Dataset creation using sumo

Step 1: Install SUMO First, make sure you have SUMO installed. You can download it from the official website: https://sumo.dlr.de/docs/Downloads.php

Step 2: Create a simple network We'll create a simple network with a single intersection. Create a file named `intersection.nod.xml`:

```
<nodes>
   <node id="1" x="0" y="0" type="traffic_light"/>
   <node id="2" x="-100" y="0" type="priority"/>
   <node id="3" x="100" y="0" type="priority"/>
   <node id="4" x="0" y="-100" type="priority"/>
   <node id="5" x="0" y="100" type="priority"/>
</nodes>
```

Now create a file named `intersection.edg.xml`:

```
<edges>
   <edge id="1to2" from="1" to="2" numLanes="2" speed="13.89"/>
   <edge id="2to1" from="2" to="1" numLanes="2" speed="13.89"/>
   <edge id="1to3" from="1" to="3" numLanes="2" speed="13.89"/>
   <edge id="3to1" from="3" to="1" numLanes="2" speed="13.89"/>
   <edge id="1to4" from="1" to="4" numLanes="2" speed="13.89"/>
   <edge id="4to1" from="4" to="1" numLanes="2" speed="13.89"/>
   <edge id="1to5" from="1" to="5" numLanes="2" speed="13.89"/>
   <edge id="5to1" from="5" to="1" numLanes="2" speed="13.89"/>
</edges>
```

Step 3: Generate the network Open a command prompt in the directory with these files and run:

```
netconvert --node-files=intersection.nod.xml --edge-files=intersection.edg.xml
--output-file=intersection.net.xml
```

Step 4: Create traffic demand Create a file named `routes.rou.xml`:

```
<routes>
```

```
<routes>

   <!-- Define different vehicle types -->

   <vType id="car" accel="0.8" decel="4.5" sigma="0.5" length="5" minGap="2.5"
maxSpeed="16.67" guiShape="passenger"/>
```

```
    <vType id="bus" accel="0.6" decel="3.5" sigma="0.5" length="12" minGap="3" maxSpeed="13.89" guiShape="bus"/>

    <vType id="truck" accel="0.4" decel="3.0" sigma="0.5" length="10" minGap="3" maxSpeed="11.11" guiShape="truck"/>

    <vType id="motorcycle" accel="1.0" decel="5.0" sigma="0.5" length="2.5" minGap="2" maxSpeed="19.44" guiShape="motorcycle"/>



    <!-- Define flows for different vehicle types -->

    <flow id="flow1" type="car" from="2to1" to="1to3" begin="0" end="3600" vehsPerHour="400"/>

    <flow id="flow2" type="car" from="4to1" to="1to5" begin="0" end="3600" vehsPerHour="400"/>

    <flow id="flow3" type="bus" from="2to1" to="1to5" begin="0" end="3600" vehsPerHour="60"/>

    <flow id="flow4" type="truck" from="4to1" to="1to3" begin="0" end="3600" vehsPerHour="50"/>

    <flow id="flow5" type="motorcycle" from="5to1" to="1to2" begin="0" end="3600" vehsPerHour="100"/>

</routes>
```

Step 5: Create traffic light programs Create two files for the different scenarios:

`tls_no_yellow.add.xml`:

```
<additional>

    <tlLogic id="1" type="static" programID="no_yellow" offset="0">

        <phase duration="31" state="GGggrrrrGGggrrrr"/>

        <phase duration="31" state="rrrrGGggrrrrGGgg"/>

    </tlLogic>

</additional>
```

`tls_with_yellow.add.xml`:

```
<additional>
    <tlLogic id="1" type="static" programID="with_yellow" offset="0">
        <phase duration="31" state="GGggrrrrGGggrrrr"/>
        <phase duration="4" state="yyggrrrryyggrrrr"/>
        <phase duration="31" state="rrrrGGggrrrrGGgg"/>
        <phase duration="4" state="rrrryyggrrrryygg"/>
    </tlLogic>
</additional>
```

Step 6: Create SUMO configuration files Create two configuration files:

`Scenario_no_yellow.sumocfg`:

```
<configuration>
    <input>
        <net-file value="intersection.net.xml"/>
        <route-files value="routes.rou.xml"/>
        <additional-files value="tls_no_yellow.add.xml"/>
    </input>
    <time>
        <begin value="0"/>
        <end value="3600"/>
    </time>
    <output>
        <tripinfo-output value="tripinfo_no_yellow.xml"/>
        <emission-output value="emissions_no_yellow.xml"/>
    </output>
</configuration>
```

`Scenario_with_yellow.sumocfg`:

```
<configuration>
    <input>
        <net-file value="intersection.net.xml"/>
        <route-files value="routes.rou.xml"/>
        <additional-files value="tls_with_yellow.add.xml"/>
    </input>
    <time>
        <begin value="0"/>
        <end value="3600"/>
    </time>
    <output>
        <tripinfo-output value="tripinfo_with_yellow.xml"/>
        <emission-output value="emissions_with_yellow.xml"/>
    </output>
</configuration>
```

Step 7: Run the simulations Run each scenario:

sumo -c scenario_no_yellow.sumocfg

sumo -c scenario_with_yellow.sumocfg

Step 8: Analyze the results You can use Python to analyze the output XML files. Here's a simple script to get you started:

analyse.py

PARAMETERS

Trip Information Parameters 8281672320

1. **id**:
    - **Description**: A unique identifier for the trip.
    - **Significance**: Essential for tracking specific vehicles throughout the simulation, enabling easy reference and data retrieval for analysis.
2. **depart**:
    - **Description**: The time at which the vehicle departs from its starting point, measured in seconds from the beginning of the simulation.
    - **Significance**: Useful for understanding traffic flow dynamics and peak times, aiding in traffic management and planning.
3. **departLane**:
    - **Description**: The lane identifier from which the vehicle departs, represented by a specific lane ID.
    - **Significance**: Helps in analyzing lane usage patterns and identifying potential bottlenecks in certain lanes.
4. **departPos**:
    - **Description**: The vehicle's initial position within the departing lane (in meters).
    - **Significance**: Important for evaluating vehicle spacing and dynamics during departure, which can affect congestion levels.
5. **departSpeed**:
    - **Description**: The speed of the vehicle at the moment of departure (in meters per second).
    - **Significance**: Provides insights into the starting conditions of the trip, which can influence traffic patterns and safety analyses.
6. **departDelay**:
    - **Description**: The delay experienced by the vehicle before it starts moving, measured in seconds.
    - **Significance**: Critical for assessing the impact of traffic signals, intersections, or congestion on vehicle departure times.
7. **arrival**:
    - **Description**: The time the vehicle arrives at its destination, again measured in seconds from the simulation start.
    - **Significance**: Key for calculating travel time and overall trip efficiency, which are vital for transportation studies.
8. **arrivalLane**:
    - **Description**: The lane where the vehicle arrives at its destination, indicated by a lane ID.
    - **Significance**: Useful for evaluating how lane selection affects arrival times and congestion at destination points.
9. **arrivalPos**:
    - **Description**: The position of the vehicle within the arrival lane upon reaching its destination (in meters).
    - **Significance**: Important for analyzing how close vehicles get to their intended stopping points, which can affect overall trip efficiency.
10. **arrivalSpeed**:
    - **Description**: The speed of the vehicle at the time of arrival (in meters per second).

    - **Significance**: Helps in assessing how the vehicle's speed changes throughout the trip and its relation to traffic conditions.
11. **duration**:
    - **Description**: The total time taken for the trip from departure to arrival (in seconds).
    - **Significance**: A key metric for evaluating trip efficiency and understanding the impact of various factors (like traffic signals and congestion) on travel time.
12. **routeLength**:
    - **Description**: The total length of the route taken by the vehicle (in meters).
    - **Significance**: Important for analyzing route selection and optimizing traffic patterns based on distance traveled.
13. **waitingTime**:
    - **Description**: The cumulative time the vehicle spends waiting during the trip (in seconds).
    - **Significance**: A critical factor in understanding the delays caused by traffic signals, stop signs, or congestion.
14. **waitingCount**:
    - **Description**: The number of instances where the vehicle experienced waiting.
    - **Significance**: Provides insights into how often vehicles face delays, which can be used to improve traffic signal timing and road layouts.
15. **stopTime**:
    - **Description**: The amount of time the vehicle remains stopped during the trip (in seconds).
    - **Significance**: Helps in assessing the frequency and impact of stops on overall trip efficiency.
16. **timeLoss**:
    - **Description**: Additional time lost during the trip due to unforeseen delays or inefficiencies (in seconds).
    - **Significance**: Key for evaluating the effectiveness of traffic management strategies and infrastructure improvements.
17. **rerouteNo**:
    - **Description**: The number of times the vehicle was rerouted during the trip.
    - **Significance**: Useful for analyzing how often drivers adjust their routes in response to changing conditions, which can inform navigation system design.
18. **devices**:
    - **Description**: A list of associated devices or modules used during the trip, such as routing and emissions monitoring systems.
    - **Significance**: Important for understanding the technological integration in traffic simulations and the data collection processes.
19. **vType**:
    - **Description**: The type of vehicle involved in the trip (e.g., `veh_passenger` indicates a passenger car).
    - **Significance**: Essential for analyzing traffic behavior and emissions profiles specific to different vehicle types.
20. **speedFactor**:

- **Description**: A multiplier affecting the speed of the vehicle based on various simulation conditions.
- **Significance**: Helps in modeling real-world variations in vehicle speed due to factors like traffic density and road conditions.

Emissions Parameters

The nested `<emissions>` element provides detailed information on the environmental impact of the trip:

1. **CO_abs**:
   - **Description**: Absolute emissions of carbon monoxide during the trip (in grams).
   - **Significance**: Important for assessing air quality impacts and understanding pollution sources.
2. **CO2_abs**:
   - **Description**: Absolute emissions of carbon dioxide during the trip (in grams).
   - **Significance**: Critical for evaluating the vehicle's contribution to greenhouse gas emissions, relevant for climate change studies.
3. **HC_abs**:
   - **Description**: Absolute emissions of hydrocarbons during the trip (in grams).
   - **Significance**: Useful for understanding the vehicle's impact on smog formation and air quality.
4. **PMx_abs**:
   - **Description**: Absolute emissions of particulate matter during the trip (in grams).
   - **Significance**: Key for assessing health risks associated with air pollution, particularly in urban areas.
5. **NOx_abs**:
   - **Description**: Absolute emissions of nitrogen oxides during the trip (in grams).
   - **Significance**: Important for evaluating the vehicle's contribution to ozone formation and respiratory problems.
6. **fuel_abs**:
   - **Description**: Total fuel consumption during the trip (in milliliters or grams, depending on configuration).
   - **Significance**: Essential for understanding fuel efficiency and the economic implications of vehicle operation.
7. **electricity_abs**:
   - **Description**: Total electricity consumption during the trip (in joules or watt-hours).
   - **Significance**: Relevant for analyzing the energy efficiency of electric vehicles and their environmental impact.

Summary

Overall, the data captured in the `<tripinfo>` element and its nested emissions details provide a comprehensive view of vehicle performance, environmental impact, and traffic dynamics. This information can be utilized for traffic management, urban planning,

environmental assessments, and the development of more efficient transportation systems. By analyzing these metrics, researchers and city planners can make informed decisions to enhance road safety, reduce emissions, and improve overall traffic flow.