Mechanical engineering, often regarded as the backbone of modern industry, stands at the intersection of innovation and precision. This field, which encompasses everything from designing cutting-edge machinery to optimizing manufacturing processes, is a testament to human ingenuity and technological progress. In the pursuit of excellence within mechanical engineering, the development of a comprehensive ontology emerges as a pivotal endeavor. This ontology, a structured repository of knowledge and expertise, not only bridges the gap between theory and practice but also fuels innovation, education, and research within the field.

You are to **build an ontology** that is to be utilized by mechanical engineers. Some sample aspects that you can cover include:

Engineering Design: The ontology will support engineers in designing and simulating mechanical systems, optimizing product performance, and ensuring compliance with industry standards.

Knowledge Discovery: Researchers will use the ontology to facilitate data integration, semantic search, and knowledge discovery in mechanical engineering, enabling innovations in product design and manufacturing.

Quality Control: Manufacturers will use the ontology to track quality parameters, inspection processes, and compliance with industry regulations, thereby improving product quality and safety.

Education and Training: Mechanical engineering students, educators, and professionals will use the ontology to enhance their understanding of mechanical engineering concepts and best practices.

b). Concept graph (i.e., Taxonomy)
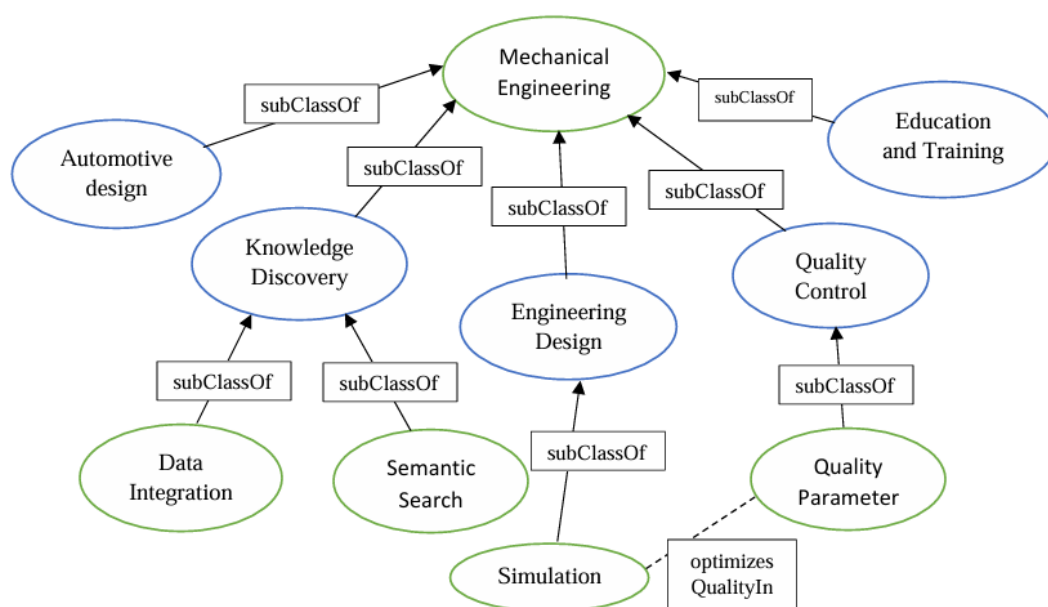
d). SPARQL queries

1. What are the titles and descriptions of the classes in the Mechanical Engineering Ontology?

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX dc: <http://purl.org/dc/elements/1.1/>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX mechanical-engineerings: <http://example.org/mechanical-
engineerings>

SELECT ?class ?title ?description
WHERE {
    ?class rdf:type owl:Class.
    OPTIONAL { ?class rdfs:label ?title. }
    OPTIONAL { ?class rdfs:comment ?description. }
}
```

	class	title	description
1	<http://example.org/mechanical-engineerings#AutomotiveDesign>	The automotive design type	The class of all automotive design.
2	<http://example.org/mechanical-engineerings#EducationAndTraining>	The education and training type	The class of all education and training.
3	<http://example.org/mechanical-engineerings#QualityControl>	The quality control type	The class of all quality control.
4	<http://example.org/mechanical-engineerings#Simulation>	The simulation type	The class of all simulation.
5	<http://example.org/mechanical-engineerings#KnowledgeDiscovery>	The knowledge discovery type	The class of all knowledge discovery.
6	<http://example.org/mechanical-engineerings#QualityParameter>	The quality parameter type	The class of all quality parameter.
7	<http://example.org/mechanical-engineerings#MechanicalEngineering>	The mechanical engineering type	The class of all mechanical engineering.
8	<http://example.org/mechanical-engineerings#EngineeringDesign>	The engineering design type	The class of all engineering design.
9	<http://example.org/mechanical-engineerings#SemanticSearch>	The semantic search type	The class of all semantic search.
10	<http://example.org/mechanical-engineerings#DataIntegration>	The data integration type	The class of all data integration.

2. Provide a hierarchical view of all classes and their subclasses in the Mechanical Engineering Ontology?

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX mechanical-engineerings: <http://example.org/mechanical-
engineerings>

SELECT ?class ?subclass ?label
WHERE {
    ?class rdf:type owl:Class.
    OPTIONAL { ?class rdfs:label ?label. }
    OPTIONAL {
        ?subclass rdf:type owl:Class.
        ?subclass rdfs:subClassOf ?class.
    }
}
ORDER BY ?class ?subclass
```

	class	subclass	label
1	<http://example.org/mechanical-engineerings#AutomotiveDesign>		The automotive design type
2	<http://example.org/mechanical-engineerings#DataIntegration>		The data integration type
3	<http://example.org/mechanical-engineerings#EducationAndTraining>		The education and training type
4	<http://example.org/mechanical-engineerings#EngineeringDesign>	<http://example.org/mechanical-engineerings#Simulation>	The engineering design type
5	<http://example.org/mechanical-engineerings#KnowledgeDiscovery>	<http://example.org/mechanical-engineerings#DataIntegration>	The knowledge discovery type
6	<http://example.org/mechanical-engineerings#KnowledgeDiscovery>	<http://example.org/mechanical-engineerings#SemanticSearch>	The knowledge discovery type
7	<http://example.org/mechanical-engineerings#MechanicalEngineering>	<http://example.org/mechanical-engineerings#AutomotiveDesign>	The mechanical engineering type
8	<http://example.org/mechanical-engineerings#MechanicalEngineering>	<http://example.org/mechanical-engineerings#EducationAndTraining>	The mechanical engineering type
9	<http://example.org/mechanical-engineerings#MechanicalEngineering>	<http://example.org/mechanical-engineerings#EngineeringDesign>	The mechanical engineering type
10	<http://example.org/mechanical-engineerings#MechanicalEngineering>	<http://example.org/mechanical-engineerings#KnowledgeDiscovery>	The mechanical engineering type
11	<http://example.org/mechanical-engineerings#MechanicalEngineering>	<http://example.org/mechanical-engineerings#QualityControl>	The mechanical engineering type
12	<http://example.org/mechanical-engineerings#QualityControl>	<http://example.org/mechanical-engineerings#QualityParameter>	The quality control type
13	<http://example.org/mechanical-engineerings#QualityParameter>		The quality parameter type
14	<http://example.org/mechanical-engineerings#SemanticSearch>		The semantic search type
15	<http://example.org/mechanical-engineerings#Simulation>		The simulation type

3. What are the object properties defined in the ontology?

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX mechanical-engineerings: <http://example.org/mechanical-
engineerings>

SELECT ?property
WHERE {
    ?property rdf:type owl:ObjectProperty.
}
```

	property
1	<http://www.example.com/mechanical-engineerings#optimizesQualityIn>

4. What is the title and description of the Mechanical Engineering Ontology?

```
PREFIX dc: <http://purl.org/dc/elements/1.1/>
PREFIX owl: <http://www.w3.org/2002/07/owl#>

SELECT ?title ?description
WHERE {
    <http://www.example.com/mechanical-engineerings> dc:title ?title;
                                        dc:description
?description.
}
```

title	description
1 Mechanical Engineering Ontology	A Mechanical Engineering ontology

5. What are the instances in the ontology, and what types/classes do they belong to?

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX mechanical-engineerings: <http://example.org/mechanical-
engineerings>

SELECT ?instance ?type
WHERE {
    ?instance rdf:type ?type.
}
ORDER BY ?instance
```

instance	type
1 <http://example.org/mechanical-engineerings#AutomotiveDesign>	<http://www.w3.org/2002/07/owl#Class>
2 <http://example.org/mechanical-engineerings#DataIntegration>	<http://www.w3.org/2002/07/owl#Class>
3 <http://example.org/mechanical-engineerings#EducationAndTraining>	<http://www.w3.org/2002/07/owl#Class>
4 <http://example.org/mechanical-engineerings#EngineeringDesign>	<http://www.w3.org/2002/07/owl#Class>
5 <http://example.org/mechanical-engineerings#KnowledgeDiscovery>	<http://www.w3.org/2002/07/owl#Class>
6 <http://example.org/mechanical-engineerings#MechanicalEngineering>	<http://www.w3.org/2002/07/owl#Class>
7 <http://example.org/mechanical-engineerings#QualityControl>	<http://www.w3.org/2002/07/owl#Class>
8 <http://example.org/mechanical-engineerings#QualityParameter>	<http://www.w3.org/2002/07/owl#Class>
9 <http://example.org/mechanical-engineerings#SemanticSearch>	<http://www.w3.org/2002/07/owl#Class>
10 <http://example.org/mechanical-engineerings#Simulation>	<http://www.w3.org/2002/07/owl#Class>
11 <http://www.example.com/mechanical-engineerings>	<http://www.w3.org/2002/07/owl#Ontology>
12 <http://www.example.com/mechanical-engineerings#Simulation>	<http://example.org/mechanical-engineerings#EngineeringDesign>
13 <http://www.example.com/mechanical-engineerings#optimizesQualityIn>	<http://www.w3.org/2002/07/owl#ObjectProperty>