Konzepte objektorientierter Programmierung

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Software Component Technology

Exercises 12: Distribution and Reflection

Wintersemester 06/07

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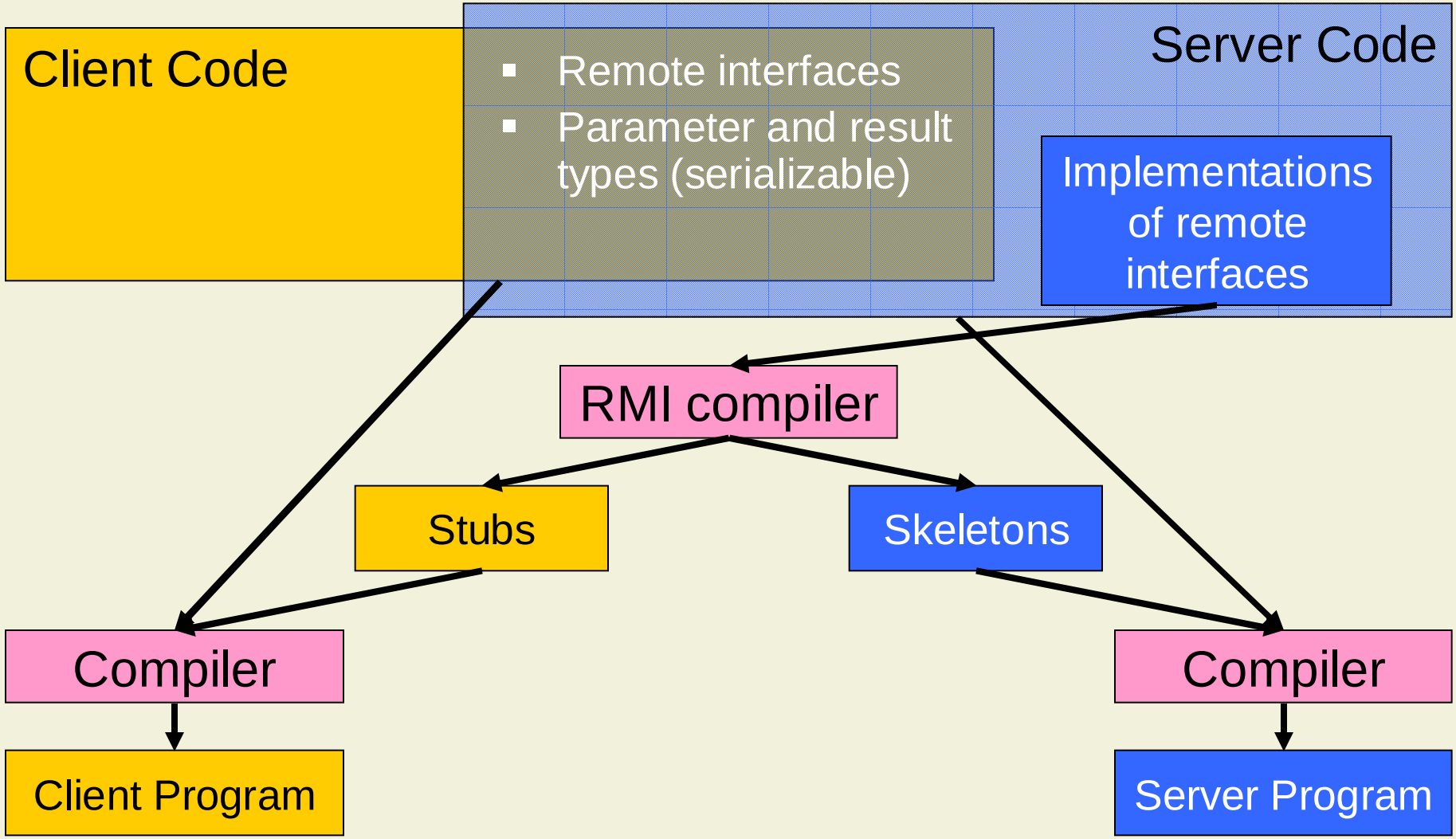
Programming with Remote Objects



Chat Application

- One server that:
  - accepts registrations from clients
  - broadcasts messages received from one client to all registered clients
- Multiple clients that:
  - register with a server
  - send a message to the server to broadcast it
  - receive messages from the server and output them

ChatServer Interface

```
package common;

import java.rmi.*;

public interface ChatServer extends Remote {

    void register( ChatClient c )
         throws RemoteException;

    void broadcast( String s )
         throws RemoteException;
}
```

ChatClient Interface

```
package common;

import java.rmi.*;

public interface ChatClient extends Remote {

    void receive( String s )
         throws RemoteException;

}
```

ChatClient Implementation

```
public class ChatClientImpl
  extends UnicastRemoteObject
  implements ChatClient, Runnable {

    private ChatServer mycs;

    public ChatClientImpl( ChatServer cs )
   throws java.rmi.RemoteException {
        mycs = cs;
        mycs.register( this );
    }

    public synchronized void receive(String s)
      throws java.rmi.RemoteException {
        System.out.println("Message: " + s );
    }
```

ChatClient Run Method

```
public void run() {
    BufferedReader ir = new BufferedReader(
            new InputStreamReader(System.in));
    String msg;

    while( true ) {
      try {
          msg = ir.readLine();
          mycs.broadcast( msg );
      } catch( Exception e ) {
          System.err.println("Problem...");
      }
    }
}
```

ChatClient Main Method

```
public static void main( String[] args ) {
 String url = "rmi://gem/ChatServer";

 try {
     ChatServer cs =
     (ChatServer) Naming.lookup(url);
     new Thread(
             new ChatClientImpl(cs)).start();
 } catch( Exception e ) {
     System.err.println(“Problem...");
     e.printStackTrace();
 }

}
```

ChatServer Implementation

```
public class ChatServerImpl extends
  UnicastRemoteObject implements ChatServer {

  private LinkedList myclients;

  public ChatServerImpl()
    throws java.rmi.RemoteException {
      myclients = new LinkedList();
  }

  public synchronized void register(ChatClient c)
    throws java.rmi.RemoteException {
      myclients.add( c );
  }
```

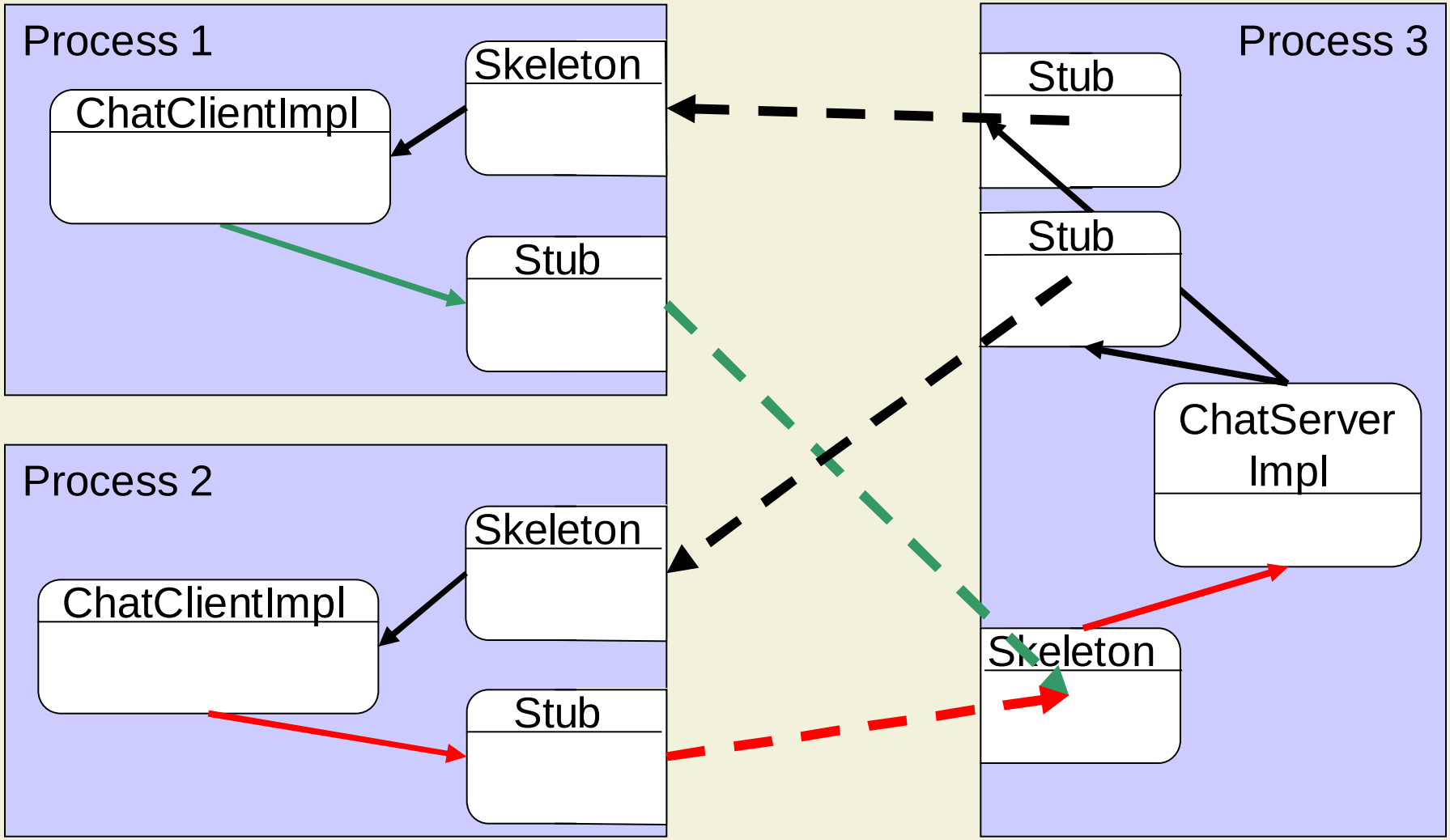
ChatServer Broadcast

```
public synchronized void broadcast( String s )
  throws java.rmi.RemoteException {

  ListIterator it = myclients.listIterator(0);
  ChatClient c;

  while( it.hasNext() ) {
     c = (ChatClient) it.next();

     c.receive( s );
  }
}
```

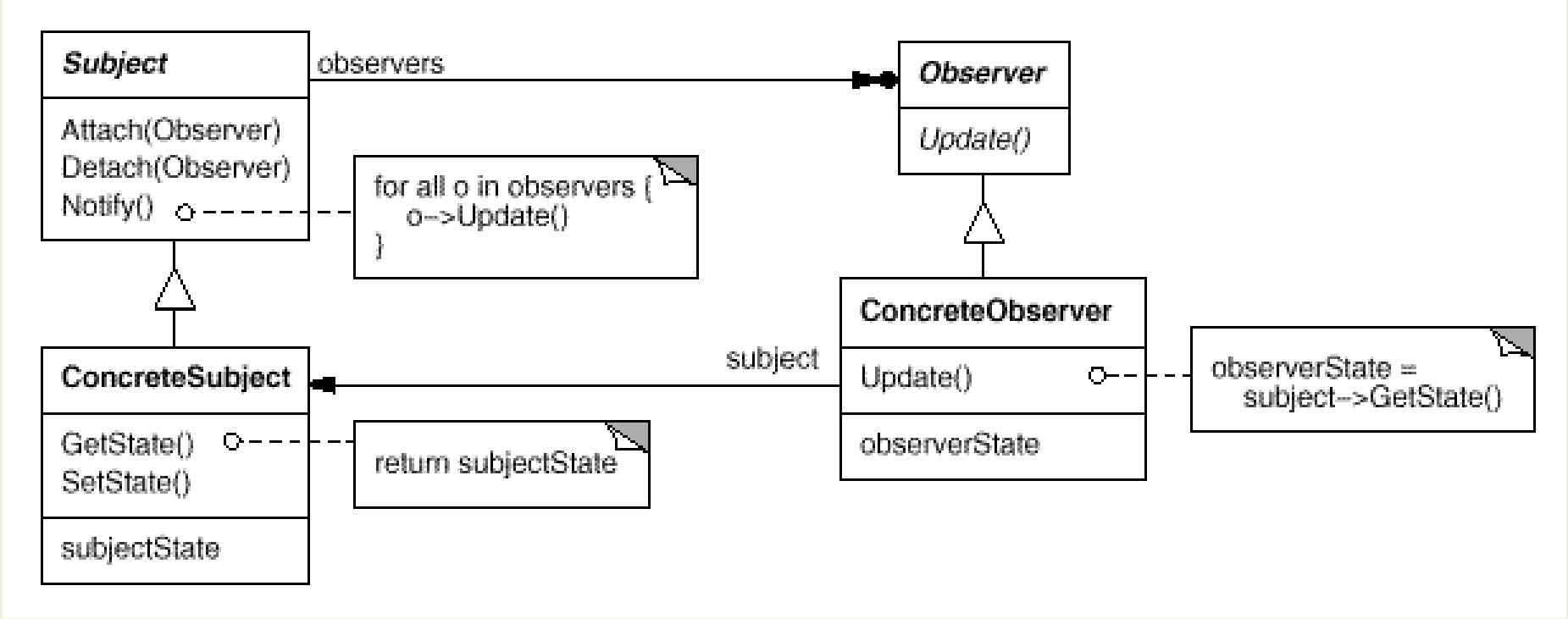
ChatServer Main Method

```
public static void main( String[] args ) {
  try {

     Naming.rebind( "ChatServer",
     new ChatServerImpl( ) );

  } catch( Exception ex ) {
      System.err.println(“Problem…");
      ex.printStackTrace();
  }
}
```

Process Interaction



Homework 2 – Observer Pattern



From: Gamma, Helm, Johnson, Vlissides: “Design Patterns”

Java support for the Observer Pattern

- Subject → `java.util.Observable`
  - `void addObserver(Observer o)`
  - `void setChanged()`
  - `void notifyObservers(Object arg)`
- Observer → `java.util.Observer`
  - `void update(Observable o, Object arg)`
- Events → `java.util.EventObject`
  - `EventObject(Object source)`
  - `Object getSource()`

ActiveValue – Setup

```
public class ActiveValue
   extends java.util.Observable {

  private int myval;

  public void run() {
   int change;
   Random crnd = new Random();

   myval = 0;

   while( true ) {  …  }
  }
}
```

SignChangeObserver

```
public class SignChangeObserver
   implements java.util.Observer {

  public void update( java.util.Observable s,
                      Object e ) {

   if( !(e instanceof ChangeEvent)) return;
   ChangeEvent ce = (ChangeEvent) e;

   if( ce instanceof IncreaseEvent ) {
        System.out.println("+");
   } else {
        System.out.println("-");
   }
  }
}
```

New Solution

- No fixed interface
- Use reflection for target observer and method
- One target can be registered with multiple methods
- One method can be registered with multiple targets

New Solution – Observable

```
import java.util.*;
import java.lang.reflect.Method;

public class MethodObservable {
  // Mapping from target object to
  // a set of methods to call
  private Map<Object, Set<Method>> calllist;

  public MethodObservable() {
   calllist = new HashMap<Object,
                  Set<Method>>();
  }
```

New Solution – Observable

```
public void addObserver(Object t, Method m) {
  Set<Method> s;
  if( calllist.containsKey(t) ) {
   s = calllist.get(t);
   s.add( m );
  } else {
   s = new HashSet<Method>();
   s.add( m );
  }
  calllist.put( t, s );
}
```

New Solution – Observable

```
public void deleteObserver(Object t,Method m){
  if( calllist.containsKey(t) ) {
   Set<Method> s = calllist.get(t);
   s.remove( m );
   if( s.isEmpty() ) {
      calllist.remove(t);
      } else {
      calllist.put( t, s );
   }
  }
}
```

New Solution – Observable

```
public void notifyObservers(Object arg) {
  Object target = null;
  Method method = null;
  try {
   for( Object t: calllist.keySet() ) {
     for( Method m: calllist.get(t) ) {
       target = t; method = m;
       method.invoke(target, this, arg); }}
  } catch( Exception e ) {
   handleException( target, method, e );
  }
}
```

New Solution – ActiveValue

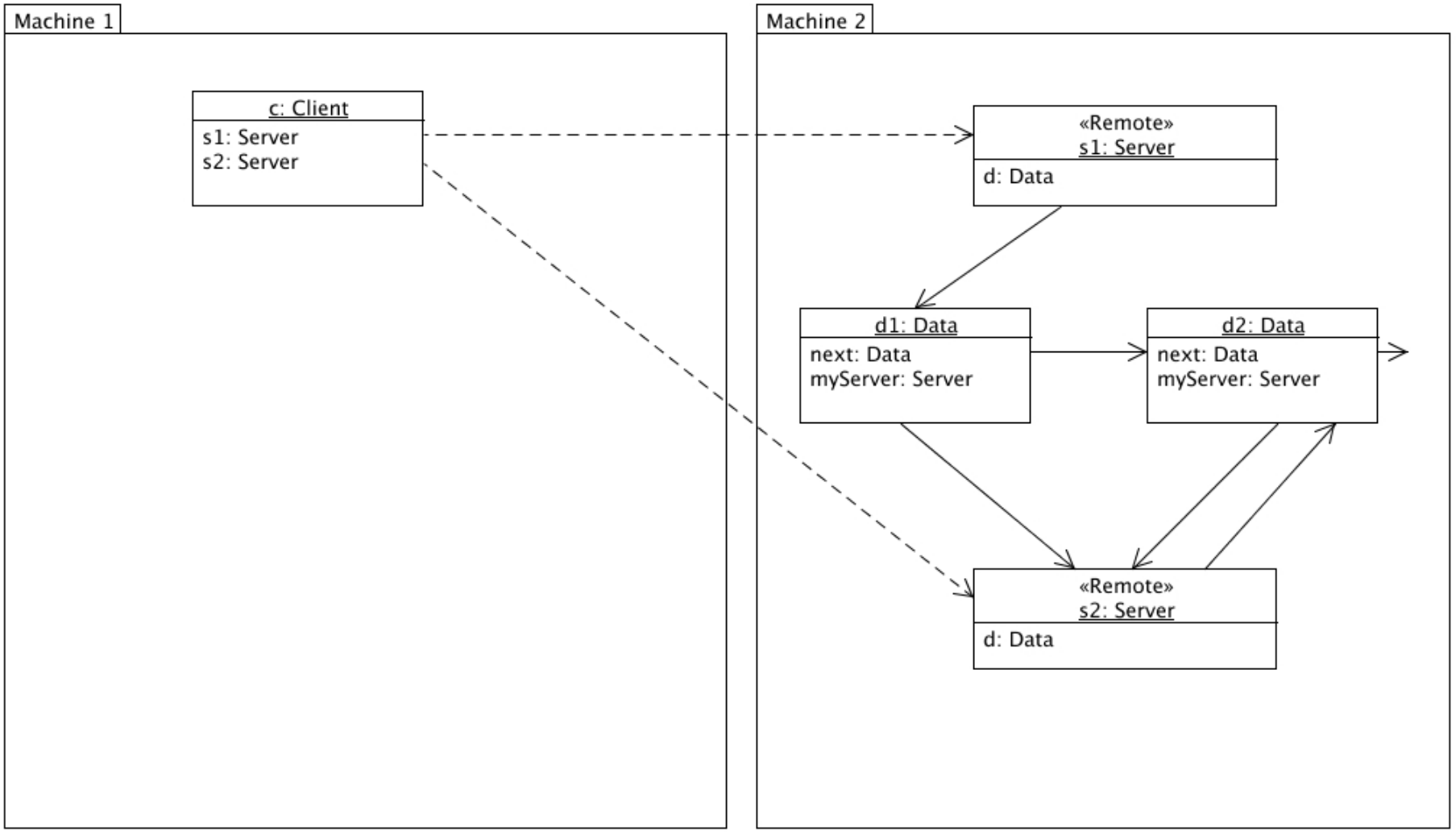
```
import java.lang.reflect.*;
public class ActiveValue
   extends MethodObservable {

// implementation of ActiveValue
// stays unchanged
```

New Solution – Observer

```
public class TextChangeObserver {
  public void update( MethodObservable source,
                      Object event ) {
   if( ! (event instanceof ChangeEvent) )
      return;
   ChangeEvent ce = (ChangeEvent) event;

   System.out.println(
      "New Value: " + ce.getValue() +
      " Change: " + ce.getChange() );
  }
}
```

New Solution – Main Program

```
public class TextMain {
 public static void main( String[] args ) {
  ActiveValue v = new ActiveValue();

  v.addObserver( new TextChangeObserver(),
   TextChangeObserver.class.getMethod(
   "update", MethodObservable.class,
      Object.class) );
  v.addObserver( new SignChangeObserver(),
   SignChangeObserver.class.getMethod(
      "update", MethodObservable.class,
      Object.class) );
```


Machine 1
Machine 2
c: Client
s1: Server
s2: Server
«Remote»
s1: Server
d: Data
d1: Data
next: Data
myServer: Server
d2: Data
next: Data
myServer: Server
«Remote»
s2: Server
d: Data