Semi-Supervised Learning for Autonomous Navigation

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Graph is a data structure consisting of two components: nodes (vertices) and edges.

A graph G can be defined as G = (V, E), where V is the set of nodes, and E are the edges between them.

If there are directional dependencies between nodes, then edges are directed. If not, edges are undirected.

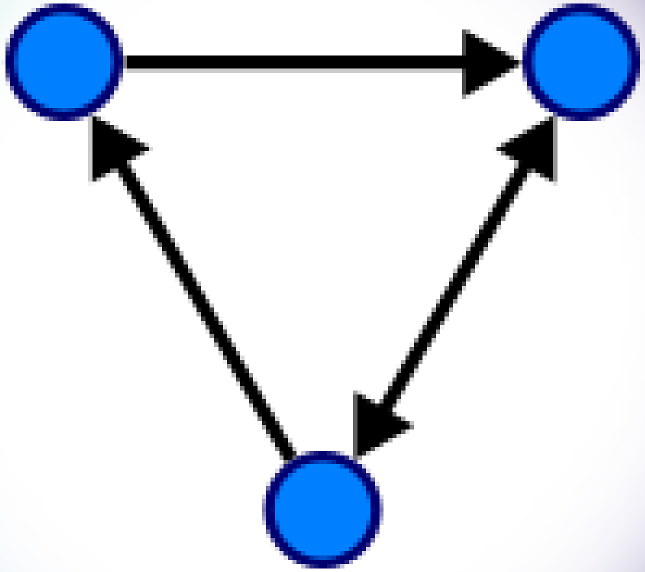

Fig. 1. A pictorial representation of a graph.

- A graph is often represented by A, an adjacency matrix.
- If a graph has n nodes, A has a dimension of (n × n).
- If the node has f numbers of features, then the node feature matrix X has a dimension of (n × f).

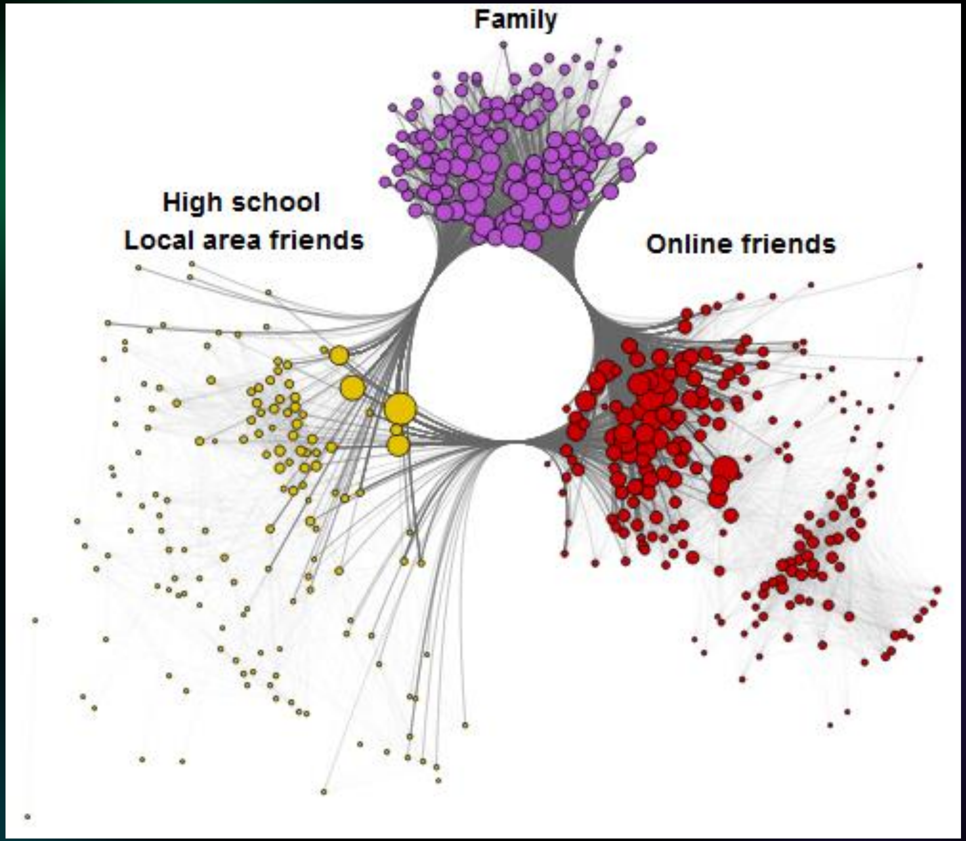

Fig. 2. A pictorial representation of a graph depicting a social network.

Graph Neural Networks

- Real world data can be easily represented using graphs.
- Graphs connects things.
- Graph Neural nets can directly learn flow networks, social networks , molecules and 3D objects.

Semi-Supervised Learning

When there is a 'shortage of labeled data'.

Train the model using a small labeled sample.

Using the same model to cluster a significant quantity of unlabeled data.

Semi-Supervised Learning Agent

Representing a Traffic Network

VERTICES REPRESENT PLACES OR HUBS

EDGES REPRESENT STREETS

EACH EDGE WILL HAVE ADDITIONAL PROPERTIES LIKE TRAFFIC DENSITY , CAPACITY AND A VIEW FACTOR

THE VIEW FACTOR REPRESENT HOW NICE LOOKING THE ROUTE IS

FOR EXAMPLE, IF A TOURIST ATTRACTION IS ON THE ROUTE THE VIEW FACTOR WILL BE HIGH

Environment

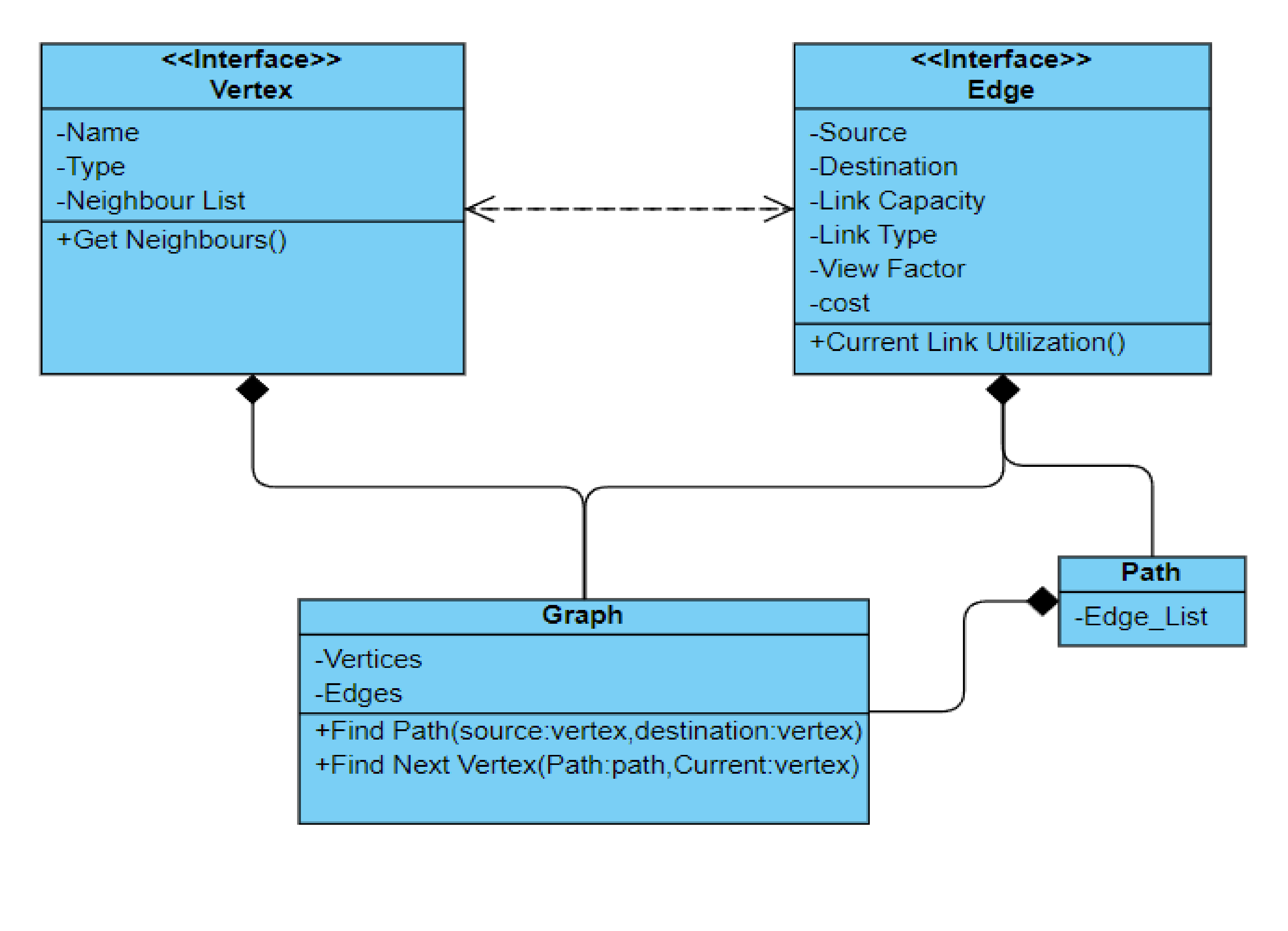

Fig. 2. UML Diagram of the Environment.

Agent Diagram

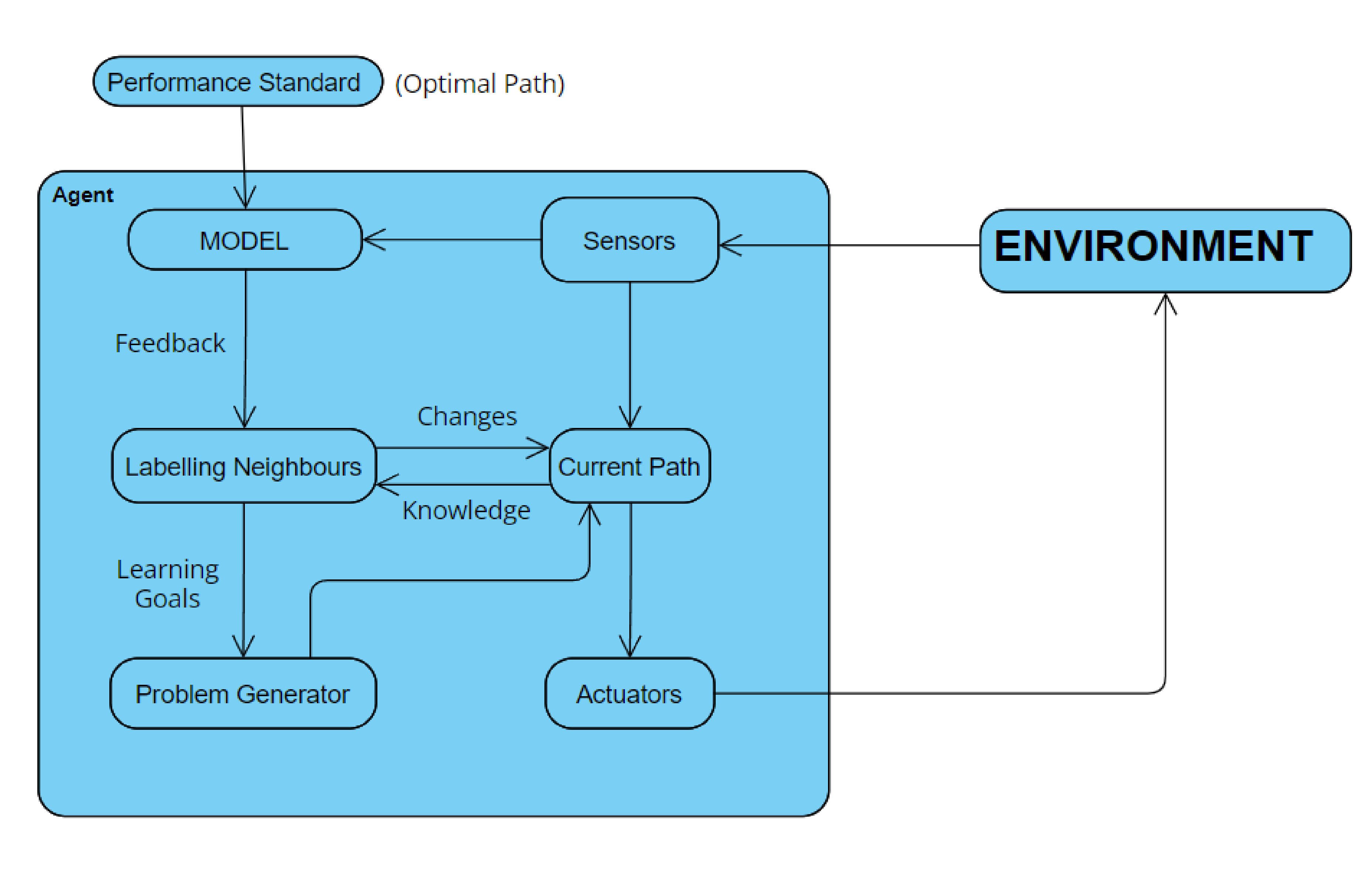

Fig. 3. Agent Diagram of the Intelligent Agent.

1. The model will be trained on a traffic network to label nodes automatically using a labelled graph.

2. The same model will be trained to label the new vertices based on the edges on an unlabeled sparse graph.

3. The agent will traverse the graph from the source during the traversal the model will automatically label the vertices based on the labelling the next vertex on the path will be chosen.

4. The shortest optimal path from the source to the destination will be chosen based on the model's experience.

1. Shortest possible path is not always the optimal path so find Optimal path instead of the shortest path.

2. Semi supervised learning ensures that the model is trained using a very small labelled dataset which ensures faster training and better performance.

3. At each vertex, the agent visits there is a possibility to update the current path based on the current state of the environment.

4. The agent can also backtrack to find an alternative path as we represent the network as an undirected graph.

Bottlenecks and Limitations

1. To make decisions dynamically while driving the computing unit should have enough computing power

2. As we are representing the graph as an undirected graph, the agent will not be able to navigate in environments with one-ways.

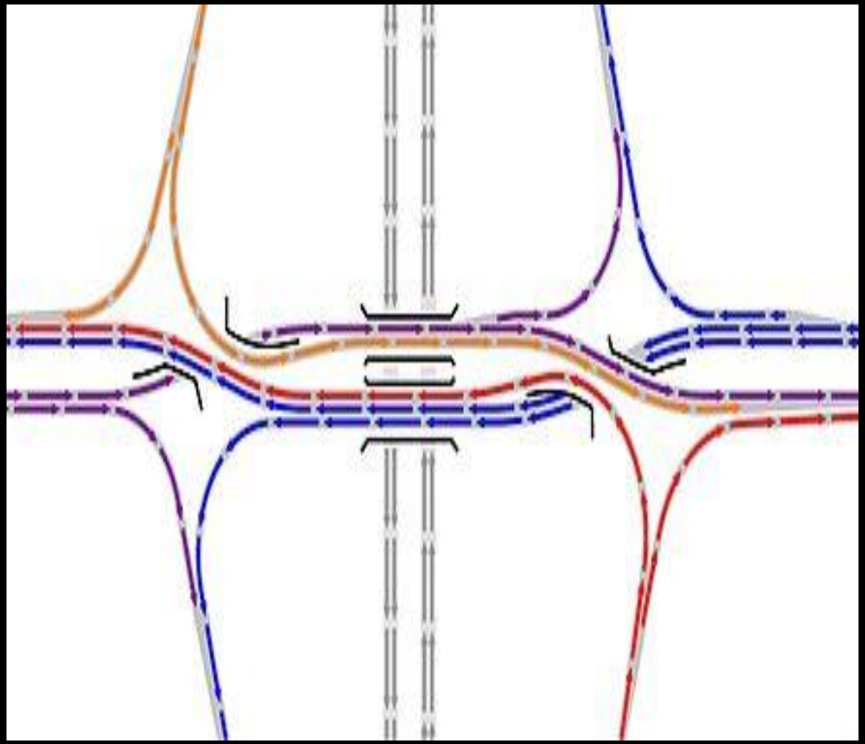

Fig. 3. Diagram representing a highway Interchange

Future Scope

We can improve the model by using self-supervised and Reinforcement Learning techniques.

If a user prefers to travel at a particular speed the model will find the optimal path considering that parameter as well.

References

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Thank You