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561. Developing Java Web Services

Version 2.0

A comprehensive look at the state of the art in developing interoperable web services on the Java EE platform. Students learn the key standards -- SOAP, WSDL, and the WS-I Basic Profile -- and the Java architecture that has evolved to build interoperable services and clients. JAX-WS is central to the course, and we cover both WSDL-driven and Java-driven development paths, as well as message handlers and attachment support. With the new Provider and Dispatch APIs, it's now much easier to integrate SAAJ, JAXB, and JAXP code into services and clients, and we explore these strategies in depth as well.

(For training within the J2EE 1.4 environment, and a concentration on JAX-RPC and SAAJ, please see version 1.5.3 of this course.)

Prerequisites

- Strong Java programming skills are essential -- Course 103 is excellent preparation.
- Students must be able to read XML documents and to write well-formed XML by hand -- consider Course 501. Knowledge of XML Schema will be helpful, too, but is not a strict prerequisite.
- Experience with other Java EE standards, especially servlets and JSP, will be very helpful in class, but is not strictly required.

Learning Objectives

- Be able to describe the interoperable web services architecture, including the roles of SOAP and WSDL.
- Understand the importance of the WS-I Basic Profile for interoperable web services.
- Build JAX-WS services and clients that take full advantage of the automated data binding of JAXB.
- Use lower-level SOAP and XML APIs for services and/or clients.
- Customize data binding by specifying specific type mappings or altering method or parameter names.
- Expose session beans as web services.
- Incorporate binary data, such as images, into service and client code.

Timeline: 5 days.

IDE Support: Eclipse Europa

In addition to the primary lab files, an optional overlay is available that adds support for Eclipse Europa. Students can code and compile all exercises from within Eclipse; deployment to the server is Ant-driven and can be triggered from the IDE as well. See also our orientation to Using Capstone's Eclipse Overlays, and please be advised that this is an optional feature; it is not a separate version of the course, and the course itself does not contain explicit Eclipse-specific lab instructions.

Chapter 1. Overview of Web Services

Why Web Services?
Service-Oriented Architecture
HTTP and XML
Simple Object Access Protocol (SOAP)
Web Service Description Language (WSDL)
Universal Description, Discovery and Integration (UDDI)
The WS-I Basic and Related Profiles
REST

Chapter 2. Web Services for Java EE

Hosting Web Services: Scenarios
Invoking Web Services: Scenarios
Web Services for Java EE (WS4JEE)
The Automated Approach: JAX-WS and JAXB
Manual Options: SAAJ and JAXP
Portable Web-Services Metadata
Service Registries: JAXR

Chapter 3. The Simple Object Access Protocol

Messaging Model
Namespaces
SOAP over HTTP
The SOAP Envelope
The Message Header
The Message Body
SOAP Faults
Attachments

Chapter 4. The Java API for XML Binding

The Need for Data Binding
XML Schema
Two Paths
JAXB Compilation
Mapping Schema Types to Java
Java-to-XML Mapping Using Annotations
Marshaling and Unmarshaling
Working with JAXB Object Models
In-Memory Validation

Chapter 5. Web Services Description Language

Web Services as Component-Based Software
The Need for an IDL
Web Services Description Language
WSDL Information Model
The Abstract Model -- Service Semantics
Message Description
Messaging Styles
The Concrete Model -- Ports, Services, Locations
Extending WSDL -- Bindings
Service Description

Chapter 6. The Java API for XML-Based Web Services

Two Paths
How It Works: Build Time and Runtime
The Service Endpoint Interface
Working from WSDL
Working from Java
RPC and Document Styles
One-Way Messaging
Binary Protocols

Chapter 7. WSDL-to-Java Development

The @WebService Annotation
Generated Code
Compilation and Assembly
Deployment
Runtime Behavior
Scope of Code Generation
More JAXB: Mapping Collections
More JAXB: Mapping Enumerations

Chapter 8. Client-Side Development

Stubs and Proxies
Generated Code
Locating a Service
Invoking a Service

Chapter 9. Java-to-WSDL Development

The @WebMethod, @XmlParam, and Related Annotations
Scope of Code Generation
More JAXB: Mapping Inheritance
Controlling the XML Model
Controlling the WSDL Description

Chapter 10. JAX-WS Best Practices

Which Way to Go?
Interoperability Impact
Portability Impact
Polymorphism in Web Services
Web Services as Java EE Components
Lifecycle Annotations
Context Interfaces
The @WebServiceRef Annotation

Chapter 11. Provider and Dispatch APIs

Stepping Down
The Provider<T> Interface
Implementing a Provider
JAXB Without WSDL
Integrating JAXP
The Dispatch<T> Interface
Building Clients

Chapter 12. The SOAP with Attachments API for Java

The SAAJ Object Model
Parsing a SOAP Message
Reading Message Content
Working with Namespaces
Creating a Message
Setting Message Content

Chapter 13. Message Handlers

Handling SOAP Headers
Servlet Endpoint Context

MessageContext and SOAPMessageContext
Message Handlers and Handler Chains
Processing Model and Patterns
Client-Side Handlers

Chapter 14. EJBs as Web Services

Enterprise JavaBeans
Three Tiers for Java EE
EJB3 and JAX-WS
Session Beans as Web Service Endpoints
The Bean's Service Endpoint Interface
SOAP as an EJB Protocol
Pitfalls

Chapter 15. Handling Binary Content

The WS-I Attachments Profile
Using base64Binary
MIME Attachments
JAX-WS Support
MTOM and XOP
SAAJ Support

Appendix A. Learning Resources

Appendix B. Compatibility and Migration

- JAX-RPC
- Comparing JAX-RPC and JAX-WS
- Using JAX-RPC and JAX-WS Together
- SOAP "Section 5" Encoding

System Requirements

Hardware Requirements (Minimum)	1 GHz, 512 meg RAM, 1 gig disk space.
Hardware Requirements (Recommended)	2 GHz, 1 gig RAM, 1 gig disk space.
Operating System	Tested on Windows XP Professional. Course software should be viable on all systems which support the Java EE 5.0 SDK.
Network and Security	Limited privileges required -- please see our standard security requirements at **http://capcourse.com/Guides/Security.html**.

Software Requirements	All free downloadable tools.