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#java-ee

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About

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Chapter 1: Getting started with java-ee

Remarks

This section provides an overview of what java-ee is, and why a developer might want to use it.

It should also mention any large subjects within java-ee, and link out to the related topics. Since the Documentation for java-ee is new, you may need to create initial versions of those related topics.

Examples

Installation

First of all, you cannot "install" Java EE. Java EE consists of a number of specifications. You can install implementations of those specifications however.

Depending on your needs, there are lots of possibilities. To install most (or all) of the specifications, you can choose a Java EE 7 compatible Application Server. Depending on your needs, you can choose between application servers that implement the web profile or application servers that implement the full profile. For a list of Java EE7 compatible application servers see Java EE Compatibility.

What is Java EE?

Java EE stands for Java Enterprise Edition. Java EE extends the Java SE (which stands for Java Standard Edition). Java EE is a set of technologies and related specifications that are oriented towards the development of large-scale enterprise applications. Java EE is developed in a community driven process. So far the following versions of Java EE have been released:

- J2EE 1.2 (December12, 1999)
- J2EE 1.3 (September 24, 2001)
- J2EE 1.4 (November 11, 2003)
- Java EE 5 (May 11, 2006)
- Java EE 6 (December 10, 2009)
- Java EE 7 (April 5, 2013)

And Java EE 8 is expected to be released on the first half of 2017.

A key concept of the Java EE is that every Java EE version is comprised by a set of specific technologies. These technologies address specific JSRs (Java Specification Requests). In order for a programmer to use these technologies he needs to download an implementation of the Java EE technology specifications. The Java Community provides a reference implementation for each technology but other Java EE compliant technologies are developed and can also be used. The community provides a set of tests, namely the Java Compatibility Kit (JCK) that can be used by the developers of a JSR implementation to check if it is compliant or not with the JSR. The following table gives an overview of the technologies that comprise Java EE 7 and the related JSR that define the specs.

Java EE 7 Technology	JSR
Java Platform, Enterprise Edition 7 (Java EE 7)	JSR 342
Java API for WebSocket	JSR 356
Java API for JSON Processing	JSR 353
Java Servlet 3.1	JSR 340
JavaServer Faces 2.2	JSR 344
Expression Language 3.0	JSR 341
JavaServer Pages 2.3	JSR 245
Standard Tag Library for JavaServer Pages (JSTL) 1.2	JSR 52
Batch Applications for the Java Platform	JSR 352
Concurrency Utilities for Java EE 1.0	JSR 236
Contexts and Dependency Injection for Java 1.1	JSR 346
Dependency Injection for Java 1.0	JSR 330
Bean Validation 1.1	JSR 349
Enterprise JavaBeans 3.2	JSR 345
Interceptors 1.2 (Maintenance Release)	JSR 318
Java EE Connector Architecture 1.7	JSR 322
Java Persistence 2.1	JSR 338
Common Annotations for the Java Platform 1.2	JSR 250
Java Message Service API 2.0	JSR 343
Java Transaction API (JTA) 1.2	JSR 907
JavaMail 1.5	JSR 919
Java API for RESTful Web Services (JAX-RS) 2.0	JSR 339
Implementing Enterprise Web Services 1.3	JSR 109

Java EE 7 Technology	JSR
Java API for XML-Based Web Services (JAX-WS) 2.2	JSR 224
Web Services Metadata for the Java Platform	JSR 181
Java API for XML-Based RPC (JAX-RPC) 1.1 (Optional)	JSR 101
Java APIs for XML Messaging 1.3	JSR 67
Java API for XML Registries (JAXR) 1.0	JSR 93
Java Authentication Service Provider Interface for Containers 1.1	JSR 196
Java Authorization Contract for Containers 1.5	JSR 115
Java EE Application Deployment 1.2 (Optional)	JSR 88
J2EE Management 1.1	JSR 77
Debugging Support for Other Languages 1.0	JSR 45
Java Architecture for XML Binding (JAXB) 2.2	JSR 222
Java API for XML Processing (JAXP) 1.3	JSR 206
Java Database Connectivity 4.0	JSR 221
Java Management Extensions (JMX) 2.0	JSR 003
JavaBeans Activation Framework (JAF) 1.1	JSR 925
Streaming API for XML (StAX) 1.0	JSR 173

Installing Payara Server Full

Prerequisites

- JDK 1.7 or later installed. You can find the Oracle JDK's here.

Steps

- Download Payara Server Full.
- Unzip the Payara Server at some location on your computer. We will use `C:\payara41` as INSTALL_DIR for Windows users and `/payara41` for Linux/Mac users.

Starting / stopping Payara from the command prompt

- Windows: Open a command prompt and execute the following command to start/stop Payara:

```
"C:\payara41\bin\asadmin" start-domain

"C:\payara41\bin\asadmin" stop-domain
```

- Linux/Max: Open a terminal and execute the following command to start/stop Payara:

```
/payara41/bin/asadmin start-domain

/payara41/bin/asadmin stop-domain
```

Starting Payara from Netbeans

- Add the Payara server to Netbeans (see previous chapter)
- Go to the 'Services' tab (Windows -> Services).
- Expand the 'Servers' item.
- Right-click on the Payara server and select 'Start'.
- (Optional) Right-click on the Payara server and select 'View Domain Admin Console' to go to the console.

To check that you're running the Application Server, open a browser and go to http://localhost:4848 to see the Payara Server Console.

Voila! Now it's time to build your first application using JavaEE and deploy it to your server!

Building my First JavaEE Application (Hello World)

Let's understand something. JavaEE consists of a number of specifications. When you install an Application Server (Payara for example), you install all of the specifications at once. For example there's a specification for an ORM called **JPA** (Java Persistence API), a specification to build *Component Based* Web Applications called **JSF** (Java Server Faces), a specification to build REST web services and clients called **JAX-RS**.

So as you might guess, there's not only one way to build a simple Hello World application in JavaEE.

Secondly, the JavaEE spec has a specific structure of folders that looks something like this (simplified):

```
/projectname/src/main/java
/projectname/src/main/resources
/projectname/src/main/resources/META-INF
/projectname/src/main/webapp
/projectname/src/main/webapp/WEB-INF
```

Inside the `/projectname/src/main/java` we put all the java classes that we need.

Inside the `/projectname/src/main/webapp` we put html files, css files, javascript files, etc.

Inside the `/projectname/src/main/webapp/WEB-INF`goes some optional configuration files, such as *web.xml* and *beans.xml*.

For simplicity we will use the NetBeans IDE (it's free) to build our first JavaEE Application. You can find it here. Choose the JavaEE version and install it.

Create new project

- Open NetBeans IDE
- Go to File > New Project > Maven > Web Application and click Next.
- Change **project name** to **HelloJavaEE**, then click Next and Finish.

Clean and build the project

- Go to Run > Clean and Build Project (HelloJavaEE).

Deploy the WAR file

- In a browser, go to http://localhost:4848 (follow instructions to install payara server).
- Go to Applications > Click Deploy, Click on Select File and choose your war file (HelloJavaEE-1.0-SNAPSHOT.war) under `../NetBeansProjects/HelloJavaEE/target`.

Deploy the WAR file directly from Netbeans

- Install Payara (see next chapter).
- In Netbeans, go to the 'Services' tab (Window-> Services if you don't see it).
- Right-click on Servers and select 'Add Server...'
- Select 'GlassFish Server', give it a name and click next.
- Point to your local Payara installation, select 'Local Domain' and click next.
- Leave the domain location settings as they are (Domain: domain1, Host: localhost, DAS Port: 4848, HTTP Port: 8080).
- Go to the 'Projects' tab (Windows -> Projects).
- Right-click on your project and select 'Properties'.
- In the left hand pane, go to 'Run' and select the Server you just added.
- (Optional) Change the context path. If you set the context path to '/MyFirstApplication' the default URL will be 'http://localhost:8080/MyFirstApplication'.

View results

- In a browser, go to http://localhost:8080/HelloJavaEE-1.0-SNAPSHOT

Voila! That's your first app using JavaEE technology. You should now start creating other "Hello World" apps using different specifications like JPA, EJB, JAX-RS, JavaBatch, etc...

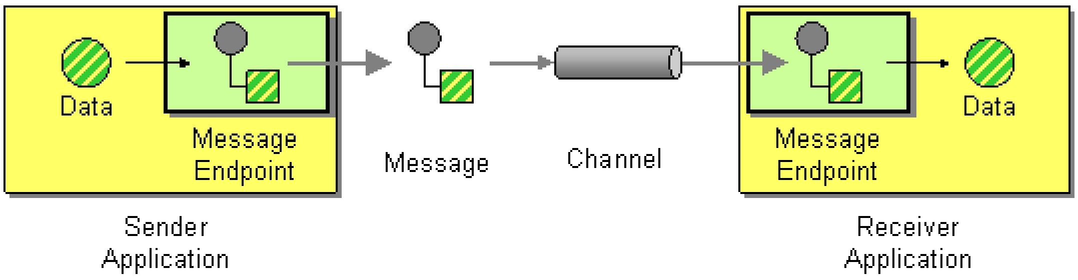
Read Getting started with java-ee online: https://riptutorial.com/java-ee/topic/2265/getting-started-with-java-ee

Chapter 2: Java Connector Architecture (JCA)

Remarks

Let's clarify some terminologies first:

- **Outbound Messaging** is where the message starts from the server (to be more accurate it's initiated from your app which you have on the server, `WebSphere Liberty` in this case) and end at the EIS.
- **Inbound Messaging** is where message starts from the EIS and end at the server.
- **Message Endpoint** in general the place where the message end up sitting/getting received at a specific stage of its life cycle.



So with outbound connectivity, we are referring the situation where an application obtains a connection to an external EIS and reads or writes data to it. With inbound connectivity we are referring the situation where the Resource Adapter (RA) listens for events from the external EIS and calls into your application when such an event occurs.

Illustration of an Outbound RA

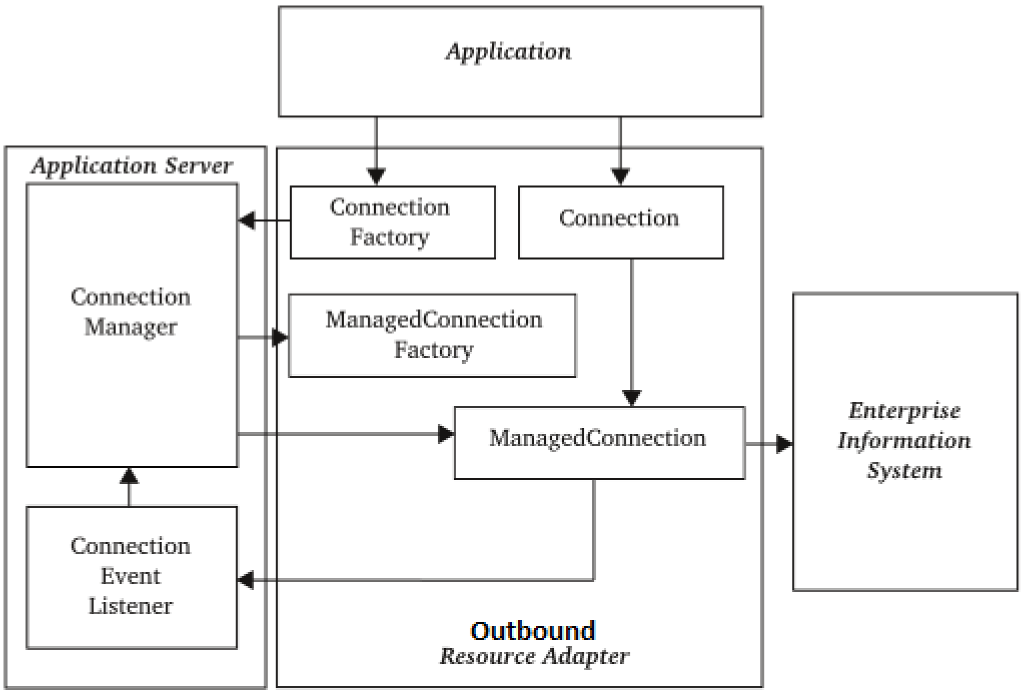
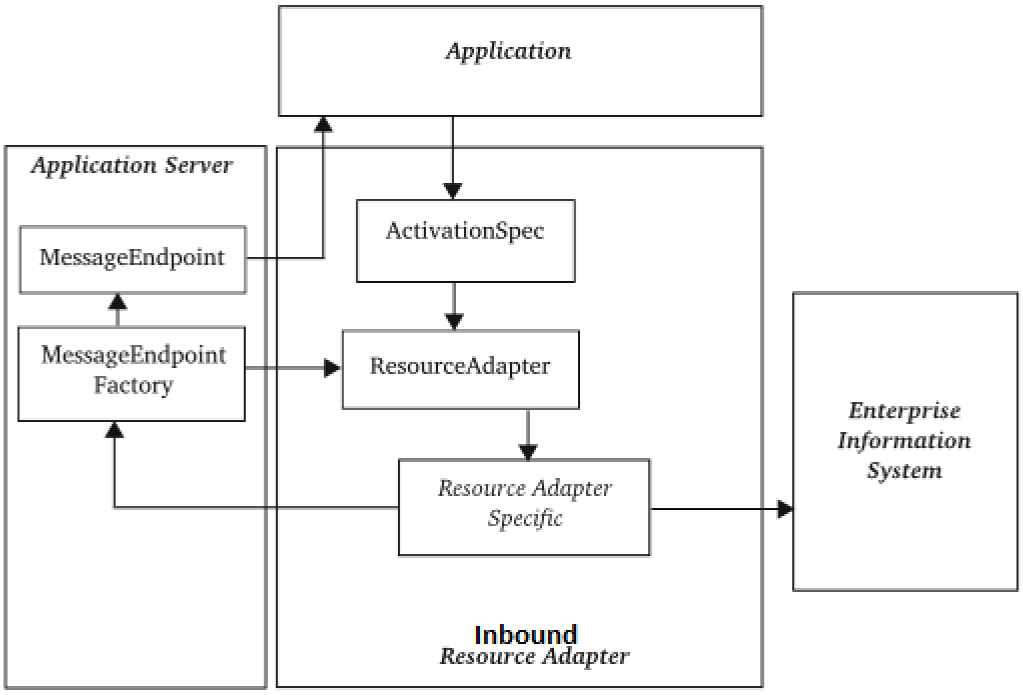

Application
Application Server
Connection Factory
Connection
Connection Manager
ManagedConnection Factory
ManagedConnection
Enterprise Information System
Connection Event Listener
Outbound Resource Adapter

Illustration of an Inbound RA



What is a MessageEndPoint mean in JCA?

The application server (ex: `WebSphere Liberty`) provides message endpoint MBeans to assist you in managing the delivery of a message to your message-driven beans that are acting as listeners on specific endpoints, which are destinations, and in managing the EIS resources that are utilized by these message-driven beans. Message-driven beans that are deployed as message endpoints are not the same as message-driven beans that are configured against a listener port. Message-driven beans that are used as message endpoints must be deployed using an `ActivationSpecification` that is defined within an RA configuration for JCA (Found in the `ra.xml` file) .

What does it mean activating a MessageEndPoint?

With message endpoint MBeans, you can activate and deactivate specific endpoints within your applications to ensure that messages are delivered only to listening message-driven beans that are interacting with healthy EIS resources. This capability allows you to optimize the performance of your JMS applications in situations where an EIS resource is not behaving as expected. Message delivery to an endpoint typically fails when the message driven bean that is listening invokes an operation against a resource that is not healthy. For example, a messaging provider, which is an inbound resource adapter that is JCA compliant, might fail to deliver messages to an endpoint when its underlying message-driven bean attempts to commit transactions against a database server that is not responding.

Does MessageEndPoint need to be a bean?

It should. Otherwise you will end up in a big mess by creating your own unconventional way of doing stuff which beat the purpose of following Java EE specification in the first place. Design your message-driven beans to delegate business processing to other enterprise beans. Do not access the EIS resources directly in the message-driven bean, but do so indirectly through a delegate bean.

Can you show some simple example on working/deploying a MessageEndPoint?

Check the second resource I'm mentioning below for a helpful example.

Useful learning resources:

- Managing messages with message endpoints
- Develop inbound connectors

Examples

Example Resource Adapter

```
class MyResourceAdapter
   implements javax.resource.spi.ResourceAdapter {

   public void start(BootstrapContext ctx){..}
   public void stop(){..}

   public void endpointActivation (MessageEndpoingFactory mf, ActivationSpec a){..}
   public void endpointDeactivation (MessageEndpoingFactory mf, ActivationSpec a){..}
   public void getXAResources(ActivationSpec[] activationSpecs){..}
}
```

Read Java Connector Architecture (JCA) online: https://riptutorial.com/java-ee/topic/7309/java-connector-architecture--jca-

Chapter 3: Java Messaging Service (JMS)

Introduction

The Java Message Service is a Java API that allows applications to create, send, receive, and read messages. The JMS API defines a common set of interfaces and associated semantics that allow programs written in the Java programming language to communicate with other messaging implementations. JMS enables communication that is not only loosely coupled but also asynchronous and reliable.

Remarks

Java Message Service (JMS) is a standard Java API that allows applications to create, send, receive and read messages asynchronously.

JMS defines general set of interfaces and classes that allow applications to interact with other messages providers.

JMS is similar to JDBC: JDBC connects to different databases (Derby, MySQL, Oracle, DB2 etc.) and JMS connects with different providers (OpenMQ, MQSeries, SonicMQ and so on).

JMS reference implementation is Open Message Queue (OpenMQ). It is open source project and can be used in standalone applications or can be built in application server. It is the default JMS provider integrated into GlassFish.

Examples

Creating ConnectionFactory

Connection factories are the managed objects that allows application to connect to provider by creating `Connection` object. `javax.jms.ConnectionFactory` is an interface that encapsulates configuration parameters defined by an administrator.

For using `ConnectionFactory` client must execute JNDI lookup (or use injection). The following code gets JNDI `InitialContext` object and uses it to lookup for `ConnectionFactory` object under JNDI name:

```
Context ctx = new InitialContext();
ConnectionFactory connectionFactory =
                    (ConnectionFactory) ctx.lookup("jms/javaee7/ConnectionFactory");
```

The methods available in this interface are `createConnection()` methods that return a `Connection` object and new JMS 2.0 `createContext()` methods that return a `JMSContext`.

It's possible to create a `Connection` or a `JMSContext` either with the default user identity or by specifying a username and password:

```
public interface ConnectionFactory {
    Connection createConnection() throws JMSException;
    Connection createConnection(String userName, String password) throws JMSException;

    JMSContext createContext();
    JMSContext createContext(String userName, String password);
    JMSContext createContext(String userName, String password, int sessionMode);
    JMSContext createContext(int sessionMode);
}
```

Using ActiveMQ library for messaging (activemq jms provider specific implementations)

Setup ActiveMQ

- Download a ActiveMQ distribution from activemq.apache.org and unpack it somewhere
- You can start the server immediately, running unsecured on localhost, using the script bin/activemq
- When it is running, you can access your local server's console on http://localhost:8161/admin/
- Configure it by modifying conf/activemq.xml
- As the title suggests following examples user activemq jms provider specific implementations and hence activemq-all.jar needs to be added to the classpath.

Sending a message through standalone client

```
import javax.jms.Connection;
import javax.jms.ConnectionFactory;
import javax.jms.JMSException;
import javax.jms.Message;
import javax.jms.MessageProducer;
import javax.jms.Queue;
import javax.jms.Session;
import org.apache.activemq.ActiveMQConnectionFactory;

public class JmsClientMessageSender {

    public static void main(String[] args) {
        ConnectionFactory factory = new ActiveMQConnectionFactory("tcp://localhost:61616"); //
ActiveMQ-specific
        Connection con = null;
        try {
            con = factory.createConnection();
            Session session = con.createSession(false, Session.AUTO_ACKNOWLEDGE); // non-
transacted session

            Queue queue = session.createQueue("test.queue"); // only specifies queue name

            MessageProducer producer = session.createProducer(queue);
            Message msg = session.createTextMessage("hello queue"); // text message
            producer.send(msg);

        } catch (JMSException e) {
            e.printStackTrace();
        } finally {
            if (con != null) {
                try {
                    con.close(); // free all resources
                } catch (JMSException e) { /* Ignore */ }
            }
        }
    }
}
```

Polling for messages

```
import javax.jms.Connection;
import javax.jms.ConnectionFactory;
import javax.jms.JMSException;
import javax.jms.Message;
import javax.jms.MessageConsumer;
import javax.jms.Queue;
import javax.jms.Session;
import javax.jms.TextMessage;
import org.apache.activemq.ActiveMQConnectionFactory;

public class JmsClientMessagePoller {

    public static void main(String[] args) {
        ConnectionFactory factory = new ActiveMQConnectionFactory("tcp://localhost:61616"); //
ActiveMQ-specific
        Connection con = null;

        try {
            con = factory.createConnection();
            Session session = con.createSession(false, Session.AUTO_ACKNOWLEDGE); // non-
transacted session

            Queue queue = session.createQueue("test.queue"); // only specifies queue name

            MessageConsumer consumer = session.createConsumer(queue);

            con.start(); // start the connection
            while (true) { // run forever
                Message msg = consumer.receive(); // blocking!
                if (!(msg instanceof TextMessage))
                    throw new RuntimeException("Expected a TextMessage");
                TextMessage tm = (TextMessage) msg;
                System.out.println(tm.getText()); // print message content
            }
        } catch (JMSException e) {
            e.printStackTrace();
        } finally {
            try {
                con.close();
            } catch (JMSException e) {/* Ignore */ }
        }
    }
}
```

Using MessageListener

```
import javax.jms.Connection;
import javax.jms.ConnectionFactory;
import javax.jms.JMSException;
import javax.jms.Message;
import javax.jms.MessageConsumer;
import javax.jms.MessageListener;
import javax.jms.Queue;
import javax.jms.Session;
import javax.jms.TextMessage;
import org.apache.activemq.ActiveMQConnectionFactory;

public class JmsClientMessageListener {

    public static void main(String[] args) {
        ConnectionFactory factory = new ActiveMQConnectionFactory("tcp://localhost:61616"); //
ActiveMQ-specific
        Connection con = null;

        try {
            con = factory.createConnection();
            Session session = con.createSession(false, Session.AUTO_ACKNOWLEDGE); // non-
transacted session
            Queue queue = session.createQueue("test.queue"); // only specifies queue name

            MessageConsumer consumer = session.createConsumer(queue);

            consumer.setMessageListener(new MessageListener() {
                public void onMessage(Message msg) {
                    try {
                        if (!(msg instanceof TextMessage))
                            throw new RuntimeException("no text message");
                        TextMessage tm = (TextMessage) msg;
                        System.out.println(tm.getText()); // print message
                    } catch (JMSException e) {
                        System.err.println("Error reading message");
                    }
                }
            });
            con.start(); // start the connection
            Thread.sleep(60 * 1000); // receive messages for 60s
        } catch (JMSException e1) {
            e1.printStackTrace();
        } catch (InterruptedException e) {
            e.printStackTrace();
        } finally {
            try {
                con.close();        // free all resources
            } catch (JMSException e) {
                e.printStackTrace();
            }
        }
    }
}
```

Using jndi based lookup for messaging (Non-implementation-specific example)

This method allows non-implementation-specific code to be written and deployed across multiple jms platforms. Below basic example connects to activemq jms server and sends a message.

```
import java.util.Properties;

import javax.jms.JMSException;
import javax.jms.Queue;
import javax.jms.QueueConnection;
import javax.jms.QueueConnectionFactory;
import javax.jms.QueueSender;
import javax.jms.QueueSession;
import javax.jms.Session;
import javax.jms.TextMessage;
import javax.naming.Context;
import javax.naming.InitialContext;
import javax.naming.NamingException;

public class JmsClientJndi {

    public static void main(String[] args) {

        Properties jndiProps = new Properties();
        // Following two could be set via a system property for flexibility in the code.
        jndiProps.setProperty(Context.INITIAL_CONTEXT_FACTORY,
"org.apache.activemq.jndi.ActiveMQInitialContextFactory");
        jndiProps.setProperty(Context.PROVIDER_URL, "tcp://localhost:61616");

        QueueConnection conn = null;
        QueueSession session = null;
        QueueSender sender = null;
        InitialContext jndi = null;
        try {
            jndi = new InitialContext(jndiProps);
            QueueConnectionFactory factory = (QueueConnectionFactory)
jndi.lookup("ConnectionFactory");
            conn = factory.createQueueConnection();
            conn.start();

            session = conn.createQueueSession(false, Session.AUTO_ACKNOWLEDGE);
            Queue queue = (Queue) jndi.lookup("dynamicQueues/test.queue");
            sender = session.createSender(queue);

            TextMessage msg = session.createTextMessage();
            msg.setText("Hello worlds !!!!! ");
            sender.send(msg);


        } catch (NamingException e) {
            e.printStackTrace();
        } catch (JMSException e) {
            e.printStackTrace();
        } finally {
            try {
                if (sender != null)
                    sender.close();
                if (session != null)
                    session.close();
                if (conn != null)
                    conn.close();
            } catch (JMSException e) {
                e.printStackTrace();
            }
        }
    }
}
```

Read Java Messaging Service (JMS) online: https://riptutorial.com/java-ee/topic/7011/java-messaging-service--jms-

Chapter 4: Java RESTful Web Services (JAX-RS)

Remarks

Unlike SOAP and the WS- stack, which are specified as W3C standards, REST is really a set of principles for designing and using web-based interface. REST / RESTful applications rely heavily on other standards:

```
HTTP
URI, URL
XML, JSON, HTML, GIF, JPEG, and so forth (resource representations)
```

The role of JAX-RS (Java API for RESTful Web Services) is to provide APIs that support building RESTful services. However, JAX-RS is just *one way of doing this*. RESTful services can be implemented other ways in Java, and (indeed) in many other programming languages.

Examples

Simple Resource

First of all for a JAX-RS application must be set a base URI from which all the resources will be available. For that purpose the `javax.ws.rs.core.Application` class must be extended and annotated with the `javax.ws.rs.ApplicationPath` annotation. The annotation accepts a string argument which defines the base URI.

```
@ApplicationPath(JaxRsActivator.ROOT_PATH)
public class JaxRsActivator extends Application {

    /**
     * JAX-RS root path.
     */
    public static final String ROOT_PATH = "/api";

}
```

Resources are simple POJO classes which are annotated with the `@Path` annotation.

```
import javax.ws.rs.GET;
import javax.ws.rs.Path;
import javax.ws.rs.Produces;

@Path("/hello")
public class HelloWorldResource {
    public static final String MESSAGE = "Hello StackOverflow!";

    @GET
    @Produces("text/plain")
    public String getHello() {
        return MESSAGE;
    }
}
```

When a `HTTP GET` request is sent to `/hello`, the resource responds with a `Hello StackOverflow!` message.

GET method types

```
import javax.ws.rs.GET;
import javax.ws.rs.Path;
import javax.ws.rs.Produces;

@Path("/hello")
public class HelloWorldResource {
    public static final String MESSAGE = "Hello World!";

    @GET
    @Produces("text/plain")
    public String getHello() {
        return MESSAGE;
    }

    @GET
    @Path("/{letter}")
    @Produces("text/plain")
    public String getHelloLetter(@PathParam("letter") int letter){
        if (letter >= 0 && letter < MESSAGE.length()) {
            return MESSAGE.substring(letter, letter + 1);
        } else {
            return "";
        }
    }
}
```

`GET` without a parameter gives all content ("Hello World!") and `GET` with path parameter gives the specific letter out of that String.

Some examples:

```
$ curl http://localhost/hello
Hello World!
```

```
$ curl http://localhost/hello/0
H
```

```
$ curl http://localhost/hello/4
o
```

Note: if you leave out the method-type annotation (e.g. the `@GET` above), a request method defaults to being a GET request handler.

DELETE method

```
import javax.ws.rs.DELETE;
import javax.ws.rs.GET;
import javax.ws.rs.Path;
import javax.ws.rs.Produces;
import javax.ws.rs.core.Response;

@Path("hello")
public class HelloWorldResource {

    private String message = "Hello StackOverflow!";

    @GET
    @Produces("text/plain")
    public String getHello() {
        return message;
    }

    @DELETE
    public Response deleteMessage() {
        message = null;
        return Response.noContent().build();
    }
}
```

Consume it with curl:

```
$ curl http://localhost/hello
Hello StackOverflow!

$ curl -X "DELETE" http://localhost/hello


$ curl http://localhost/hello
null
```

POST Method

```
import javax.ws.rs.FormParam;
import javax.ws.rs.POST;
import javax.ws.rs.Path;
import javax.ws.rs.core.Response;

@Path("hello")
public class HelloWorldResource {
    @POST
    @Path("/receiveParams")
    public Response receiveHello(@FormParam("name") String name, @FormParam("message") String
message) {
        //process parameters
        return Response.status(200).build();
    }

    @POST
    @Path("/saveObject")
    @Consumes("application/json")
    public Response saveMessage(Message message) {
        //process message json
        return Response.status(200).entity("OK").build();
    }
}
```

First method can be invoked through HTML form submission by sending captured input parameters. Form submit action should point to -

```
/hello/receiveParams
```

Second method requires Message POJO with getters/setters. Any REST client can call this method with JSON input as -

```
{"sender":"someone","message":"Hello SO!"}
```

POJO should have the same property as JSON to make serialization work.

```
public class Message {

    String sender;
    String message;

    public String getSender() {
        return sender;
    }
    public void setSender(String sender) {
        this.sender = sender;
    }
    public String getMessage() {
        return message;
    }
    public void setMessage(String message) {
        this.message = message;
    }
}
```

Exception Mapper

```
@Provider
public class IllegalArgumentExceptionMapper implements
ExceptionMapper<IllegalArgumentException> {

  @Override
  public Response toResponse(IllegalArgumentException exception) {
    return Response.serverError().entity("Invalid input: " + exception.getMessage()).build();
  }
}
```

This exception mapper will catch all IllegalArgumentExceptions thrown in the application, and show the user a clear message instead of a stacktrace.

UriInfo

In order to get information about the URI the user agent used to access your resource, you can use the `@Context` parameter annotation with a `UriInfo` parameter. The `UriInfo` object has a few methods that can be used to get different parts of the URI.

```
//server is running on https://localhost:8080,
// webapp is at /webapp, servlet at /webapp/servlet
@Path("class")
class Foo {

    @GET
    @Path("resource")
    @Produces(MediaType.TEXT_PLAIN)
    public Response getResource(@Context UriInfo uriInfo) {
        StringBuilder sb = new StringBuilder();
        sb.append("Path: " + uriInfo.getPath() + "\n");
        sb.append("Absolute Path: " + uriInfo.getAbsolutePath() + "\n");
        sb.append("Base URI: " + uriInfo.getBaseUri() + "\n");
        sb.append("Request URI: " + uriInfo.getRequestUri() + "\n");
        return Response.ok(sb.toString()).build();
    }
}
```

output of a GET to `https://localhost:8080/webapp/servlet/class/resource`:

```
Path: class/resource
Absolute Path: https://localhost:8080/webapp/servlet/class/resource#
Base URI: https://localhost:8080/webapp/servlet/
Request URI: https://localhost:8080/webapp/servlet/class/resource
```

SubResources

Sometimes for organizational or other reasons it makes sense to have your top level resource return a sub-resource that would look like this. (Your sub-resource does not need to be an inner class)

```
import javax.ws.rs.GET;
import javax.ws.rs.Path;
import javax.ws.rs.Produces;

@Path("items")
public class ItemsResource {

    @Path("{id}")
    public String item(@PathParam("id") String id) {
        return new ItemSubResource(id);
    }

    public static class ItemSubResource {

        private final String id;

        public ItemSubResource(String id) {
            this.id = id;
        }

        @GET
        @Produces("text/plain")
        public Item item() {
            return "The item " + id;
        }
    }
}
```

Custom parameter converters

This is an example of how to implement custom parameter converters for JAX-RS endpoints. The example shows two classes from Java 8's `java.time` library.

```
@Provider
public class ParamConverters implements ParamConverterProvider {
  @Override
  public <T> ParamConverter<T> getConverter(Class<T> rawType,
                                            Type genericType,
                                            Annotation[] annotations)
  {
    if (rawType == LocalDate.class)
      return (ParamConverter<T>) new ParamConverter<LocalDate>() {
        @Override
        public LocalDate fromString(String value) {
          return LocalDate.parse(value);
        }

        @Override
        public String toString(LocalDate value) {
          return null;
        }
      };
    else if (rawType == MonthDay.class)
      return (ParamConverter<T>) new ParamConverter<MonthDay>() {
        @Override
        public MonthDay fromString(String value) {
          int[] ddmm = Arrays.stream(value.split("/"))
                             .mapToInt(Integer::parseInt)
                             .toArray();
          return MonthDay.of(ddmm[1], ddmm[0]);
        }

        @Override
        public String toString(MonthDay value) {
          return null;
        }
      };
    return null;
  }
}
```

Name binding

Name binding is a concept that allows to say to a JAX-RS runtime that a specific filter or interceptor will be executed only for a specific resource method. When a filter or an interceptor is limited only to a specific resource method we say that it is *name-bound*. Filters and interceptors that do not have such a limitation are called *global*.

Defining a name binding annotation

Filters or interceptors can be assigned to a resource method using the `@NameBinding` annotation. This annotation is used as meta annotation for other user implemented annotations that are applied to a providers and resource methods. See the following example:

```
@NameBinding
@Retention(RetentionPolicy.RUNTIME)
public @interface Compress {}
```

The example above defines a new `@Compress` annotation which is a name binding annotation as it is annotated with `@NameBinding`. The `@Compress` annotation can be used to bind filters and interceptor to endpoints.

Binding a filter or interceptor to an endpoint

Consider you have an interceptor that performs GZIP compression and you want to bind such interceptor to a resource method. To do it, annotate both the resource method and the interceptor, as following:

```
@Compress
public class GZIPWriterInterceptor implements WriterInterceptor {

    @Override
    public void aroundWriteTo(WriterInterceptorContext context)
                    throws IOException, WebApplicationException {
        final OutputStream outputStream = context.getOutputStream();
        context.setOutputStream(new GZIPOutputStream(outputStream));
        context.proceed();
    }
}
```

```
@Path("helloworld")
public class HelloWorldResource {

    @GET
    @Produces("text/plain")
    public String getHello() {
        return "Hello World!";
    }

    @GET
    @Path("too-much-data")
    @Compress
    public String getVeryLongString() {
        String str = ... // very long string
        return str;
    }
}
```

The `@Compress` is applied on the resource method `getVeryLongString()` and on the interceptor

`GZIPWriterInterceptor`. The interceptor will be executed only if any resource method with such a annotation will be executed.

In above example, the interceptor will be executed only for the `getVeryLongString()` method. The interceptor will not be executed for method `getHello()`. In this example the reason is probably clear. We would like to compress only long data and we do not need to compress the short response of `"Hello World!"`.

Name binding can be applied on a resource class. In the example `HelloWorldResource` would be annotated with `@Compress`. This would mean that all resource methods will use compression in this case.

Note that global filters are executed always, so even for resource methods which have any name binding annotations.

Documentation

- `@NameBinding` annotation documentation
- Jersey documentation about filters and interceptors

Read Java RESTful Web Services (JAX-RS) online: https://riptutorial.com/java-ee/topic/7008/java-restful-web-services--jax-rs-

Chapter 5: The Javamail API

Remarks

The JavaMail page on the Oracle website describes it as follows

> The JavaMail API provides a platform-independent and protocol-independent framework to build mail and messaging applications. The JavaMail API is available as an optional package for use with the Java SE platform and is also included in the Java EE platform.

The primary site for the JavaMail project is now on java.net. From there you can find the javadocs for many versions of the APIs, links to the source code repositories, links for downloads, examples and hints for using JavaMail with some popular Email service providers.

Examples

Sending an email to a POP3 email server

This example shows how to establish a connection to an SSL-enabled POP3 email server and send a simple (text only) email.

```
// Configure mail provider
Properties props = new Properties();
props.put("mail.smtp.host", "smtp.mymailprovider.com");
props.put("mail.pop3.host", "pop3.mymailprovider.com");
// Enable SSL
props.put("mail.pop3.ssl.enable", "true");
props.put("mail.smtp.starttls.enable", "true");

// Enable SMTP Authentication
props.put("mail.smtp.auth","true");

Authenticator auth = new PasswordAuthentication("user", "password");
Session session = Session.getDefaultInstance(props, auth);

// Get the store for authentication
final Store store;
try {
    store = session.getStore("pop3");
} catch (NoSuchProviderException e) {
    throw new IllegalStateException(e);
}

try {
    store.connect();
} catch (AuthenticationFailedException | MessagingException e) {
    throw new IllegalStateException(e);
}

try {
  // Setting up the mail
```

```
        InternetAddress from = new InternetAddress("sender@example.com");
        InternetAddress to = new InternetAddress("receiver@example.com");

        MimeMessage message = new MimeMessage(session);
        message.setFrom(from);
        message.addRecipient(Message.RecipientType.TO, to);

        message.setSubject("Test Subject");
        message.setText("Hi, I'm a Mail sent with Java Mail API.");

        // Send the mail
        Transport.send(message);
    } catch (AddressException | MessagingException e)
        throw new IllegalStateException(e);
    }
```

Caveats:

- Various details have been hardwired into the code above for illustration purposes.
- The exception handling is NOT examplary. The `IllegalStateException` is a bad choice, for a start.
- No attempt has been made to handle *resources* correctly.

Send Simple Email

```
public class GoogleMailTest {

    GoogleMailTest() {

    }

    public static void Send(final String username, final String password, String
recipientEmail, String title, String message) throws AddressException, MessagingException {
        GoogleMailTest.Send(username, password, recipientEmail, "", title, message);
    }

    public static void Send(final String username, final String password, String
recipientEmail, String ccEmail, String title, String message) throws AddressException,
MessagingException {
        Security.addProvider(new com.sun.net.ssl.internal.ssl.Provider());
        final String SSL_FACTORY = "javax.net.ssl.SSLSocketFactory";
        // Get a Properties object
        Properties props = System.getProperties();
        props.setProperty("mail.smtps.host", "smtp.gmail.com");
        props.setProperty("mail.smtp.socketFactory.class", SSL_FACTORY);
        props.setProperty("mail.smtp.socketFactory.fallback", "false");
        props.setProperty("mail.smtp.port", "465");
        props.put("mail.debug", "true");
        props.setProperty("mail.smtp.socketFactory.port", "465");
        props.setProperty("mail.smtps.auth", "true");
        props.put("mail.smtps.quitwait", "false");
        Session session = Session.getInstance(props, null);
        // -- Create a new message --
        final MimeMessage msg = new MimeMessage(session);
        // -- Set the FROM and TO fields --
        msg.setFrom(new InternetAddress(username));
        msg.setRecipients(Message.RecipientType.TO, InternetAddress.parse(recipientEmail,
false));
```

```
        JOptionPane.showMessageDialog(null, msg.getSize());
        if (ccEmail.length() > 0) {
            msg.setRecipients(Message.RecipientType.CC, InternetAddress.parse(ccEmail,
false));
        }
        msg.setSubject(title);
        msg.setText(message);
        msg.setSentDate(new Date());
        SMTPTransport t = (SMTPTransport) session.getTransport("smtps");
        t.connect("smtp.gmail.com", username, password);
        t.sendMessage(msg, msg.getAllRecipients());
        t.close();
    }
    //    And use this code in any class, I'm using it in the same class in main method
    public static void main(String[] args) {
        String senderMail = "inzi769@gmail.com"; //sender mail id
        String password = "769inzimam-9771"; // sender mail password here
        String toMail = "inzi.rogrammer@gmail.com"; // recepient  mail id here
        String cc = ""; // cc mail id here
        String title = "Java mail test"; // Subject of the mail
        String msg = "Message here"; // message to be sent

        GoogleMailTest gmt = new GoogleMailTest();

        try {
            if (cc.isEmpty()) {
                GoogleMailTest.Send(senderMail, password, toMail, title, msg);
            } else {
                GoogleMailTest.Send(senderMail, password, toMail, cc, title, msg);
            }
        } catch (MessagingException ex) {
            Logger.getLogger(GoogleMailTest.class.getName()).log(Level.SEVERE, null, ex);
        }
    }

}
```

Send HTML Formatted Mail

You can use the same Example above **Send Simple Mail** with a little modification. Use `msg.setContent()` instead of `msg.setText()` and use content type **html** as `text/html`.

check this

```
msg.setContent(message, "text/html; charset=utf-8");
```

instead of

```
msg.setText(message);
```

Read The Javamail API online: https://riptutorial.com/java-ee/topic/8089/the-javamail-api

Chapter 6: The WebSockets API

Remarks

WebSocket is a protocol which allows for communication between the client and the server/endpoint using a single TCP connection.

WebSocket is designed to be implemented in web browsers and web servers, but it can be used by any client or server application.

This topic about the Java APIs for websockets that were developed by JSR 356 and incorporated into the Java EE 7 specifications.

Examples

Creating a WebSocket communication

WebSocket provides a duplex/bidirectional communication protocol over a single TCP connection.

- the client opens a connection to a server that is listening for a WebSocket request
- a client connects to a server using a URI.
- A server may listen to requests from multiple clients.

Server Endpoint

You can create a WebSocket server entpoint by just annotate a POJO with `@ServerEndpoint`. `@OnMessage` decorates a method that receives incoming messages. `@OnOpen` can be used to decorate a method to be called when a new connection from a peer is received. Similarly, a method annotated with `@OnClose` is called when a connection is closed.

```
@ServerEndpoint("/websocket")
public class WebSocketServerEndpoint
{

    @OnOpen
    public void open(Session session) {
     System.out.println("a client connected");
    }

    @OnClose
    public void close(Session session) {
     System.out.println("a client disconnected");
    }

    @OnMessage
    public void handleMessage(String message) {
        System.out.println("received a message from a websocket client! " + message);
    }

}
```

Client Enpoint

Similar to the server endpoint you can create a WebSocket client endpoint by annotate a POJO with `@ClientEndpoint`.

```
@ClientEndpoint
public class WebsocketClientEndpoint {

    Session userSession = null;

    // in our case i.e. "ws://localhost:8080/myApp/websocket"
    public WebsocketClientEndpoint(URI endpointURI) {
        WebSocketContainer container = ContainerProvider.getWebSocketContainer();
        container.connectToServer(this, endpointURI);
    }

    @OnOpen
    public void onOpen(Session userSession) {
        System.out.println("opening websocket");
        this.userSession = userSession;
    }

    @OnClose
    public void onClose(Session userSession, CloseReason reason) {
        System.out.println("closing websocket");
        this.userSession = null;
    }

    @OnMessage
    public void onMessage(String message) {
        System.out.println("received message: "+ message);
    }

    public void sendMessage(String message) {
        System.out.println("sending message: "+ message);
        this.userSession.getAsyncRemote().sendText(message);
    }
}
```

Encoders and Decoder: Object-Oriented WebSockets

Thanks to encoders and decoders, the JSR 356 offers a object oriented communication models.

Messages definition

Let's assume all received messages have to be transformed by the server before being sent back to all connected sessions:

```
public abstract class AbstractMsg {
    public abstract void transform();
}
```

Let's now assume that the server manage two message types: a text-based message and an integer-based message.

Integer messages multiply the content by itself.

```
public class IntegerMsg extends AbstractMsg {

    private Integer content;

    public IntegerMsg(int content) {
        this.content = content;
    }

    public Integer getContent() {
        return content;
    }

    public void setContent(Integer content) {
        this.content = content;
    }

    @Override
    public void transform() {
        this.content = this.content * this.content;
    }
}
```

String message prepend some text:

```
public class StringMsg extends AbstractMsg {

    private String content;

    public StringMsg(String content) {
        this.content = content;
    }

    public String getContent() {
        return content;
    }

    public void setContent(String content) {
        this.content = content;
    }

    @Override
    public void transform() {
        this.content = "Someone said: " + this.content;
    }
}
```

Encoders and Decoder

There is one encoder per message type and a single decoder for all messages. Encoders must implements `Encoder.XXX<Type>` interface when Decoder must implements `Decoder.XXX<Type>`.

Encoding is fairly straightforward: from a message, the `encode` method must output a JSON formatted String. Here is the example for `IntegerMsg`.

```
public class IntegerMsgEncoder implements Encoder.Text<IntegerMsg> {

    @Override
    public String encode(IntegerMsg object) throws EncodeException {
        JsonObjectBuilder builder = Json.createObjectBuilder();

        builder.add("content", object.getContent());

        JsonObject jsonObject = builder.build();
        return jsonObject.toString();
    }

    @Override
    public void init(EndpointConfig config) {
        System.out.println("IntegerMsgEncoder initializing");
    }

    @Override
    public void destroy() {
        System.out.println("IntegerMsgEncoder closing");
    }
}
```

Similar encoding for `StringMsg` class. Obviously, encoders can be factorized via abstract classes.

```
public class StringMsgEncoder implements Encoder.Text<StringMsg> {

    @Override
    public String encode(StringMsg object) throws EncodeException {
        JsonObjectBuilder builder = Json.createObjectBuilder();

        builder.add("content", object.getContent());

        JsonObject jsonObject = builder.build();
        return jsonObject.toString();
    }

    @Override
    public void init(EndpointConfig config) {
        System.out.println("StringMsgEncoder initializing");
    }

    @Override
    public void destroy() {
        System.out.println("StringMsgEncoder closing");
    }

}
```

Decoder proceeds in two steps: checking if the received message fits the excepted format with `willDecode` and then transform the received raw message into a object with `decode`:

public class MsgDecoder implements Decoder.Text {

```
@Override
public AbstractMsg decode(String s) throws DecodeException {
    // Thanks to willDecode(s), one knows that
    // s is a valid JSON and has the attribute
    // "content"
    JsonObject json = Json.createReader(new StringReader(s)).readObject();
    JsonValue contentValue = json.get("content");
    // to know if it is a IntegerMsg or a StringMsg,
    // contentValue type has to be checked:
    switch (contentValue.getValueType()) {
        case STRING:
            String stringContent = json.getString("content");
            return new StringMsg(stringContent);
        case NUMBER:
            Integer intContent = json.getInt("content");
            return new IntegerMsg(intContent);
        default:
            return null;
    }

}

@Override
public boolean willDecode(String s) {

    // 1) Incoming message is a valid JSON object
    JsonObject json;
    try {
        json = Json.createReader(new StringReader(s)).readObject();
    }
    catch (JsonParsingException e) {
        // ...manage exception...
        return false;
    }
    catch (JsonException e) {
        // ...manage exception...
        return false;
    }

    // 2) Incoming message has required attributes
    boolean hasContent = json.containsKey("content");

    // ... proceed to additional test ...
    return hasContent;
}

@Override
public void init(EndpointConfig config) {
    System.out.println("Decoding incoming message...");
}

@Override
public void destroy() {
    System.out.println("Incoming message decoding finished");
}
```

}

ServerEndPoint

The Server EndPoint pretty looks like the *WebSocket communication* with three main differences:

1. ServerEndPoint annotation has the `encoders` and `decoders` attributes
2. Messages are not sent with `sendText` but with `sendObject`

3. OnError annotation is used. If there was an error thrown during `willDecode`, it will be processed here and error information is sent back to the client

   @ServerEndpoint(value = "/webSocketObjectEndPoint", decoders = {MsgDecoder.class}, encoders = {StringMsgEncoder.class, IntegerMsgEncoder.class}) public class ServerEndPoint {

   ```
   @OnOpen
   public void onOpen(Session session) {
       System.out.println("A session has joined");
   }

   @OnClose
   public void onClose(Session session) {
       System.out.println("A session has left");
   }

   @OnMessage
   public void onMessage(Session session, AbstractMsg message) {
       if (message instanceof IntegerMsg) {
           System.out.println("IntegerMsg received!");
       } else if (message instanceof StringMsg) {
           System.out.println("StringMsg received!");
       }

       message.transform();
       sendMessageToAllParties(session, message);
   }

   @OnError
   public void onError(Session session, Throwable throwable) {
       session.getAsyncRemote().sendText(throwable.getLocalizedMessage());
   }

   private void sendMessageToAllParties(Session session, AbstractMsg message) {
       session.getOpenSessions().forEach(s -> {
           s.getAsyncRemote().sendObject(message);
       });
   }
   ```

   }

As I was quite verbose, here is a basic JavaScript client for those who want to have a visual example. Please note that this is a chat-like example: all the connected parties will received the answer.

```
<!DOCTYPE html>
<html>
    <head>
        <title>Websocket-object</title>
        <meta http-equiv="Content-Type" content="text/html; charset=UTF-8">
        <!-- start of BAD PRACTICE! all style and script must go into a
             dedicated CSS / JavaScript file-->
        <style>
            body{
                background: dimgray;
            }
```

```
            .container{
                width: 100%;
                display: flex;
            }

            .left-side{
                width: 30%;
                padding: 2%;
                box-sizing:  border-box;
                margin: auto;
                margin-top: 0;
                background: antiquewhite;
            }
            .left-side table{
                width: 100%;
                border: 1px solid black;
                margin: 5px;
            }
            .left-side table td{
                padding: 2px;
                width: 50%;
            }
            .left-side table input{
                width: 100%;
                box-sizing: border-box;
            }

            .right-side{
                width: 70%;
                background: floralwhite;
            }
        </style>

        <script>
            var ws = null;
            window.onload = function () {
                // replace the 'websocket-object' with the
                // context root of your web application.
                ws = new WebSocket("ws://localhost:8080/websocket-
object/webSocketObjectEndPoint");
                ws.onopen = onOpen;
                ws.onclose = onClose;
                ws.onmessage = onMessage;
            };

            function onOpen() {
                printText("", "connected to server");
            }

            function onClose() {
                printText("", "disconnected from server");
            }

            function onMessage(event) {
                var msg = JSON.parse(event.data);
                printText("server", JSON.stringify(msg.content));
            }

            function sendNumberMessage() {
                var content = new Number(document.getElementById("inputNumber").value);
                var json = {content: content};
                ws.send(JSON.stringify(json));
                printText("client", JSON.stringify(json));
            }

            function sendTextMessage() {
                var content = document.getElementById("inputText").value;
                var json = {content: content};
                ws.send(JSON.stringify(json));
                printText("client", JSON.stringify(json));
            }

            function printText(sender, text) {
                var table = document.getElementById("outputTable");
                var row = table.insertRow(1);
                var cell1 = row.insertCell(0);
                var cell2 = row.insertCell(1);
                var cell3 = row.insertCell(2);

                switch (sender) {
                    case "client":
                        row.style.color = "orange";
                        break;
                    case "server":
                        row.style.color = "green";
                        break;
                    default:
                        row.style.color = "powderblue";
                }
                cell1.innerHTML = new Date().toISOString();
                cell2.innerHTML = sender;
                cell3.innerHTML = text;
            }
        </script>

        <!-- end of bad practice -->
    </head>
    <body>

        <div class="container">
            <div class="left-side">
                <table>
                    <tr>
                        <td>Enter a text</td>
                        <td><input id="inputText" type="text" /></td>
                    </tr>
                    <tr>
                        <td>Send as text</td>
                        <td><input type="submit" value="Send"
onclick="sendTextMessage();"/></td>
                    </tr>
                </table>

                <table>
                    <tr>
                        <td>Enter a number</td>
                        <td><input id="inputNumber" type="number" /></td>
                    </tr>
                    <tr>
                        <td>Send as number</td>
                        <td><input type="submit" value="Send"
```

```
onclick="sendNumberMessage();"/></td>
                    </tr>
                </table>
            </div>
            <div class="right-side">
                <table id="outputTable">
                    <tr>
                        <th>Date</th>
                        <th>Sender</th>
                        <th>Message</th>
                    </tr>
                </table>
            </div>
        </div>
    </body>
</html>
```

Code is complete and was tested under Payara 4.1. Example is pure standard (no external library/framework)

Read The WebSockets API online: https://riptutorial.com/java-ee/topic/7009/the-websockets-api

Credits

S. No	Chapters	Contributors
1	Getting started with java-ee	Barathon, Community, mylenereiners, Pablo Andrés Martínez Vargas, Spyros K
2	Java Connector Architecture (JCA)	M. A. Kishawy
3	Java Messaging Service (JMS)	DimaSan, Setu, Stephen C
4	Java RESTful Web Services (JAX-RS)	Cassio Mazzochi Molin, Daniel Käfer, efreitora, Eric Finn, Jeff Hutchins, Jesse van Bekkum, justderb, kann, mico, RobAu, sargue, Stephen C
5	The Javamail API	Inzimam Tariq IT, Johannes B, Stephen C, Stephen Leppik
6	The WebSockets API	Adrian Krebs, Al1, Stephen C