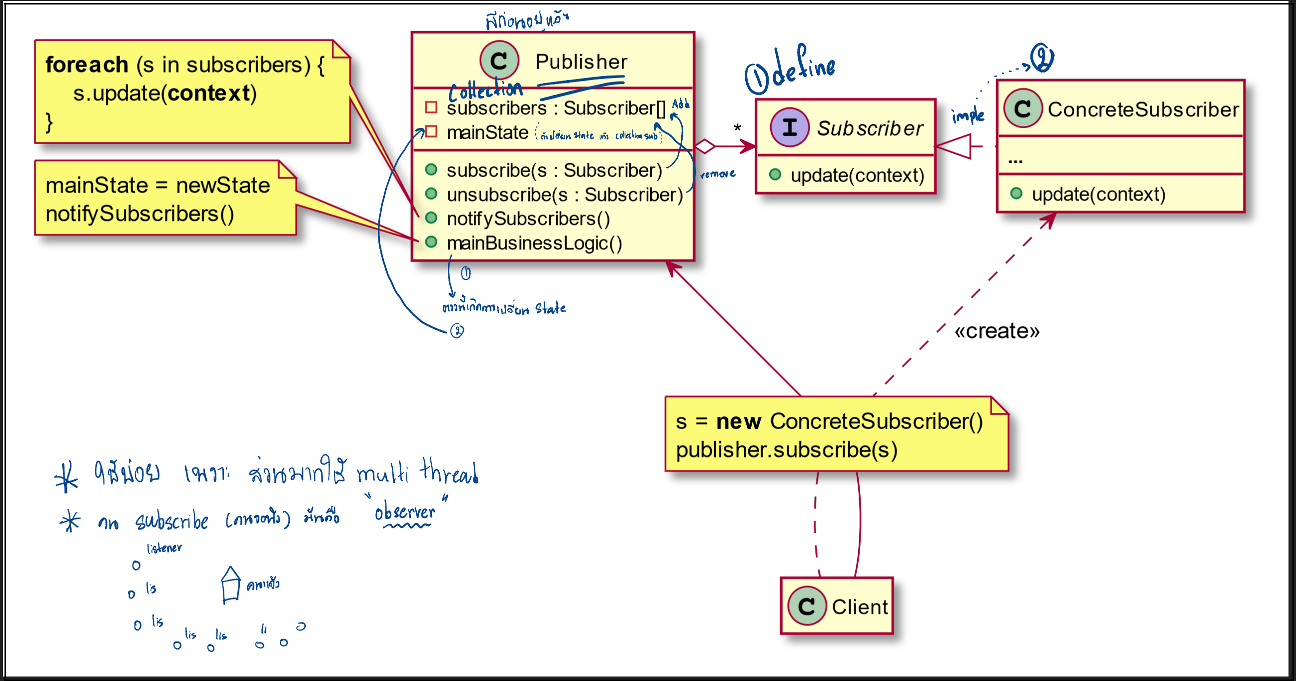
Intent

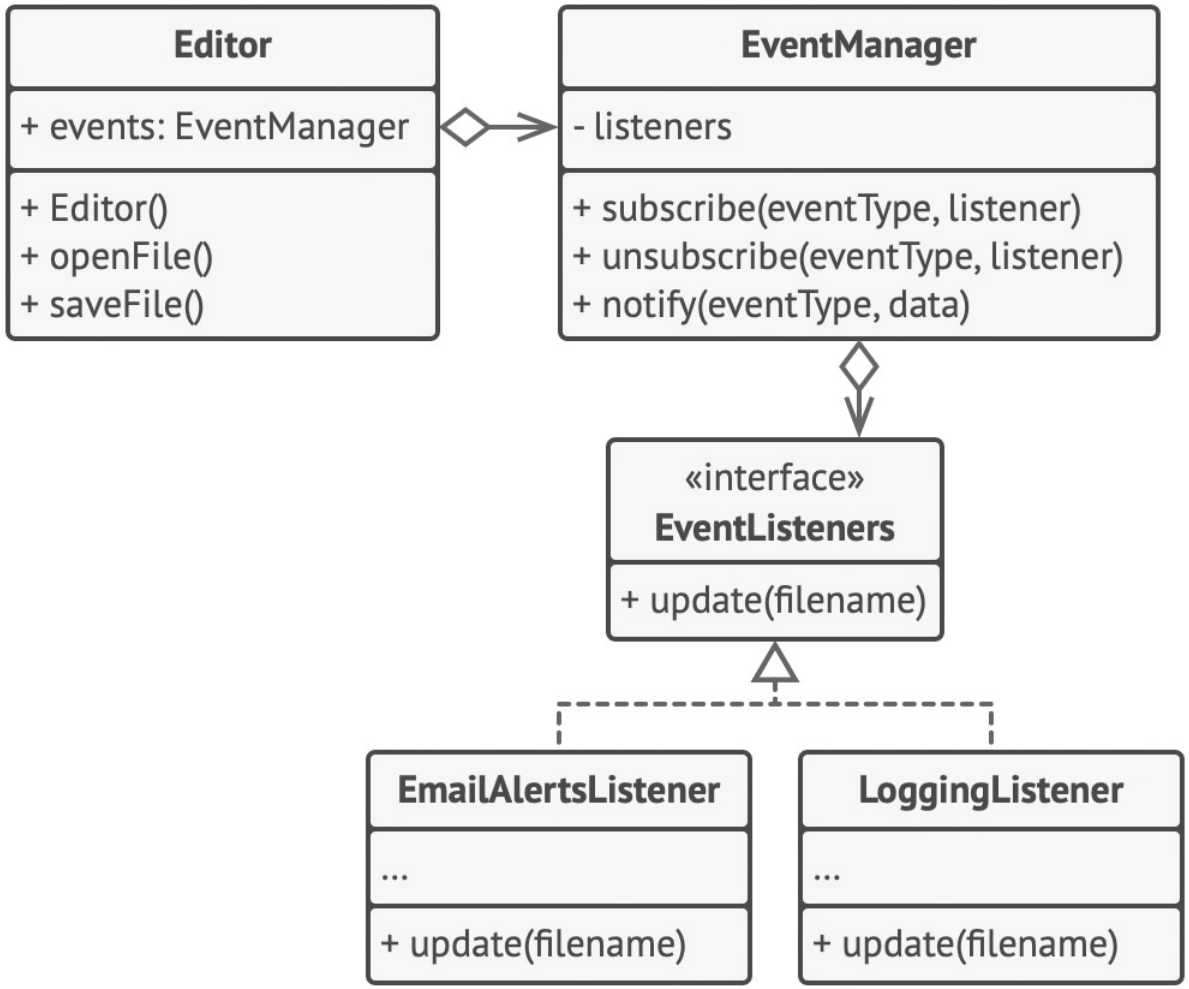
- Define a one-to-many dependency between objects so that when one object changes state, all dependents are notified & updated.

What solution does the Observer design pattern describe?

- Define Subject and Observer objects.
- So that when a subject changes state, all registered observers are notified and updated automatically (and probably asynchronously).

observer / listener





Notifying objects about events that happen to other objects.

Observer: Consequences

+ Modularity: subject & observers may vary independently.
+ Extensibility: can define & add any number of observers.
+ Customizability: different observers offer different views of subject.
– Unexpected updates: observers don't know about each other.
– Update overhead: might need hints or filtering.

Observer: Examples

- Observer (refactoring.guru)
- Observer pattern – Wikipedia
- Observer Design Pattern in Java – JournalDev

ใช้บ่อยกับ App ที่มี user interface
mobile ใช้เยอะ, เงินไม่ค่อย

Command

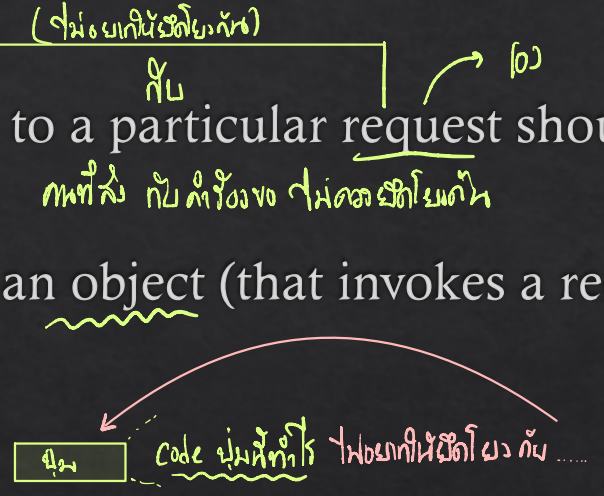
Also known as:

อีกเสียง อีกเรื่อง

Action, Transaction

Command: Problem

- Coupling the invoker of a request to a particular request should be avoided. That is, hard-wired requests should be avoided.
- It should be possible to configure an object (that invokes a request) with a request.



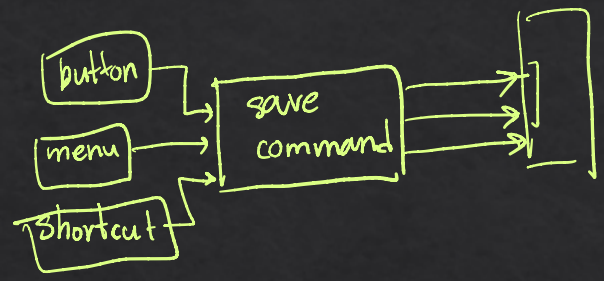
Applicability

- To parameterize objects with an action to perform
- To specify, queue, & execute requests at different times
- For multilevel undo/redo.

Command: Solution

Intent

- Encapsulate the request for a service.

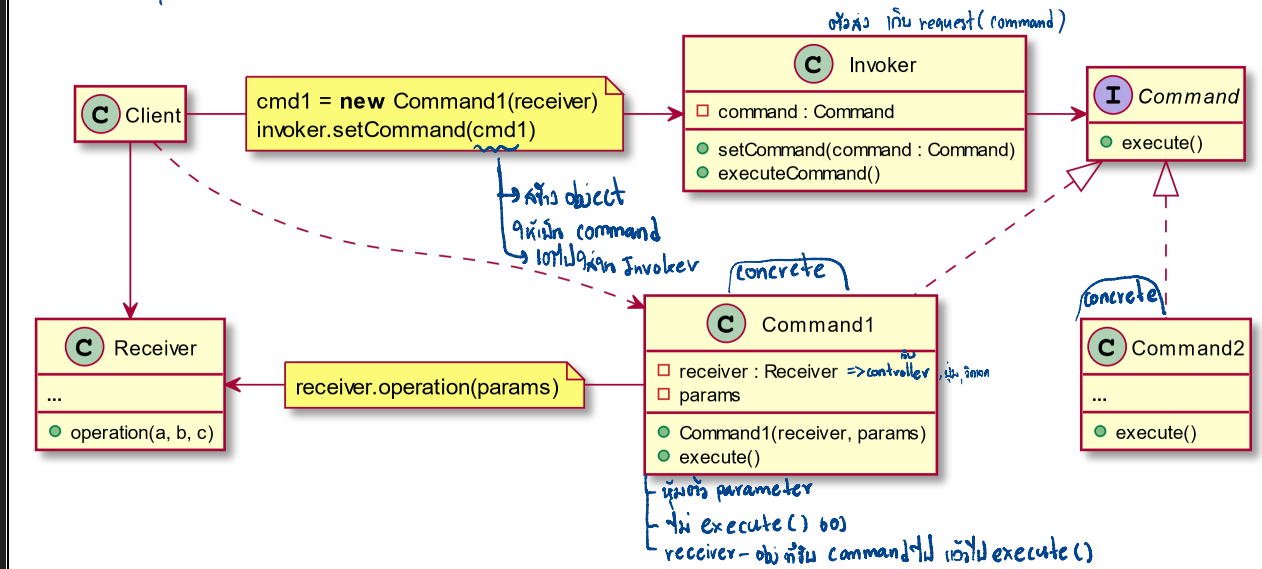


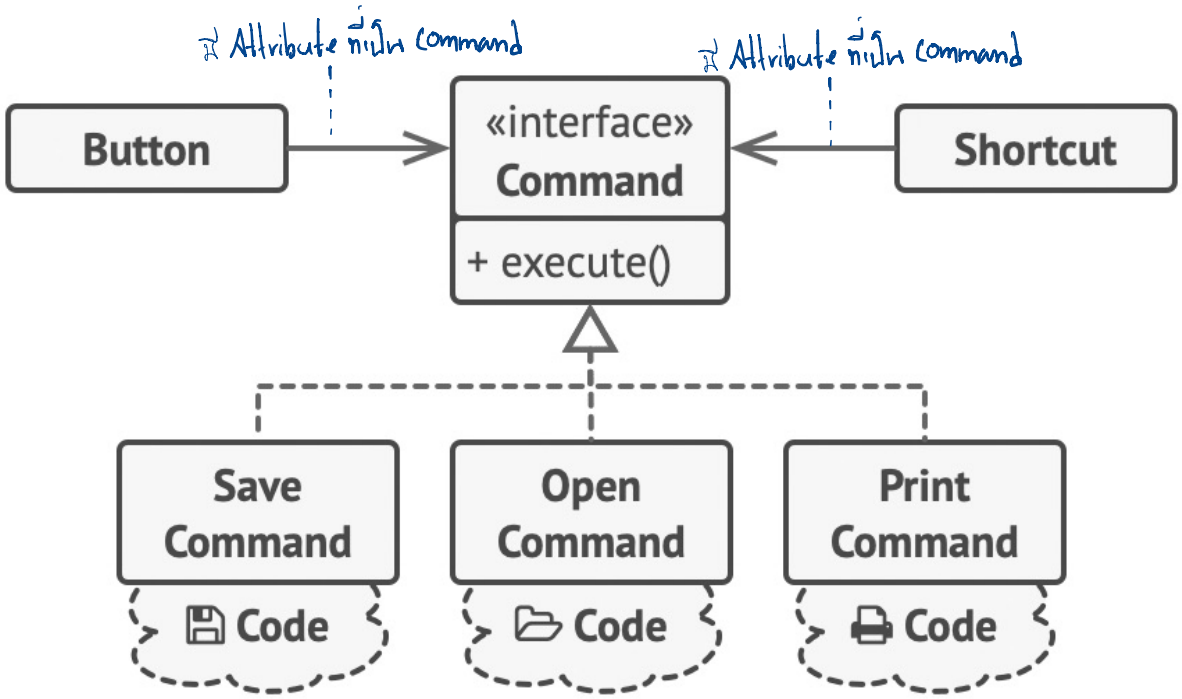
Using the command design pattern describes the following solution:

- Define separate (command) objects that encapsulate a request.
- A class delegates a request to a command object instead of implementing a particular request directly.

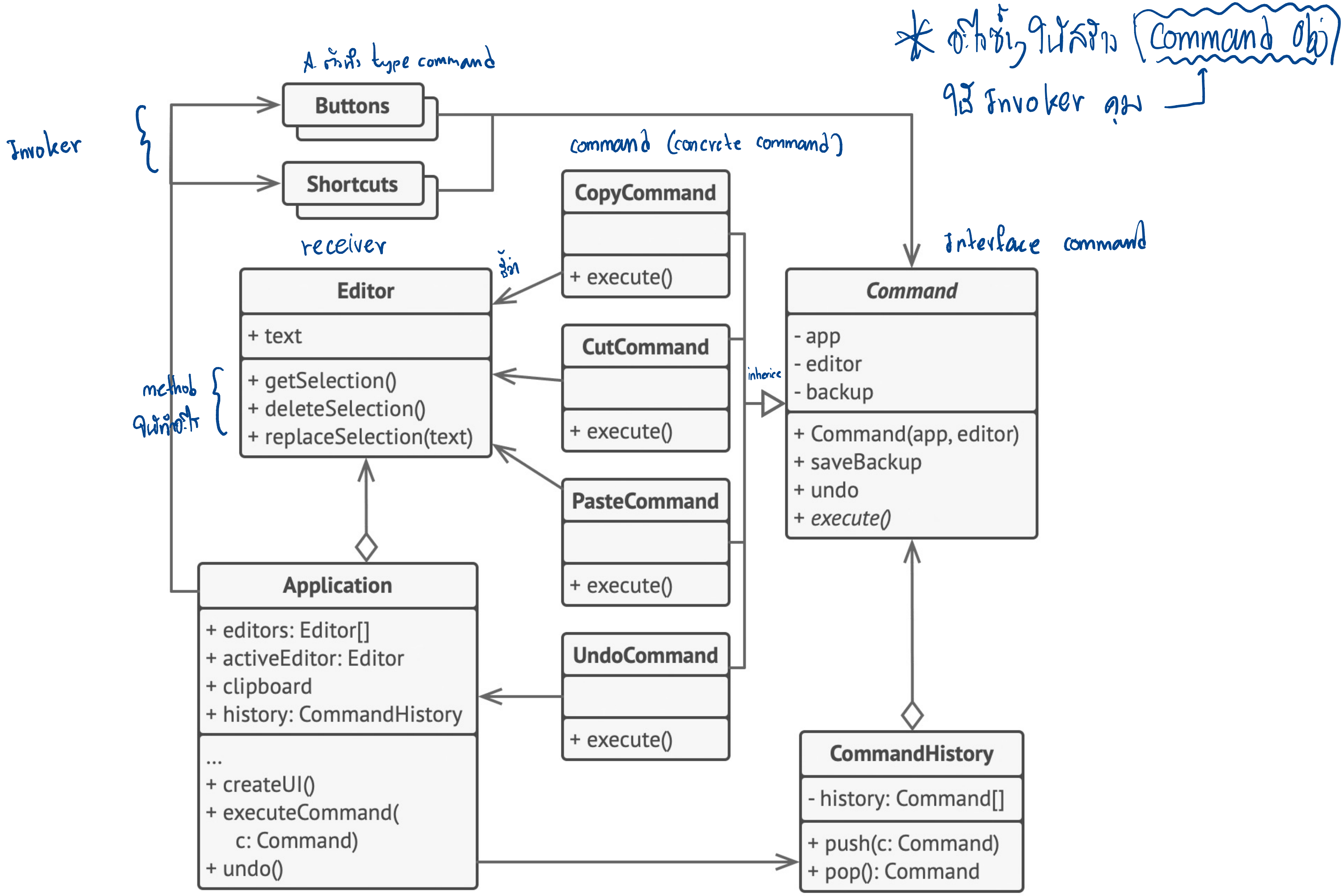
Command การส่ง request กับ การเรียงของ request ที่ควรยืดหยุ่นได้ / ผลลัพธ์ 1 คำสั่งที่ได้หลายอย่าง เช่น copy ที่ได้ทั้ง กริยา, state เป็นต้น

- พฤติกรรม
- ลูกค้ามมากกว่า





The GUI objects delegate the work to commands.

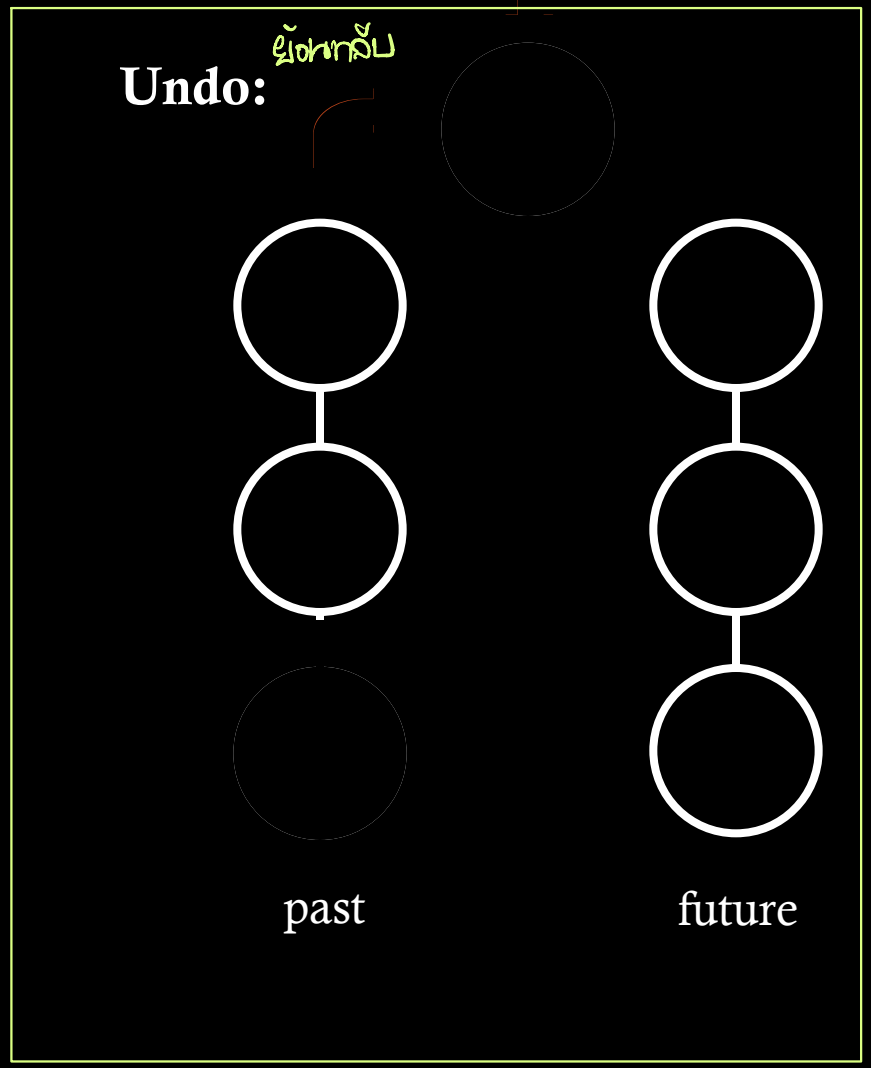

Buttons
Shortcuts
Invoker
receiver
command (concrete command)
interface command
CopyCommand
+ execute()
CutCommand
+ execute()
PasteCommand
+ execute()
UndoCommand
+ execute()
Editor
+ text
+ getSelection()
+ deleteSelection()
+ replaceSelection(text)
method
Command
- app
- editor
- backup
+ Command(app, editor)
+ saveBackup
+ undo
+ execute()
Application
+ editors: Editor[]
+ activeEditor: Editor
+ clipboard
+ history: CommandHistory
...
+ createUI()
+ executeCommand(
c: Command)
+ undo()
CommandHistory
- history: Command[]
+ push(c: Command)
+ pop(): Command
Command obj

List of Commands = Execution History

unexecute

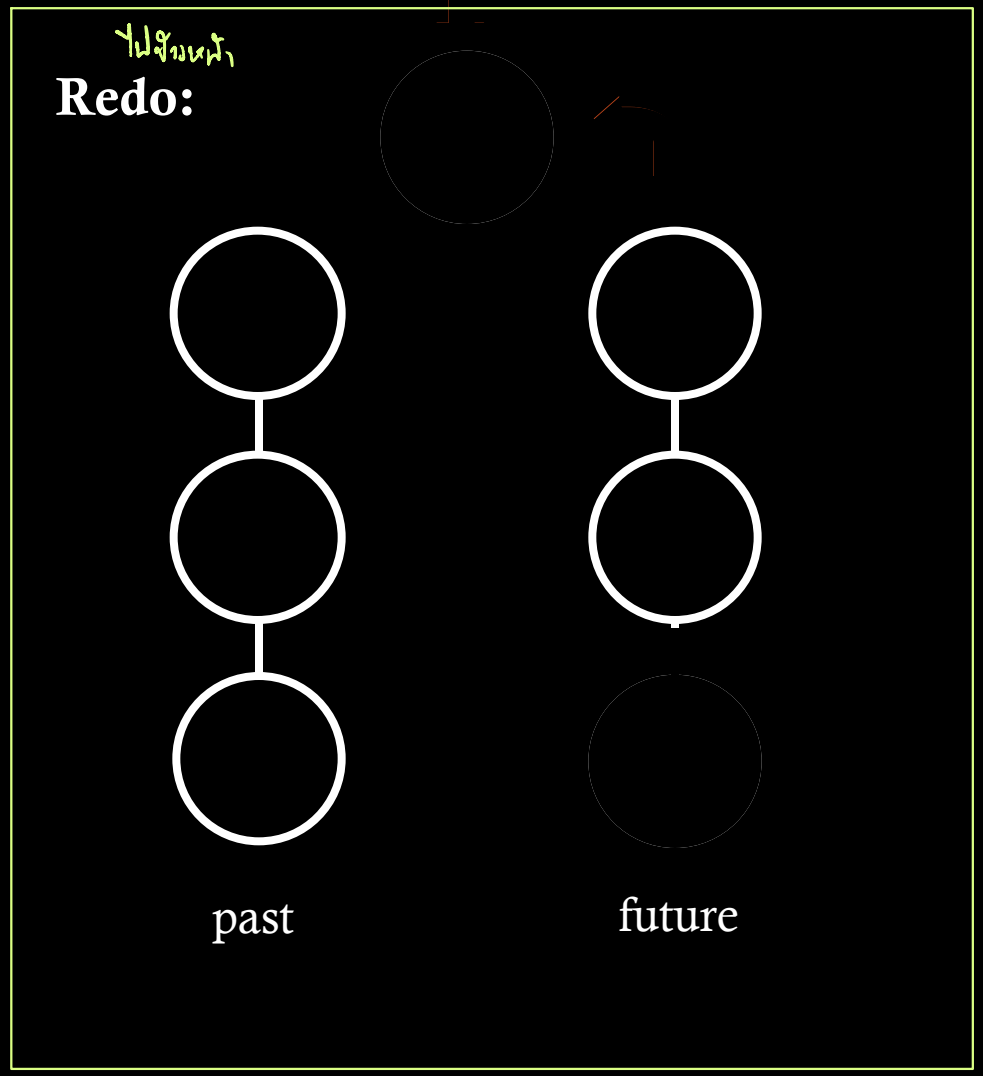
ย้อนกลับ

Undo:



ไปข้างหน้า

Redo:



Command: Consequences

Command คือ ใครเอาไปทำ

+ Abstracts executor of a service.
+ Supports arbitrary-level undo-redo.
+ Composition yields macro-commands.
– Might result in lots of trivial command subclasses. เยอะไปไหม
– Excessive memory may be needed to support undo/redo operations.

ถ้าอยากได้ undo /redo ต้องใช้ memory เก็บ list ตัว command

Command: Examples

- Command (refactoring.guru)
- Command pattern – Wikipedia
- Command Design Pattern – JournalDev

เหมือน factory method

Template Method

Template Method: Problem

- How to define the overall structure of the operation in a base class, but allow subclasses to refine, or redefine, certain steps?

Applicability

- Implement invariant aspects of an algorithm once & let subclasses define variant parts.
- Localize common behavior in a class to increase code reuse.
- Control subclass extensions.

Template Method: Solution

Intent

- Provide a skeleton of an algorithm in a method, deferring some steps to subclasses.

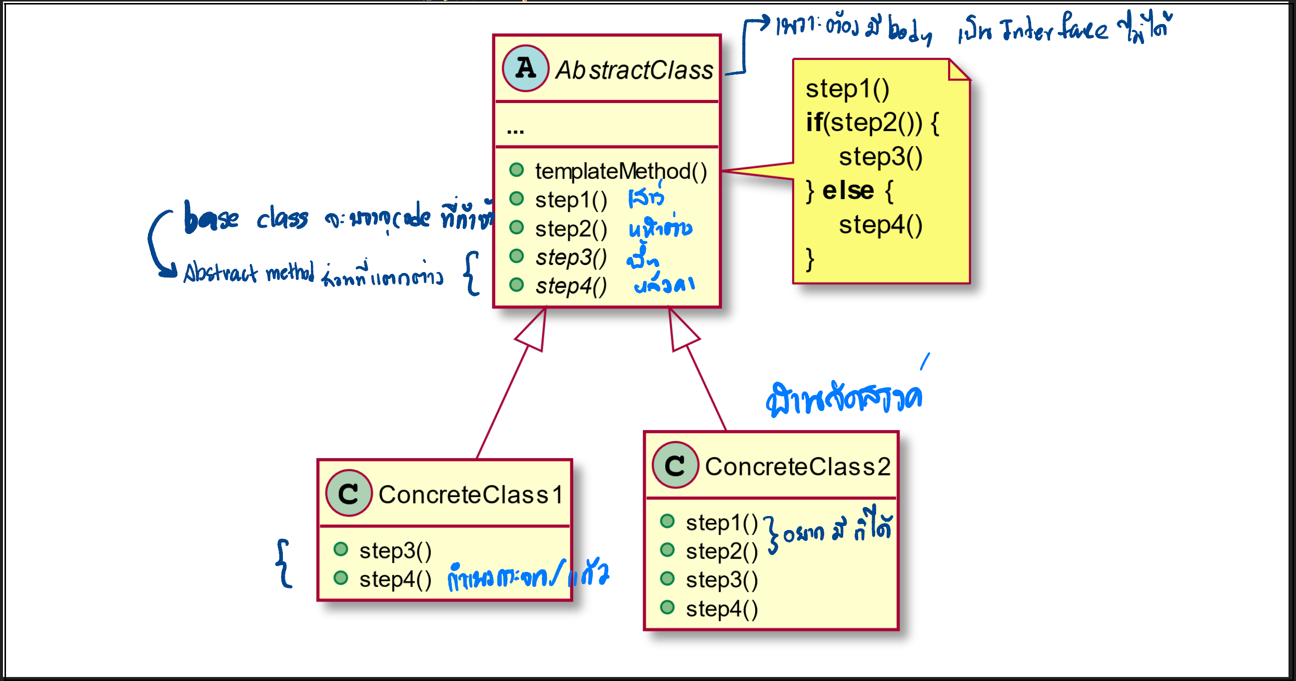
This pattern has two main parts:

- The "template method" is implemented as a method in a base class (usually an abstract class). This method contains code for the parts of the overall algorithm that are invariant. The template ensures that the overarching algorithm is always followed.
- Subclasses of the base class "fill in" the empty or "variant" parts of the "template" with specific algorithms that vary from one subclass to another.

Template Method

เหมือน factory method

อนุญาตให้ subclass แก้ไขส่วนที่ต่างได้ โดย base class ยังคงรูปแบบเดิมไว้



Template Method: Consequences

+ Leads to inversion of control (“Hollywood principle”: don't call us – we'll call you).
+ Promotes code reuse.
+ Lets you enforce overriding rules.
– Must subclass to specialize behavior (cf. Strategy pattern).

Template Method: Examples

- Template Method (refactoring.guru)
- Template method pattern – Wikipedia
- Template Method Design Pattern in Java – JournalDev

ไม่ได้เองหน่อย

Iterator

แนะนำให้ลอง standard library ดู

Iterator: Problem

- The elements of an aggregate object should be accessed and traversed without exposing its representation (data structures).
- New traversal operations should be defined for an aggregate object without changing its interface.

Applicability

- Require multiple traversal algorithms over an aggregate
- Require a uniform traversal interface over different aggregates
- When aggregate classes & traversal algorithm must vary independently

Iterator: Solution

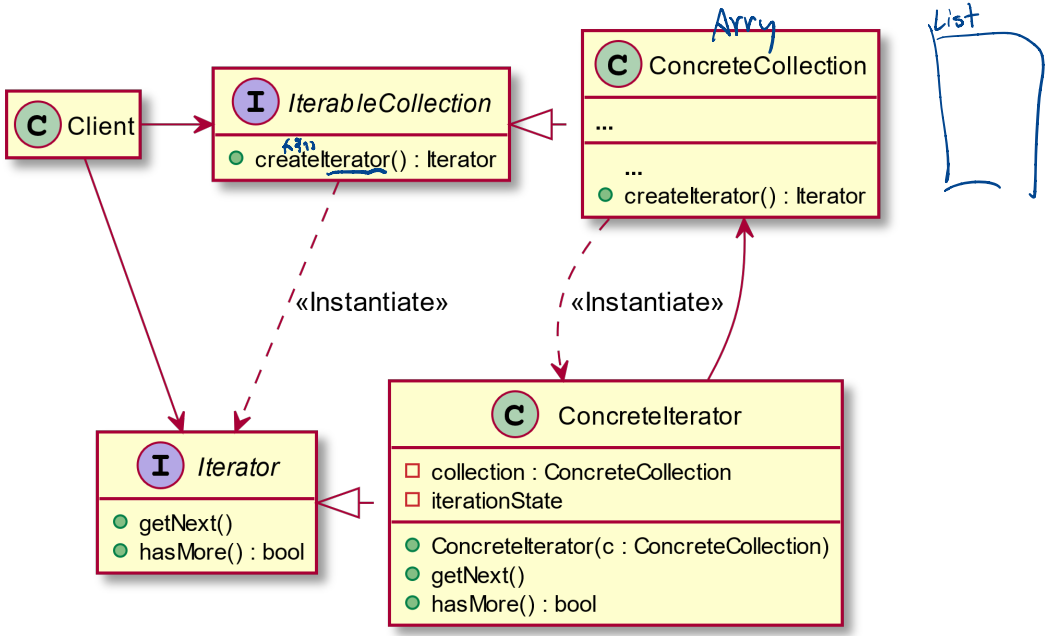
Intent

- Access elements of an aggregate (container) without exposing its representation.

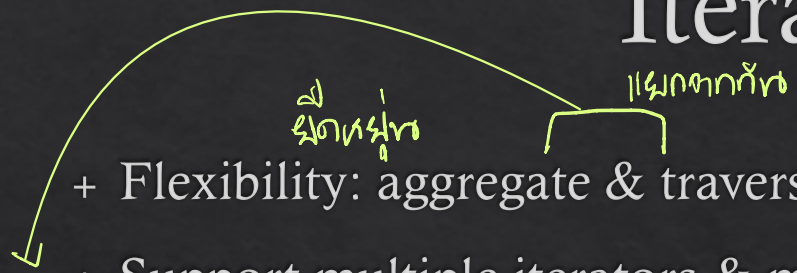
What solution does the Iterator design pattern describe?

- Define a separate (iterator) object that encapsulates accessing and traversing an aggregate object.
- Clients use an iterator to access and traverse an aggregate without knowing its representation (data structures).

Iterator


Client
IterableCollection
createIterator() : Iterator
ConcreteCollection
...
...
createIterator() : Iterator
«Instantiate»
«Instantiate»
Iterator
getNext()
hasMore() : bool
ConcreteIterator
collection : ConcreteCollection
iterationState
ConcreteIterator(c : ConcreteCollection)
getNext()
hasMore() : bool

Iterator: Consequences

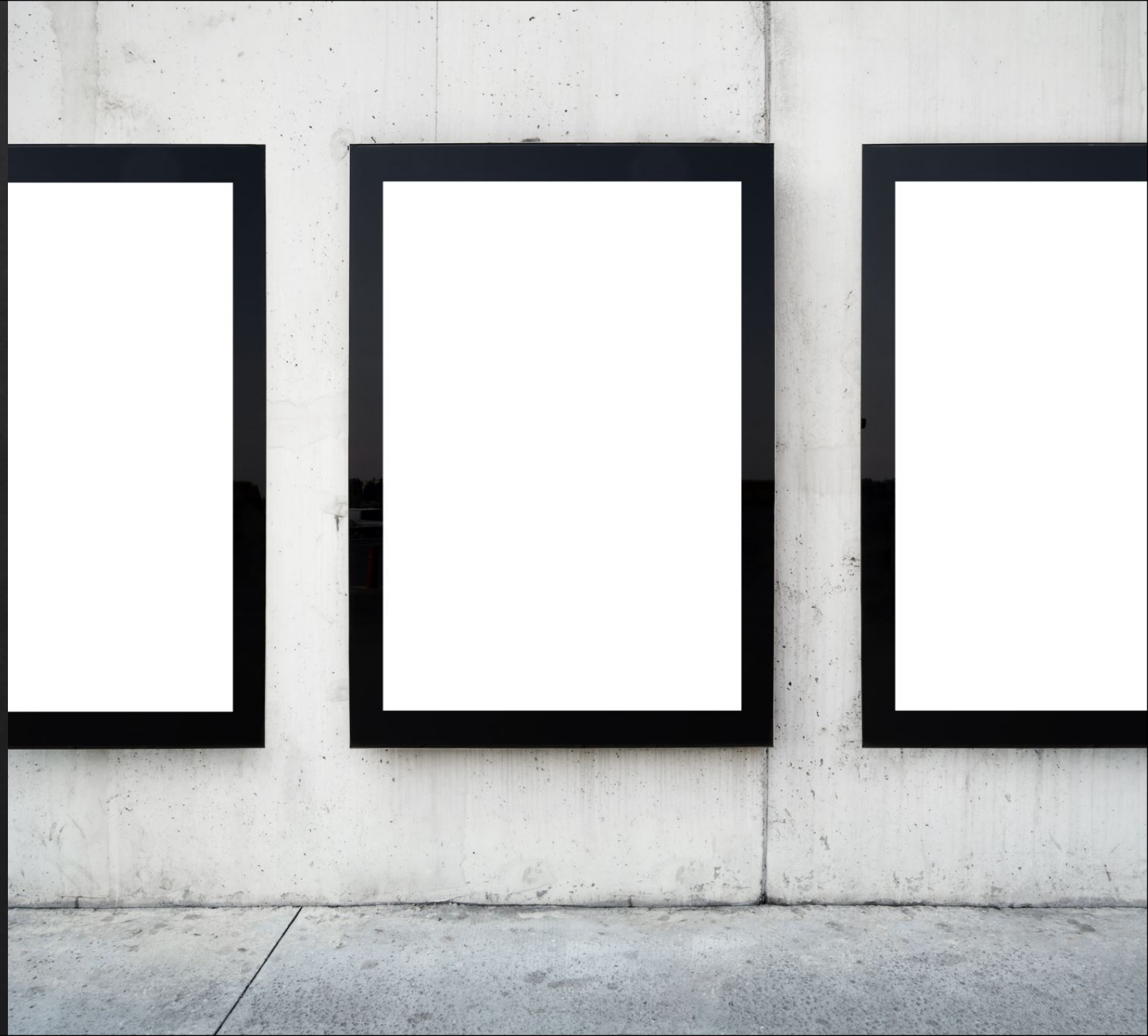


+ Flexibility: aggregate & traversal are independent.
+ Support multiple iterators & multiple traversal algorithms.
– Incur additional communication overhead between iterator & aggregate. This is particularly problematic for iterators in concurrent or distributed systems.

Iterator: Examples

- Iterator (refactoring.guru)
- Iterator pattern – Wikipedia
- Iterator Design Pattern in Java – JournalDev

Null Object



Null Object: Problem

- In most object-oriented languages, references may be null.
- These references need to be checked to ensure they are not null before invoking any methods, because methods typically cannot be invoked on null references.
- How can the absence of an object — the presence of a null reference — be treated transparently?

Applicability

- An object requires a collaborator.
- Some collaborator instances should do nothing.
- You want to abstract the handling of null away from the client.

Null Object: Solution

Intent

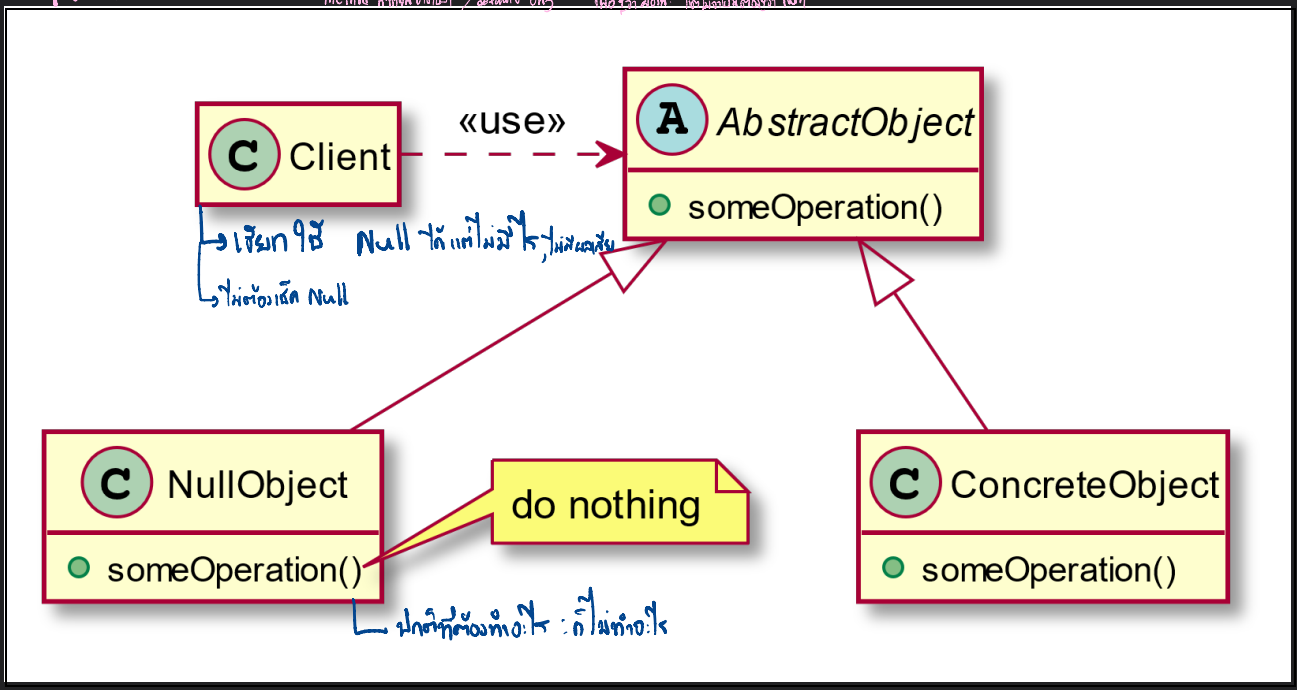
- Provide an object as a surrogate for the lack of an object of a given type.

What solution does the Null Object design pattern describes?

- The uses of a Null Object, an object with no referenced value or with defined neutral ("null") behavior.
- The behavior (or lack thereof) of such objects.

Null Object

เพื่อที่ client code ไม่ต้องมา check อีกรอบว่า ค่าเป็น Null
method ที่มีพื้นฐานอยู่แล้ว / default อยู่แล้ว เพื่อประโยชน์: จะได้ไม่ต้องมาเช็คว่า Null



Null Object: Consequences

ทำให้ client code เขียนง่าย

+ Simplifies client code, because it avoids having to write testing code which handles the null collaborator specially.

ไม่ต้องเขียน

- Can be difficult to implement if various clients do not agree on how the null object should do nothing as when your AbstractObject interface is not well defined.

ยากที่จะตกลงกันว่าให้ Null obj ทำอะไรให้แสดง, ทำแบบไหน
อย่าใช้ถ้าตกลงกันไม่ได้

Null Object: Examples

- Null object pattern – Wikipedia
- Null Object Design Pattern (sourcemaking.com)