Chain of Responsibility Pattern

This lesson discusses how a request can travel down a chain of handlers till an appropriate handler is found.

What is it ?

In a ***chain of responsibility*** pattern implementation, the sender's request is passed down a series of handler objects till one of those objects, handles the request or it remains unhandled and falls off the chain. Multiple objects are given a chance to handle the request. This allows us to decouple the sender and the receiver of a request.

The requestor has no knowledge of the object that will eventually handle its request nor does it have a reference to the handling object. Similarly, the object eventually handling the request isn't aware of the requestor.

Each object in the chain should implement a common supertype and have a reference to its successor. The handler objects can be added to or removed from the chain at runtime.

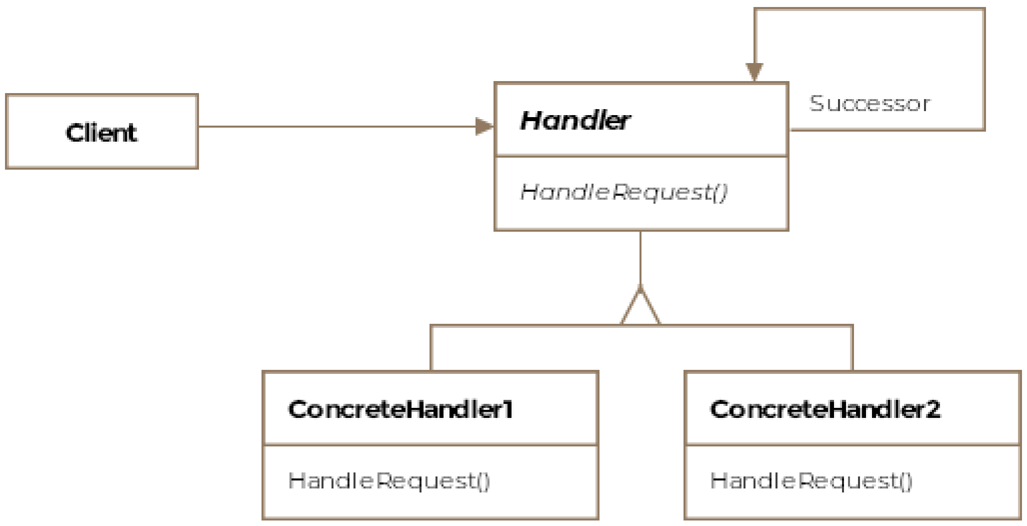
Formally, the pattern is defined as ***decoupling the sender of a request from its receiver by chaining the receiving objects together and passing the request along the chain until an object handles it***.

Usually the pattern is applied when the request can be handled by multiple objects and it is not known in advance which object will end up handling the request.

Class Diagram

The class diagram consists of the following entities

- **Handler**
- **Concrete Handler**
- **Client**



Example

Imagine an aircraft's cockpit. It would be running some software that would indicate to the pilot about equipment failure, engine temperature, or something as disastrous as a fire. Let's say when some failure happens, the hardware sends an error code to the cockpit's computer which then takes some corrective action based on the error code it receives.

We can model the error codes as requests that require handling by appropriate components. Say, if an engine failure happens, there might be a series of corrective actions that can try to fix the problem successively. For instructional purposes, say the hardware can send out either a ***fire detected*** or a ***low on fuel*** request, which have corresponding handlers. Let's see the listing for `AbstractHandler` and `AbstractRequest` classes first.

```
abstract public class AbstractRequest {

    // Each request is identified by a an integer
    // FireRequest: 1
    // LowFuelRequest: 2
    // LowFuelRequest: 2
    private int requestCode;

    public AbstractRequest(int requestCode) {
        this.requestCode = requestCode;
    }

    public int getRequestCode() {
        return requestCode;
    }
}

abstract public class AbstractHandler {

    private AbstractHandler next;

    public AbstractHandler(AbstractHandler next) {
        this.next = next;
    }

    public void setNext(AbstractHandler next) {
        this.next = next;
    }

    public void handleRequest(AbstractRequest request) {
        if (next != null) {
            next.handleRequest(request);
        }
    }
}
```

The naive implementations of the classes `LowFuelRequest` and `FireDetectedRequest` appear below alongside the implementation for the concrete handler `FireHandler`. We skip the implementation for `LowFuelHandler` as it would be similar to `FireHandler`.

```
public class FireDetectedRequest extends AbstractRequest {

    // Fire request is assigned code of 1
    public FireDetectedRequest() {
        super(1);
    }
}

public class LowFuelRequest extends AbstractRequest {
    // Low on fuel request is assigned code of 2
    public LowFuelRequest() {

        super(2);
    }
}

public class FireHandler extends AbstractHandler {

    // Only interested in handling requests with code 1
    private static int code = 1;

    public FireHandler(AbstractHandler successor) {
        super(successor);
    }

    @Override
    public void handleRequest(AbstractRequest request) {
        if (code == request.getRequestCode()) {
            // Handle the request here.
        } else {
            // If the handler, doesn't handle these type of
            // requests, it can just call the super class's
            // forward request method.
            super.handleRequest(request);
        }
    }
}
```

Finally the interaction between these different classes is exhibited in the client code.

```
public class Client {

    public void main() {

        // Setup the chain like so:
        // FireHandler --> LowFuelHandler --> null
        // The chain has just two handlers with the firstHandler
        // at the head of the chain.
        AbstractHandler lowFuelHandler = new LowFuelHandler(null);
        FireHandler fireHandler = new FireHandler(lowFuelHandler);

        // Create a emergency request that the airplane is running lo
w
        // on fuel.
        LowFuelRequest lowFuelRequest = new LowFuelRequest();


        // Let the chain handle the request
        fireHandler.handleRequest(lowFuelRequest);
    }
}
```

Notice, how in our example, the request moves along the chain till a handler that is capable of addressing the request receives it. The chain also defines an order in which the request gets handled. If more than one handler can serve the request, then it'll get handled by the one occurring first in the chain.

Other Examples

- Frontend developers might recall how event handlers work in javascript. If a button is clicked and its event handler method is implemented then the event would get handled and can be stopped from bubbling up to the parent element's event handler. The event handlers can be thought of as forming a chain starting from the leaf (innermost) HTML element all the way to the root element. Note that browsers also support ***event capturing*** where the event travels from the outermost HTML element to the innermost. One departure from the textbook definition of the pattern is that stopping the event from propagation to the next successor is optional.

- Another example is how a web request passes through several filters. `javax.servlet.Filter.doFilter()` follows the chain of responsibility pattern. The `doFilter` method of the Filter is called by the container each time a request/response pair is passed through the chain due to a client request for a resource at the end of the chain. The FilterChain passed into this method allows the Filter to pass on the request and response to the next entity in the chain.

Caveats

- To form the handler chain, individual objects might need to store references to their successors. However, in certain cases the links might already exist such as that in a composite structure like a tree.