### **Difference between JPA, Hibernate and Spring Data JPA**

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### **🔷 1. JPA (Java Persistence API) – The Specification**

* **What it is**: A **standard** (interface-based) specification in Java for **object-relational mapping (ORM)**.
* **Part of**: Java EE / Jakarta EE.
* **Defines**: How Java objects map to database tables, how queries work (JPQL), entity lifecycle, etc.
* **Provides**: Interfaces like EntityManager, @Entity, @Table, @Id, etc.
* **Does NOT implement anything** — needs a **provider** (like Hibernate) to work.

📝 Think of JPA as a **set of rules** or a **contract**.

### **🔶 2. Hibernate – The Implementation**

* **What it is**: The most popular **implementation** of JPA.
* **More than JPA**: Offers additional features not in JPA like @Filter, @BatchSize, StatelessSession, etc.
* **Can be used directly**, even without JPA.
* Acts as the **engine** behind JPA operations.

📝 Hibernate **implements the JPA spec**, and can also offer its own API when more power/flexibility is needed.

### **🟢 3. Spring Data JPA – The Abstraction + Productivity Tool**

* **What it is**: A **Spring module** that builds on JPA (and Hibernate) to **simplify DAO/Repository creation**.
* **Adds abstraction**: You just define interfaces like UserRepository extends JpaRepository<User, Long> — no need to write query methods.
* **Provides**:  
  + Derived query methods (findByUsername, etc.)
  + Pagination, sorting
  + Custom queries with @Query
  + Auditing, specification API
  + Transaction management integration

📝 Spring Data JPA **uses JPA under the hood**, and often Hibernate is the default provider.

### **✅ Summary Table**

| **Feature** | **JPA** | **Hibernate** | **Spring Data JPA** |
| --- | --- | --- | --- |
| Type | Specification (API) | Implementation (Library) | Spring abstraction/framework |
| Provided by | Java EE / Jakarta EE | Red Hat | Spring (Pivotal) |
| Can it work alone? | No | Yes | No (needs JPA + provider) |
| Goal | Define ORM standard | Provide ORM capabilities | Simplify DAO layer |
| Extra Features | None | Yes (caching, filters) | Yes (auto repos, queries) |