Information Integration Systems

Sisteme de Integrare Informațională

Course Plan

SDBIS & SIA 2025

Course Plan

- Chapter 1. Intro: Integration Problem
- Chapter 2. Data Integration with Federated Database Architecture
- Chapter 3. Data Service Integration Architecture
- Chapter 4. Enterprise Application Integration

Chapter 1. Intro: Integration Problem

- 1.1 Integration Problem
- 1.2 Integration Strategies
  - Federated Data Systems,
  - Data Service Integration (SOA/MSA & Cloud Computing),
  - Enterprise Architecture Integration.

Chapter 2. Data Integration with Federated Database Architecture

- 2.1 Data Integration Concept
- 2.2 Architecture and components
  - 2.2.1 Data Source Access Model
  - 2.2.2 Integration and Analytical Model
  - 2.2.3 Integration Web Model

2.2.1 Data Source Access Model

- SQL Data Source Access
- Structured Documents
  - XML Data Source Access
  - XLSx/CSV Data Source Access
  - JSON Data Source Access
- NoSQL Data Sources (e.g. MongoDB, Cassandra, Neo4J)

Data Source Model and Access Components

- SQL Access: Federated Oracle Databases
  - Database Link Schema Objects
- Case Study: Oracle Federated Database with DB-Links
  - Remote SQL Views on other Oracle Instances

Data Source Model and Access Components

- SQL Access: Heterogeneous Databases
  - REST.SQL
- Case Study: SQL Federated Databases with Oracle
  - Remote PostgreSQL Views with PostgREST
  - (deprecated) Remote PostgreSQL Views with OG4ODBC

Data Source Model and Access Components

- SQL Federated Database integration with external CSV and XLSX (semistructured document) data sources
  - External Tables with Oracle Loader
  - External Views with ExcelTable PL/SQL Library
- Case Study: CSV and XLSX Access
  - External Table on local CSV file
  - Remote View on local XLSx file
  - Remote View on FTP XLSx file

Data Source Model and Access Components

- SQL Federated Database integration with external XML and JSON (structured document) data sources
  - XML Data Type and XML Table in Oracle
  - JSON Data Type and JSON Table in Oracle
- Case Study: XML and JSON Access
  - Local Table import from external XML and JSON files
  - Remote Views on external local XML and JSON files

2.2.2 Integration and Analytical Model

- Oracle SQL ROLAP Extensions
  - ROLLUP, CUBE, PIVOT operators
- Case-Study: multidimensional analytical schema in Oracle DB
  - Consolidation Dimensional and Fact Views
  - Analytical Views with ROLAP processing

2.2.3 Integration Web Model

- Web views with Oracle APEX
- REST views with Oracle REST Data Services [ORDS] and Oracle APEX
- Case Study
  - Web Application with Reports and Charts (APEX)
  - SQL REST Endpoints from Oracle Schema (ORDS)

Chapter 3. Data Services Integration with REST Java Spring Architecture

- 3.1 Concept: REST Data Services from SOA
- 3.2 Architecture and components
  - 3.2.1 Data Source Access Model
  - 3.2.2 Integration and Analytical Model
  - 3.2.3 Integration Web Model
    - With REST Services

Data Access Model

- SQL Data Source Access
  - JDBC Access Strategies and Framework
- Case Study: JDBC REST Data Service
  - JDBC SQL Internal Bean Views
  - JDBC XML Web views
  - JDBC Service Integration with Oracle FDB

Data Access Model

- SQL Data Source Access
  - JPA Access Strategies and Framework
- Case Study: JPA REST Data Service Framework
  - JPA JPQL/SQL Internal Entity Views
  - JPA XML Web views
  - JPA Service Integration with Oracle FDB

Data Access Model

- XML Data Source Access
  - JAXB Access Strategies and Frameworks
- Case Study: XML REST Data Service
  - JAXB Internal Bean Views
  - XML Web views
  - XML Service Integration with Oracle FDB

Data Access Model

- JSON Data Source Access:
  - Jackson Access Strategies and Frameworks
- Case Study: JSON REST Services
  - JSON Internal JavaBean Views
  - JSON Web views
  - JSON Service Integration with Oracle FDB

Data Access Model

- XLSx Data Source Access:
  - Apache POI Access Strategies and Frameworks
- Case Study: XLSx REST Services
  - Apache POI Internal Bean Views
  - XLSx XML Web views
  - XLSx Service Integration with Oracle FDB

3.2.2 Integration and Analytical Model

- REST Data Services Orchestration
  - Spring Cloud integration
- Data Processing with Java Stream API
- Data Processing with Apache Spark SQL

Integration and Analytical Model

- Java Stream API Framework Architecture and specific DSL
- Case Study
  - REST Source Data Services Endpoints and Connectors
    - Spring Cloud Integration
  - Consolidation Views with Java Stream Builders
  - Analytical Views with Java Stream Builders

Integration and Analytical Model

- SparkSQL Framework Architecture and specific DSLs
- Case Study
  - REST Source Data Services Endpoints and Connectors
    - HTTP.URI Point-to-Point Integration
  - Consolidation Views with SparkSQL Java Builders
  - Analytical Views with SparkSQL Java Builders

Integration Web Model: REST Web Services

- Web REST View Model
- Case Study
  - SpringBoot framework to expose endpoints for Consolidation and Analytical Views
  - Vaadin Web Views to expose Consolidation and Analytical Views

Chapter 4. Enterprise Application Integration with Apache Camel

4.1 EAI Concept and Enterprise Integration Patterns

- EAI Architectural components
- EAI framework basic components of Apache Camel

4.2 Access Model: Apache Camel connectors

4.3 Integration and Analytical Model: data service orchestration with Apache Camel

4.4 Integration Web Model: Apache Camel components to expose web REST services

4.2 EAI Architectural components

- EAI framework basic components
  - endpoint, message, channel, processor, route
- Case Study: Data Service Orchestration with Apache Camel EAI framework
  - Consumer Endpoint for Data Source REST Services
  - Message Processor for JSON/XML REST Resources
  - Producer Endpoint for Analytical REST Services
  - Final Route to orchestrate REST Data Services

References for Data Integration

AnHai Doan, Alon Halevy, Zachary Ives, Principles of Data Integration, 2012 Elsevier, Inc.

Anthony Giordano, Data integration: blueprint and modeling techniques for a scalable and sustainable architecture, 2010, Pearson Education, Inc.

April Reeve, Managing Data in Motion Data Integration Best Practice Techniques and Technologies, 2013 Elsevier, Inc.

References for SOA

Erl, Thomas, Service-Oriented Architecture: Analysis and Design for Services and Microservices, PRENTICE HALL, 2017

K. Siva Prasad Reddy, Beginning Spring Boot 2 Applications and Microservices with the Spring Framework, Apress, 2017

Craig Walls, Spring Boot in Action, Manning; 1st edition (January 3, 2016)

Magnus Larsson, Microservices with Spring Boot and Spring Cloud: Build resilient and scalable microservices using Spring Cloud, Istio, and Kubernetes, Packt Publishing; 2nd ed. edition (July 29, 2021)

References for EAI

Gregor Hohpe, Bobby Woolf, Enterprise Integration Patterns: Designing, Building, and Deploying Messaging Solutions, Addison-Wesley Professional; 1st edition (October 10, 2003)

David S. Linthicum, Enterprise Application Integration, Addison-Wesley Professional; 1st edition (November 12, 1999)

William A. Ruh, Francis X. Maginnis, William J. Brown, Enterprise Application Integration: A Wiley Tech Brief, Wiley; 1st edition (October 13, 2000)

References for EAI

Claus Ibsen, Jonathan Anstey, Camel in Action, Manning; 2nd edition (February 18, 2018)

Guilherme Camposo, Cloud Native Integration with Apache Camel: Building Agile and Scalable Integrations for Kubernetes Platforms, Apress (August 25, 2021)

Jean-Baptiste Onofre, Mastering Apache Camel, Packt Publishing (June 30, 2015)