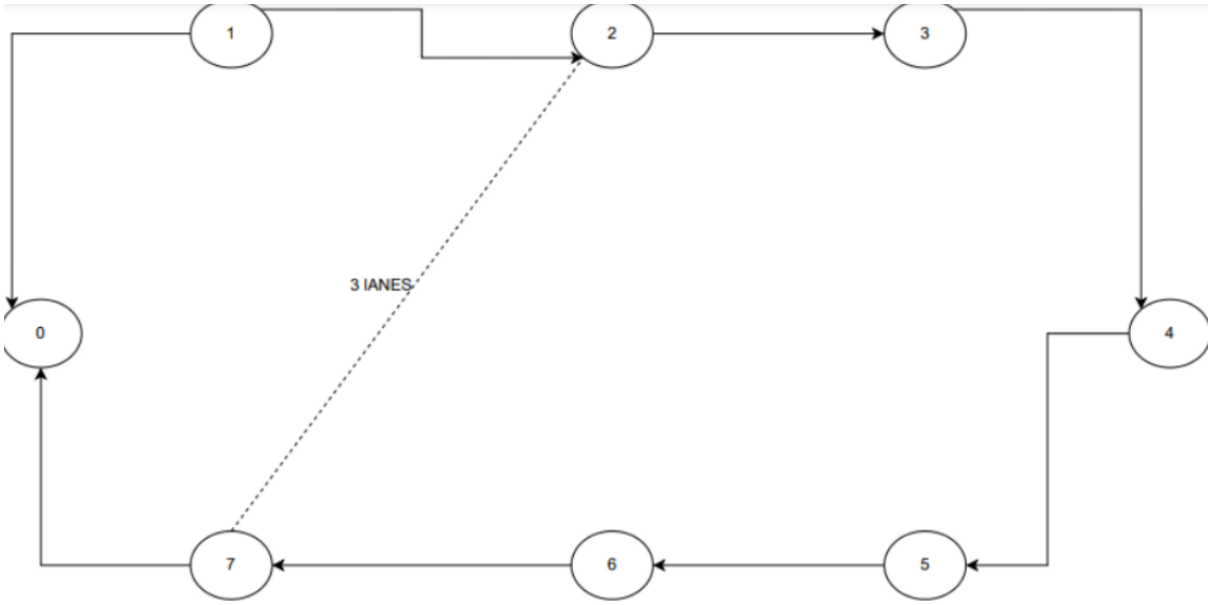
Lab 9: CPS Design For Analysing The Air Pollution Gases In Custom Defined Roads

Q. Design the following road structure with 8 junctions and each junction to other junctions there will be two lanes and between 7 and 2, there will be 3 lanes. Design a CPS system for Air pollution monitoring in all the roads and compute the lane that has highest concentration of carbon Monoxide and Hydrocarbons. The Simulation time for the system is 200 seconds. Compare the average CO and HC when the simulation time is 100 seconds.



OUTPUT:

File.node.xml:

Open | file.node.xml ~/Customroad | Save

```
<nodes>
<!--  The opening tag  -->
<node id="0" x="-500.0" y="+250.0" type="priority"/>
<!--  def. of node "0"  -->
<node id="1" x="-250.0" y="+500.0" type="priority"/>
<!--  def. of node "1"  -->
<node id="2" x="0.0" y="+500.0" type="traffic_light"/>
<!--  def. of node "2"  -->
<node id="3" x="+250.0" y="+500.0" type="priority"/>
<!--  def. of node "3"  -->
<node id="4" x="+500.0" y="+250.0" type="priority"/>
<!--  def. of node "4"  -->
<node id="5" x="+250.0" y="0.0" type="priority"/>
<!--  def. of node "5"  -->
<node id="6" x="0.0" y="0.0" type="priority"/>
<!--  def. of node "6"  -->
<node id="7" x="-250.0" y="0.0" type="traffic_light"/>
<!--  def. of node "7"  -->
</nodes>
<!--  The closing tag  -->
```

File.edge.xml:

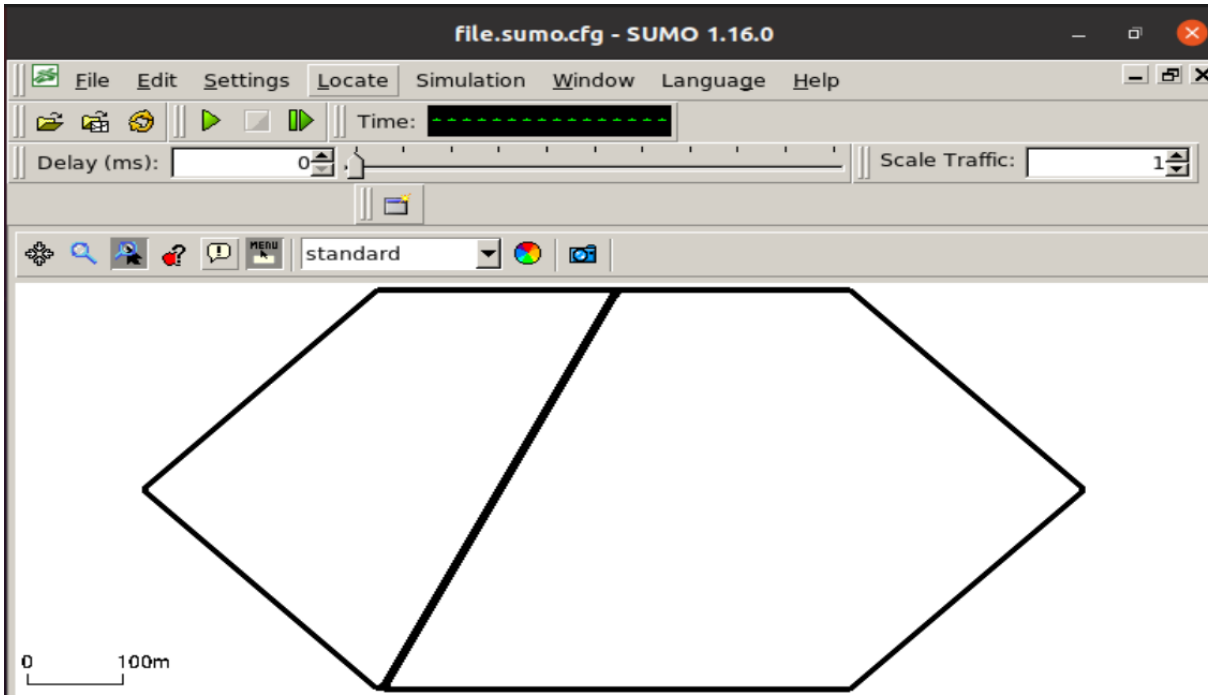
Open | file.edge.xml ~/Customroad | Save

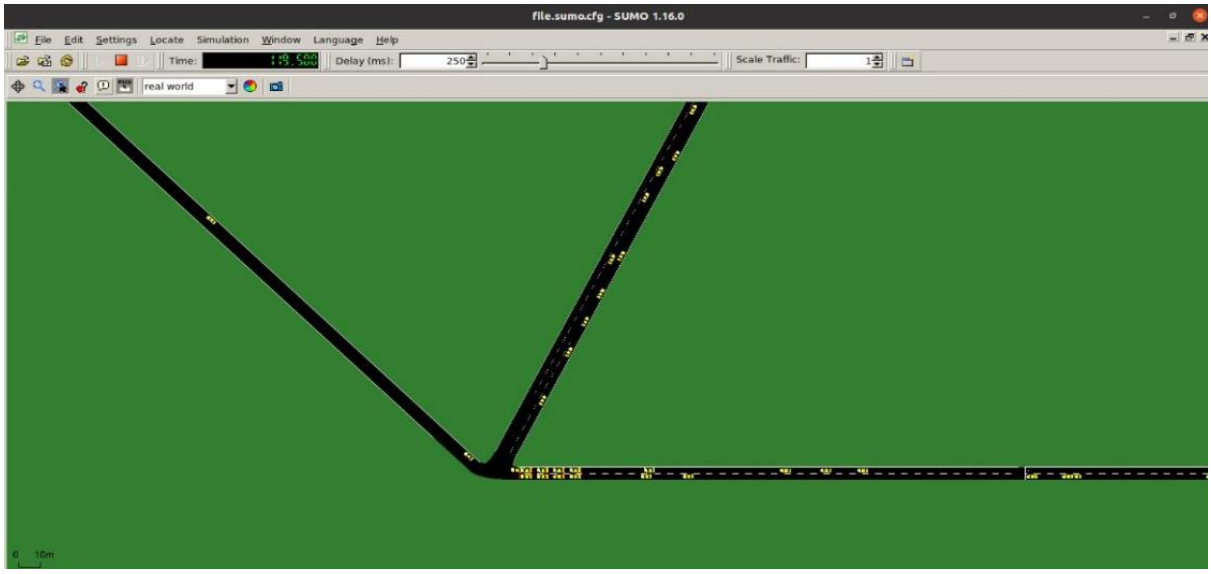
```
<edges>
<edge id="u01" from="0" to="1" priority="2" numLanes="2" speed="11.11"/>
<edge id="u12" from="1" to="2" priority="2" numLanes="2" speed="13.89"/>
<edge id="u23" from="2" to="3" priority="2" numLanes="2" speed="11.11"/>
<edge id="u34" from="3" to="4" priority="2" numLanes="2" speed="11.11"/>
<edge id="u45" from="4" to="5" priority="2" numLanes="2" speed="13.89"/>
<edge id="u56" from="5" to="6" priority="2" numLanes="2" speed="11.11"/>
<edge id="u67" from="6" to="7" priority="2" numLanes="2" speed="11.11"/>
<edge id="u70" from="7" to="0" priority="2" numLanes="2" speed="13.89"/>
<edge id="u72" from="7" to="2" priority="1" numLanes="3" speed="11.11"/>
<edge id="d01" from="0" to="1" priority="2" numLanes="2" speed="11.11"/>
<edge id="d12" from="1" to="2" priority="2" numLanes="2" speed="13.89"/>
<edge id="d23" from="2" to="3" priority="2" numLanes="2" speed="11.11"/>
<edge id="d34" from="3" to="4" priority="2" numLanes="2" speed="11.11"/>
<edge id="d45" from="4" to="5" priority="2" numLanes="2" speed="13.89"/>
<edge id="d56" from="5" to="6" priority="2" numLanes="2" speed="11.11"/>
<edge id="d67" from="6" to="7" priority="2" numLanes="2" speed="11.11"/>
<edge id="d70" from="7" to="0" priority="2" numLanes="2" speed="13.89"/>
<edge id="d72" from="7" to="2" priority="1" numLanes="3" speed="11.11"/>
<edge id="m72" from="7" to="2" priority="1" numLanes="3" speed="11.11"/>
</edges>
```

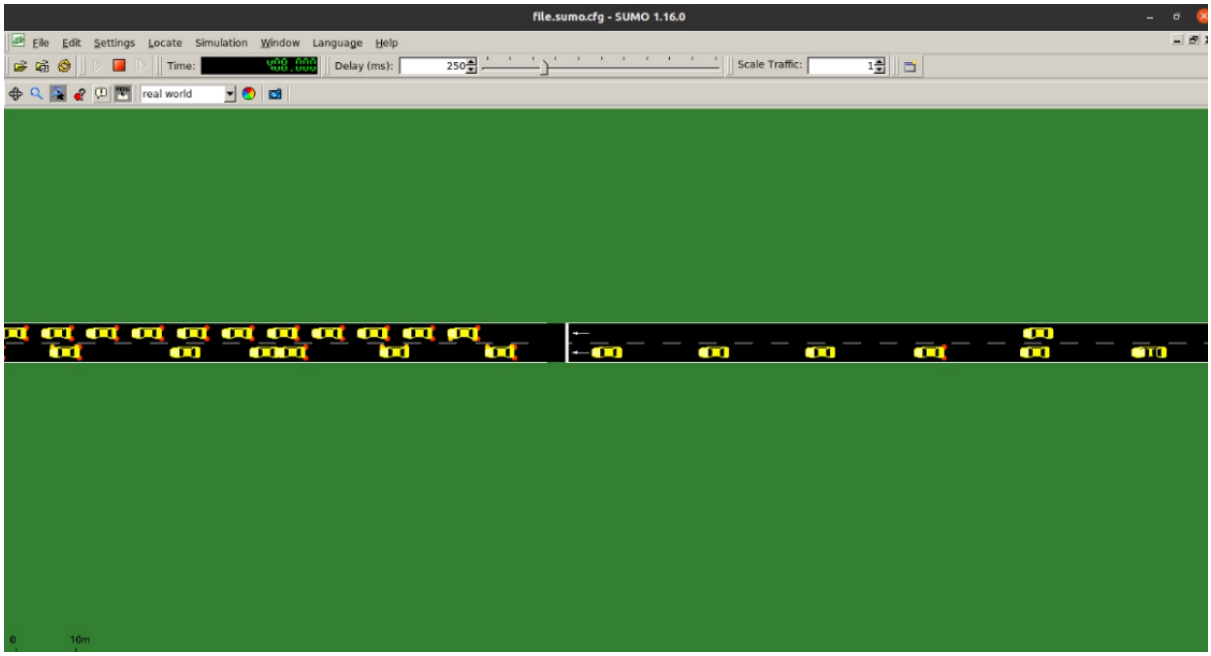
File.sumo.cfg:(200 seconds)

Open | file.sumo.cfg ~/Customroad

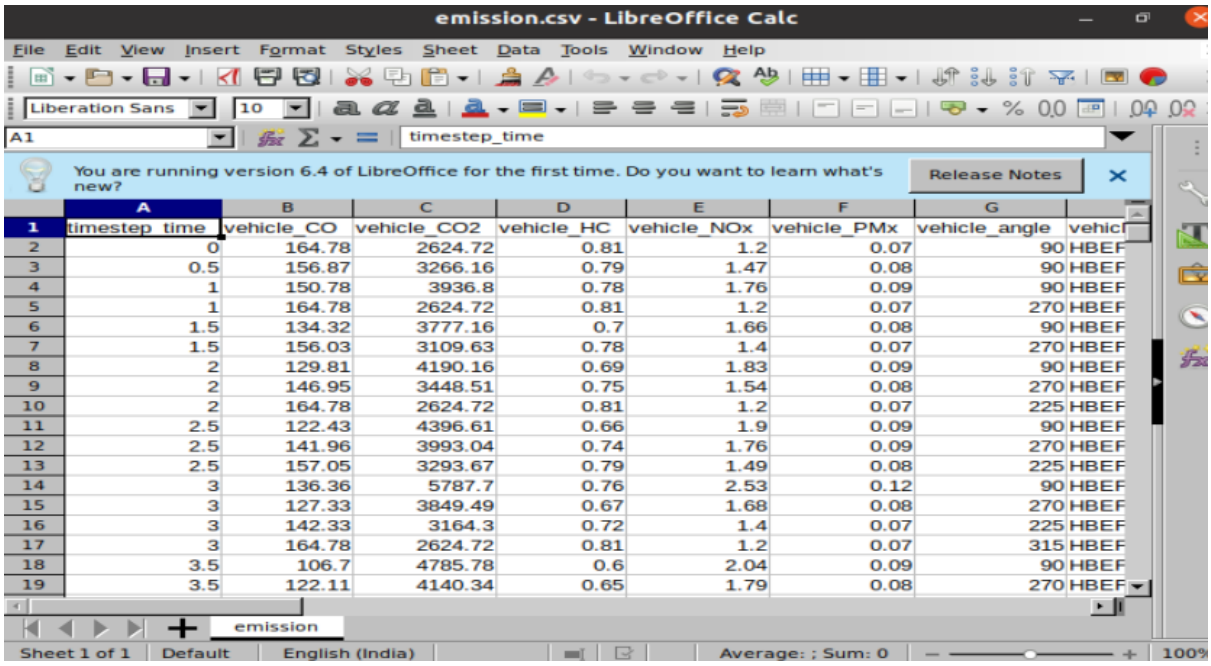
```
<configuration>

<input>

<net-file value="file.net.xml"/>

<route-files value="file.rou.xml"/>

</input>

<time>

<begin value="0"/>

<end value="200"/>

<step-length value="0.5"/>

</time>

 </configuration>
```


file.sumo.cfg - SUMO 1.16.0
File Edit Settings Locate Simulation Window Language Help
Time:
Delay (ms):
0
Scale Traffic:
1
standard
0
100m


file.sumo.cfg - SUMO 1.16.0
File Edit Settings Locate Simulation Window Language Help
Time:
Delay (ms):
250
Scale Traffic:
1
real world



Emission.csv:



	A	B	C	D	E	F	G	
1	timestep_time	vehicle_CO	vehicle_CO2	vehicle_HC	vehicle_NOx	vehicle_PMx	vehicle_angle	vehicl
2	0	164.78	2624.72	0.81	1.2	0.07	90	HBEF
3	0.5	156.87	3266.16	0.79	1.47	0.08	90	HBEF
4	1	150.78	3936.8	0.78	1.76	0.09	90	HBEF
5	1	164.78	2624.72	0.81	1.2	0.07	270	HBEF
6	1.5	134.32	3777.16	0.7	1.66	0.08	90	HBEF
7	1.5	156.03	3109.63	0.78	1.4	0.07	270	HBEF
8	2	129.81	4190.16	0.69	1.83	0.09	90	HBEF
9	2	146.95	3448.51	0.75	1.54	0.08	270	HBEF
10	2	164.78	2624.72	0.81	1.2	0.07	225	HBEF
11	2.5	122.43	4396.61	0.66	1.9	0.09	90	HBEF
12	2.5	141.96	3993.04	0.74	1.76	0.09	270	HBEF
13	2.5	157.05	3293.67	0.79	1.49	0.08	225	HBEF
14	3	136.36	5787.7	0.76	2.53	0.12	90	HBEF
15	3	127.33	3849.49	0.67	1.68	0.08	270	HBEF
16	3	142.33	3164.3	0.72	1.4	0.07	225	HBEF
17	3	164.78	2624.72	0.81	1.2	0.07	315	HBEF
18	3.5	106.7	4785.78	0.6	2.04	0.09	90	HBEF
19	3.5	122.11	4140.34	0.65	1.79	0.08	270	HBEF

File.sumo.cfg(100 seconds):

Open file.sumo.cfg ~/Customroad

```
<configuration>

<input>

<net-file value="file.net.xml"/>

<route-files value="file.rou.xml"/>

</input>

<time>

<begin value="0"/>

<end value="100"/>

<step-length value="0.5"/>

</time>

 </configuration>
```

Emission1.csv:

emission1.csv - LibreOffice Calc

File Edit View Insert Format Styles Sheet Data Tools Window Help

Liberation Sans 10

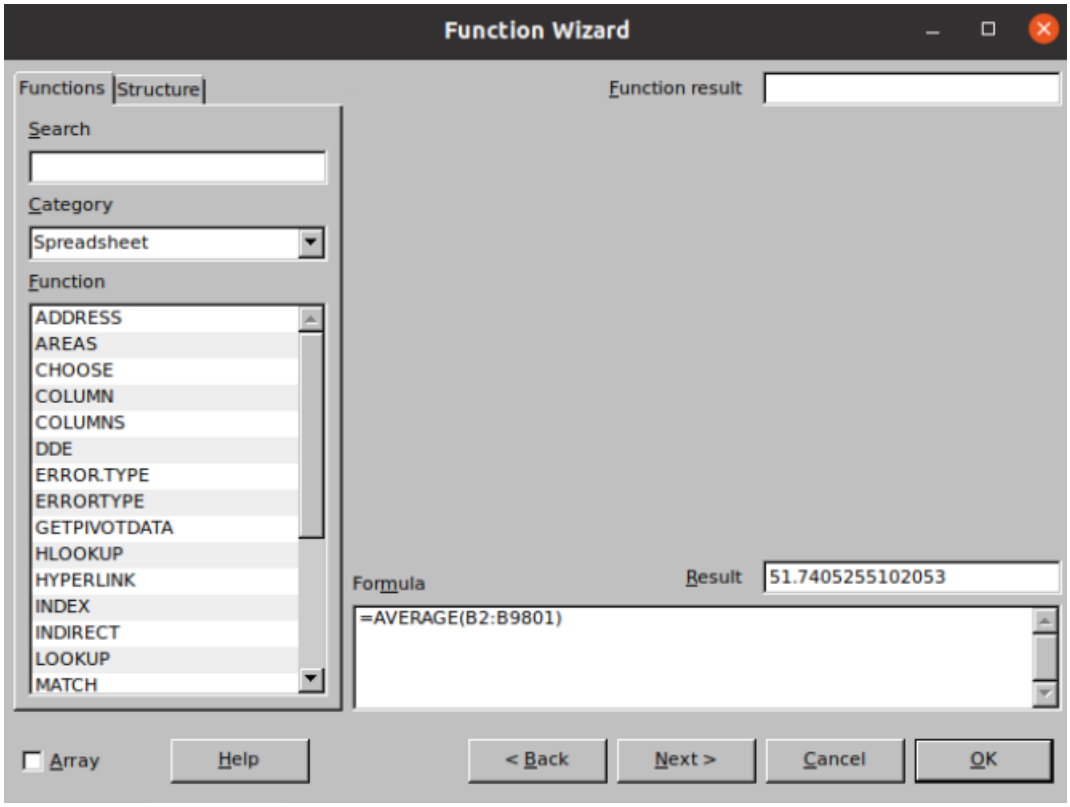
A1 timestep_time

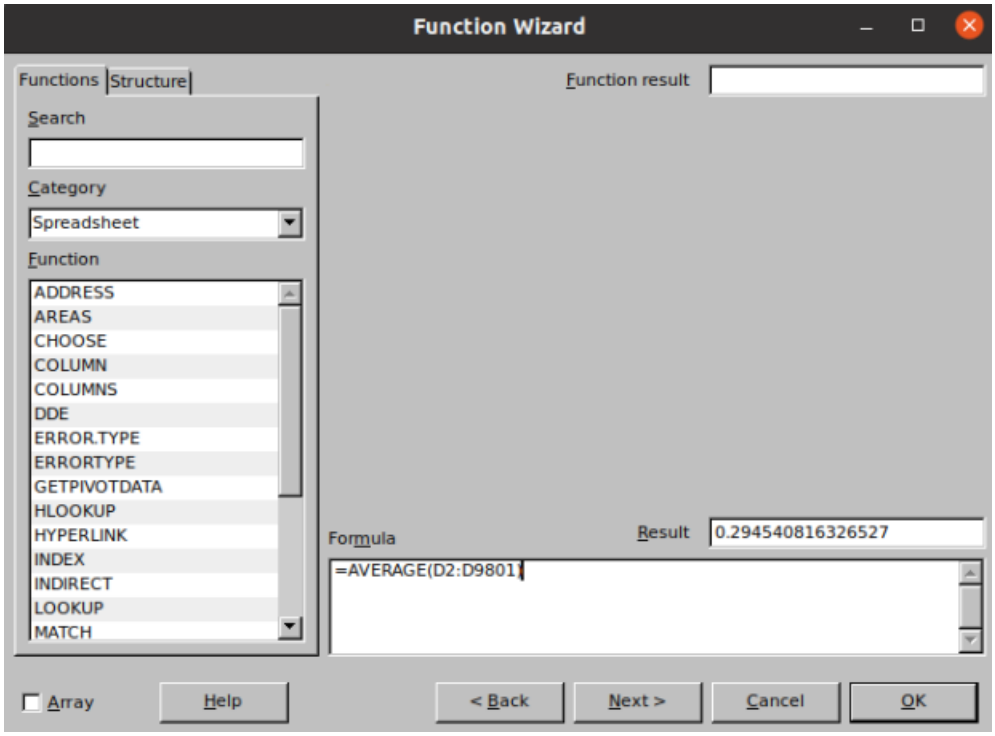
	A	B	C	D	E	F	G	
1	timestep_time	vehicle_CO	vehicle_CO2	vehicle_HC	vehicle_NOx	vehicle_PMx	vehicle_angle	vehicl
2	0	164.78	2624.72	0.81	1.2	0.07	90	HBEF
3	0.5	156.87	3266.16	0.79	1.47	0.08	90	HBEF
4	1	150.78	3936.8	0.78	1.76	0.09	90	HBEF
5	1	164.78	2624.72	0.81	1.2	0.07	270	HBEF
6	1.5	134.32	3777.16	0.7	1.66	0.08	90	HBEF
7	1.5	156.03	3109.63	0.78	1.4	0.07	270	HBEF
8	2	129.81	4190.16	0.69	1.83	0.09	90	HBEF
9	2	146.95	3448.51	0.75	1.54	0.08	270	HBEF
10	2	164.78	2624.72	0.81	1.2	0.07	225	HBEF
11	2.5	122.43	4396.61	0.66	1.9	0.09	90	HBEF
12	2.5	141.96	3993.04	0.74	1.76	0.09	270	HBEF
13	2.5	157.05	3293.67	0.79	1.49	0.08	225	HBEF
14	3	136.36	5787.7	0.76	2.53	0.12	90	HBEF
15	3	127.33	3849.49	0.67	1.68	0.08	270	HBEF
16	3	142.33	3164.3	0.72	1.4	0.07	225	HBEF
17	3	164.78	2624.72	0.81	1.2	0.07	315	HBEF
18	3.5	106.7	4785.78	0.6	2.04	0.09	90	HBEF
19	3.5	122.11	4140.34	0.65	1.79	0.08	270	HBEF
20	3.5	147.31	4321.06	0.77	1.92	0.09	225	HBEF
21	3.5	156.33	3173.52	0.79	1.43	0.07	315	HBEF

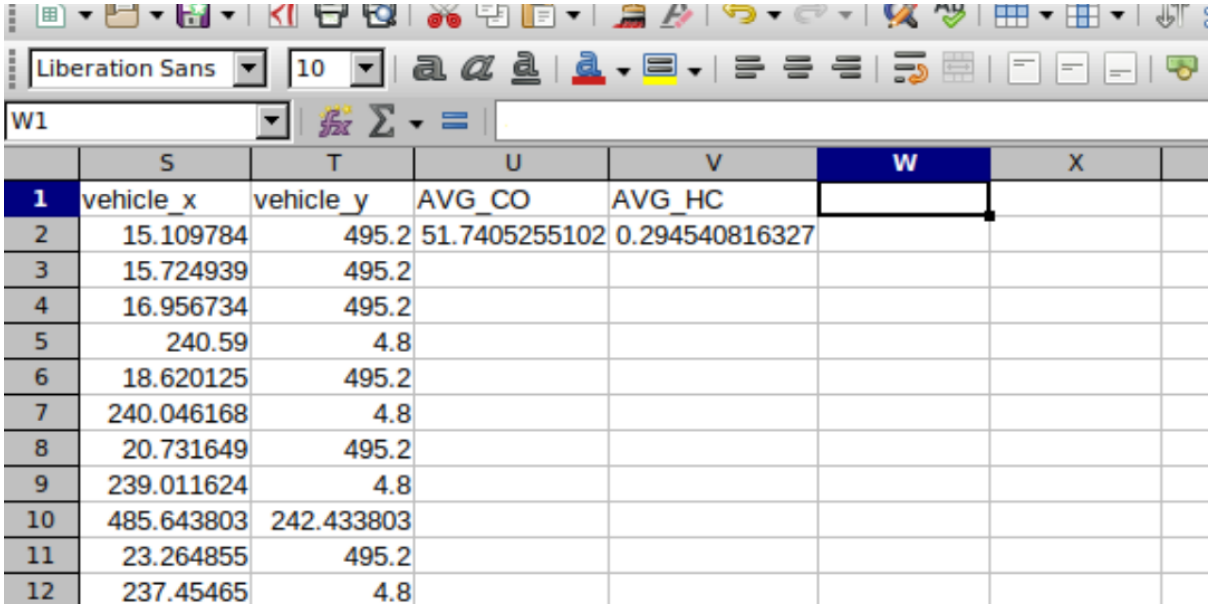
emission1

Sheet 1 of 1 Default English (India) Average: ; Sum: 0 100%

Comparing the average CO and HC when the simulation time is 100 seconds:







	S	T	U	V	W	X
1	vehicle_x	vehicle_y	AVG_CO	AVG_HC		
2	15.109784	495.2	51.7405255102	0.294540816327		
3	15.724939	495.2				
4	16.956734	495.2				
5	240.59	4.8				
6	18.620125	495.2				
7	240.046168	4.8				
8	20.731649	495.2				
9	239.011624	4.8				
10	485.643803	242.433803				
11	23.264855	495.2				
12	237.45465	4.8				