Training: Capstone Courseware
106 Advanced Java Programming

TRAINING GOALS:

Version 8.0

This course provides advanced training in developing software using the **Java Platform**, **Standard Edition**, or **Java SE**. It is intended for students with solid experience in structured and object-oriented Java programming, including use of the Collections API and exception handling. Generic types should be understood, at least at a basic level; the course does begin with a refresher and then a more advanced treatment of generic types.

After a quick introduction to the Java Time API, students get familiar with the I/O streams model, file handling, and object serialization, and learn to use streams to communicate over network sockets. A two-chapter unit covers multi-threaded programming and concurrency techniques. We look at dynamic typing in Java, in the Reflection API and with dynamic proxies, and understand the underpinnings of source-code annotations.

Finally, several chapters at the end of the course introduce unit-testing and test-driven-development practices. Here for the first time we introduce external libraries -- **JUnit**, and the **Mockito** dynamic-mocking library -- and the study is not entirely about technology but leans more into design and good practice.

Learning Objectives

- Make effective use of Java generic types.

- Understand the structure of streams in Java, and learn how to use streams to manage file I/O.

- Learn how to use Java Serialization to internalize and externalize potentially complex graphs of objects.

- Communicate between processes using network sockets.

- Write multi-threaded Java applications that safely manage concurrent access to application state.

- Use the Reflection API and dynamic proxies for highly generic tasks, discovery, or code-generation.

- Use standard annotations and develop custom annotations to express meta-data in Java source files.

- Build unit tests for Java classes using JUnit.

- Write effective tests, and design classes for testability.

- Understand test-driven development (TDD) and use dynamic mocking to support isolated

testing.

CONSPECT:

- Generics
    - Using Generics
    - Type Erasure
    - Type Boundaries
    - Wildcards
    - Generic Methods
    - Strengths and Weaknesses of Generics
    - Legacy Code and Generics
- The Time API
    - A History of Time ... in Java
    - Limitations of Date and Calendar
    - The Time API
    - Temporal Types
    - Accessors and Adjusters
    - Formatting
    - Decomposition Into Fields
    - Date Arithmetic
    - Managing Precision
    - Duration and Period
    - Time Zones and Offsets
    - Converting Between Time Zones
- The Java Streams Model
    - Delegation-Based Stream Model
    - InputStream and OutputStream
    - Media-Based Streams
    - Filtering Streams
    - Readers and Writers
    - Byte-Array Streams
    - String Readers and Writers
    - Closing Streams, Readers and Writers
- Working with Files
    - The File Class
    - Modeling Files and Directories

- File Streams
- Working with File Systems
- The Path Interface
- The Paths and Files Utilities
- Processing with java.util.stream.Streams

- Delegating Streams
  - Buffering
  - Data Streams
  - Push-Back Parsing
  - Byte-Array Streams and String Readers and Writers

- Java Serialization
  - The Challenge of Object Serialization
  - Serialization API
  - Serializable Interface
  - ObjectInputStream and ObjectOutputStream
  - The Serialization Engine
  - Transient Fields
  - readObject and writeObject
  - Externalizable Interface

- Sockets
  - The OSI Reference Model
  - Network Protocols
  - The Socket Class
  - The ServerSocket Class
  - Connecting Through URL Objects
  - HTTP and Other TCP Servers
  - Datagram Clients and Servers
  - Non-Blocking Sockets

- Threads
  - Java Thread Model
  - Creating and Running Threads
  - Manipulating Thread State
  - Thread Synchronization
  - Synchronized Blocks and Methods
  - wait and notify
  - join and sleep

- Multi-Threading in Servers
- Concurrency
  - The Concurrency API
  - Semaphore and Other Synchronizers
  - Concurrent Collections
  - Atomic Operations
  - Executor and ExecutorService
  - Thread Pools
  - Parallel Processing
- Reflection
  - Uses for Meta-Data
  - The Reflection API
  - The ClassClass
  - The java.lang.reflect Package
  - Reading Type Information
  - Navigating Inheritance Trees
  - Dynamic Instantiation
  - Dynamic Invocation
  - Reflecting on Generics
- Dynamic Proxies
  - The Proxy Pattern
  - Dynamic Proxies in Java
  - Use Cases
  - The InvocationHandler Interface
  - Proxy Classes
- Annotations
  - Aspect-Oriented Programming and Java
  - The Annotations Model
  - Annotation Types and Annotations
  - Built-In Annotations
  - Annotations vs. Descriptors (XML)
- Automated Unit Testing with JUnit
  - Automated Testing
  - JUnit and Related Tools
  - The @Test Annotation
  - The Assert Class Utility

- - Test Runners
    - Lifecycle Methods
    - Expecting Exceptions
    - Test Suites
  - Writing Tests
    - Test Granularity
    - Reusing Test Logic
    - Recording and Comparing Output
    - Test Isolation
    - Controlling the Test Environment
    - Managing Dependencies
    - Non-Invasive Testing
    - Designing for Testability
    - Factories
    - Testing and Threads
  - Test-Driven Development
    - Writing the Test First
    - The TDD Cycle
    - Advantages of TDD
    - Resistance to TDD
    - A Case Study
  - Mocking
    - Mock Objects in Testing
    - Mock Objects in Test-Driven Development
    - Static vs. Dynamic Mocks
    - Stubbing
    - Verifying
    - Matching and Capturing
    - Using a Spy
    - Partial Mocking

REQUIREMENTS:

Solid **Java programming** experience is essential -- especially object-oriented use of the language. Language features and techniques that are integral to some lab exercises include interfaces and abstract classes, threading, generics and collections, and recursive methods. Course 103, "**Java Programming**," is excellent preparation.

Difficulty level

CERTIFICATE:

The participants will obtain certificates signed by Capstone Courseware.

TRAINER:

Authorized Capstone Courseware Trainer.