Component based Development

Web Application Development

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Table of Contents

Software System

- Provide Services
  - Functional
  - Non-Functional
- Single Unit
  - Looks Like
  - Communicates with Others
  - Integrated
- Complex
- Usually Modular
- Software Architectures
  - MVC
  - n-Tier
  - SOA

Terms

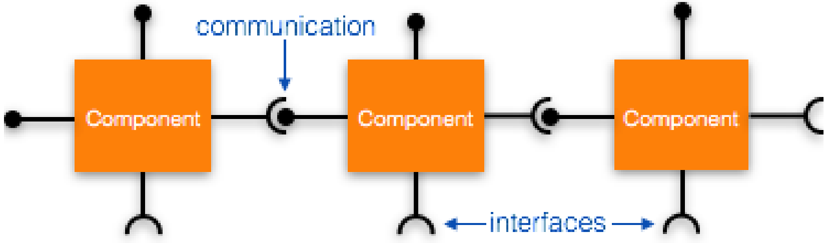
sub–system	A part of the entire system that provide a well–defined functionality.
module	A development unit that has a well–defined purpose. Modules are identified by their name.
component	A module used by another module.
artifact	A specific version of a module. A module with a version number.

These terms are slightly different. During the course, we will stick to these definitions. Do not mix them.

Modules, Components

- Tests
  - Unit
  - Component
  - Integration
- Dependencies
- Build process
- Deployment

- Version number
  - major.minor.build.revision
  - alpha, beta, release candidate, commercial distribution
  - Never use multiple version of the same module!



Component

- Standalone Development Unit
- Specific Functionality
  - Abstractness
  - Granularity
  - Communicates via Interface
- Specific Technologies
  - JDBC, JPA, myBatis
  - J2EE, Spring
  - Jackson, JAXB
- Other Components
  - Integrate
  - Depend

+ Encapsulate Functionalities

+ Simplify Development
  - Standardization
  - Categorize Services
  - Lock Up Technologies

+ Facilitates Testing
  - Component Tests
  - Integration Tests

- Difficult to Design
  - Experience Required
  - Costly Decisions

- Obedience to Standards
  - Code Review

3rd Party Components

Pros

- Boxed Solutions
- General Tasks
- Faster Development
- Reusable Components

Cons

- Learning
- Depends on Providers
    - Versions
- Bugs!!!
- Support???

Logging

- log4j, log4j2, slf4j

Data Access

- JDBC, myBatis
- JPA, Hibernate
- Spring Data

Data Conversion, Marshalling

- JAXB,
- Jackson, gson

Testing

- JUnit
- EasyMock, Mockito

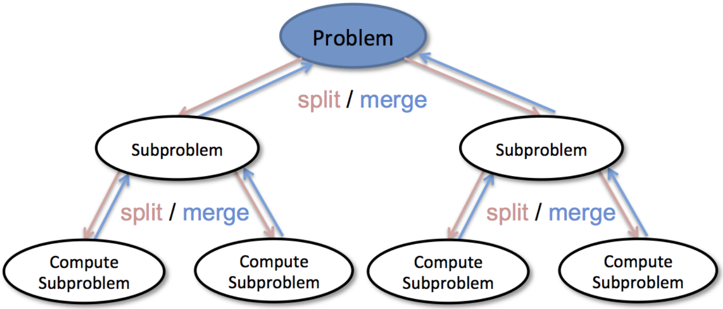
Table of Contents

Component Design

Divide and Conquer!

- Complex tasks can be broken down
- Increase re–usability
- Simplify tasks

- Separate different
  - programming language
  - tools
  - technologies



Interface–based Programming

- Component Communication
- Separation of
  - Definition
  - Implementation
- Decouple Components
  - Loose Coupling
  - Exchangeable Components
- Facilitates
  - Design
  - Development
  - Maintenance

Interface

- Defines expected behavior
  - return type
  - parameters
  - exceptions
  - documentation
- Static Type
- Various Implementations
- Abstractness

```
/**
Interface Description
*/
interface MoneyExchangeService{
        /**
        Method details
        @param amount ...
        @param currency ...
        @return ...
        @throws ...
        */
        void exchange(
                Double amount,
                Currency
                        currency)
        throws
            ExchangingException;
}
```

Abstract Class vs Interface

Similarities

- Design Elements
- Abstract Types
- Define Behavior

Differences

- Fields
- Concrete Methods
- Multiple Inheritance

Decision Support

- Abstract class if:
  - Fields are Needed.
  - Constructor is Needed.
  - Concrete Method is Defined
    - Template Method
- Otherwise Interface

Testing Dependencies

Component Tests

- Tested Separately
- Mocking External Dependencies

Does the component work properly, if the external dependencies work expectedly?

Integration Tests

- Testing with External Dependencies
- No Mocking
- Testing in "Real" Environment
- Assume Everything is Available

Does the component works properly in the System?

Table of Contents

Tools – Maven

- Application
  - `mvn <goal>`
  - Eclipse plugin
- Packaging
  - `pom`
  - `jar`
  - `war`
- Properties
  - Inheritance
- Command Line Tool
- Scripts
- Integration

Project Structure

- src
  - main
  - test
- target
- `pom.xml`
  - `groupId`, `artifactId`, `version`

Project Object Model - `pom.xml`

- Artifact Identification

groupId	Company or Project Name
artifactId	Component Name
version	Version Number

- Parent Project
- Packaging
- Properties
- Build Configuration
- Project Information
- Development Environment
  - Source Code Management
  - Issue Tracker
  - Mailing Lists
  - Developers

```
<!--Custom -->
<junit.version>4.12</junit.version>
${junit.version}
<!-- Built-in -->
${project.basedir}
${project.version}
```

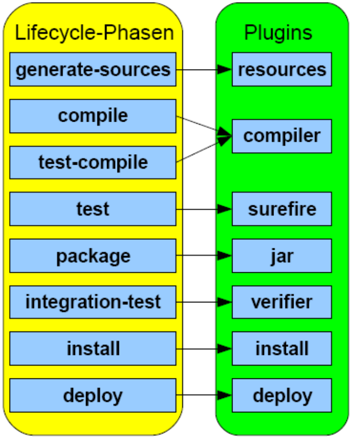
Maven Build

- Source code $\rightarrow$ Software
- Common Task & Fix Steps
  - Compile
    - Classes
    - Components
  - Testing
  - Linking
  - Distribution
- Automation & Tools
  - make
  - maven, gradle, ant
  - Jenkins CI

1. validate
2. compile
3. test
4. package
5. integration-test
6. verify
7. install
8. deploy

Maven Life-Cycle

- Build Steps $\rightarrow$ Goals
- Previous Steps are Required
- Step Failure $=$ Build Failure
- Configuration via Plugins



Maven Life-Cycle

`clean`

- Remove `target` directory

`validate`

- Check `pom.xml`

`compile`

- `src/**.java` $\rightarrow$ `*.class`

`test`

- JUnit (`test/**Test.java`)
- Surefire

`package`

- Zip to `jar` or `war`

`integration-test`

- JUnit (`test/**IT.java`)

`verify`

- Check Quality Criteria

`install`

- Copy to Local Repository

`deploy`

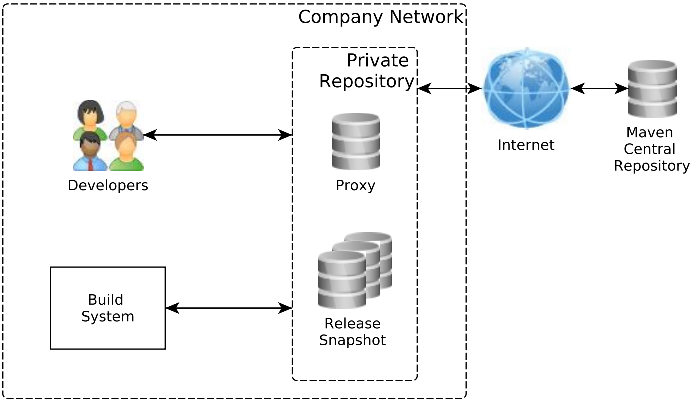
- `distributionManagement`
- Publishing, Sharing

Maven Dependency Management

- Other Component
    - 3rd Party Library
    - Other Part of the System
- Deployed Artifact
- Stored in Repository
- Automatic
    - Search
    - Download
    - Adding to `ClassPath`

```
<dependency>
 <groupId>
  org.apache.logging.log4j
 </groupId>
 <artifactId>
  log4j
 </artifactId>
 <version>
  2.8.2
 </version>
</dependency>
```

Repositories



Maven Central & Company's Private Repositories

Maven Central Repository

- Known Location
- `www.maven.org`
- Public
- Libraries
  - Free
  - Common Tasks

Private Repository

- Proxy
- Our Precious Products
- Kept in Secret
  - LAN
  - VPN

Local Repository `$HOME/.m2/`

- Maven Configurations
- Used Dependencies
- Known Location
  - `repository` directory
  - `settings.xml`
  - `security-settings.xml`
- Stored Locally
- Downloaded Once
- Shared Among Projects

```
repository
+--org/apache/logging
|+--log4j/log4j-core
||+--2.2
||\log4j-core-2.2.jar
||\log4j-core-2.2.pom
||+--2.5
||\log4j-core-2.5.jar
||\log4j-core-2.5.pom
||+--2.6.2
||\...
...
```

settings.xml

- Developer's Settings
- Shared Among Projects
- Server Access
  - username, password
  - Encryption
  - `security-settings.xml`
- Profiles
  - Build Settings
  - Conditions
    - OS
    - JDK Version
  - Properties

```
<settings xmlns="..">
<localRepository/>
<interactiveMode/>
<usePluginRegistry/>
<offline/>
<pluginGroups/>
<servers/>
<mirrors/>
<proxies/>
<profiles/>
<activeProfiles/>
</settings>
```

Table of Contents

Project Structures

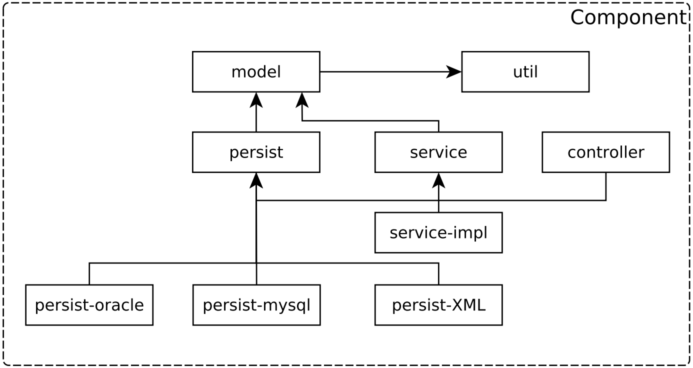
No Silver Bullet

- Depends on
  - Company
  - Architect
  - Project Requirements
  - Competence
  - Laziness
  - etc.
- Defined by
  - Software Architects
  - Senior Developers

Should be Considered:

- Functionalities based on
  - Users / Roles
  - Commercial Units
  - Reusability
- Technologies
  - Programming Techniques
  - Programming Languages
- Build and Testings

Example Project Structure #1



Example Project Structure #1

`util`

- Utility Functions
- Logging Configuration
- Do not Fit Elsewhere

`model`

- Domain Model
- Low Level Validation

`persist`

- Data Access Object
- Interfaces

`persist-*`

- DAO Implementation
- Depends on Technology

`service`

- Service Definition
- Interfaces

`service-impl`

- Service Implementation

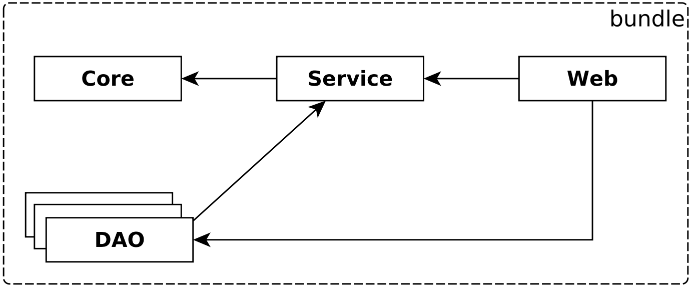
`controller`

- Entry Point of the Component
- Validate & Sanitize

Discussion

Pros and Cons ?
Why?

Example Project Structure #2



Example Project Structure #2

`core`

- Domain Objects
  - Validation
- Service Definition
  - Interface
  - Exception

`service`

- Service Implementation
- DAO General Definition
  - Interface
  - Exception

`DAO`

- Multiple Implementations
- Technology Dependent

`web`

- Entry Point of Component
- Deployable

Discussion

Pros and Cons ?
Why?