Fifth assignment  Enterprise Java Beans 3.0 principles

Send the finished task by e-mail to your teaching assistant. Deadlines for the submission are at the subject web page http://d3s.mff.cuni.cz/teaching/middleware/.

The assignment uses a simple algorithm to measure distance between two nodes in a graph of objects, to mimic working with entities with relationships. Understanding the assignment requires no special knowledge.

Prerequisities

As a technology for client/server architecture and data persistence, the assignment uses the Enterprise Java Beans standard, version 3.0. OpenEJB version 4.7.4 was chosen as a concrete implementation of the standard. The following knowledge is needed for the implementation:

- Defining remote business interfaces (annotating the interface with the javax.ejb.Remote annotation).
- Implementing remotely accessible Stateless Session Bean (annotating the class with javax.ejb.Stateless, implementing remote business interface).
- Implementing Entity Beans with persistent attributes (annotating the class with javax.persistence.Entity) and specifying the mapping to a relational database via persistence.xml.
- Managing persistent Entity Beans via EntityManager injected using the @PersistenceContext annotation into the Stateless Session Bean.
- Defining relations between Entity Bean classes (annotations @OneToMany, @ManyToMany etc.).
- Launching an OpenEJB server, deployment of EJB Beans. Connecting client and server via Naming Service and RMI.

A simple example of remote use of the EJB Beans variants will be provided.

Assignment details

http://d3s.mff.cuni.cz/teaching/middleware/files/as5.zip

The assignment consists of a simple algorithm to measure distance between two nodes in a graph. Graph nodes are represented by objects of the class Node.

```java
public Node {
    private int id;
    public Collection<Node> getNeighbors ();
    public void addNeighbor (Node oNeighbor);
}
```

The id attribute is an unique number identifying the node. The addNeighbor() method adds a node to the set of neighbors of the node and is used when a graph is being created. The getNeighbors() method returns a set of all neighbors of the node and is used when measuring the distance. The measuring itself is provided by the Searcher interface. The interface also provides methods for creating and connecting nodes, so that the client does not work directly with the Node objects. The addNode() method thus returns the id of the newly created node, the getDistance() and connectNodes() methods expect the id's of nodes to work with.

```java
public interface Searcher {
    public static final int DISTANCE_INFINITE = -1;
    public int getDistance (int nodeFrom, int nodeTo);
    public int addNode ();
    public void connectNodes(int nodeFrom, int nodeTo);
```
Your tasks are:

1. Examine the provided local implementation of the assignment.

2. Implement the Searcher as a Stateless Remote Bean and the Node as an Entity Bean with container-managed persistence, and the id attribute as a primary key. Represent the set of neighbors as a suitable relationship between entities.

   Modify the client to create nodes and measure distances using a Searcher deployed on the EJB server.

3. Verify that the Node entities are persistent.

4. Extend the Searcher implementation to offer working with persistent nodes to multiple clients simultaneously, so that each client has his own graph.

   Consider what is the best way of keeping track of client id (clients should not send their id on each request) and how to change the attributes of the Node objects to allow storing independent graphs of multiple clients.