

PROXY DESIGN PATTERN

Week 08 Lecture 01



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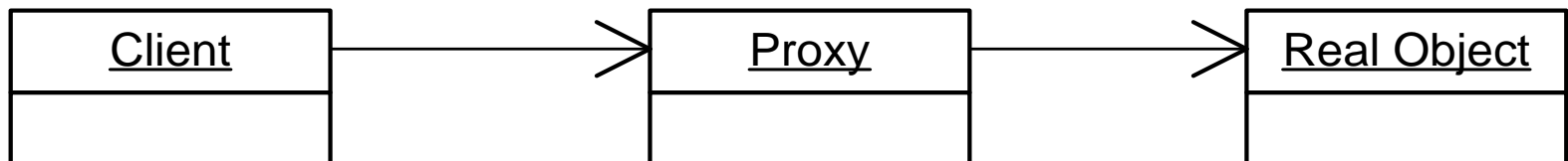
PROBLEM

- You need to control access to an object

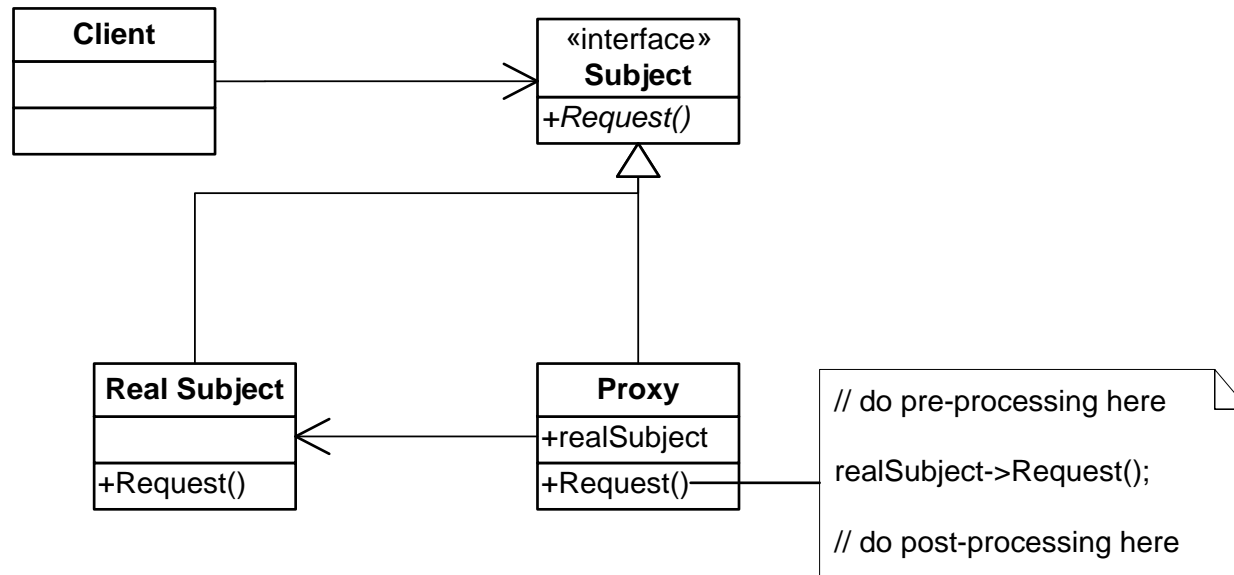


SOLUTION

- Create a Proxy object that implements the same interface as the real object
- Proxy is a structural design pattern that provides an object that acts as a substitute for a real service object used by a client. A proxy receives client requests, does some work (access control, caching, etc.) and then passes the request to a service object.
- The Proxy object (usually) contains a reference to the real object
- Clients are given a reference to the Proxy, not the real object
- All client operations on the object pass through the Proxy, allowing the Proxy to perform additional processing



SOLUTION



CONSEQUENCES

- Provides an additional level of indirection between client and object that may be used to insert arbitrary services
- Proxies are invisible to the client, so introducing proxies does not affect client code



TYPES OF PROXIES

- **Remote proxies:** They are responsible for representing the object located remotely. Talking to the real object might involve marshalling and unmarshalling of data and talking to the remote object. All that logic is encapsulated in these proxies and the client application need not worry about them.
- **Virtual proxies:** These proxies will provide some default and instant results if the real object is supposed to take some time to produce results. These proxies initiate the operation on real objects and provide a default result to the application. Once the real object is done, these proxies push the actual data to the client where it has provided dummy data earlier.
- **Protection proxies:** If an application does not have access to some resource then such proxies will talk to the objects in applications that have access to that resource and then get the result back.



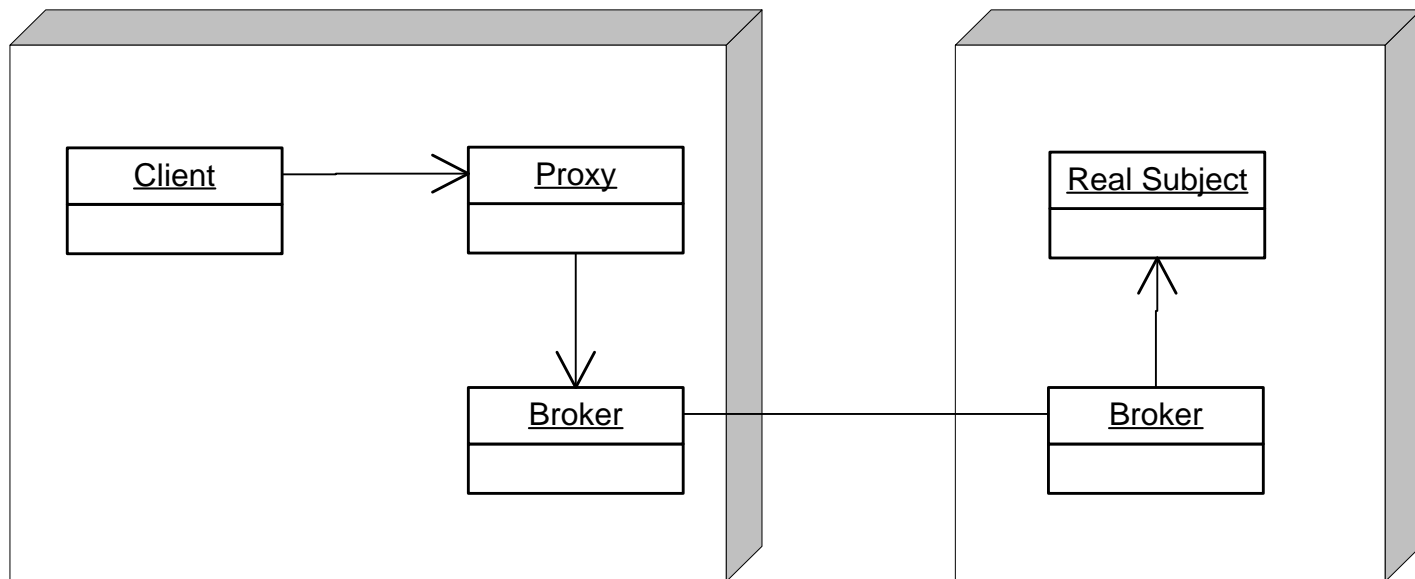
KNOWN USES: COLLECTIONS

- Read-only Collections
 - Wrap collection object in a proxy that only allows read-only operations to be invoked on the collection
 - All other operations throw exceptions
 - `List Collections.unmodifiableList(List list);`
 - Returns read-only List proxy
- Synchronized Collections
 - Wrap collection object in a proxy that ensures only one thread at a time is allowed to access the collection
 - Proxy acquires lock before calling a method, and releases lock after the method completes
 - `List Collections.synchronizedList(List list);`
 - Returns a synchronized List proxy



KNOWN USES: DISTRIBUTED OBJECTS

- The Client and Real Subject are in different processes or on different machines, and so a direct method call will not work
- The Proxy's job is to pass the method call across process or machine boundaries, and return the result to the client (with Broker's help)



KNOWN USES: SECURE OBJECTS

- Different clients have different levels of access privileges to an object
- Clients access the object through a proxy
- The proxy either allows or rejects a method call depending on what method is being called and who is calling it (i.e., the client's identity)



KNOWN USES: LAZY LOADING

- Some objects are expensive to instantiate (i.e., consume lots of resources or take a long time to initialize)
- Rather than instantiating an expensive object right away, create a proxy instead, and give the proxy to the client
- The proxy creates the object on demand when the client first uses it
- If the client never uses the object, the expense of creating it is never incurred
- A hybrid approach can be used, where the proxy implements some operations itself, and only needs to create the real object if the client calls one of the operations it doesn't implement
- Proxies must store whatever information is needed to create the object on-the-fly (file name, network address, etc.)



KNOWN USES: LAZY LOADING

- Examples
- Object-Oriented Databases
 - Graph of objects stored on disk
 - Objects contain references to each other
 - Load proxies initially, and only load the real object from disk if a method is actually called on it
- Resource Conservation
 - If you need to store thousands of objects in memory at once, proxies can be used to save memory by only loading objects that are actually used
 - Objects that are used can be unloaded after awhile, freeing up memory
- Word Processor
 - Documents that contain lots of multimedia objects should still load fast
 - Create proxies that represent large images, movies, etc., and only load objects on demand as they become visible on the screen (only a small part of the document is visible at a time)

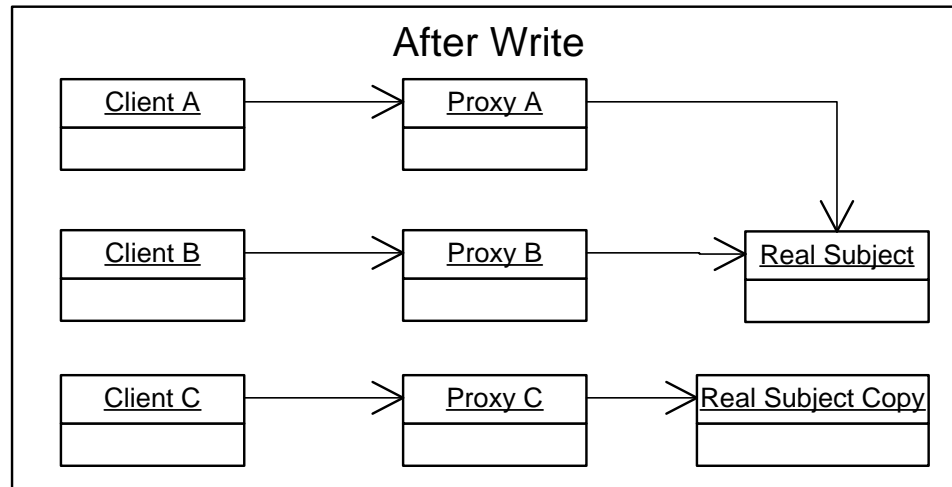
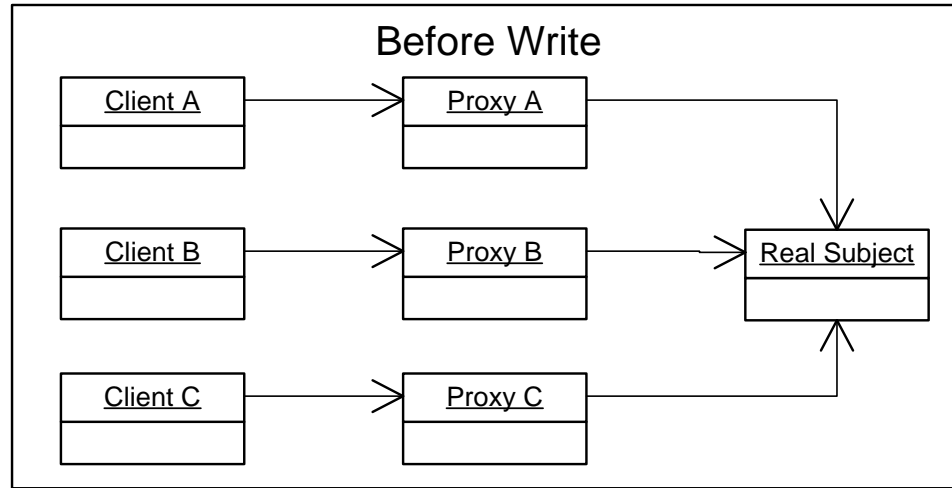


KNOWN USES: COPY-ON-WRITE

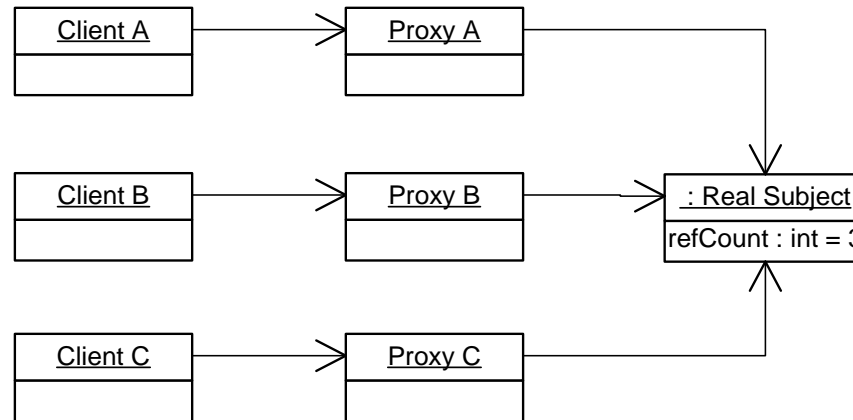
- Multiple clients share the same object as long as nobody tries to change it
- When a client attempts to change the object, they get their own private copy of the object
- Read-only clients continue to share the original object, while writers get their own copies
- Allows resource sharing, while making it look like everyone has their own object
- A String class could use this approach to optimize copying
- To make this work, clients are given proxies rather than direct references to the object
- When a write operation occurs, a proxy makes a private copy of the object on-the-fly to insulate other clients from the changes



KNOWN USES: COPY-ON-WRITE



KNOWN USES: REFERENCE COUNTING



- Proxies maintain the reference count inside the object
- The last proxy to go away is responsible for deleting the object (i.e., when the reference count goes to 0, delete the object)

