**Difference Between JPA, Hibernate, and Spring Data JPA**

**1. JPA (Java Persistence API)**

* **Type**: **Specification**
* **Defined by**: Java EE (JSR 338)
* **Purpose**: JPA is a *standardized API* to manage **relational data** in Java applications.
* **Functionality**:
  + Defines a set of interfaces and annotations.
  + Allows mapping Java classes to database tables (ORM).
  + Enables CRUD operations through EntityManager.

**Note**: JPA is *just a specification* — it does **not have its own implementation**.

**2. Hibernate**

* **Type**: **Implementation**
* **Implements**: JPA
* **Purpose**: Hibernate is a **powerful ORM tool** and the most popular **implementation** of JPA.
* **Functionality**:
  + Provides additional features over JPA like **caching**, **lazy loading**, and **HQL (Hibernate Query Language)**.
  + Can be used *with* or *without* JPA.
* **Usage**:
  + When using Hibernate directly, developers write more boilerplate code like managing sessions, transactions, etc.

Hibernate is the engine behind many JPA-based applications.

**3. Spring Data JPA**

* **Type**: **Abstraction**
* **Built on**: JPA + Hibernate
* **Purpose**: Spring Data JPA is a **wrapper framework** provided by Spring to **simplify JPA-based persistence**.
* **Functionality**:
  + Reduces boilerplate by providing **Repository interfaces** (like JpaRepository, CrudRepository).
  + Automatically generates implementations for common database operations.
  + Supports **custom queries** using method naming conventions and annotations.

Spring Data JPA internally uses Hibernate (or another JPA provider), but **abstracts away** its complexity.

Comparison:

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| --- | --- | --- | --- |
| Feature | JPA | Hibernate | Spring Data JPA |
| Type | Specification | Implementation (ORM Tool) | Abstraction Layer over JPA + Hibernate |
| Author | Java EE (Oracle) | Red Hat | Spring Framework |
| Implementation | None (spec only) | Implements JPA + extra features | Uses Hibernate (or other JPA providers) |
| Boilerplate Reduction | No | Partial | Yes (using Repository interfaces) |
| Vendor-independent | Yes | No (Hibernate-specific features) | Yes |