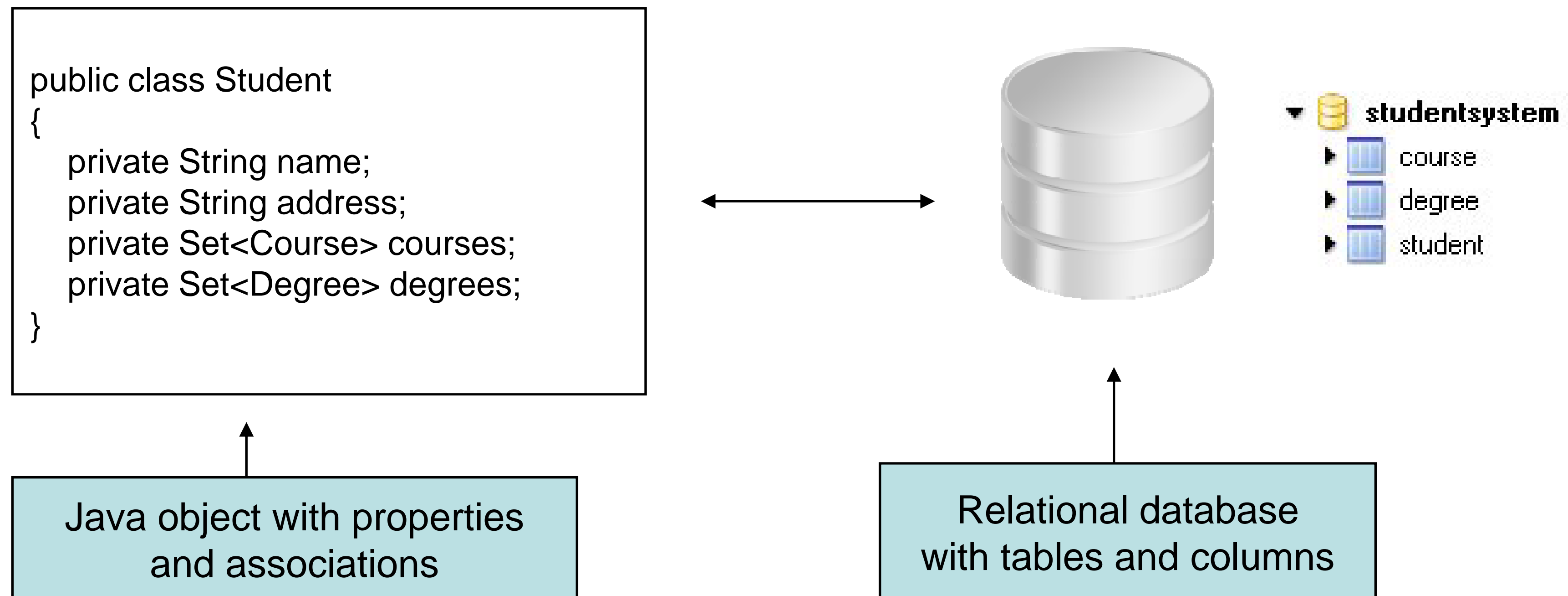
Object-Relational Mapping (ORM)

and

Hibernate

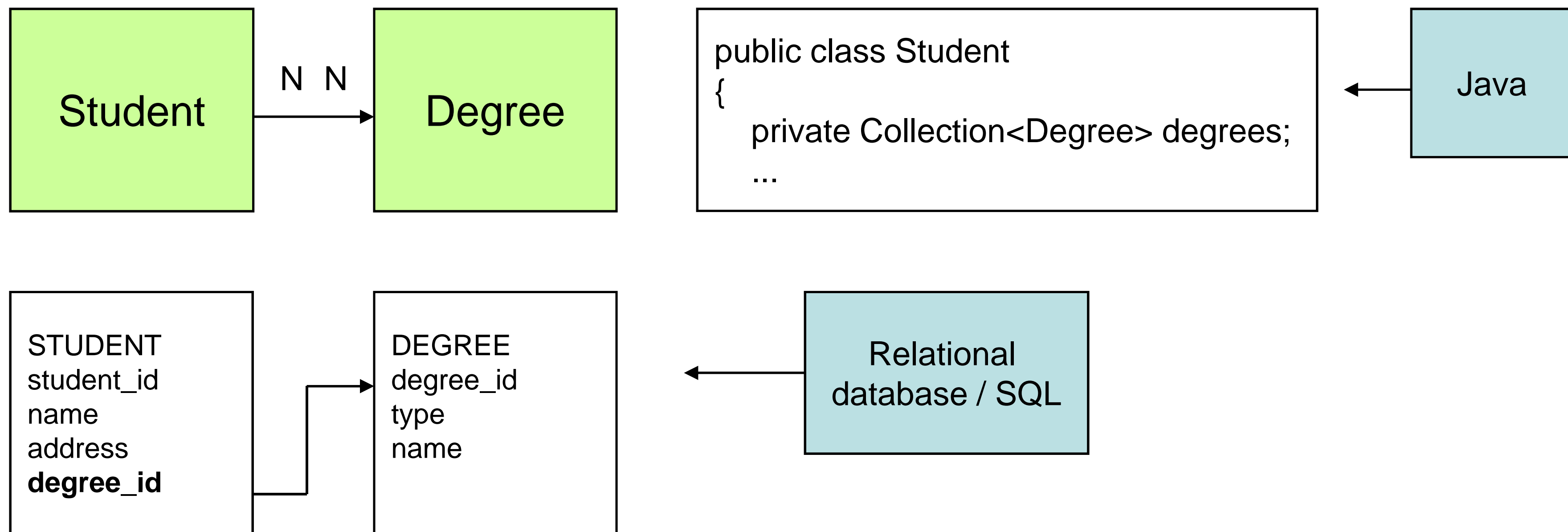
Problem area

- 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

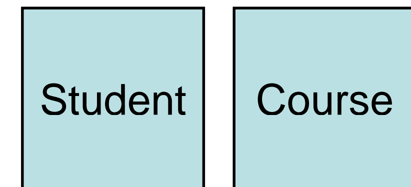
- How to map associations between objects?
  - References are directional, foreign keys not
  - Foreign keys can't represent many-to-many associations

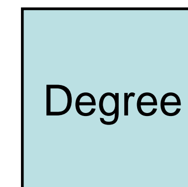


Technology

- 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)



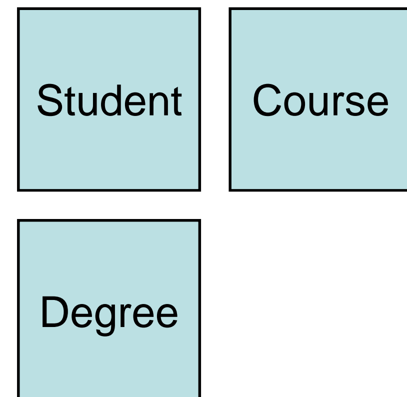


(Database)

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
}
```

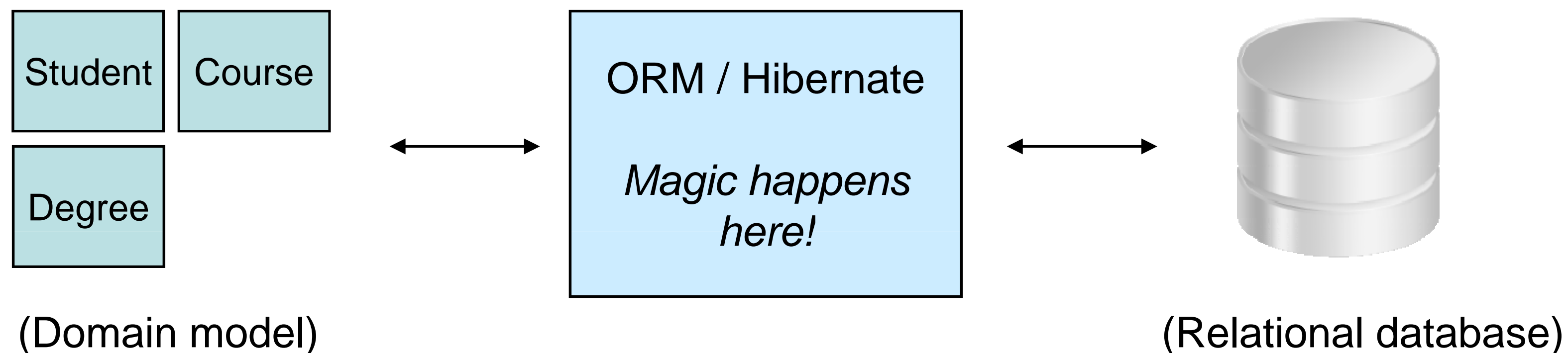


Approaches to ORM

- 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

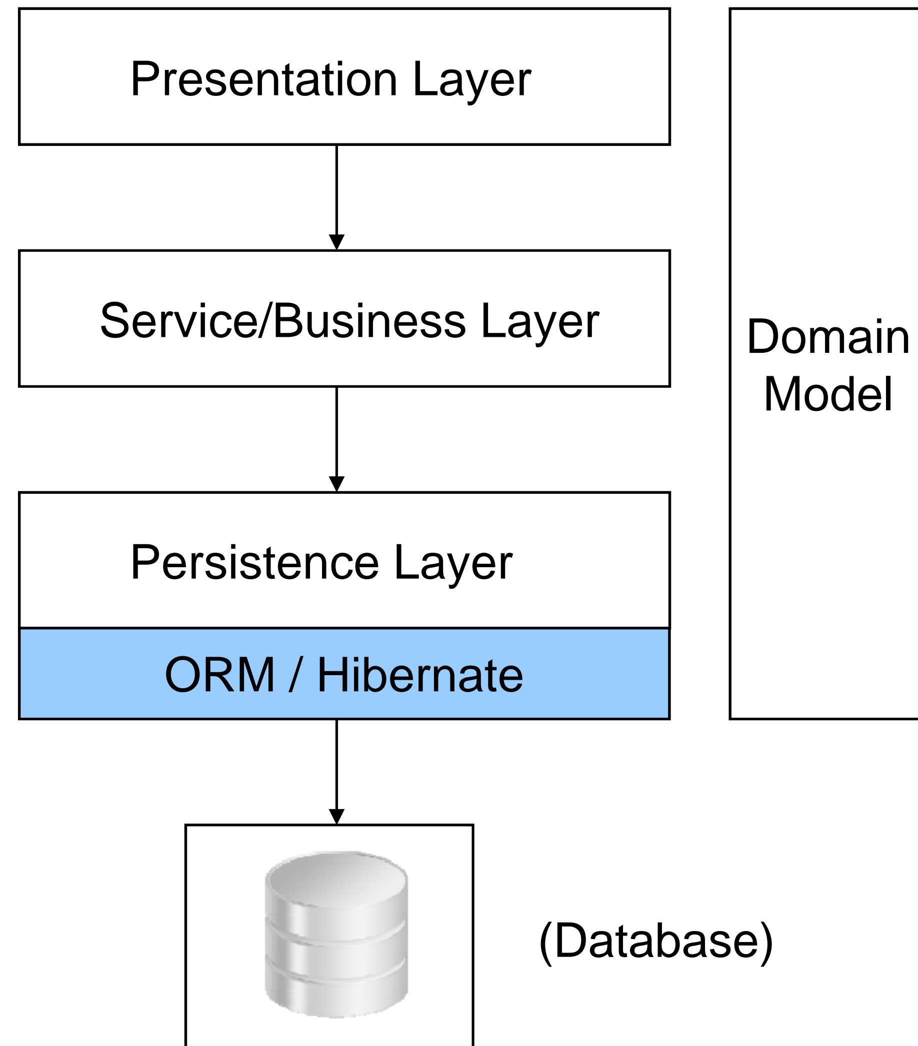
The preferred solution

- 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

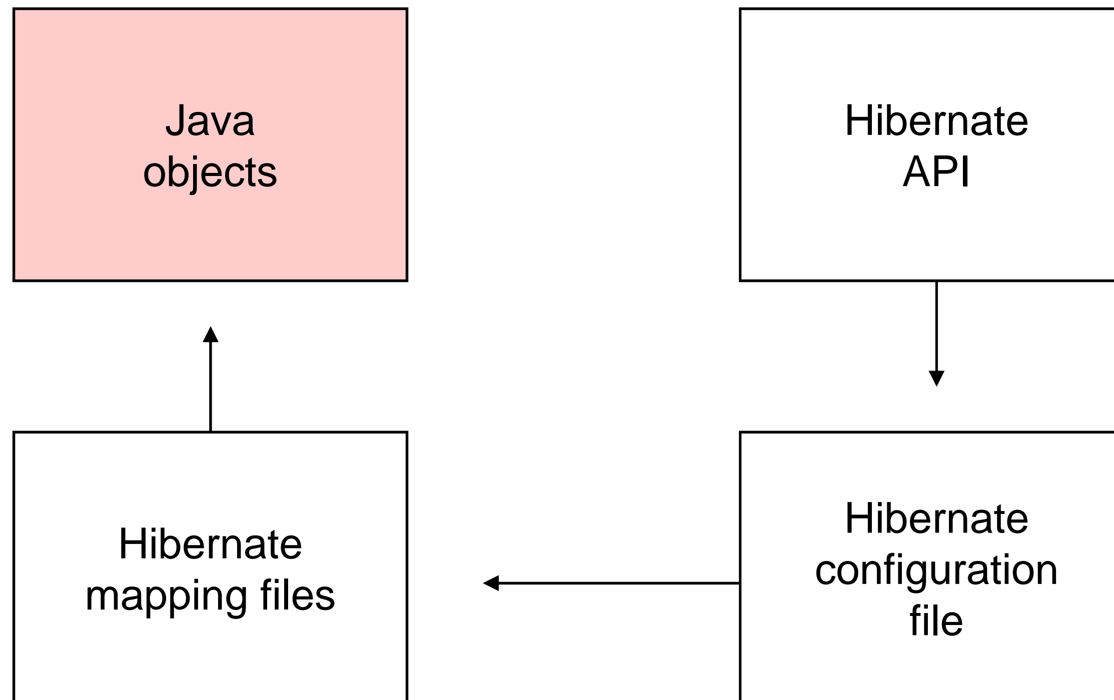


ORM and Architecture

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



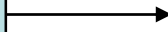
Example app: The EventManager



Java objects

Identifier property

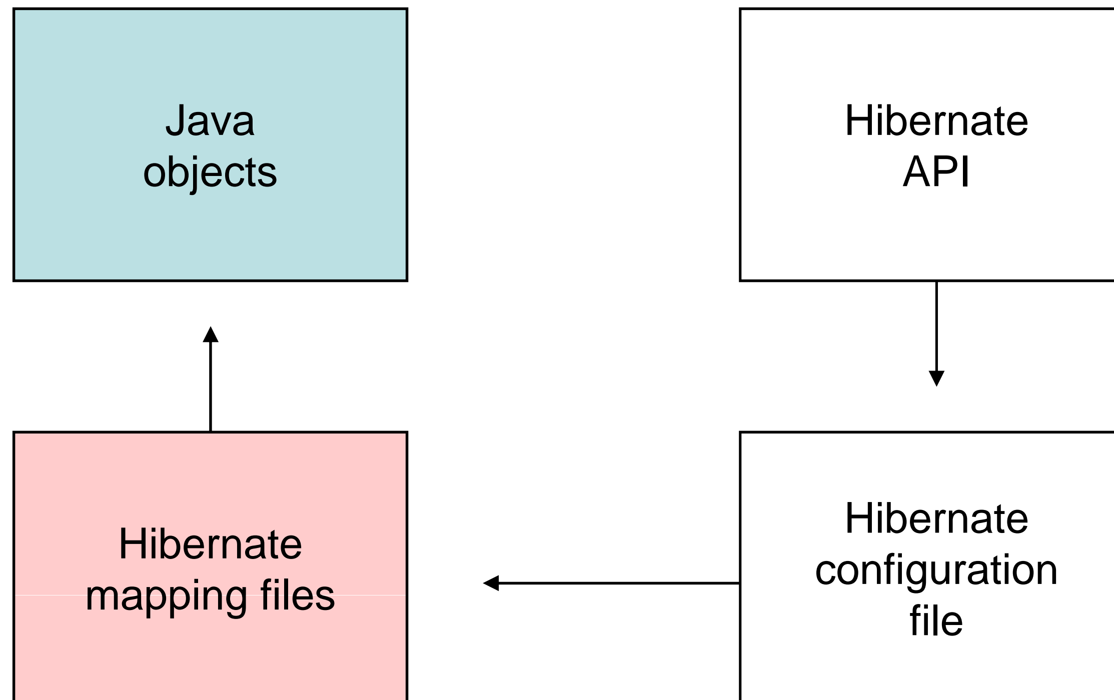
No-argument constructor



Follows the JavaBean naming conventions

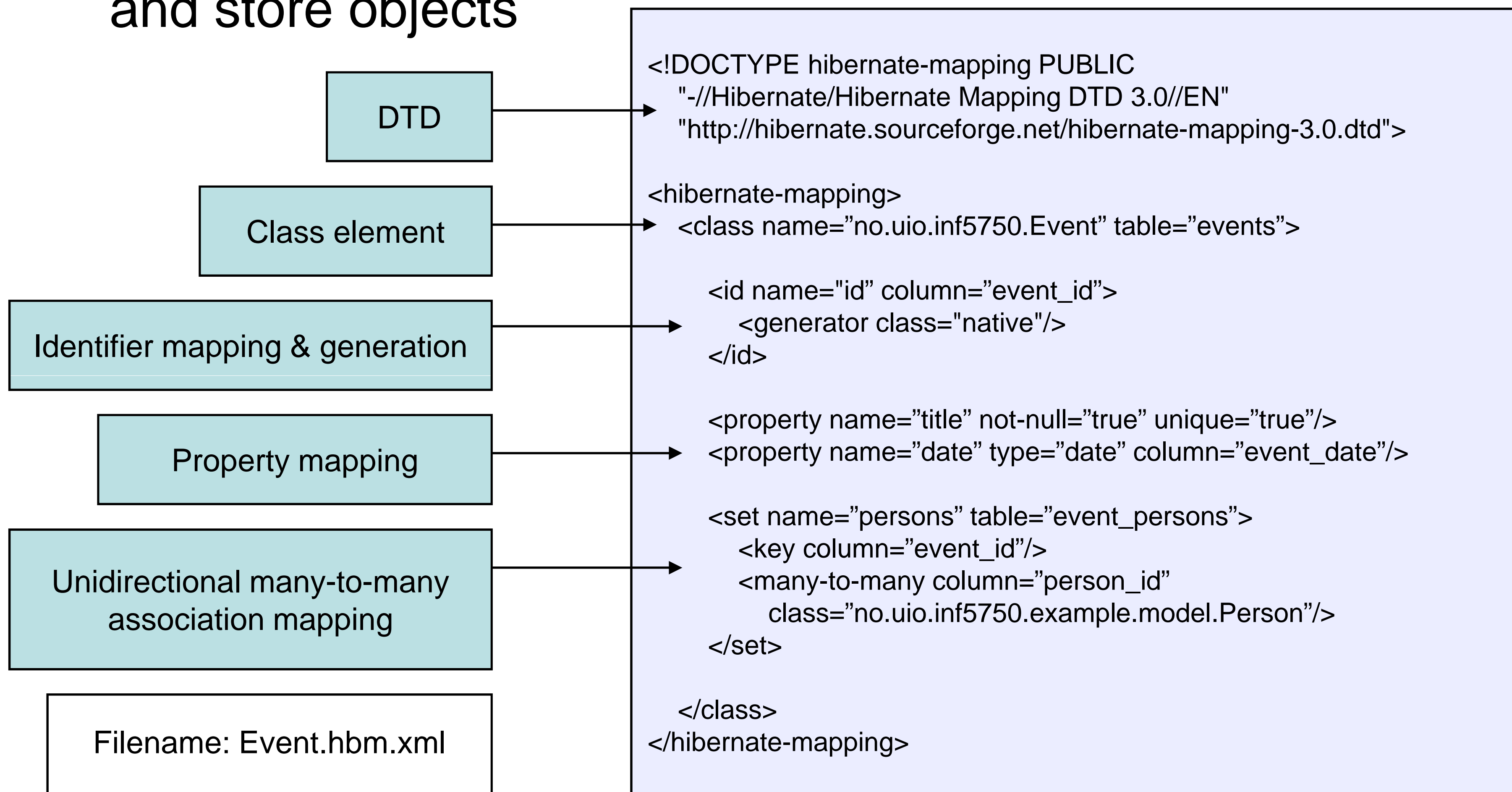
```
public class Event
{
    private int id;
    private String title;
    private Date date;
    private Set<Person> persons = new HashSet<Person>();

    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

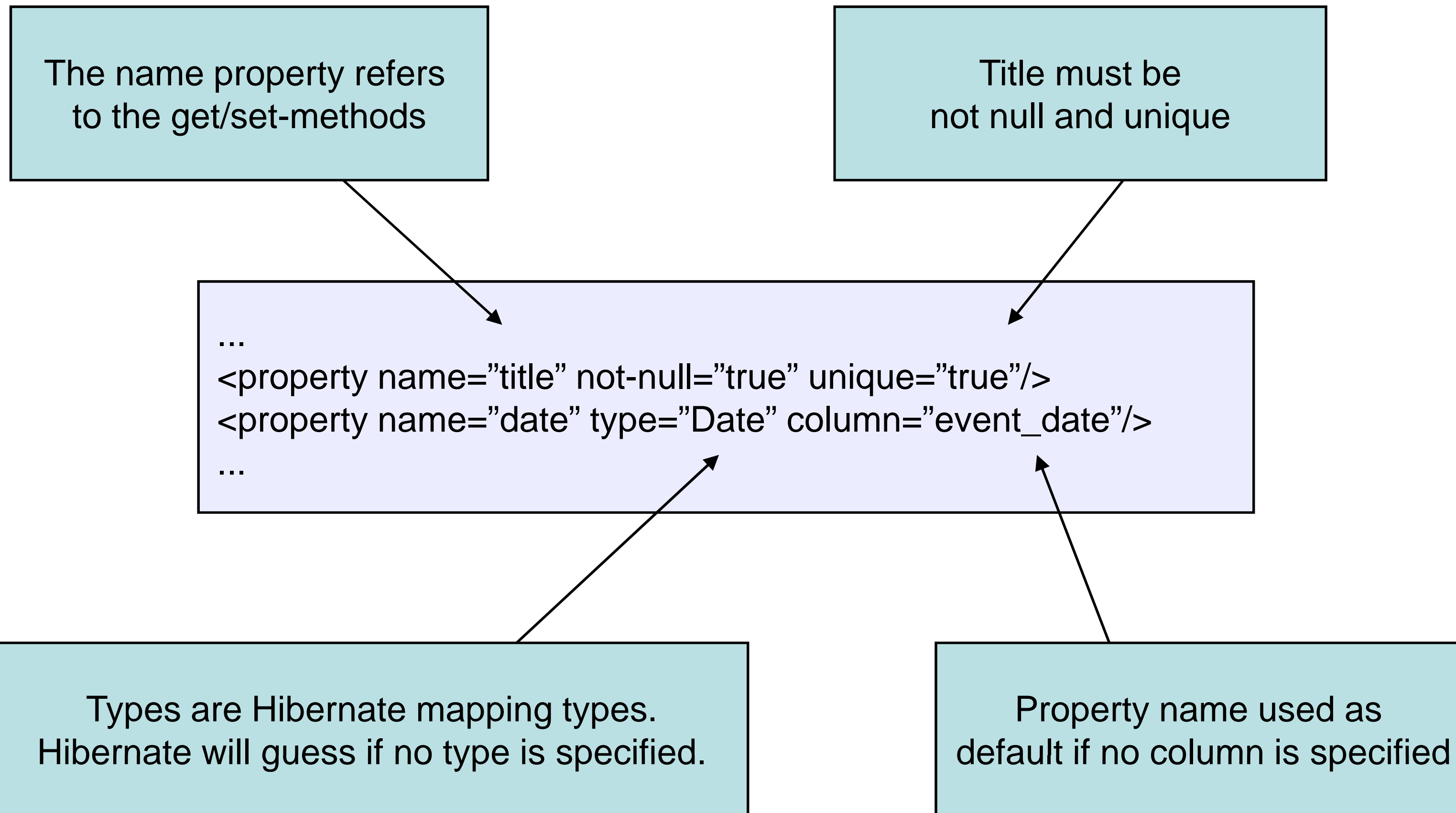


Hibernate mapping files

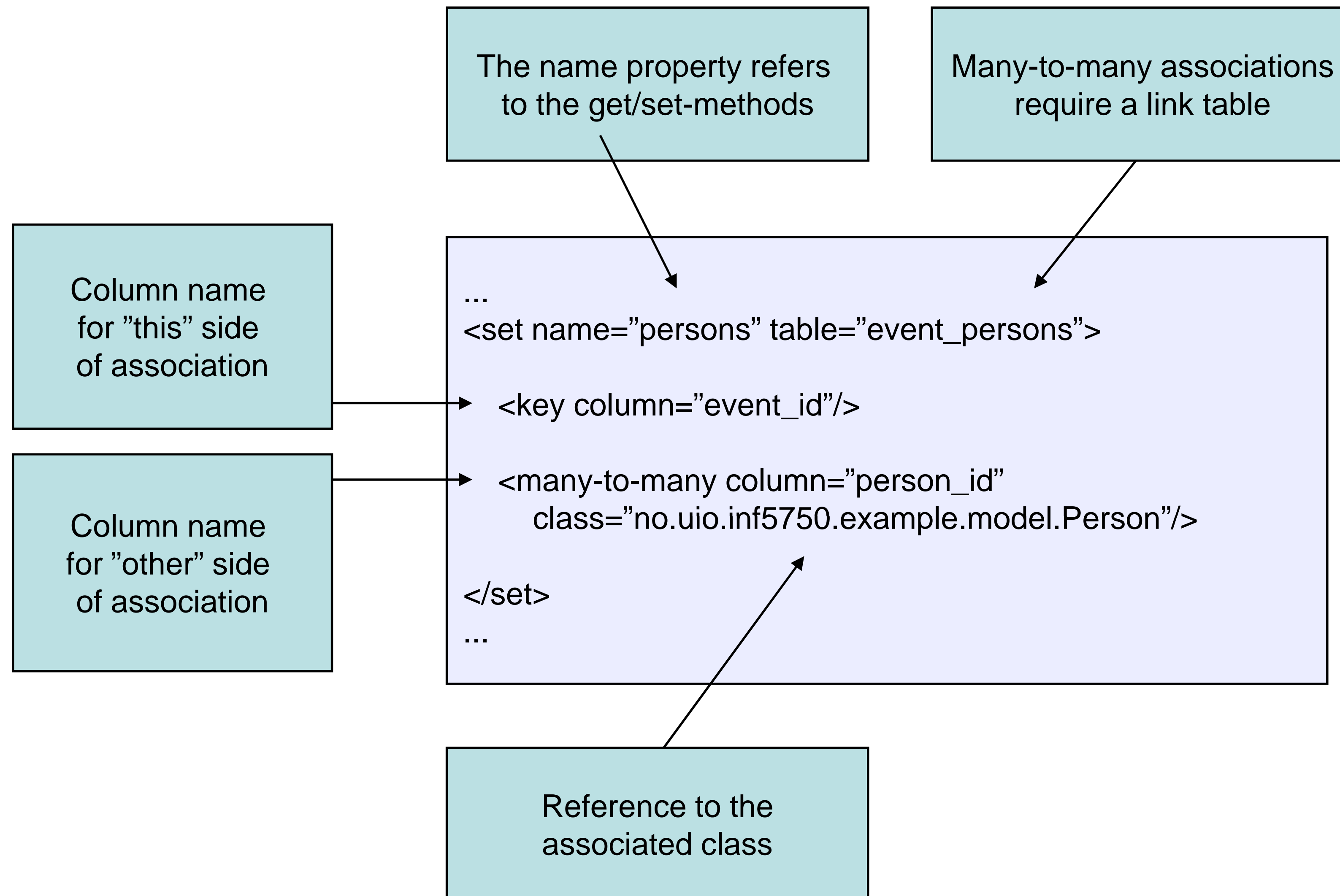
- Tells Hibernate which tables and columns to use to load and store objects



Property mapping



Association mapping

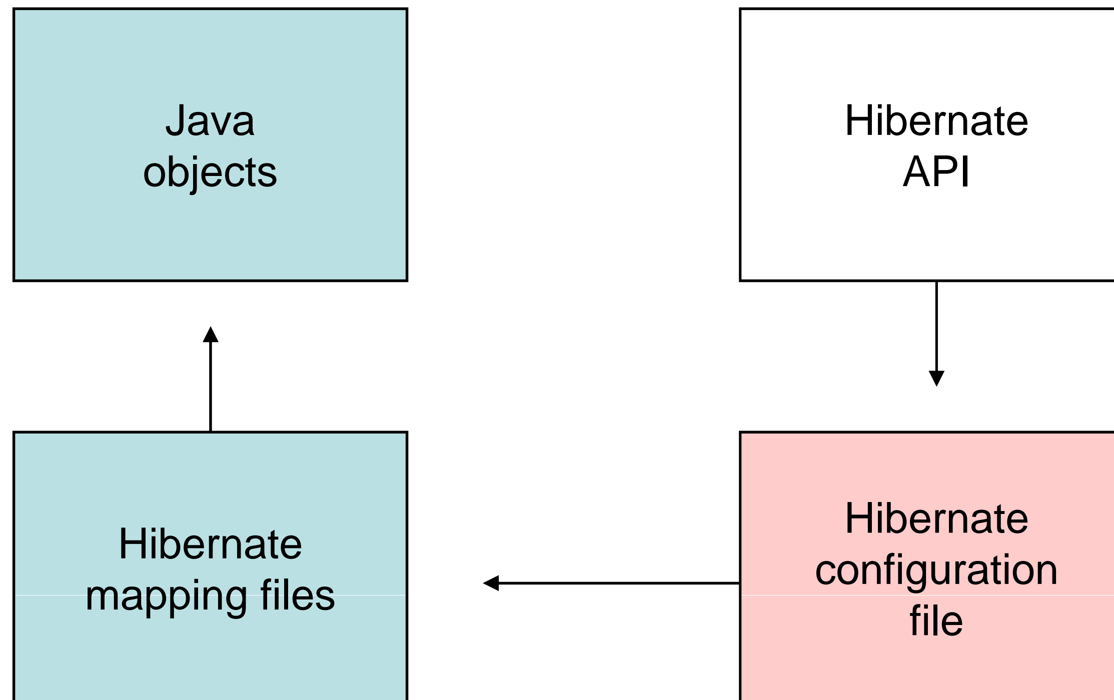


Hibernate mapping types

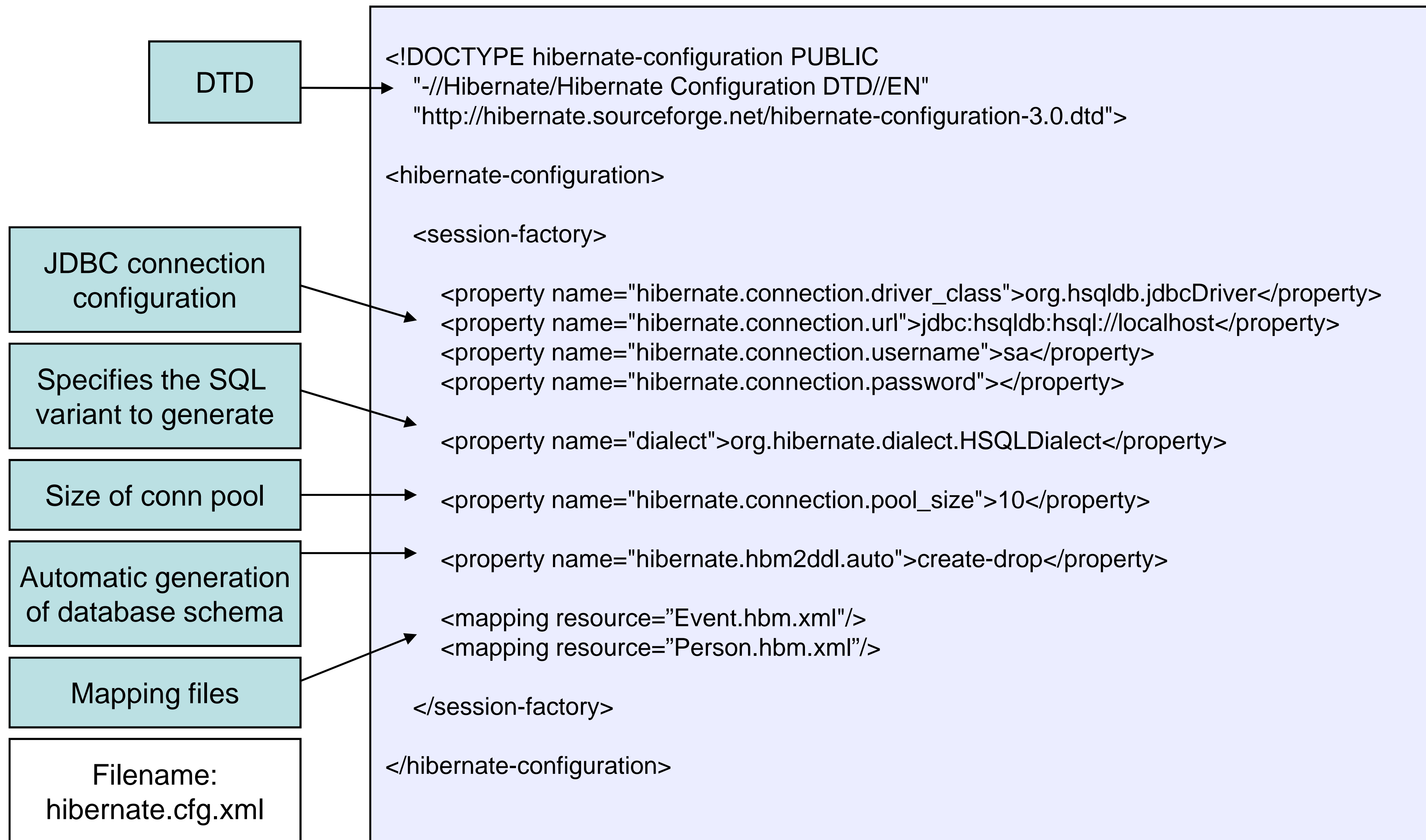
- Hibernate will translate Java types to SQL / database types for the properties of your mapped classes

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

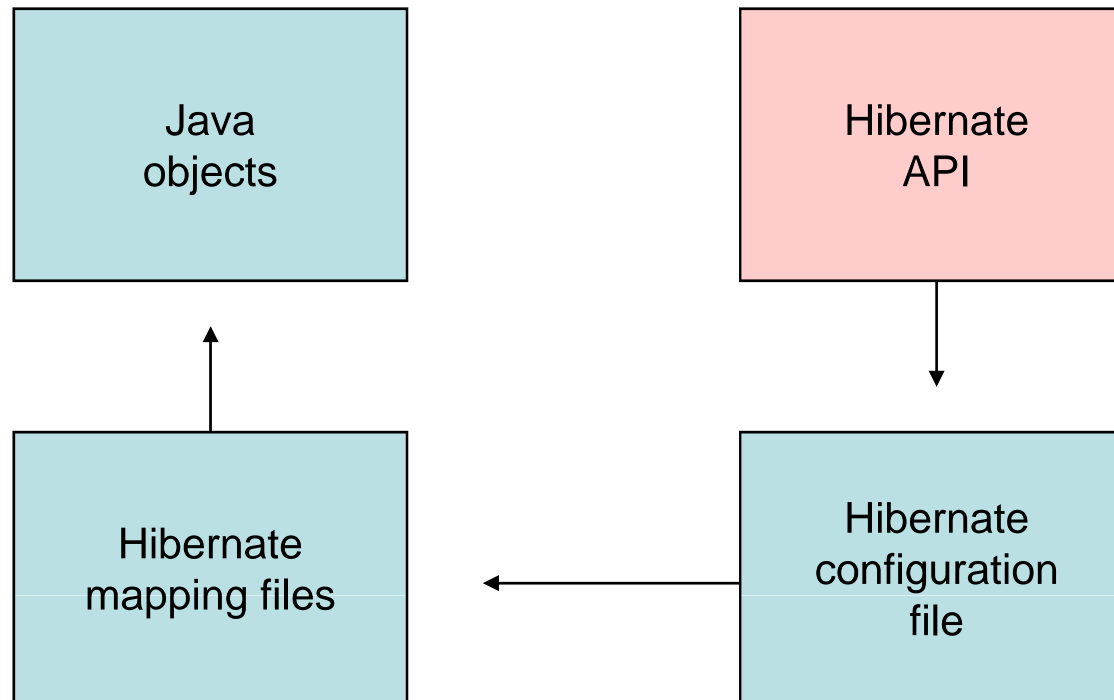
Example app: The EventManager



The Hibernate configuration file



Example app: The EventManager



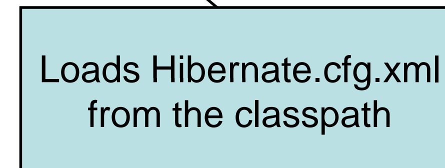
The Configuration class

- Represents a set of mapping files
- Mapping files can be specified programmatically or through the Hibernate configuration file
- Intended as a startup-time object

```
Configuration configuration = new Configuration()
    .addResource( "Event.hbm.xml" )
    .addResource( "Person.hbm.xml" );
```

...or...

```
Configuration configuration = new Configuration();

configuration.configure();
```



The SessionFactory interface

- Obtained from a Configuration instance
- Shared among application threads
- Main purpose is to provide *Session* instances
- Allowed to instantiate more than one SessionFactory
- Sophisticated implementation of the *factory design pattern*

```
SessionFactory sessionFactory =
    configuration.buildSessionFactory();
```

The Session interface

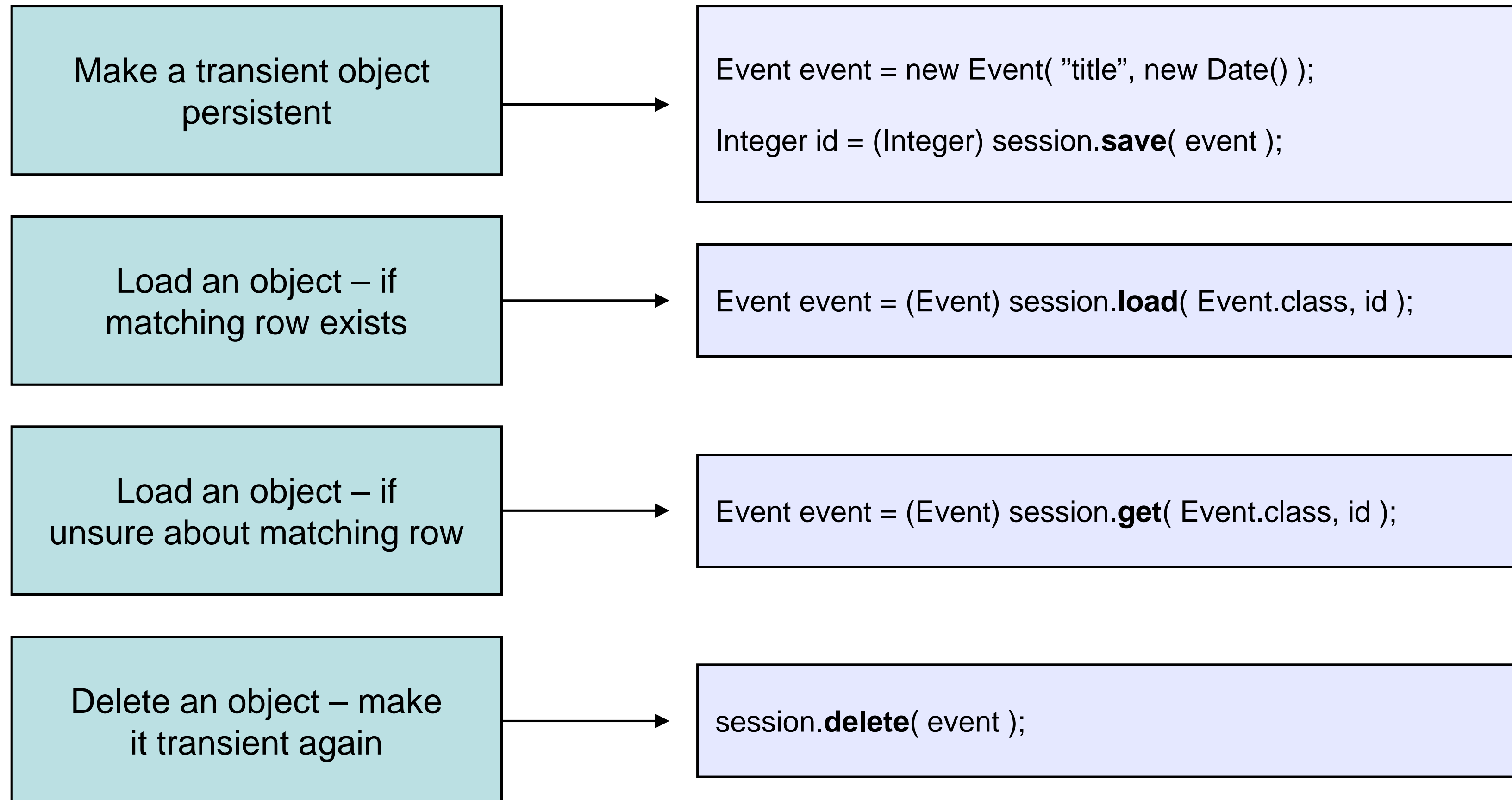
- Obtained from a SessionFactory instance
- Main runtime interface between a Java application and Hibernate
- Responsible for storing and retrieving objects
- Think of it as a collection of loaded objects related to a *single unit of work*

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

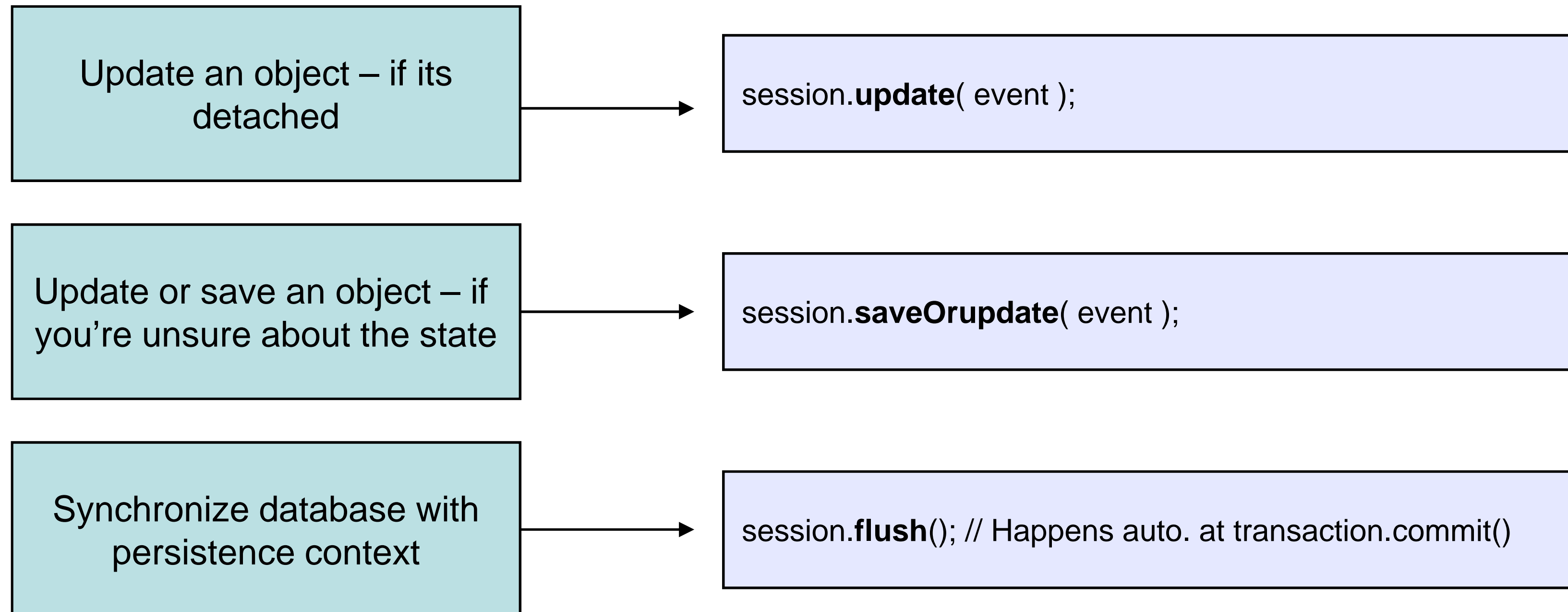
Instance states

- 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

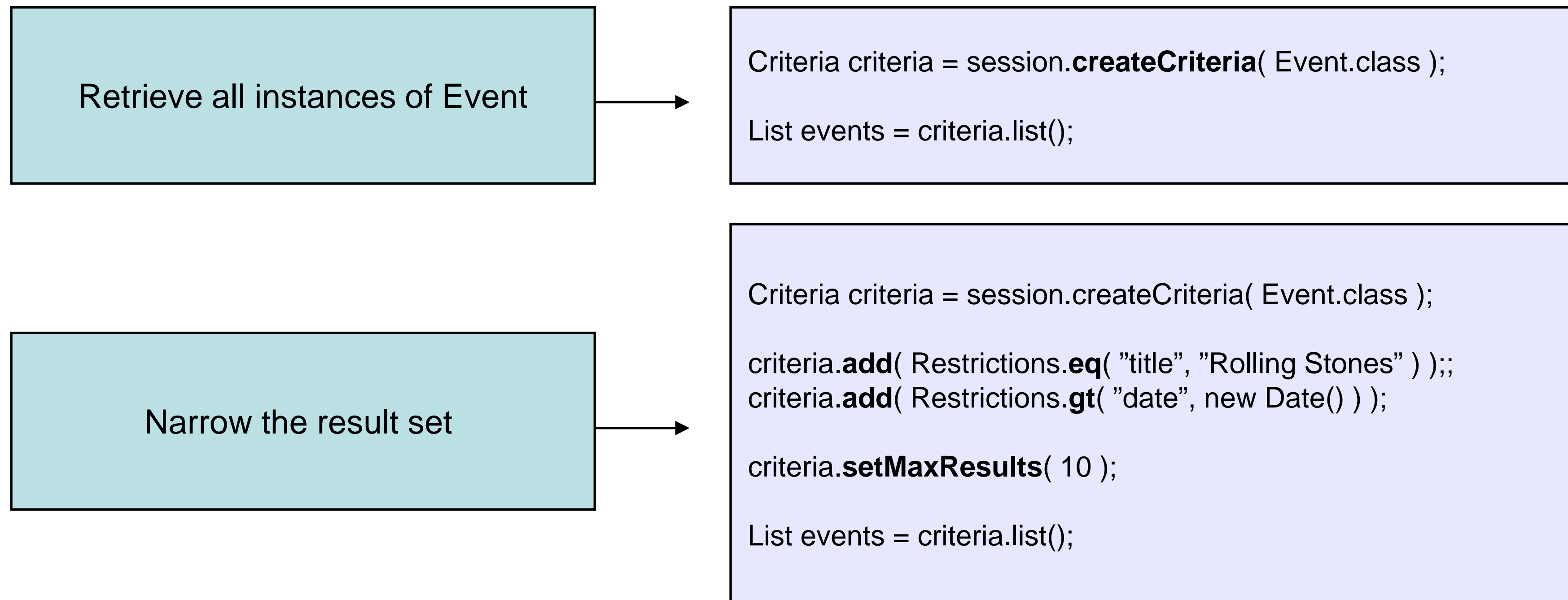


The Session interface



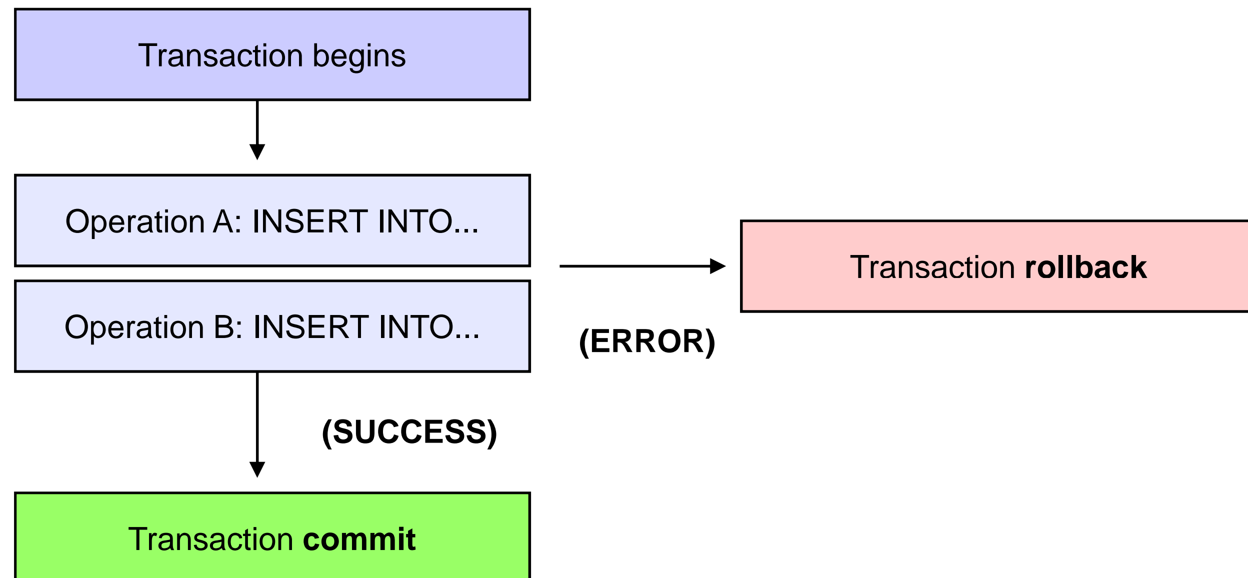
The Criteria interface

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



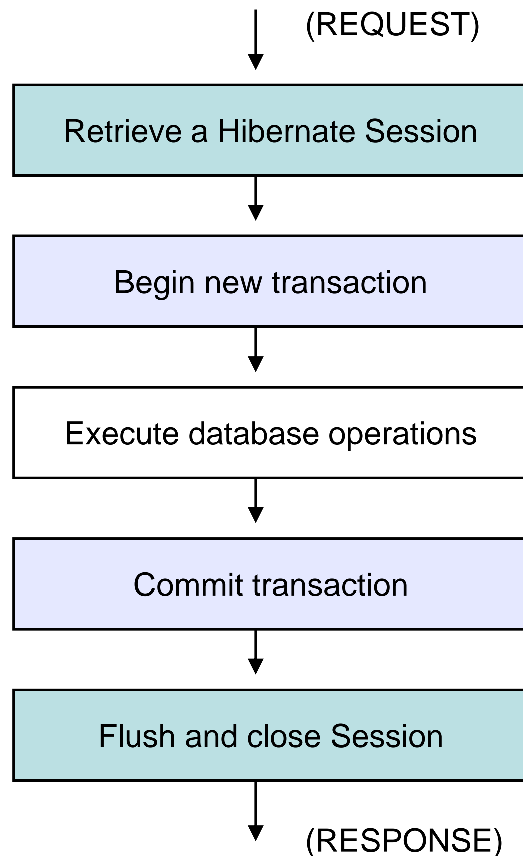
Transactions

- 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!



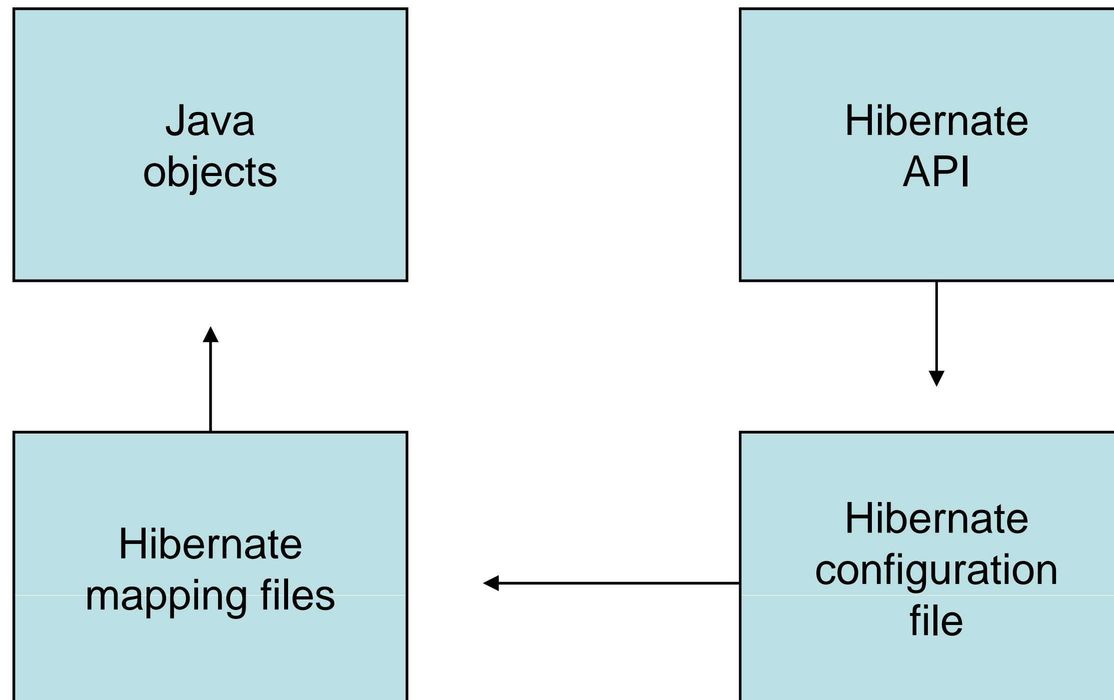
Transactions

- Most common pattern is *session-per-request*




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

Transaction transaction = null;

try
{
   transaction = session.beginTransaction();

   session.save( event );
   session.save( person );

   transaction.commit();
}
catch ( RuntimeException ex )
{
   if ( transaction != null )
   {
      transaction.rollback();
      throw ex;
   }
}
finally
{
   session.close();
}
```

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

- Books on Hibernate
  - Christian Bauer and Gavin King: *Hibernate in Action*
  - James Elliot: *Hibernate – A Developer's notebook*
  - Justin Gehtland, Bruce A. Tate: *Better, Faster, Lighter Java*

- The Hibernate reference documentation
  - www.hibernate.org