

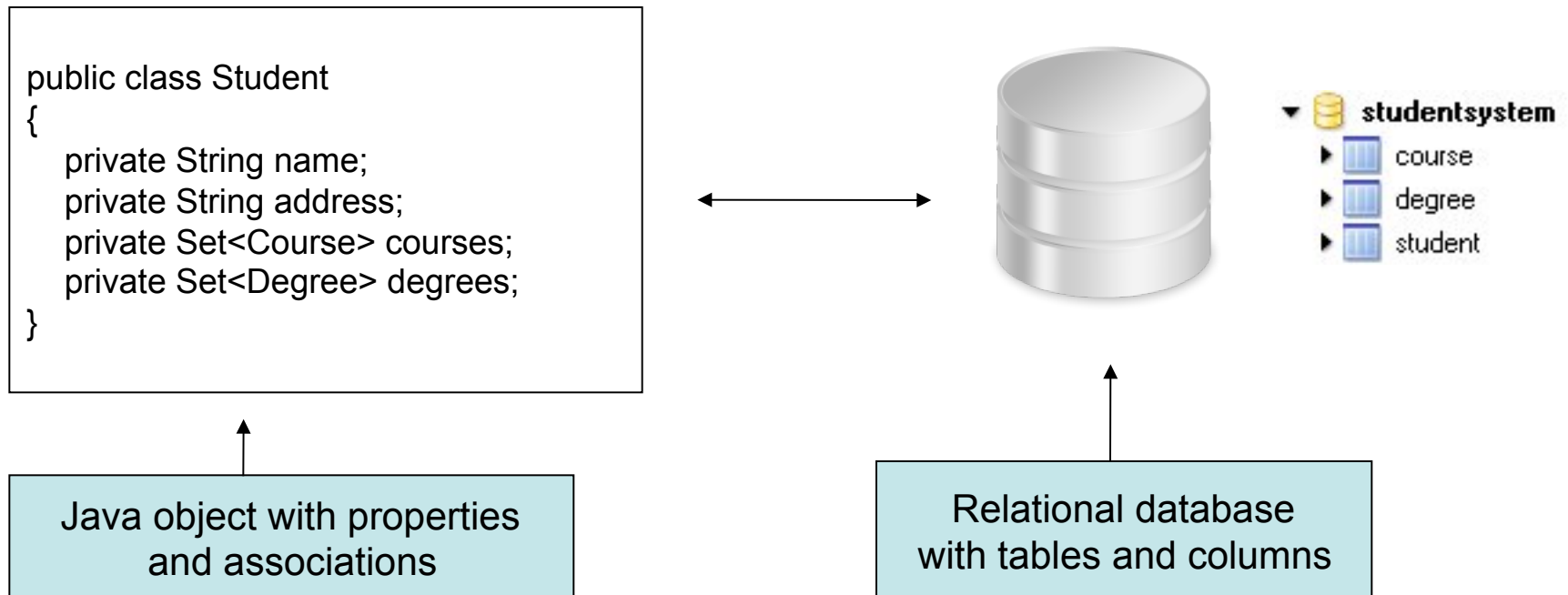
Object-Relational Mapping (ORM)

and

Hibernate

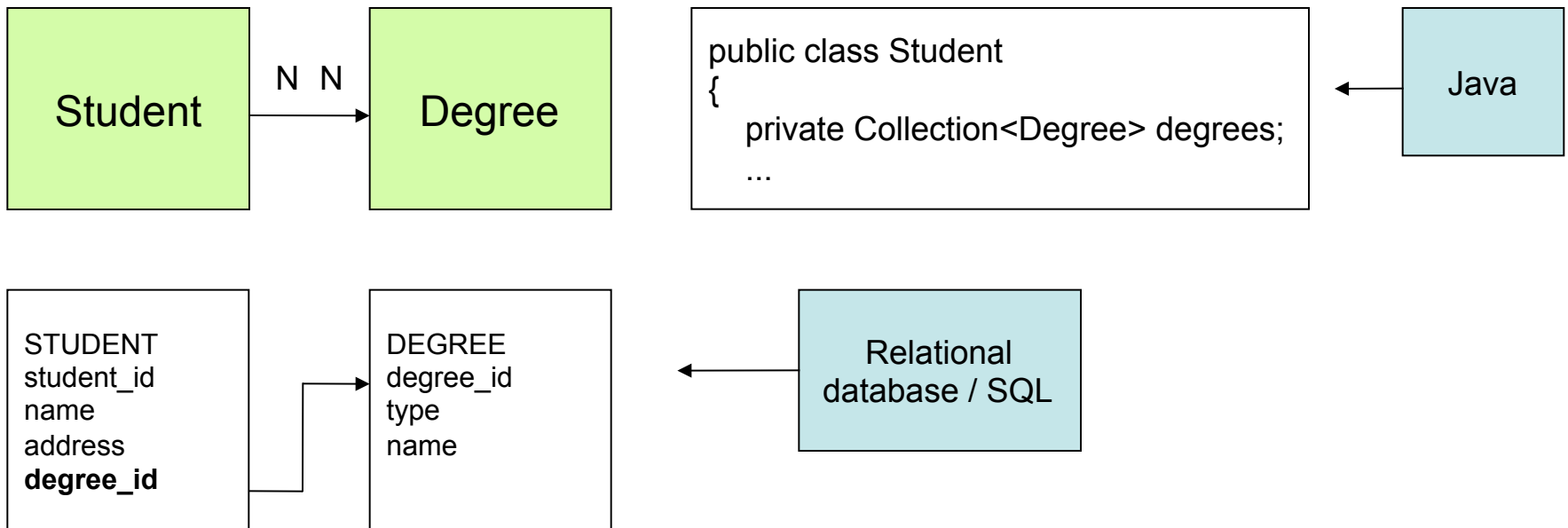
Problem area

- When working with object-oriented systems, there's a mismatch between the *object model* and the *relational database*
- How do we map one to the other?



Problem area

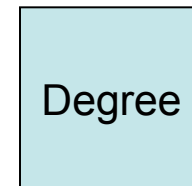
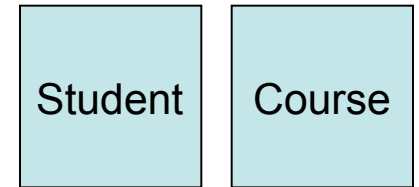
- How to map associations between objects?
 - References are directional, foreign keys not
 - Foreign keys can't represent many-to-many associations



Technology

- Why relational databases?
 - Flexible and robust approach to data management
 - De-facto standard in software development
- Why object-oriented models?
 - Business logic can be implemented in Java (opposed to stored procedures)
 - Allows for use of design patterns and concepts like polymorphism
 - Improves code reuse and maintainability
- Demand for mapping interaction!

(Domain model)



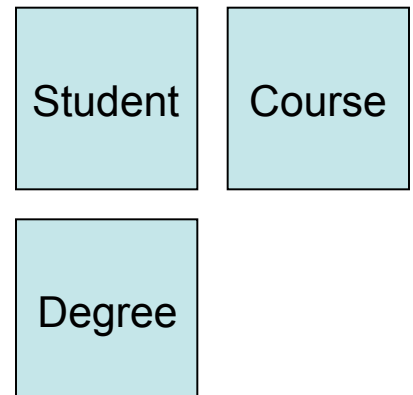
(Database)

Approaches to ORM

- Write SQL conversion methods by hand using JDBC
 - Tedious and requires lots of code
 - Extremely error-prone
 - Non-standard SQL ties the application to specific databases
 - Vulnerable to changes in the object model
 - Difficult to represent associations between objects

```
public void addStudent( Student student )
{
    String sql = "INSERT INTO student ( name, address ) VALUES ( '" +
        student.getName() + "', '" + student.getAddress() + "' )";

    // Initiate a Connection, create a Statement, and execute the query
}
```

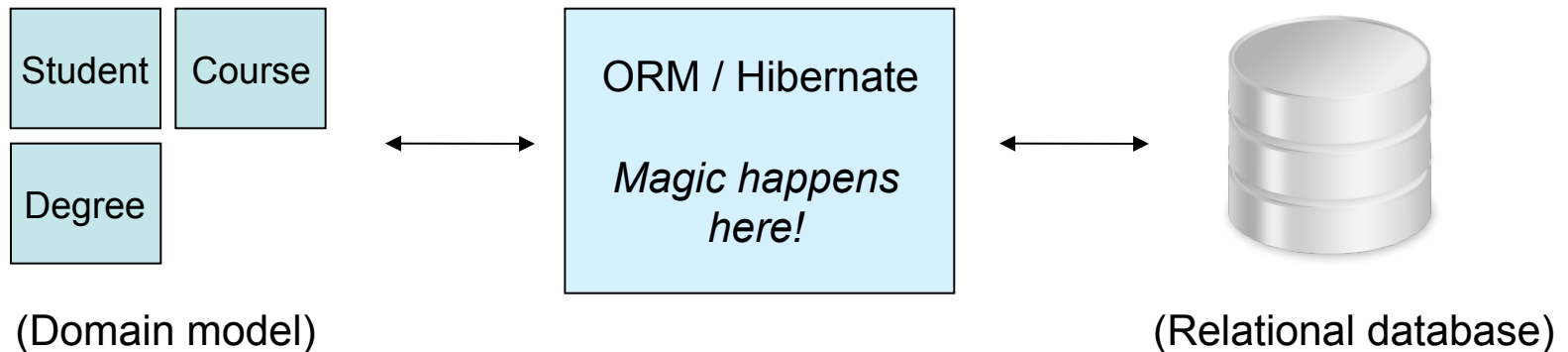


Approaches to ORM

- Use Java serialization – write application state to a file
 - Can only be accessed as a whole
 - Not possible to access single objects
- Object oriented database systems
 - No complete query language implementation exists
 - Lacks necessary features

The preferred solution

- Use a *Object-Relational Mapping System* (eg. Hibernate)
- Provides a simple API for storing and retrieving Java objects directly to and from the database
- *Non-intrusive*: No need to follow specific rules or design patterns
- *Transparent*: Your object model is unaware



Side step - preferred solution?

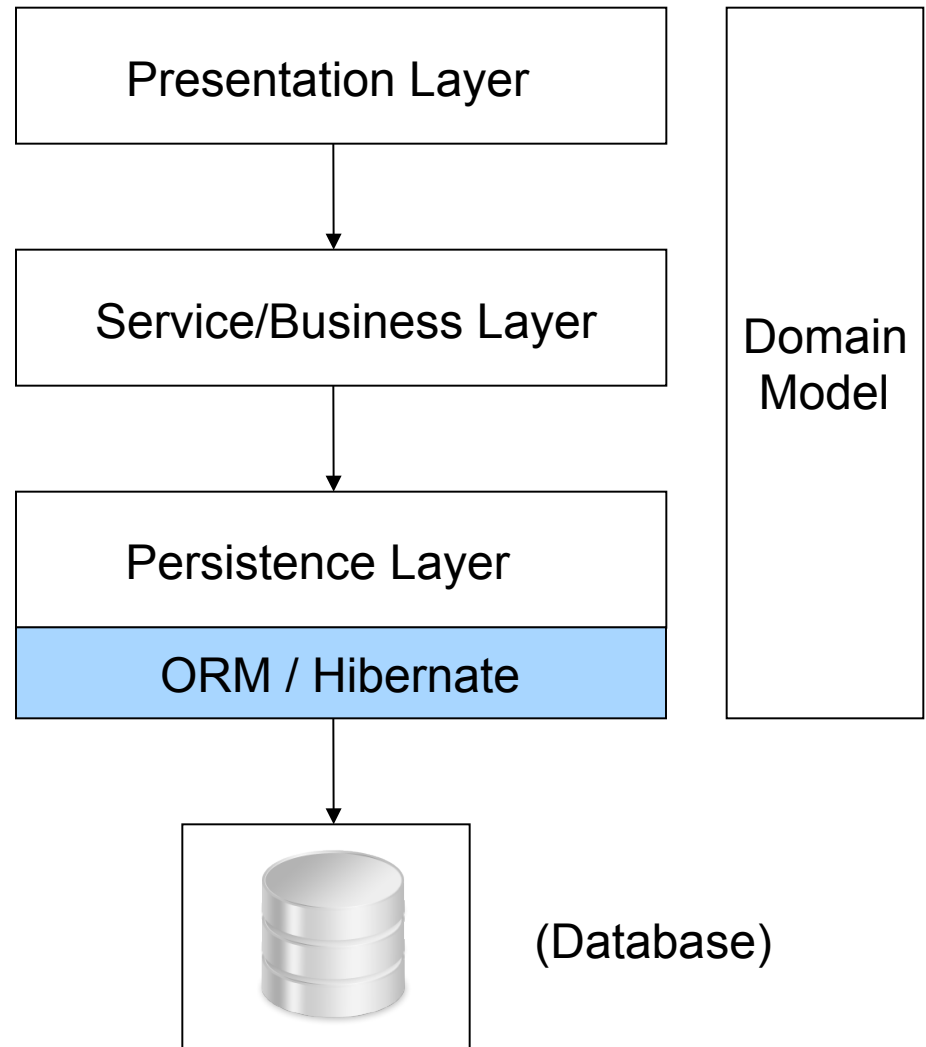
- Well, at topic of debate... NoSQL
- Pushed mostly by “really big” use cases
- Hits limits in traditional RDMS’s
- Hardware has changed (multicore, lots of cheap RAM)
- Don’t necessarily need RDMS’s traditional properties
 - E.g. realtime more important than (guaranteed) consistency

NoSQL

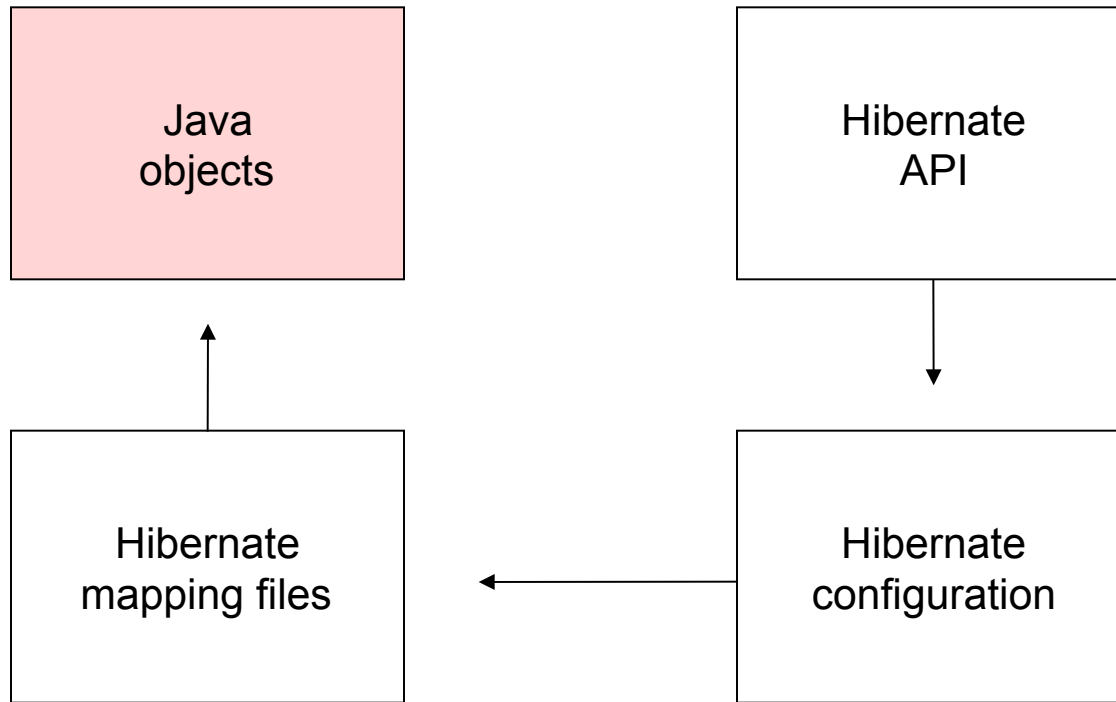
- Not one type of solution
 - Document oriented
 - Graph dbs
 - Key-value stores
- NoSQL - Not Only SQL
- Interesting – but not “mainstream”
 - at least not yet

ORM and Architecture

- Middleware that manages persistence
- Provides an abstraction layer between the domain model and the database



Example app: The EventManager



Java objects (POJO)

Identifier property

No-argument
constructor

Follows the
JavaBean naming
conventions

```
public class Event
{
    private int id;
    private String title;
    private Date date;
    private Set<Person> persons = new HashSet<Person>();

    public Event() {
    }

    public int getId() {
        return id;
    }

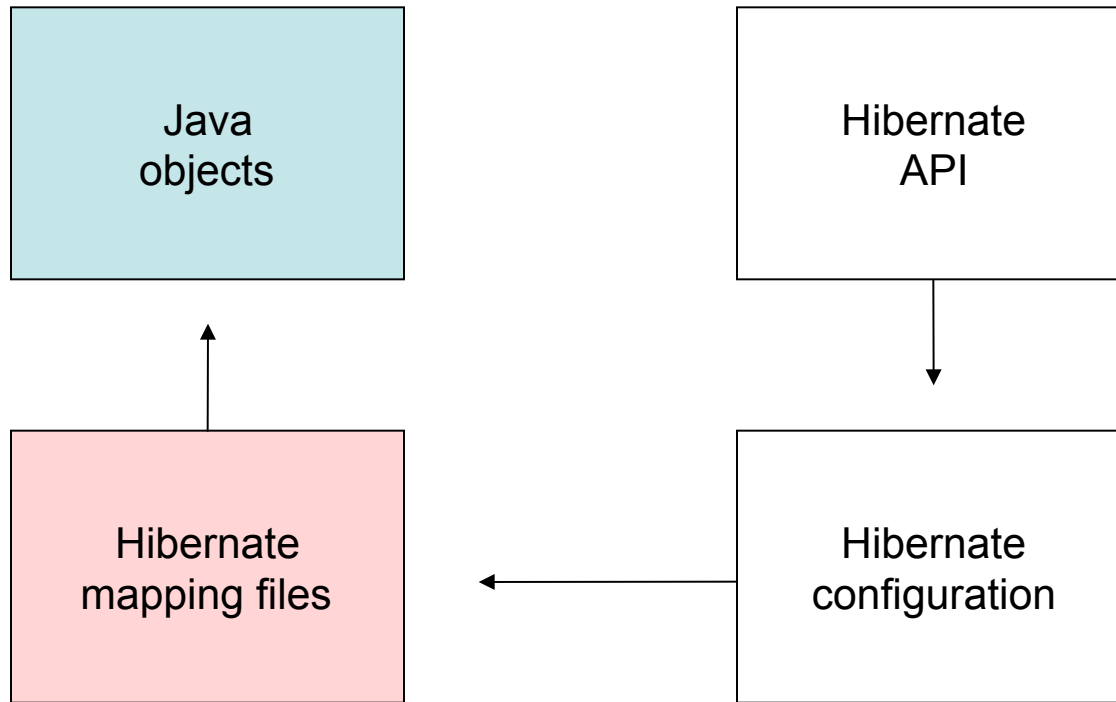
    private void setId( int id ) {
        this.id = id;
    }

    public String getTitle() {
        return title;
    }

    public void setTitle( String title ) {
        this.title = title;
    }

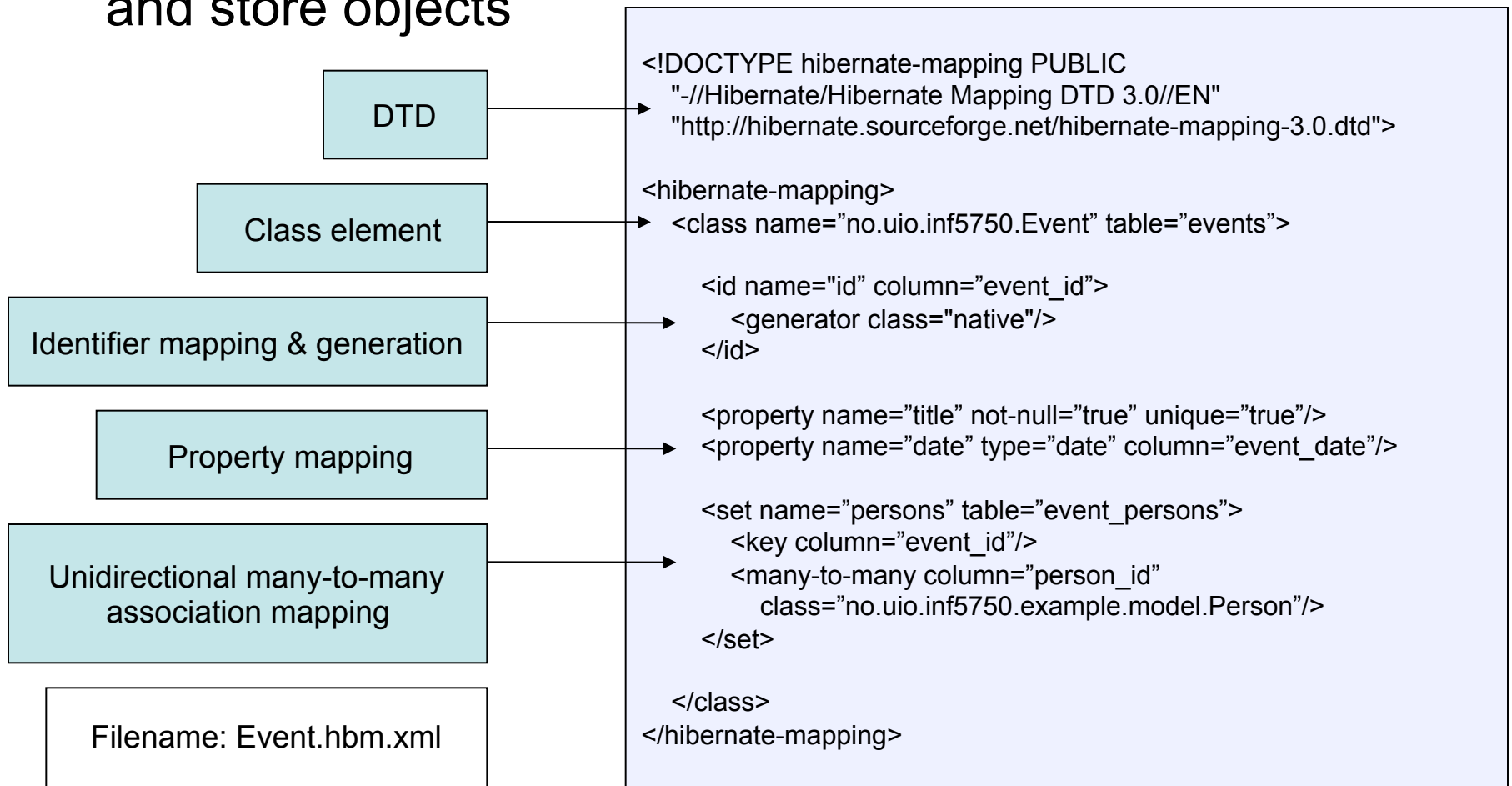
    // Getter and setter for date and persons
}
```

Example app: The EventManager



Hibernate mapping files

- Tells Hibernate which tables and columns to use to load and store objects



Property mapping

The name property refers to the get/set-methods

Title must be not null and unique

```
...  
<property name="title" not-null="true" unique="true"/>  
<property name="date" type="Date" column="event_date"/>  
...
```

Types are Hibernate mapping types.
Hibernate will guess if no type is specified.

Property name used as default if no column is specified

Association mapping

The name property refers to the get/set-methods

Many-to-many associations require a link table

Column name for "this" side of association

Column name for "other" side of association

```
...  
<set name="persons" table="event_persons">  
  <key column="event_id"/>  
  <many-to-many column="person_id"  
    class="no.uio.inf5750.example.model.Person"/>  
</set>  
...
```

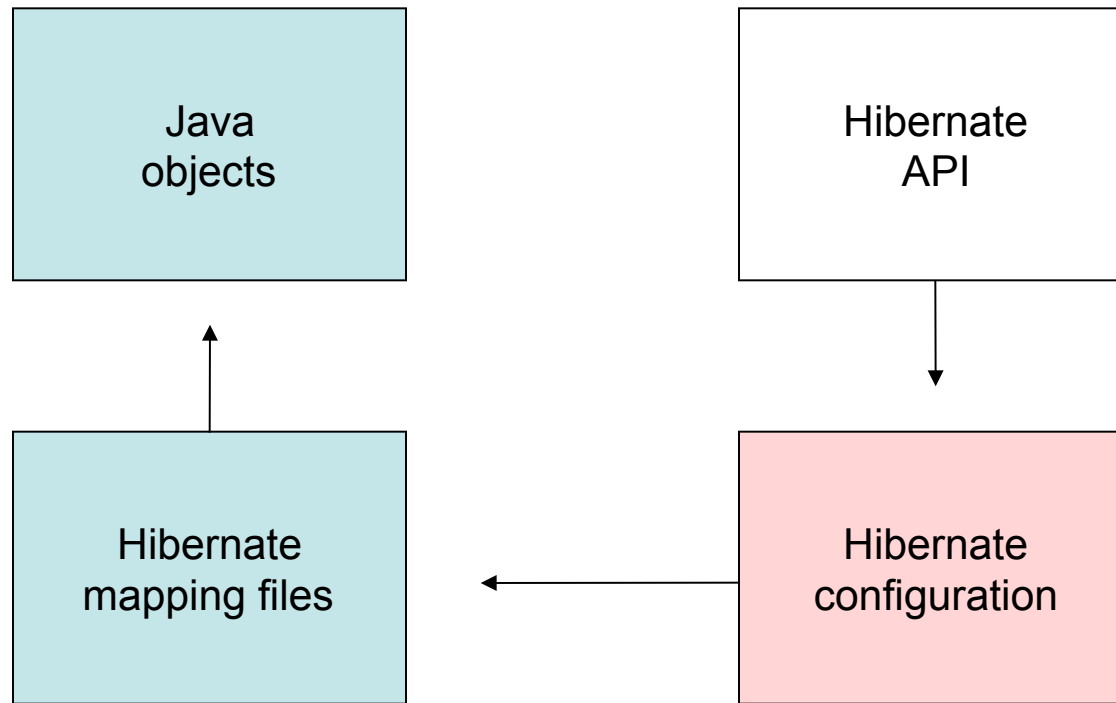
Reference to the associated class

Hibernate mapping types

- Hibernate will translate Java types to SQL / database types for the properties of your mapped classes

Java type	Hibernate type	SQL type
java.lang.String	string	VARCHAR
java.util.Date	date, time	DATE, TIME
java.lang.Integer, int	integer	INT
java.lang.Class	class	varchar
java.io.Serializable	serializable	BLOB, BINARY

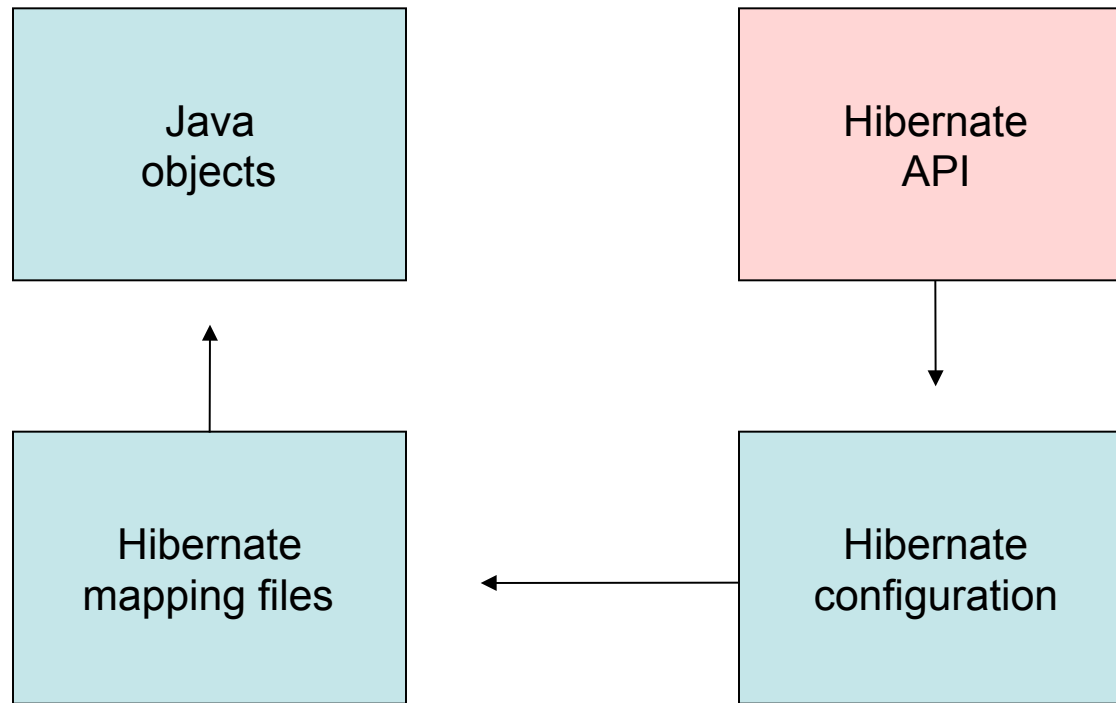
Example app: The EventManager



Hibernate configuration

- Each database has a *dialect*
 - `hibernate.dialect = org.hibernate.dialect.H2Dialect`
- Must also specify:
 - JDBC driver class
 - Connection URL
 - Username
 - Password
- More later in the lecture...

Example app: The EventManager



The SessionFactory interface

- Provides Session instances to the application
- Shared among application threads
- Most important method is *getCurrentSession*

The Session interface

- Obtained from a SessionFactory
- Main runtime interface between a Java application and Hibernate
- Responsible for storing and retrieving objects
- Think of it as a collection of loaded objects related to a *single unit of work*

```
Session session = sessionFactory.getCurrentSession();
```

Instance states

- An object instance state is related to the *persistence context*
- The persistence context = a *Hibernate Session* instance
- Three types of instance states:
 - Transient
 - The instance is *not* associated with any persistence context
 - Persistent
 - The instance is associated with a persistence context
 - Detached
 - The instance was associated with a persistence context which has been closed – currently *not* associated

The Session interface

Make a transient object persistent

```
Event event = new Event( "title", new Date() );  
Integer id = (Integer) session.save( event );
```

Load an object – if matching row exists

```
Event event = (Event) session.load( Event.class, id );
```

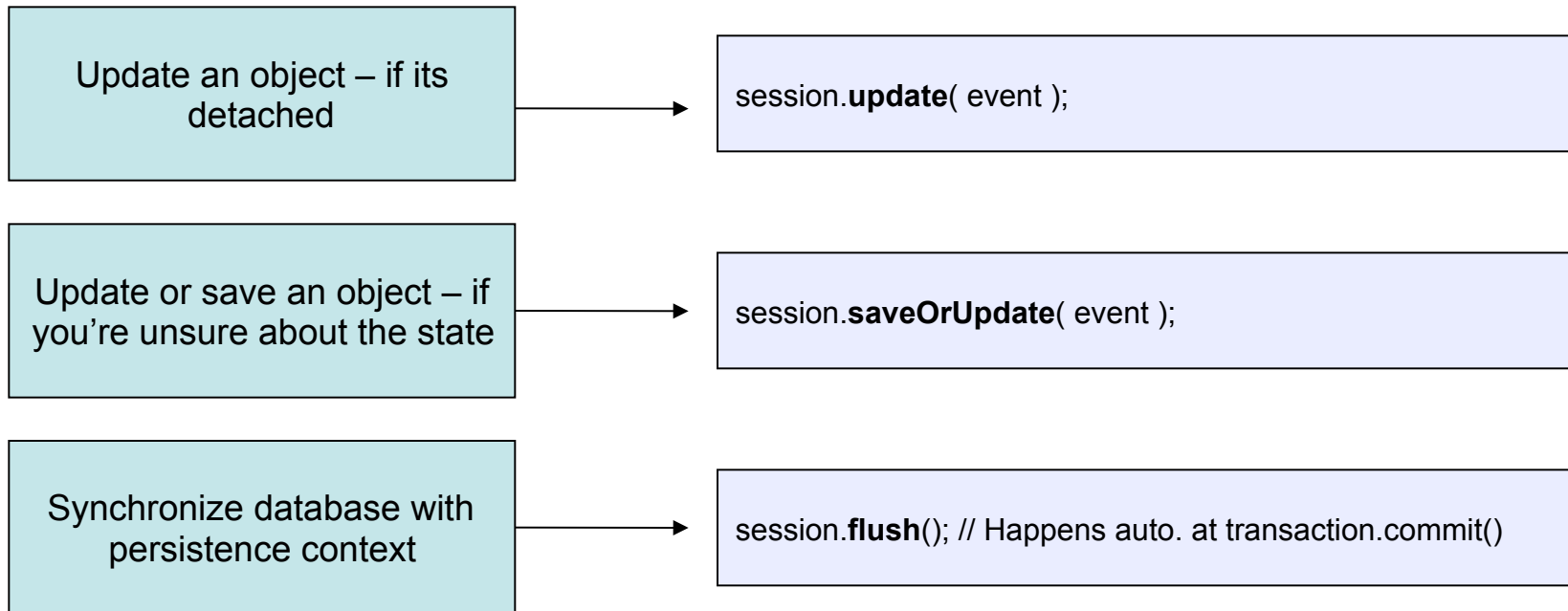
Load an object – if unsure about matching row

```
Event event = (Event) session.get( Event.class, id );
```

Delete an object – make it transient again

```
session.delete( event );
```


The Session interface



The Criteria interface

- You need a *query* when you don't know the identifiers of the objects you are looking for
- Criteria used for *programmatic* query creation

Retrieve all instances of Event

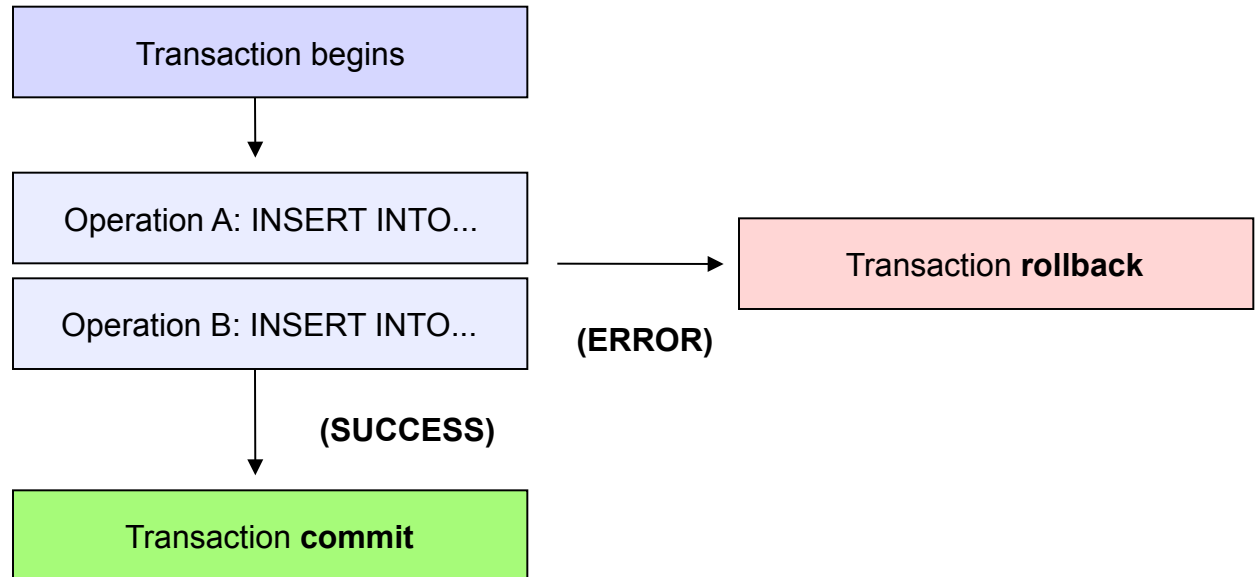
```
Criteria criteria = session.createCriteria( Event.class );  
List events = criteria.list();
```

Narrow the result set

```
Criteria criteria = session.createCriteria( Event.class );  
criteria.add( Restrictions.eq( "title", "Rolling Stones" ) );  
criteria.add( Restrictions.gt( "date", new Date() ) );  
  
criteria.setMaxResults( 10 );  
  
List events = criteria.list();
```

Transactions

- Transaction: A set of database operations which must be executed in entirety or not at all
- Should end either with a *commit* or a *rollback*
- All communication with a database has to occur inside a transaction!



Hibernate in real-life apps

- Spring used for SessionFactory management
 - Spring has excellent ORM integration
 - Custom SessionFactory management is “boilerplate-code”
- Spring used for Transaction management
 - Custom tx management is error prone
 - Support for declarative tx management with annotations
 - Consistent programming model across JTA, JDBC, Hibernate
- Annotate transactional methods / class with *@Transactional*

Spring-Hibernate dependencies

```
<dependency>
  <groupId>org.springframework</groupId>
  <artifactId>spring-core</artifactId>
  <version>3.0.4.RELEASE</version>
</dependency>
<dependency>
  <groupId>org.springframework</groupId>
  <artifactId>spring-context</artifactId>
  <version>3.0.4.RELEASE</version>
</dependency>
<dependency>
  <groupId>org.springframework</groupId>
  <artifactId>spring-tx</artifactId>
  <version>3.0.4.RELEASE</version>
</dependency>
<dependency>
  <groupId>org.springframework</groupId>
  <artifactId>spring-orm</artifactId>
  <version>3.0.4.RELEASE</version>
</dependency>
```

```
<dependency>
  <groupId>org.hibernate</groupId>
  <artifactId>hibernate-core</artifactId>
  <version>3.5.1-Final</version>
</dependency>
<dependency>
  <groupId>org.hibernate</groupId>
  <artifactId>hibernate-entitymanager</artifactId>
  <version>3.5.1-Final</version>
</dependency>
<dependency>
  <groupId>geronimo-spec</groupId>
  <artifactId>geronimo-spec-jta</artifactId>
  <version>1.0-M1</version>
</dependency>
<dependency>
  <groupId>c3p0</groupId>
  <artifactId>c3p0</artifactId>
  <version>0.9.1.2</version>
</dependency>
<dependency>
  <groupId>org.slf4j</groupId>
  <artifactId>slf4j-log4j12</artifactId>
  <version>1.5.8</version>
</dependency>
<dependency>
  <groupId>com.h2database</groupId>
  <artifactId>h2</artifactId>
  <version>1.2.136</version>
</dependency>
```

Spring-Hibernate configuration

```
<tx:annotation-driven transaction-manager="transactionManager"/>

<bean id="transactionManager" class="org.springframework.orm.hibernate3.HibernateTransactionManager">
  <property name="sessionFactory" ref="sessionFactory"/>
  <property name="dataSource" ref="dataSource"/>
</bean>

<bean id="sessionFactory" class="org.springframework.orm.hibernate3.LocalSessionFactoryBean">
  <property name="dataSource" ref="dataSource"/>
  <property name="mappingResources">
    <list>
      <value>hibernate/Event.hbm.xml</value>
      <value>hibernate/Person.hbm.xml</value>
    </list>
  </property>
  <property name="hibernateProperties">
    <props>
      <prop key="hibernate.dialect">org.hibernate.dialect.H2Dialect</prop>
      <prop key="hibernate.hbm2ddl.auto">create-drop</prop>
    </props>
  </property>
</bean>

<bean id="dataSource" class="com.mchange.v2.c3p0.ComboPooledDataSource" destroy-method="close">
  <property name="driverClass" value="org.h2.Driver"/>
  <property name="jdbcUrl" value="jdbc:h2:mem:eventmanager;DB_CLOSE_ON_EXIT=FALSE"/>
  <property name="user" value="sa"/>
  <property name="password" value=""/>
</bean>
```

Enables annotations

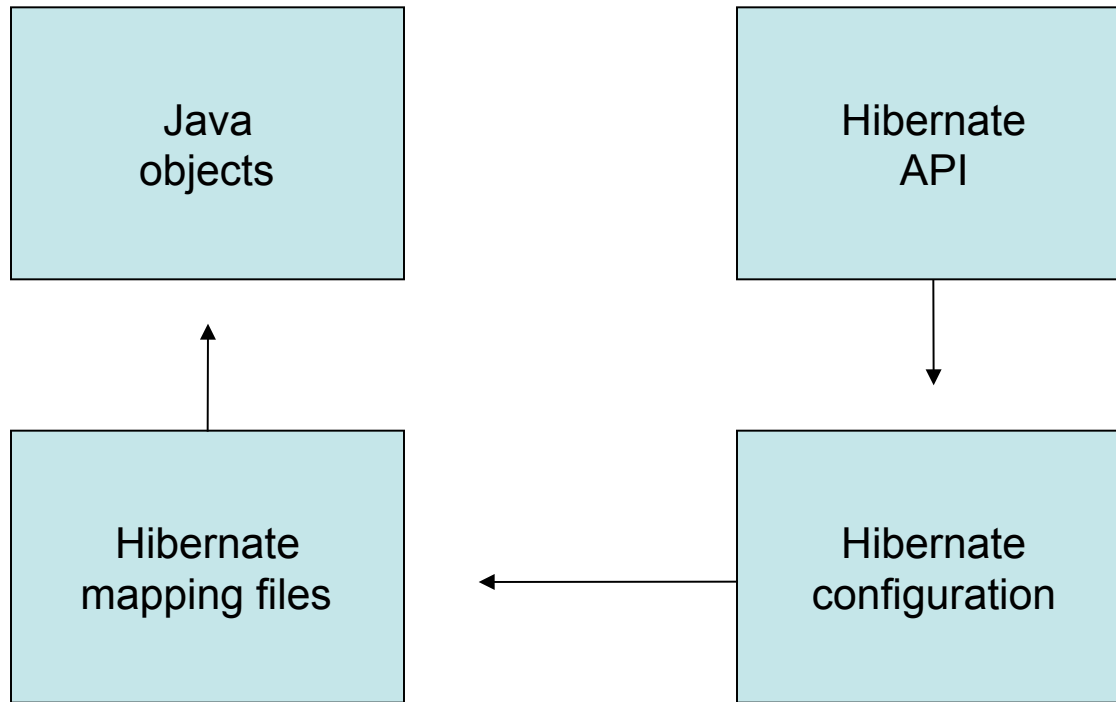
Can be injected like any bean

Points to mapping files

Hibernate properties

Connection properties

Example: The EventManager



Advantages of ORM

- **Productivity**
 - Eliminates lots of repetitive code – focus on business logic
 - Database schema is generated automatically
- **Maintainability**
 - Fewer lines of code – easier to understand
 - Easier to manage change in the object model

Advantages of ORM

- Performance
 - Lazy loading – associations are fetched when needed
 - Caching
- Database vendor independence
 - The underlying database is abstracted away
 - Can be configured outside the application

Resources

- Spring documentation chapter 13
- Hibernate reference documentation
 - www.hibernate.org -> Documentation -> Reference