Command Pattern

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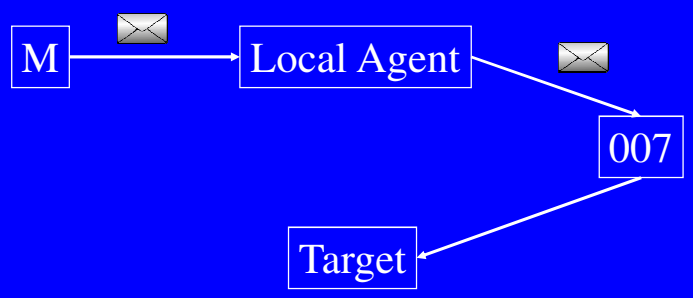
Command: Intent

- Encapsulate a request as an object
  - thereby letting you parameterize clients with different requests
  - queue or log requests
  - and support undoable operations.
- Also known as
  - Action, Transaction

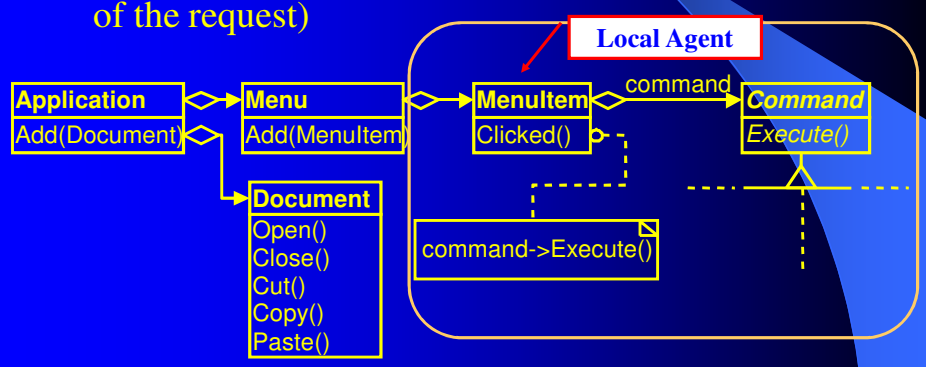
Command: Motivation

- You are a secret agent (local agent). How do you issue a command without knowing anything?



Command: Motivation (1)

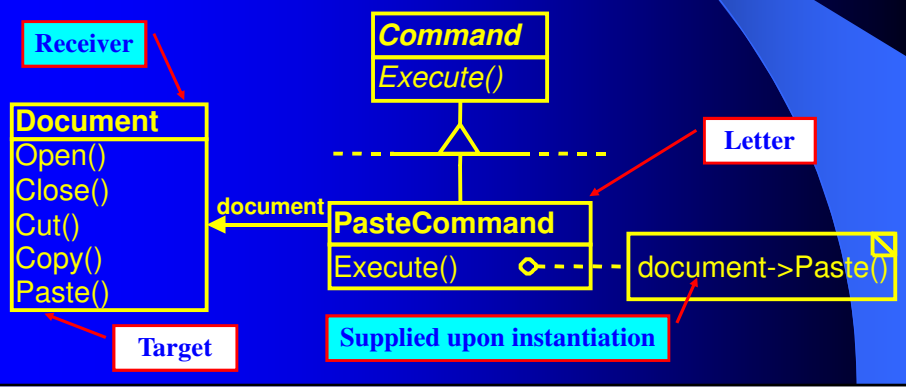
- Issue requests without knowing anything about the operation being requested (including the receiver of the request)



Command: Motivation (2)

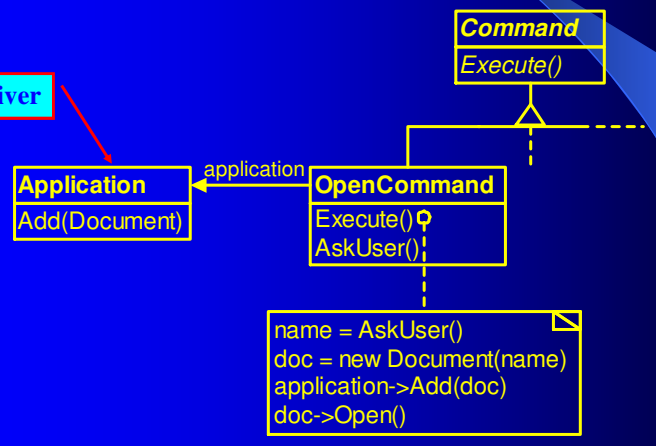
Example: PasteCommand

- receiver is the document object (supplied upon instantiation)



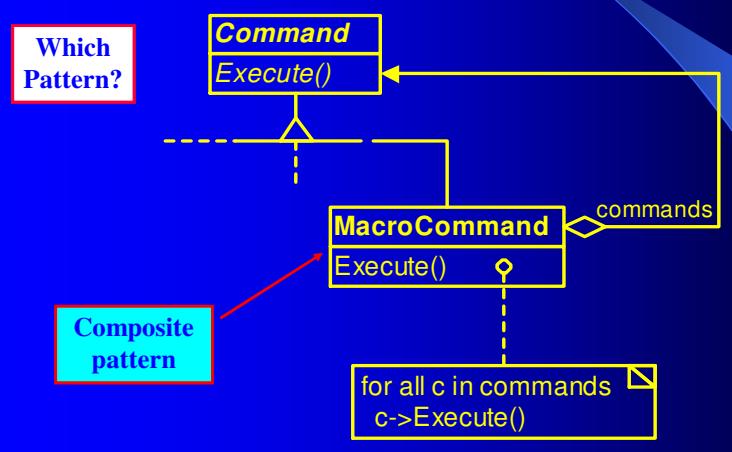
Command: Motivation (3)

Example: OpenCommand



Command: Motivation (4)

Example: Macro Command



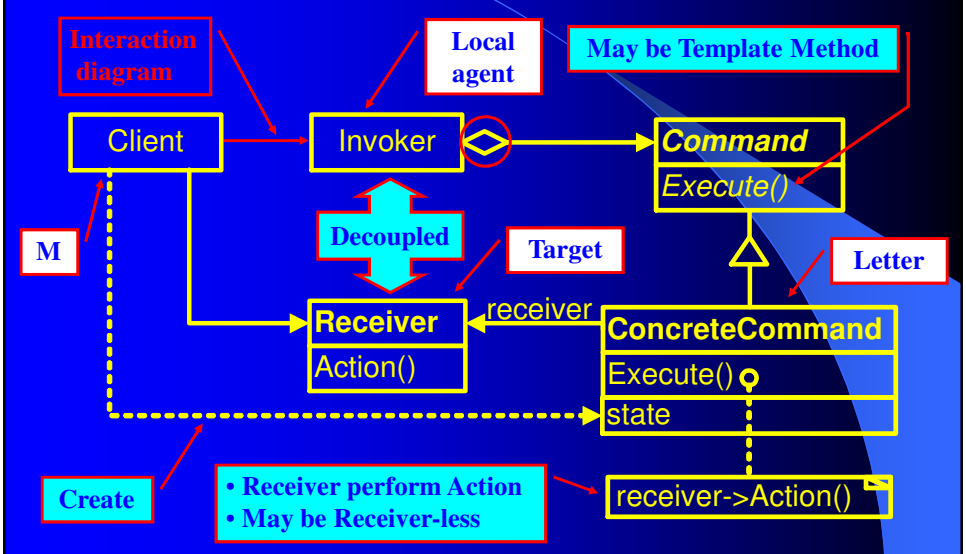
Command: Motivation (5)

- Command pattern decouples the object that invokes the operation from the one performing it → flexibility
  - two user interfaces may share an instance of the same concrete Command subclass.
  - commands can be replaced dynamically (for context-sensitive menus).
  - macro commands.
  - all because the command requester only needs to know how to issue it; it doesn't need to know how to perform it.

Command: Applicability

- Use the Command Pattern when you want to
  - parameterize objects (invoker) by an action to perform (commands). Commands are an object-oriented replacement for callbacks.
  - specify, queue, and execute requests at different times → a command object can have life time independent of the original request.
  - support undo: add Unexecute() and store executed commands in a history list.
  - support logging: can be reapplied in case of a system crash (add Load() and Store() operations)
  - structure a system around high-level operations built on primitive operations (e.g., transactions).

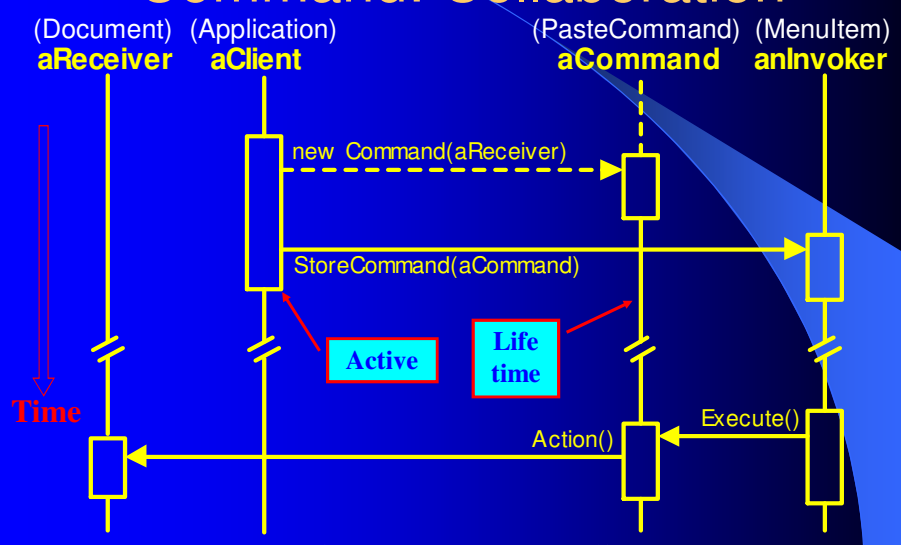
Command: Structure



Command: Participants

- Command
  - declare an interface for executing an operation.
- ConcreteCommand (PasteCommand, etc.)
  - defines a binding between a Receiver object and an action.
  - implements Execute by invoking the corresponding operation(s) on Receiver.
- Client (Application)
  - creates a ConcreteCommand object and sets receiver.
- Invoker (MenuItem)
  - asks the command to carry out the request.
- Receiver (Document, Application)
  - Knows how to perform the operations

Command: Collaboration



Interaction (sequence) diagram

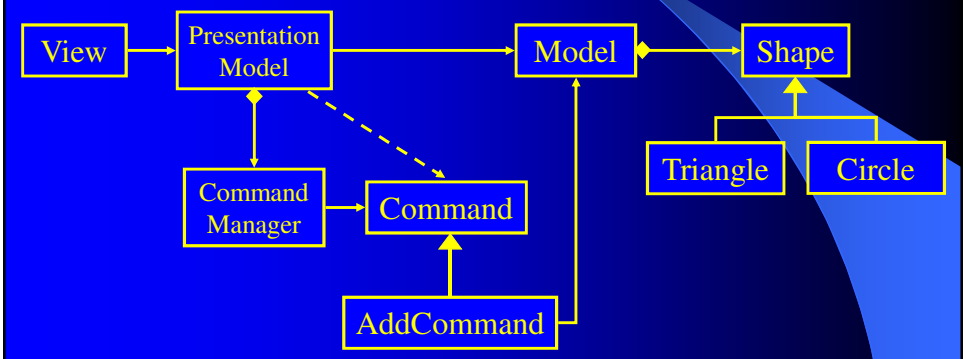
Command: Consequences

- Command decouples the object that invokes the operation from the one that knows how to perform it.
- Commands are first-class objects. They can be manipulated and extended like any other object.
- MacroCommand: composite commands are an instance of the Composite pattern.
- It's easy to add new commands.

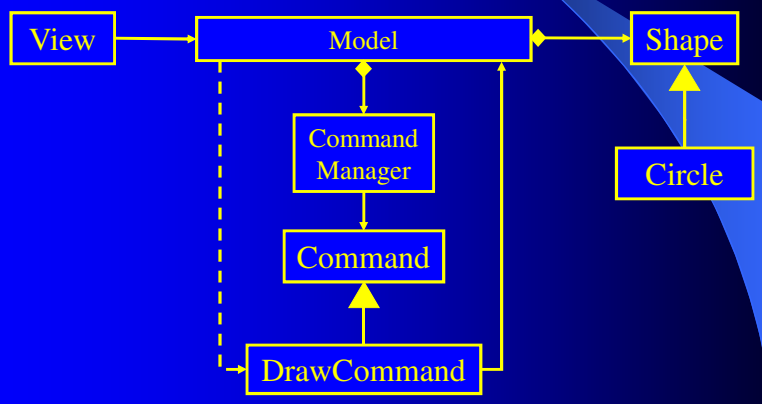
Command: Implementation

- How intelligent should a command be?
  - receiver perform all actions ⇔ receiver-less
- Supporting undo and redo.
  - add Unexecute
  - history list
    - Template Method (auto store) and Prototype (copy) pattern
- Avoiding error accumulation in the undo process
  - apply Memento pattern to give command access to information without exposing the internals of other objects.
- Using C++ templates
  - for commands that are not undoable and do not require arguments.

Command: Example (C++)



Command: Example (C#)



Command: Related patterns

- A Composite pattern can be used to implement MacroCommands.
- A Memento can keep state that the command requires to undo its effect.
- A command that must be copied before being placed on the history list act as a Prototype.
- Patterns using similar ideas (inheritance and polymorphism)
  - Command: command as object
  - Strategy: algorithm as object
  - Iterator: pointer as object
  - State: state as object
  - Composite: composite as object (with uniform interface)
  - Decorator: decorator as object (with uniform interface)
  - Proxy: proxy as object (with uniform interface)