

From Protégé to SPARQL

OWL, GraphDB, SPARQL, and Their Connections

Understand the semantic stack as one connected pipeline.

Big Picture Flow

Protégé → OWL → GraphDB → SPARQL

- Design
- Store meaning
- Build graph
- Query knowledge

1. Protégé – Ontology Editor

Protégé is a tool (GUI editor).

Used to:

- Define Classes
 - Person, Food, Company
- Define Relationships
 - eats, worksAt
- Add Constraints
- Create Individuals

Protégé helps humans design knowledge models visually.

2. OWL – Semantic Modeling Language

OWL = Ontology Web Language

Purpose:

- Describe meaning and logic
- Enable machine reasoning
- Support inheritance and constraints

Example:

$\text{Student} \subseteq \text{Person}$

$\text{Person} \subseteq \text{Mammal}$

- Student is automatically a Person
- Person is automatically a Mammal

OWL adds **logic + semantics + inference**

3. Knowledge Graph (Stored Semantic Data)

Knowledge Graph = Meaningful graph database

A Knowledge Graph is built from three fundamental components:

- **Nodes (Entities)** → Things that exist
- **Edges (Relationships)** → Connections between things
- **Labels (Meaning)** → Semantic interpretation of those connections

Together, they allow machines to store **data + meaning + logic**.

4. SPARQL – Query Language for Graphs

SPARQL = SQL for Knowledge Graphs

Example:

```
SELECT ?x
WHERE {
  ?x rdf:type :Person .
  ?x :eats :Pizza .
}
```

5. SHACL – Shapes Constraint Language

- Used to validate ontology data
- Ensures data follows rules

Example:

“Every Product must have a price”

“Every Person must have exactly one birth date”

How Everything Connects

Step-by-step:

1. Design ontology in Protégé
2. Save as OWL file
3. Load into Graph Database (Knowledge Graph)
4. Query using SPARQL

Pipeline view:

Design → Logic → Graph Storage → Query

Real-World Usage Pattern

Typical workflow:

1. Model domain in Protégé
2. Export OWL
3. Upload to GraphDB / Fuseki
4. Run SPARQL queries or SHACL validations
5. Connect to applications or AI systems

Key Takeaways

- Protégé → Design tool
- OWL → Semantic language
- Knowledge Graph → Storage model
- SPARQL → Query interface
- SHACL → Validation language

Together they form the Semantic Web Stack.