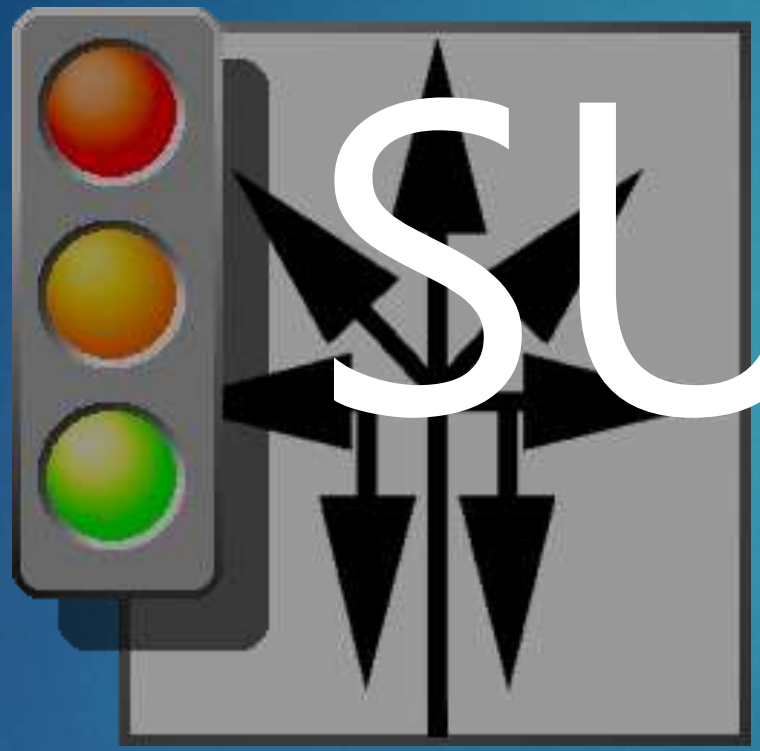
SUMO



SUMO

What is SUMO?

SUMO is an open source traffic simulation package

Was created by the German Aerospace Center (DLR)

The development of SUMO started back in 2001

You can use SUMO to :

- Build a Network and assign routes within a network
- Develop traffic light algorithm
- Simulate and analyze trafic within a network, given Origin-Destination (OD) Matrix
- Etc.

Overview of Transportation Simulation Software

Aimsun Live (Commercial),

TSIS-CORSIM, CORridor SIMulation (Commercial)

Paramics, PARAllel MICroscopic Simulation (Commercial),

PTV Vissim, (Commercial),

SimMobility, (by Singapore-MIT)

Synchro + SimTraffic, (Commercial)

MATSim, Multi-Agent Transport Simulation , (**Open Source**)

Transims, TRansportation ANalysis SIMulation System (NASA **Open Source**)

SUMO Simulation of Urban Mobility, (**DLR, Open Source**)

Preliminary

- Download and install
- SUMO: http://www.sumo.dlr.de/userdoc/Downloads.html
- Python: https://www.python.org/downloads/

- Python is necessary for some simulations

- In SUMO, road network can be created in three ways:
- Manually by creating our own node, edge, route, connection files.
- Using **netgenerate** command.
- Importing road network from external sources such as OSM, VISSIM, VISUM etc.

Part I:

Manual Node, Edge and Route assignment

Part II:

From OSM to Network +

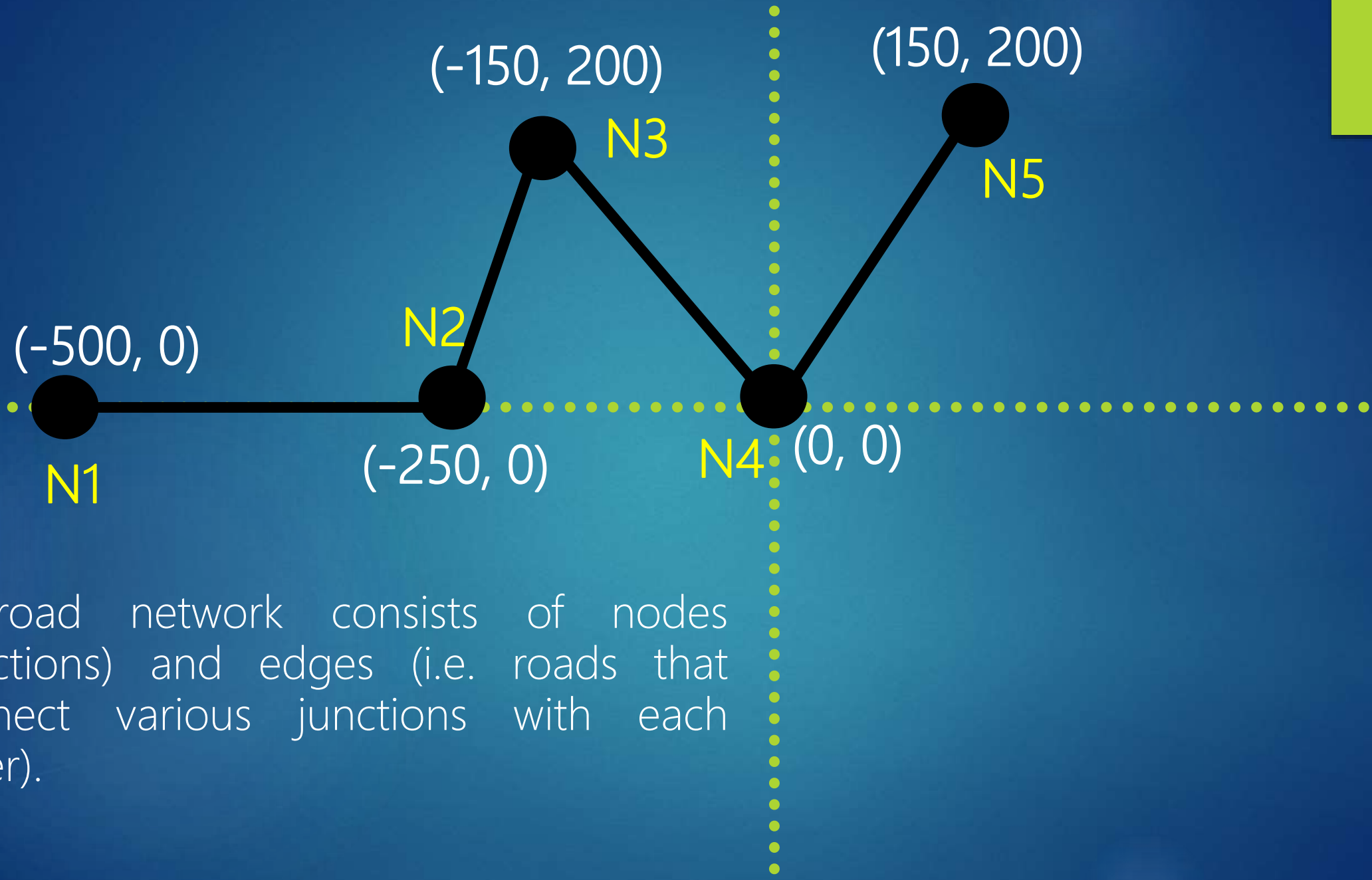
Random Trips Simulation

Part III:

Origin-Destination to trip Simulation

Part I:

Manual Node, Edge and Route assignment



A road network consists of nodes (junctions) and edges (i.e. roads that connect various junctions with each other).

1) Node file creation (.nod.xml)

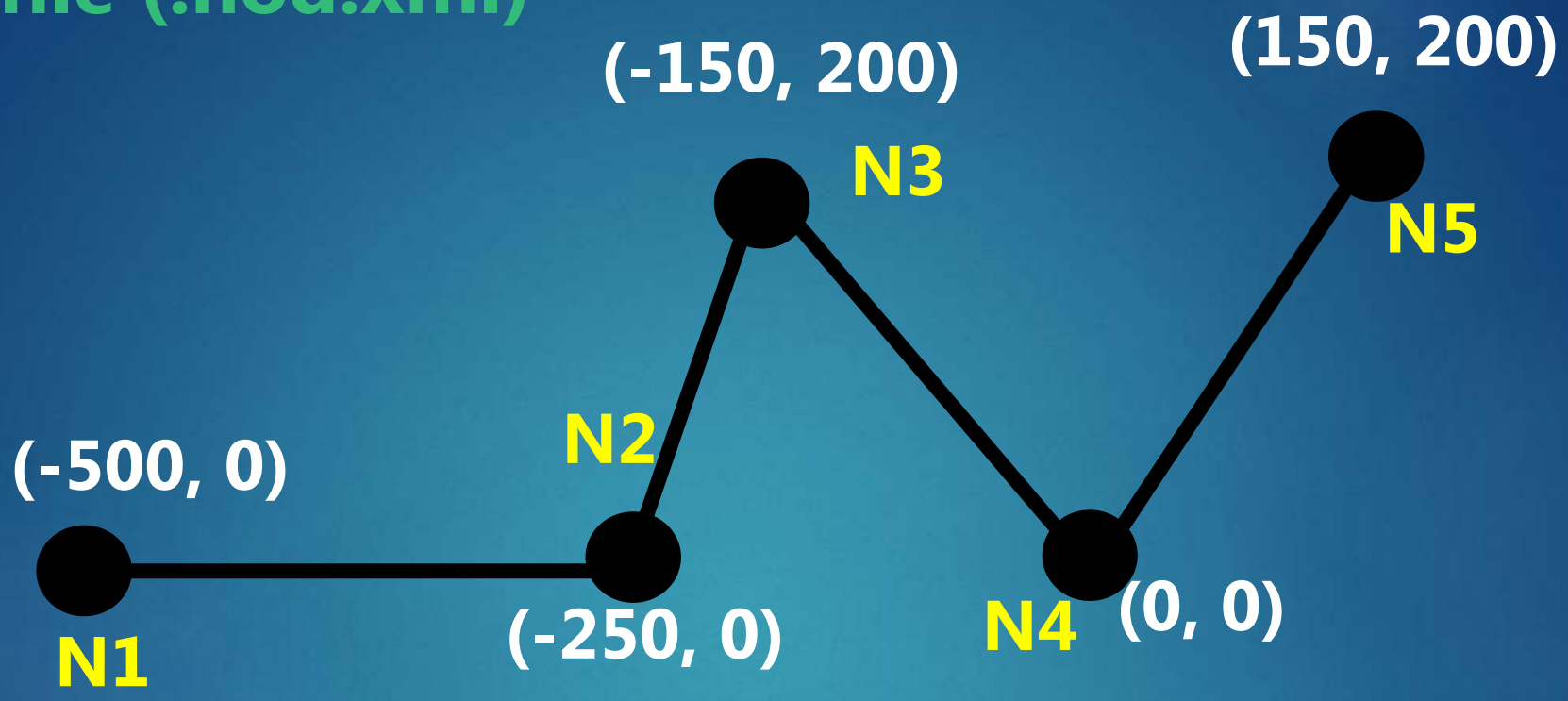
2) Edge file creation (.edg.xml)

3) Edge type file creation (.type.xml)

4) Network creation from the node, edge and type files

5) Route file (.rou.xml)

1) node file (.nod.xml)

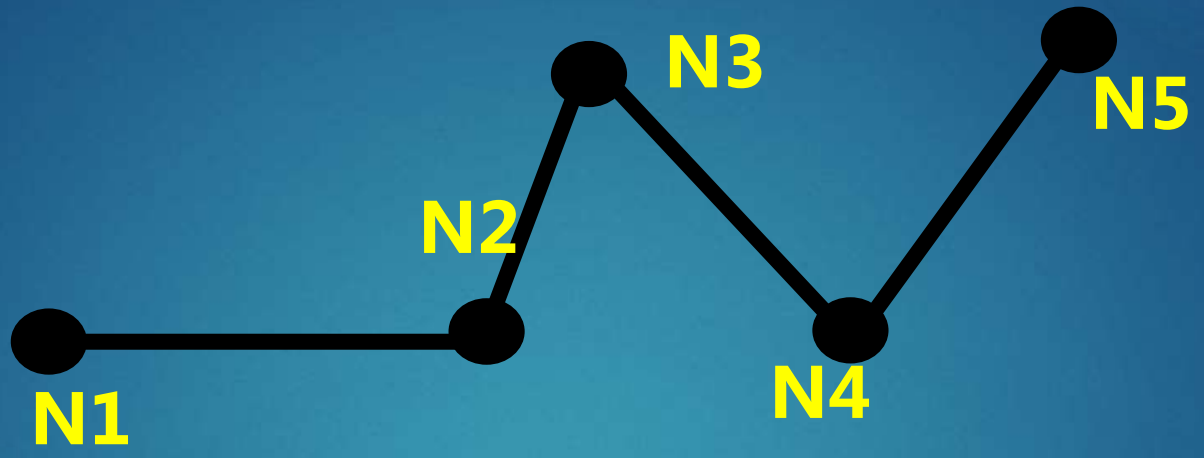



```
<nodes>
<node id="n1" x = "-500" y="0" type="priority"/>
<node id="n2" x = "-250" y="0"  type="traffic_light"/>
<node id="n3" x = "-150" y="200" type="traffic_light"/>
<node id="n4" x ="0" y="0"/>
<node id="n5" x ="150" y="200" />
</nodes>
```

File name: my_nod.**nod.xml**

2) Edge file (.edg.xml) define the connect node together to form links.

Example:




```
<edges>
<edge from="n1" to="n2"  id="1to2" type="3L45"/>
<edge from="n2" to="n3"  id="2to3" type="2L15"/>
<edge from="n3" to="n4"  id="3to4" type="3L30"/>
<edge from="n4" to="n5"  id="out"  type="3L30"/>
</edges>
```

Fine name: my_edge.edg

3) Type file (.type.xml) include road priority, the number of lanes, speed limit, type of vehicles allow, etc.

Example:

```
<types>
<type id=“3L45" priority="3" numLanes="3" speed="45"/>
<type id=“2L15" priority="3" numLanes="2" speed="15"/>
<type id=“3L30" priority="2" numLanes="3" speed="30"/>
</types>
```

Fine name: my_type.type.xml

4) netconvert

my_nodes.nod.xml my_edge.edg.xml my_type.type.xml my_net.net.xml

```
netconvert --node-files my_nodes.nod.xml --edge-files my_edge.edg.xml -t my_type.type.xml -o my_net.net.xml
```

5) Route file (.rou.xml)

```
<routes>
<vType accel="1.0" decel="5.0" id="Car" length="2.0" maxSpeed="100.0" sigma="0.0" />
<vType accel="1.0" decel="5.0" id="Bus" length="12.0" maxSpeed="1.0" sigma="0.0" />

<route id="route0" edges="1to2 2to3"/>
<vehicle depart="10" id="veh0" route="route0" type="Bus" />
<route id="route1" edges="2to3 3to4"/>
<vehicle depart="10" id="veh1" route="route1" type="Car" />
<route id="route2" edges="3to4 out"/>
<vehicle depart="30" id="veh2" route="route2" type="Car" />
</routes>
```

Lastly, the Sumo Configuration file (.sumocfg)

```
<configuration>

<input>
<net-file value="my_net.net.xml"/>
<route-files value="my_route.rou.xml"/>
</input>
<time>
<begin value="0"/>
<end value="2000"/>
</time>

</configuration>
```

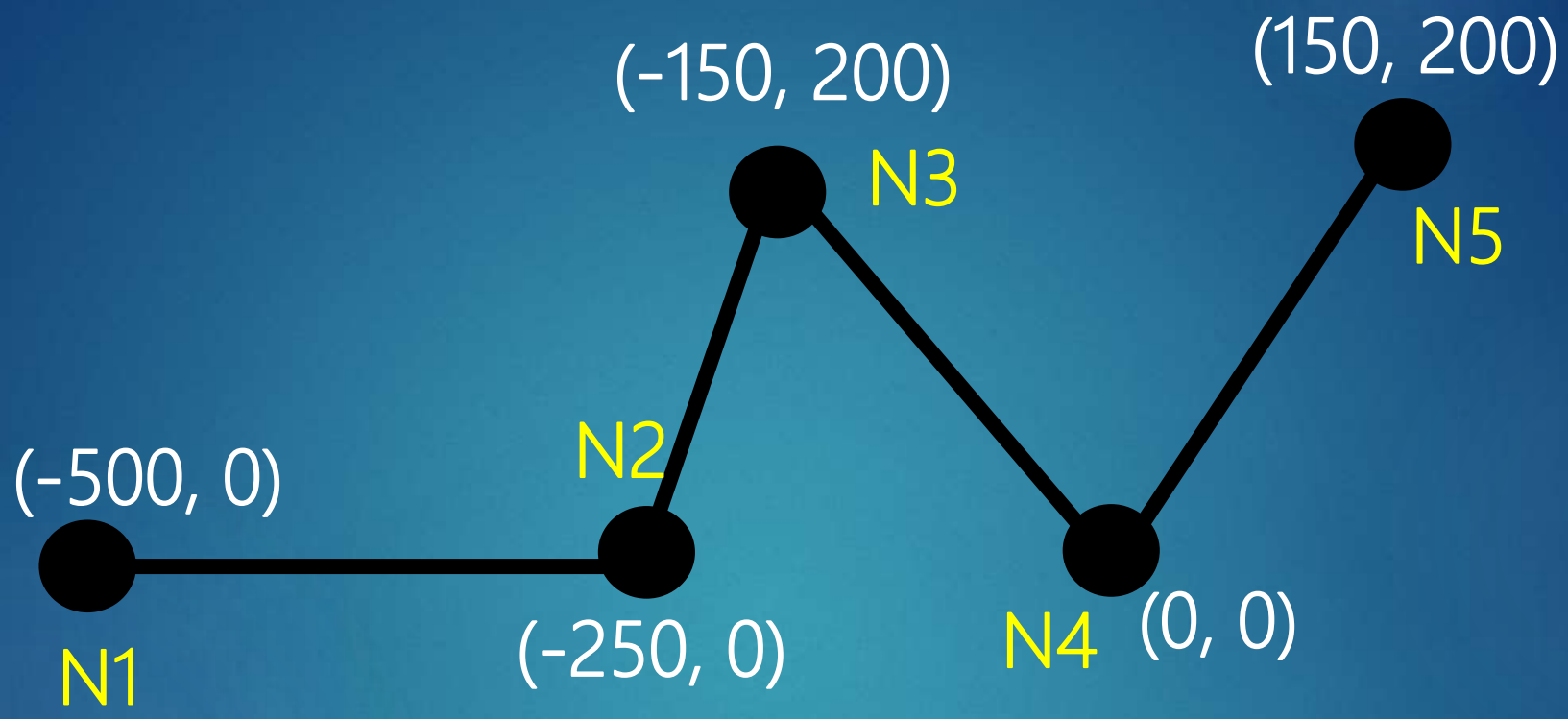
File name: my_config_file

sumo -c my_config_file.sumocfg

Or

sumo-gui -c my_config_file.sumocfg

Part II:
From OSM to Network + Random Trips Simulation



Previously, we manually built this network (nodes, edges), and manually defined the route, the vehicle types and parameters.

But, what if we have a large set of network?

1) Search and Download Open Street Map (OSM)

2) Convert the Map into SUMO Network

netconvert --osm-files map.osm -o test.net.xml

3) Add trip and route to the network using build-in Python scripts **randomTrips.py**

python PATH\randomTrips.py -n test.net.xml -r test.rou.xml -e 50 -l

py PATH\randomTrips.py -n test.net.xml -r test.rou.xml -e 50 -l

5) Setup the configuration file and run the Network

Lastly, the Sumo Configuration file (.sumocfg)

```
<configuration>

<input>
<net-file value="my_net.net.xml"/>
<route-files value="my_route.rou.xml"/>
</input>
<time>
<begin value="0"/>
<end value="2000"/>
</time>

</configuration>
```

File name: my_config_file

"randomTrips.py" generates a set of random trips for a given network (option -n).

By default, it does so by choosing source and destination edge uniformly at random distribution.

The resulting trips are by default stored in an XML file **trips.trips.xml**

The trips are distributed evenly in an interval defined by the beginning time **–b** (default 0) and end time **-e** (default 3600) in seconds.

```
py PATH\randomTrips.py -n test.net.xml -r test.rou.xml -e 50 -l
```

Part III:
Origin-Destination to trip Simulation

Assumption

We assume here we already have our Sumo network ready to be used.

If you don't know how to build a network in Sumo, please watch our two previous tutorials

0) Make/have the **network file** ready (.net.xml)

1) Make the **TAZ** (Traffic analysis zone) file (.xml)

2) Make the **OD** (Origine-Destination) Matrix file (.od)

3) Make the **od2trips.config** file (.xml)

4) Make the **duarouter.config** file (.duarcfg)

Trip Generation, from OD matrix

```
od2trips -c PATH\od2trips.config.xml -n PATH\taz_file.taz.xml -d PATH\OD_file.od -o PATH\od_file.odtrips.xml
```

TAZ_file.taz.xml + OD_file.od + od2trips.config.xml = od_file.odtrips.xml

Route assignment, using DUAROUTER
(shortest length path)

duarouter –c PATH\duarcfg_file.trips2routes.duarcfg – o od_route_file.odtrips.rou.xml

duarcfg_file.trips2routes.duarcfg

```
<configuration>

<input>
<net-file value="network_file.net.xml"/>
<route-files value="od_file.odtrips.xml"/>
</input>

</configuration>
```

network_file.net.xml od_file.odtrips.xml od_route_file.odtrips.rou.xml

The output can be specified either in the xml configuration file, or from the command line

duarouter –c PATH\duarcfg_file.trips2routes.duarcfg ~~– o od_route_file.odtrips.rou.xml~~

duarcfg_file.trips2routes.duarcfg

```
<configuration>

<input>
<net-file value="network_file.net.xml"/>
<route-files value="od_file.odtrips.xml"/>
 </input>
  <output>
  <output-file value="od_route_file.odtrips.rou.xml"/>
 </output>

</configuration>
```

network_file.net.xml od_file.odtrips.xml od_route_file.odtrips.rou.xml

Recap

```
od2trips -c PATH\od2trips.config.xml -n PATH\taz_file.taz.xml -d PATH\OD_file.od -o PATH\od_file.odtrips.xml
```

```
duarouter –c PATH\duarcfg_file.trips2routes.duarcfg
```

By default, duarouter calculates the shortest length path for each trip.

Traffic Assignment Zone (TAZ) definition

1

```
<additional>

<tazs>

   <taz id="1" edges="put_your_taz_edge_id_here">
   </taz>
   <taz id="2" edges="put_your_taz_edge_id_here">
   </taz>
   <taz id="3" edges="put_your_taz_edge_id_here">
   </taz>
   <taz id="4" edges="put_your_taz_edge_id_here">
   </taz>
   <taz id="5" edges="put_your_taz_edge_id_here">

</taz>

</tazs>

</additional>
```

File name: TAZ_file.taz.xml

2

Origin-Destination Matrix

```
$O;D2
* From-Time  To-Time
0.00 1.00
* Factor
1.00
*
* some
* additional
* comments
        1         3         10
        4         2         10
```

File name: OD_file.od

3

Trips generation

```
<configuration>
    <input>
        <taz-files value="taz_file.taz.xml"/>
        <od-matrix-files value="OD_file.od"/>
    </input>

        <!--
    <output>
        <output-file value="od_file.odtrips.xml"/>
    </output>
        -->
</configuration>
```

File name: od2trips.config.xml

Route assignment

4

```
<configuration>

<!-- The duarouter configuration file takes as input your network and the OD Trips File and output the route file -->

<input>
 <net-file value="my_net.net.xml"/>          <!-- Your SUMO Network File -->
<route-files value="od_file.odtrips.xml"/> <!-- Your SUMO OD Trips File -->
</input>

<output>
<output-file value="od_route_file.odtrips.rou.xml"/>
</output>

 <report>
 <xml-validation value="never"/>
<no-step-log value="true"/>
</report>

</configuration>
```

File name: duarcfg_file.trips2routes.duarcfg

5

The Sumo Configuration file (.sumocfg)

```
<configuration>

<input>
<net-file value="my_net.net.xml"/>
<route-files value="od_route_file.odtrips.rou.xml"/>
</input>
<time>
<begin value="0"/>
<end value="2000"/>
</time>

</configuration>
```

File name: config_file.sumocfg

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Your Network