SOAP Web-Services with JAX-WS

Introduction to Service Design and Engineering 2013/2014.

Lab session #10

University of Trento

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Some slides from LabSDE-2012/2013

Outline

- JAX-WS Overview
- JAX-WS Example
- Assignment #3

Pre-Requisites

- Download JAX-WS RI (just in case, libraries should be already available as part of java distribution)

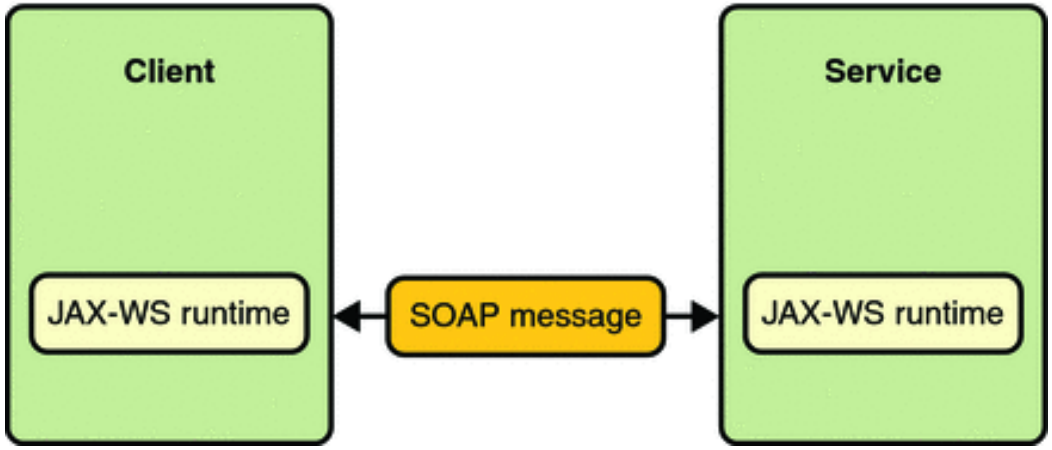
JAX-WS Overview (1)

- JAX-WS stands for Java API for XML Web Services.
- Technology for building web services and clients that communicate using XML.
- JAX-WS allows developers to write message-oriented as well as RPC-oriented web services.
- Web service invocation is represented by an XML-based protocol such as SOAP.
- SOAP defines the envelope structure, encoding rules, and conventions for representing web service invocations and responses. * Calls and responses are transmitted as SOAP messages (XML files) over HTTP.

JAX-WS Overview (2)

- JAX-WS API hides SOAP's complexity from the application developer.
- On the server side, the developer specifies the web service operations by defining methods in an interface
- The developer also codes one or more classes that implement those methods.
- A client creates a proxy (a local object representing the service) and then simply invokes methods on the proxy.
- The developer does not generate or parse SOAP messages. (JAX-WS runtime system converts API calls and responses to and from SOAP messages)

JAX-WS Overview (3)



JAX-WS Overview (4)

- **RPC Style** web service uses the names of the method and its parameters to generate XML structures that represent a method's call stack.
- **Document style** indicates that the SOAP body contains a XML document which can be validated against pre-defined XML schema document.

JAX-WS Tutorial - RPC Style (1)

- Create a Java Project (in eclipse, let's make it a Web Dynamic Project)
- Create a package named **introsde.ws**
- Create a *Web Service Enpoint Interface*
  - A web service endpoint is a service that is published for users to access
  - The web service client is the party who access the published service
  - In this case, a **HelloWorld** java interface like the following

```
package introsde.ws;
import javax.jws.WebMethod;
import javax.jws.WebService;
import javax.jws.soap.SOAPBinding;
import javax.jws.soap.SOAPBinding.Style;
//Service Endpoint Interface
@WebService
@SOAPBinding(style = Style.RPC)
public interface HelloWorld{
    @WebMethod String getHelloWorldAsString(String name);
}
```

JAX-WS Tutorial - RPC Style (2)

- Create the *Web Service Endpoint Implementation*

```
package introsde.ws;
import javax.jws.WebService;
//Service Implementation
@WebService(endpointInterface = "introsde.ws.HelloWorld")
public class HelloWorldImpl implements HelloWorld {
    @Override
    public String getHelloWorldAsString(String name) {
        return "Hello World JAX-WS " + name;
    }
}
```

JAX-WS Tutorial - RPC Style (3)

- Create the package **introsde.endpoint**
- Create the *Web Service Endpoint Publisher* in this package
- Run your first JAX-WS Service as a Java application
- Test that is working by accessing: http://localhost:6900/ws/hello?wsdl

```
package introsde.endpoint;
import javax.xml.ws.Endpoint;
import introsde.ws.HelloWorldImpl;
//Endpoint publisher
public class HelloWorldPublisher{
    public static void main(String[] args) {
       Endpoint.publish("http://localhost:6900/ws/hello", new HelloWorldImpl());
    }
}
```

JAX-WS Tutorial - RPC Style (4)

- Call the service via an HTTP POST request on localhost:6900/ws/hello with body

```
<soap:Envelope
xmlns:soap="http://schemas.xmlsoap.org/soap/envelope/"
soap:encodingStyle="http://www.w3.org/2001/12/soap-encoding">
  <soap:Body xmlns:m="http://ws.introsde/">
  <m:getHelloWorldAsString>
    <arg0>Pinco</arg0>
  </m:getHelloWorldAsString>
</soap:Body>
</soap:Envelope>
```

- This should be the response

```
<S:Envelope
    xmlns:S="http://schemas.xmlsoap.org/soap/envelope/">
    <S:Body>
        <ns2:getHelloWorldAsStringResponse
            xmlns:ns2="http://ws.introsde/">
            <return>Hello World JAX-WS Pinco</return>
        </ns2:getHelloWorldAsStringResponse>
    </S:Body>
</S:Envelope>
```

JAX-WS Tutorial - Implementing Clients

- Create a package **introsde.client** and add the following class

```
package introsde.client;
import java.net.URL;
import javax.xml.namespace.QName;
import javax.xml.ws.Service;
import introsde.ws.HelloWorld;
public class HelloWorldClient {
    public static void main(String[] args) throws Exception {
        URL url = new URL("http://localhost:6900/ws/hello?wsdl");
        // 1st argument service URI, refer to wsdl document above
        // 2nd argument is service name, refer to wsdl document above
        QName qname = new QName("http://ws.introsde/", "HelloWorldImplService");
        Service service = Service.create(url, qname);
        HelloWorld hello = service.getPort(HelloWorld.class);
        System.out.println(hello.getHelloWorldAsString("Pinco"));
    }
}
```

JAX-WS Tutorial - Implementing Clients - Automatic (1)

- You can also use **wsimport** to parse the wsdl file and generate client files (stub) to access the published web service.
- wsimport should be in JDK_PATH/bin folder.
- Create a **my-solutions** folder on your local copy of lab10.
- From the command line, execute the following inside that new folder

```
wsimport -keep http://localhost:6900/ws/hello?wsdl
```

JAX-WS Tutorial - Implementing Clients - Automatic (2)

- You should now have an interface and a service implementation as follows:
- File **introsde/ws/HelloWorld.java**

```
package introsde.ws;
import javax.jws.WebMethod;
import javax.jws.WebParam;
import javax.jws.WebResult;
import javax.jws.WebService;
import javax.jws.soap.SOAPBinding;
import javax.xml.ws.Action;
@WebService(name = "HelloWorld", targetNamespace = "http://ws.introsde/")
@SOAPBinding(style = SOAPBinding.Style.RPC)
public interface HelloWorld {
    @WebMethod
    @WebResult(partName = "return")
    @Action(input = "http://ws.introsde/HelloWorld/getHelloWorldAsStringRequest",
        output = "http://ws.introsde/HelloWorld/getHelloWorldAsStringResponse")
    public String getHelloWorldAsString(
        @WebParam(name = "arg0", partName = "arg0")
        String arg0);
}
```

JAX-WS Tutorial - Implementing Clients - Automatic (3)

- File **introsde/ws/HelloWorldImplService.java**

```
package introsde.ws;
import java.net.MalformedURLException;
import java.net.URL;
import javax.xml.namespace.QName;
import javax.xml.ws.Service;
import javax.xml.ws.WebEndpoint;
import javax.xml.ws.WebServiceClient;
import javax.xml.ws.WebServiceException;
import javax.xml.ws.WebServiceFeature;
@WebServiceClient(name = "HelloWorldImplService",
    targetNamespace = "http://ws.introsde/",
    wsdlLocation = "http://localhost:6900/ws/hello?wsdl")
public class HelloWorldImplService extends Service
{
    private final static URL HELLOWORLDIMPLSERVICE_WSDL_LOCATION;
    private final static WebServiceException HELLOWORLDIMPLSERVICE_EXCEPTION;
    private final static QName HELLOWORLDIMPLSERVICE_QNAME =
            new QName("http://ws.introsde/", "HelloWorldImplService");
    static {
        URL url = null;
        WebServiceException e = null;
        try {
            url = new URL("http://localhost:6900/ws/hello?wsdl");
        } catch (MalformedURLException ex) {
            e = new WebServiceException(ex);
        }
        HELLOWORLDIMPLSERVICE_WSDL_LOCATION = url;
        HELLOWORLDIMPLSERVICE_EXCEPTION = e;
    }
```

JAX-WS Tutorial - Implementing Clients - Automatic (3)

```
    public HelloWorldImplService() {
        super(__getWsdlLocation(), HELLOWORLDIMPLSERVICE_QNAME);
    }
    public HelloWorldImplService(WebServiceFeature... features) {
        super(__getWsdlLocation(), HELLOWORLDIMPLSERVICE_QNAME, features);
    }
    public HelloWorldImplService(URL wsdlLocation) {
        super(wsdlLocation, HELLOWORLDIMPLSERVICE_QNAME);
    }
    public HelloWorldImplService(URL wsdlLocation, WebServiceFeature... features) {
        super(wsdlLocation, HELLOWORLDIMPLSERVICE_QNAME, features);
    }
    public HelloWorldImplService(URL wsdlLocation, QName serviceName) {
        super(wsdlLocation, serviceName);
    }
    public HelloWorldImplService(URL wsdlLocation, QName serviceName, WebServiceFeature... features) {
        super(wsdlLocation, serviceName, features);
    }
    @WebEndpoint(name = "HelloWorldImplPort")
    public HelloWorld getHelloWorldImplPort() {
        return super.getPort(new QName("http://ws.introsde/", "HelloWorldImplPort"),
            HelloWorld.class);
    }
    @WebEndpoint(name = "HelloWorldImplPort")
    public HelloWorld getHelloWorldImplPort(WebServiceFeature... features) {
        return super.getPort(new QName("http://ws.introsde/", "HelloWorldImplPort"),
            HelloWorld.class, features);
    }
    private static URL __getWsdlLocation() {
        if (HELLOWORLDIMPLSERVICE_EXCEPTION!= null) {
            throw HELLOWORLDIMPLSERVICE_EXCEPTION;
        }
        return HELLOWORLDIMPLSERVICE_WSDL_LOCATION;
    }
```

JAX-WS Tutorial - Implementing Clients - Automatic (4)

- To use this stub, create the following program in the file **introsde/client/HelloWorldClient.java**:

```
package introsde.client;
import introsde.ws.HelloWorld;
import introsde.ws.HelloWorldImplService;
public class HelloWorldClient{
     public static void main(String[] args) {
        HelloWorldImplService helloService = new HelloWorldImplService();
        HelloWorld hello = helloService.getHelloWorldImplPort();
        System.out.println(hello.getHelloWorldAsString("Pinco"));
    }
}
```

```
javac introsde/client/HelloWorldClient.java
java introsde/client/HelloWorldClient
```

JAX-WS Tutorial - Document style (1)

- Create a new Web Dynamic Project
- Create the packages introsde.ws, introsde.document.client, introsde.document.endpoint, introsde.document.ws.jaxws
- Create the Web Service Endpoint Interface **HelloWorld** as follows (the only change is the SOAPBinding annotation):

```
package introsde.document.ws;
import javax.jws.WebMethod;
import javax.jws.WebService;
import javax.jws.soap.SOAPBinding;
import javax.jws.soap.SOAPBinding.Style;
//Service Endpoint Interface
@WebService
@SOAPBinding(style = Style.DOCUMENT, use=Use.LITERAL) //optional
public interface HelloWorld{
    @WebMethod String getHelloWorldAsString(String name);
}

---

## JAX-WS Tutorial - Document Style (2)

* Create the Web Service Endpoint Implementation **HelloWorldImpl.java** (no changes here)

```java
package introsde.document.ws;
import javax.jws.WebService;
//Service Implementation
@WebService(endpointInterface = "introsde.document.ws.HelloWorld")
public class HelloWorldImpl implements HelloWorld{
    @Override
```
```

JAX-WS Tutorial - Document Style - Generating Artifacts (1)

- You can use **wsgen** to generate all necessary Java artifacts (mapping classes, wsdl or xsd schema).
- Run the following command on build/classes (where the compiled classes are):

```
wsgen -keep -cp . introsde.document.ws.HelloWorldImpl
```

- It will generate two classes in build/classes/introsde/ws/jaxws,
- Copy them to your **src/introsde/ws/jaxws** folder.
- These can be seen as the equivalents to the **model** in Jersey.

JAX-WS Tutorial - Document Style - Generating Artifacts (2)

- GetHelloWorldAsString.java

```
package introsde.document.ws.jaxws;
import javax.xml.bind.annotation.XmlAccessType;
import javax.xml.bind.annotation.XmlAccessorType;
import javax.xml.bind.annotation.XmlElement;
import javax.xml.bind.annotation.XmlRootElement;
import javax.xml.bind.annotation.XmlType;
@XmlRootElement(name = "getHelloWorldAsString", namespace = "http://ws.document.introsde/")
@XmlAccessorType(XmlAccessType.FIELD)
@XmlType(name = "getHelloWorldAsString", namespace = "http://ws.document.introsde/")
public class GetHelloWorldAsString {
    @XmlElement(name = "arg0", namespace = "")
    private String arg0;
    public String getArg0() {
        return this.arg0;
    }
    public void setArg0(String arg0) {
        this.arg0 = arg0;
    }
}
```

JAX-WS Tutorial - Document Style - Generating Artifacts (3)

- GetHelloWorldAsStringResponse.java

```
package introsde.document.ws.jaxws;
import javax.xml.bind.annotation.XmlAccessType;
import javax.xml.bind.annotation.XmlAccessorType;
import javax.xml.bind.annotation.XmlElement;
import javax.xml.bind.annotation.XmlRootElement;
import javax.xml.bind.annotation.XmlType;
@XmlRootElement(name = "getHelloWorldAsStringResponse", namespace = "http://ws.document.introsde/")
@XmlAccessorType(XmlAccessType.FIELD)
@XmlType(name = "getHelloWorldAsStringResponse", namespace = "http://ws.document.introsde/")
public class GetHelloWorldAsStringResponse {
    @XmlElement(name = "return", namespace = "")
    private String _return;
    public String getReturn() {
        return this._return;
    }
    public void setReturn(String _return) {
        this._return = _return;
    }
}
```

JAX-WS Tutorial - Document Style client (3)

- Create the Web Service Client

```
package introsde.document.client;
import java.net.URL;
import javax.xml.namespace.QName;
import javax.xml.ws.Service;
import introsde.document.ws.HelloWorld;
public class HelloWorldClient{
    public static void main(String[] args) throws Exception {
        URL url = new URL("http://localhost:6901/ws/hello?wsdl");
        //1st argument service URI, refer to wsdl document above
        //2nd argument is service name, refer to wsdl document above
        QName qname = new QName("http://ws.document.introsde/", "HelloWorldImplService");
        Service service = Service.create(url, qname);
        HelloWorld hello = service.getPort(HelloWorld.class);
        System.out.println(hello.getHelloWorldAsString("Pinco"));
    }
}
```

Assignment #3: Part 1 (1)

- Using JAX-WS, implement CRUD services for the following model including the following operations
  - readPerson(int id)
  - createPerson()
  - updatePerson(int id)
  - deletePerson(int id)
  - updatePersonHealthProfile(HealthProfile hp)

// Person & HealthProfile

```
<person>
    <personId>1</personId>
    <firstname>Chuck</name>
    <lastname>Norris</lastname>
    <birthdate>1945-01-01</birthdate>
    <healthProfile>
        <date>2013-12-05</date>
        <weight>78.9</weight>
        <height>172</height>
        <steps>5000</steps>
        <calories>2120</calories>
    </healthProfile>
</person>
```

Assignment #3: Part 1 (2)

- **Extra points:** Include also the service getHealthProfileHistory(int personId)

// History of the health profile

```
<healthProfile-history>
    <healthProfile>
        <date>2013-12-05</date>
        <weight>78.9</weight>
        <height>172</height>
        <steps>5000</steps>
        <calories>2120</calories>
    </healthProfile>
    <healthProfile>
        <date>2013-11-29</date>
        <weight>null</weight>
        <height>null</height>
        <steps>6430</steps>
        <height>null</height>
    </healthProfile>
    <healthProfile>
        <date>2013-11-05</date>
        <weight>null</weight>
        <height>null</height>
        <steps>12083</steps>
        <height>null</height>
    </healthProfile>
</healthProfile-history>
```

Assignment #3: Part 2

- Create a simple client that call each of this services and prints the result.

Assignment Rules

- Before submission make a zip file that includes only
  - All Java source files
  - please, do not include .class or IDE generated project files
- Rename the Zip file to: your full name + assignment_no. for example: cristhian_parra_3.zip
- Submission link: www.dropitto.me/introsde2013
- Password will be given and class and sent to the group
- **Deadline:** 17/december
  - On this date, we will test the services matching clients and servers

Assignment Evaluation

- The assignment will be evaluated in terms of:
  - Requirements satisfaction
  - Execution & Deployment
  - Code design/independence/competence
  - Submitted in time ?
  - Report (or documentation)
  - Code originality (if you choose to do it in pairs)
- Extra points are used as "recovery" you didn't finish the requirements or didn't submit in time

Other Resources

- This lab session is heavily based on examples from JAX-WS Tutorials online
- Oracle Java EE tutorials on JAX-WS
- SOAP Binding: difference between Document and RPC Style
- Tutorial that mixes JAX-WS with JPA