Semantic Network Report – Vehicle Domain

CPCS-331 – Artificial Intelligence Student: Faris Alzahrani

---

1. Introduction

Semantic networks are a classical **knowledge representation technique** in Artificial Intelligence. They represent knowledge as a set of **nodes** (concepts) connected by labeled **edges** (relationships). This structure makes it easier for AI systems to understand how concepts relate, inherit properties, and produce explainable reasoning.

This report presents a semantic network for the **Vehicle** domain, including its design, implementation, basic and advanced operations, and visual representations before and after applying inference.

---

2. Domain Description: Vehicle Semantic Network

The vehicle domain was chosen for its simplicity and familiarity. The semantic network includes vehicles, their parts, and fuel types.

2.1 Core Concepts

- Vehicle
- Car
- Truck
- Electric Car

2.2 Parts

- Engine

- Wheel
- Battery

2.3 Fuel Types

- Petrol
- Diesel
- Electricity

2.4 Relationships

- **is-a:** Car → Vehicle, Electric Car → Car
- **has-part:** Vehicle → Engine, Vehicle → Wheel, Electric Car → Battery
- **uses-fuel:** Car → Petrol, Truck → Diesel, Electric Car → Electricity

These relationships form the foundation of the semantic network.

---

3. Basic Operations

The system provides all the required basic operations for manipulating a semantic network.

3.1 Adding Nodes and Relationships

Functions are implemented to add:

- Concepts
- Parts
- Fuel types
- Relations such as *is-a*, *has-part*, *uses-fuel*

3.2 Removing Nodes and Relationships

Nodes and edges can be removed from the network without affecting unrelated structures.

3.3 Querying the Network

Search functions retrieve:

- Relations from a source node
- Incoming relations to a target node
- All nodes of a specific type (concept, part, fuel)

These queries allow exploring patterns and structure inside the semantic net.

---

4. Advanced Features

The project includes extra credit features.

4.1 Property Inheritance (Inference)

If a parent concept has a property, its child can automatically inherit that property. Example:

- Vehicle has-part Wheel
- Car is-a Vehicle
- **Inference result:** Car has-part Wheel

4.2 Conflict Detection

If a concept has multiple conflicting values for the same relation (e.g., two different fuels), the system detects this ambiguity.

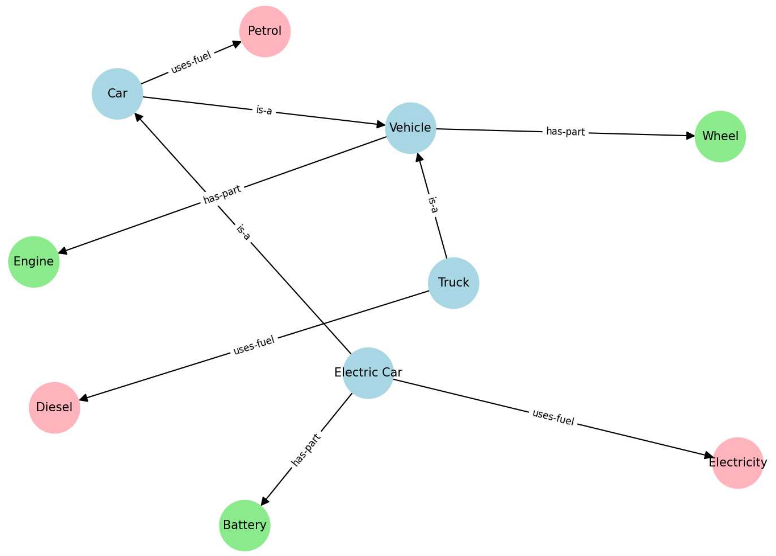
These advanced features increase the reasoning capability of the semantic network.

---

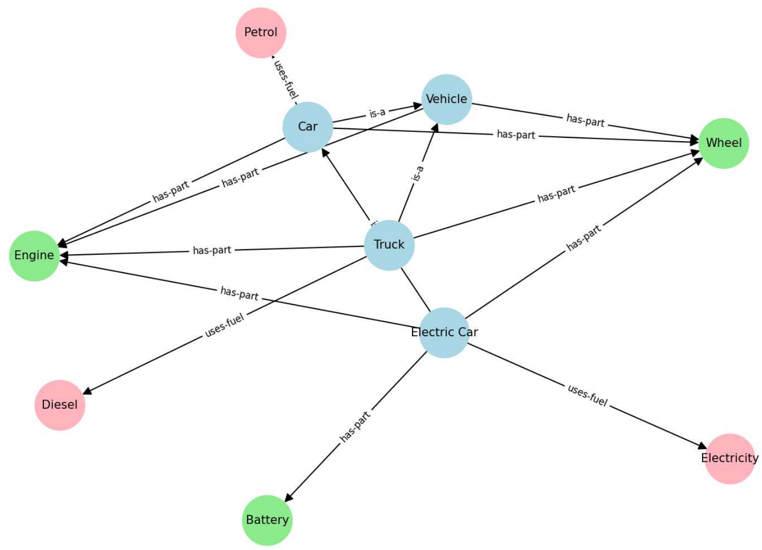
5. Semantic Network Graphs

Below are placeholders for the semantic network visualizations.

5.1 Graph Before Inference



5.2 Graph After Inference



6. Future of Semantic Nets in AI

Semantic networks influenced the creation of modern **knowledge graphs**, now used by search engines, reasoning systems, and intelligent agents. Their structure supports:

- Explainable reasoning
- Domain modeling
- Hybrid symbolic + machine learning systems

As AI moves toward more transparent and structured systems, semantic nets will remain key in representing relations, inheriting knowledge, and improving interpretability.

---

7. Conclusion

This project demonstrates how semantic networks can effectively model a real-world domain. Using nodes, relations, inference, conflict detection, and visualization, the vehicle domain was represented cleanly and meaningfully. The implementation fulfills all assignment requirements and showcases both foundational and advanced concepts in knowledge representation.