Object-Oriented Programming

9. Lecture
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Java Reflection API (java.lang.reflect)

- Examining and modifying a program during runtime (itself)
- Inspection of classes, interfaces, methods during runtime
- Creating new class instances
- Dynamic method calls
- Get and set method attributes

- Note: this does not make Java a dynamic language (we cannot add attributes, methods, classes, etc.) and does not always support "OOP"

The java.lang.reflect core

- Class
- Field
- Method
- Constructor
- Modifier

get() vs getDeclared()

https://docs.oracle.com/javase/tutorial/reflect/class/classMembers.html

Class Methods for Locating Fields

`Class` API	List of members?	Inherited members?	Private members?
`getDeclaredField()`	no	no	yes
`getField()`	no	yes	no
`getDeclaredFields()`	yes	no	yes
`getFields()`	yes	yes	no

Class Methods for Locating Methods

`Class` API	List of members?	Inherited members?	Private members?
`getDeclaredMethod()`	no	no	yes
`getMethod()`	no	yes	no
`getDeclaredMethods()`	yes	no	yes
`getMethods()`	yes	yes	no

Class Methods for Locating Constructors

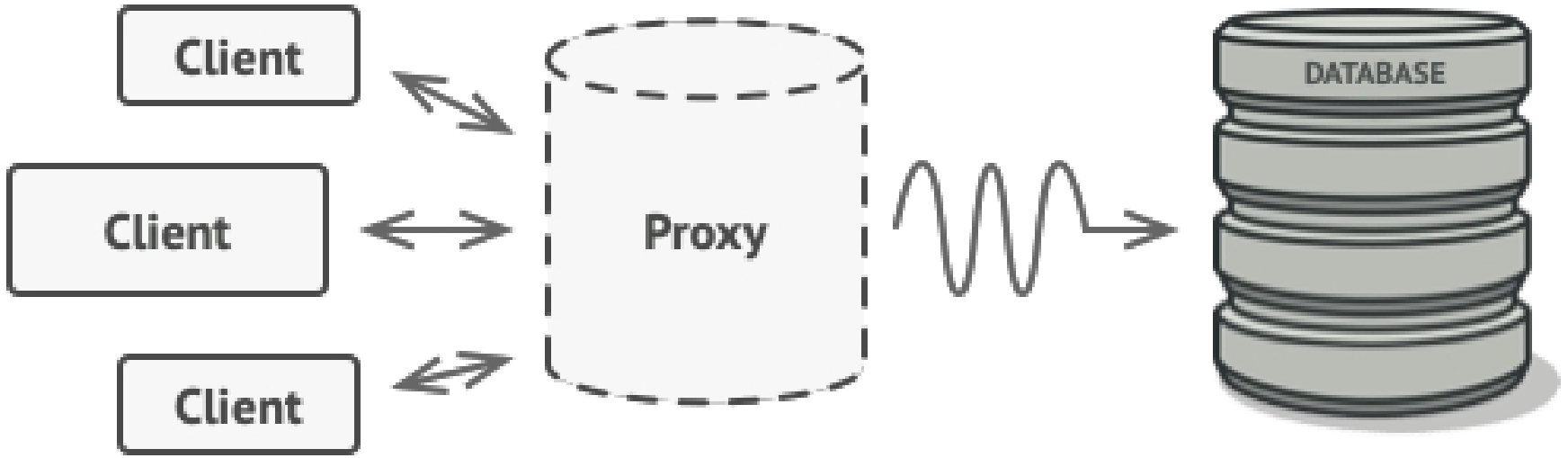
`Class` API	List of members?	Inherited members?	Private members?
`getDeclaredConstructor()`	no	N/A[1]	yes
`getConstructor()`	no	N/A[1]	no
`getDeclaredConstructors()`	yes	N/A[1]	yes
`getConstructors()`	yes	N/A[1]	no

[1] Constructors are not inherited.

Methods	getMethods()	getDeclaredMethods
public	✔	✔
protected	✘	✔
private	✘	✔
static public	✔	✔
static protected	✘	✔
static private	✘	✔
default public	✔	✔
default protected	✘	✔
default private	✘	✔
inherited public	✔	✘
inherited protected	✘	✘
inherited private	✘	✘
inherited static private	✔	✘
inherited static protected	✘	✘
inherited static private	✘	✘
default inherited public	✔	✘
default inherited protected	✘	✘
default inherited private	✘	✘

getMethods() vs getDeclaredMethods()

Proxy pattern



- https://refactoring.guru/design-patterns/proxy

Real world usage

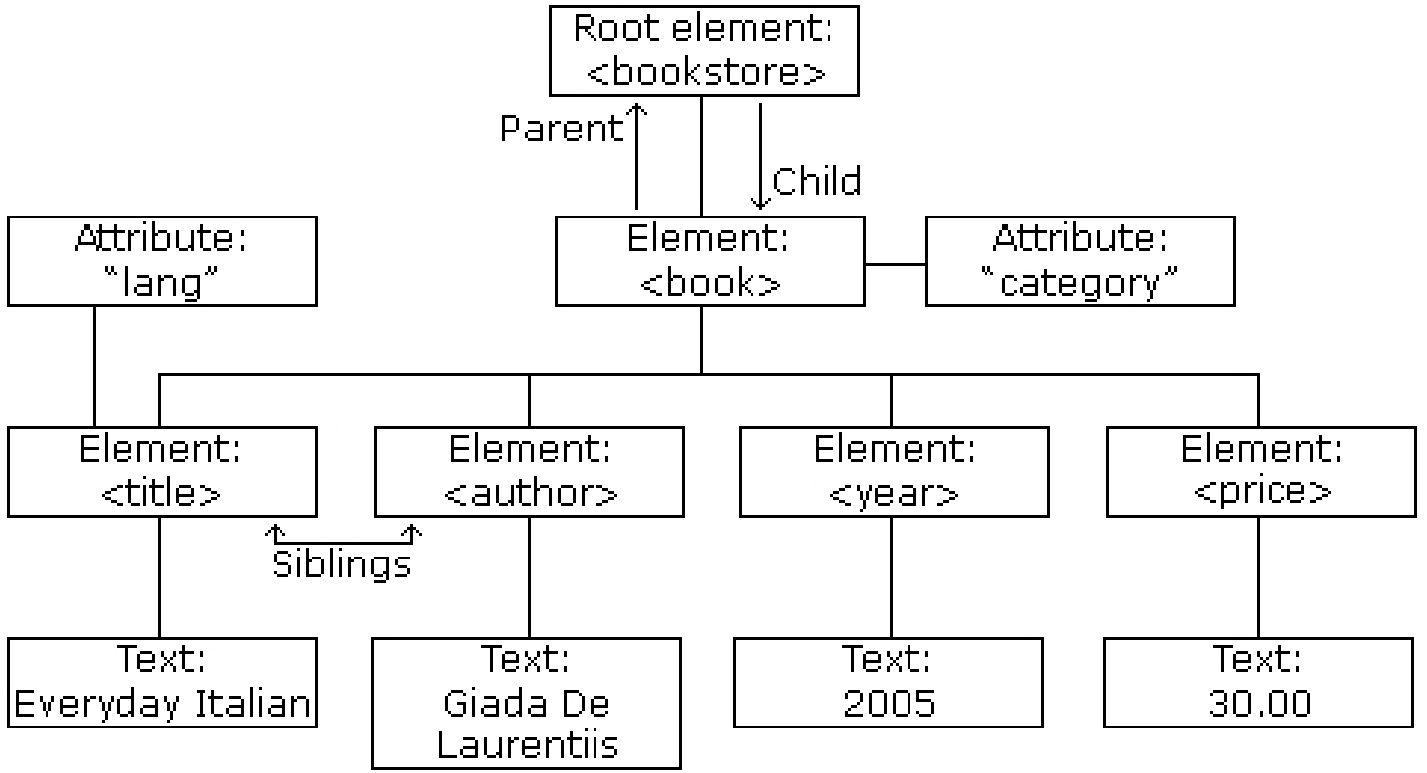
- Spring framework – e.g. proxies (AOP), configs (XML)
- Hibernate – e.g. fields
- JUnit, Mockito – e.g. Runners
- Jackson/GSON – e.g. fields
- JavaFX, Swing

XML

- eXtensible Markup Language
- Configuration files (e.g. Maven, Spring), data transfer
- Relatively verbose
- Tree structure:

```
<?xml version="1.0" encoding="UTF-8"?>
  <note>
    <to>Tove</to>
    <from>Jani</from>
    <heading>Reminder</heading>
    <body>Don't forget me this weekend!</body>
  </note>
```

XML structure



XML Schema

- Prescription of how (specific) XML should look:

```
<xs:element   name="note">

  <xs:complexType>
    <xs:sequence>
      <xs:element   name="to"   type="xs:string"/>
      <xs:element   name="from"    type="xs:string"/>
      <xs:element   name="heading"    type="xs:string"/>
      <xs:element   name="body"    type="xs:string"/>
    </xs:sequence>
  </xs:complexType>

  </xs:element>
```

javax.xml.*

- DOM (Document Object Model) - Tree-based **in-memory** representation
- SAX (Simple API for XML) - **Event-based** streaming parser
- StAX (Streaming API for XML) - **Pull-parser** approach

Maven

- Project management
- (Build)
- (Manage dependencies)

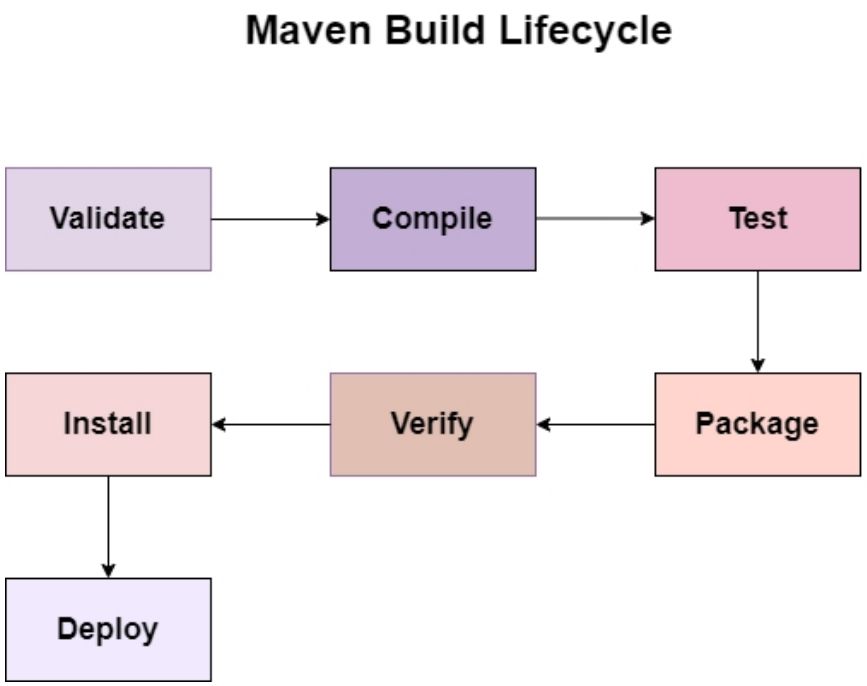
- Standardized project structure
- Dependency hell!
- CI/CD integration
- We don't want to do the same thing manually over and over again

Maven

- POM (Project Object Model) – pom.xml
- Lifecycle and Phases (clean, compile, test, package, install, deploy)
- Dependency Management
- Repositories (local, central, remote)

Lifecycle

- mvn clean: deletes the target directory.
- mvn compile: compiles source code.
- mvn test: runs unit tests.
- mvn package: creates JAR/WAR file.
- mvn install: installs artifact in local repository.
- mvn dependency:tree: shows dependency hierarchy.



pom.xml

```
<project>
  <modelVersion>4.0.0</modelVersion>
  <groupId>com.example</groupId>
  <artifactId>my-app</artifactId>
  <version>1.0.0</version>

  <dependencies>
    <dependency>
      <groupId>junit</groupId>
      <artifactId>junit</artifactId>
      <version>4.12</version>
      <scope>test</scope>
    </dependency>
  </dependencies>
</project>
```

Quiz time