

SVL Simulation

Deliverable #2B

Project Assignment – AV Test Project

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May 9, 2022

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Section 1: Table #1: Test plan #1
Section 2: AV-01 Traffic Light Test
Section 3: Table #3: Test scenario #1

Prit Lakhani

Section 1: Table #6: Test plan #2
Section 2: AV-02 End-to-End Navigation Test
Section 3: Table #9: Test scenario #4

Huyen Nguyen:

Section 1: Table #12: Test plan #3
Section 2: AV-03 Collision and Emergency Braking Test
Section 3: Table #14: Test scenario #3

Richard Ngo

Section 1: Table #17: Test plan #4
Section 2: AV-04 Encounter a blocked route
Section 3: Table #19: Test scenario #4

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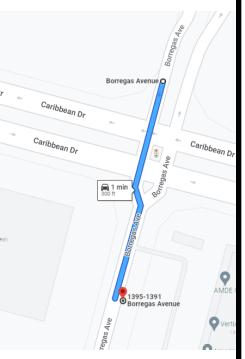
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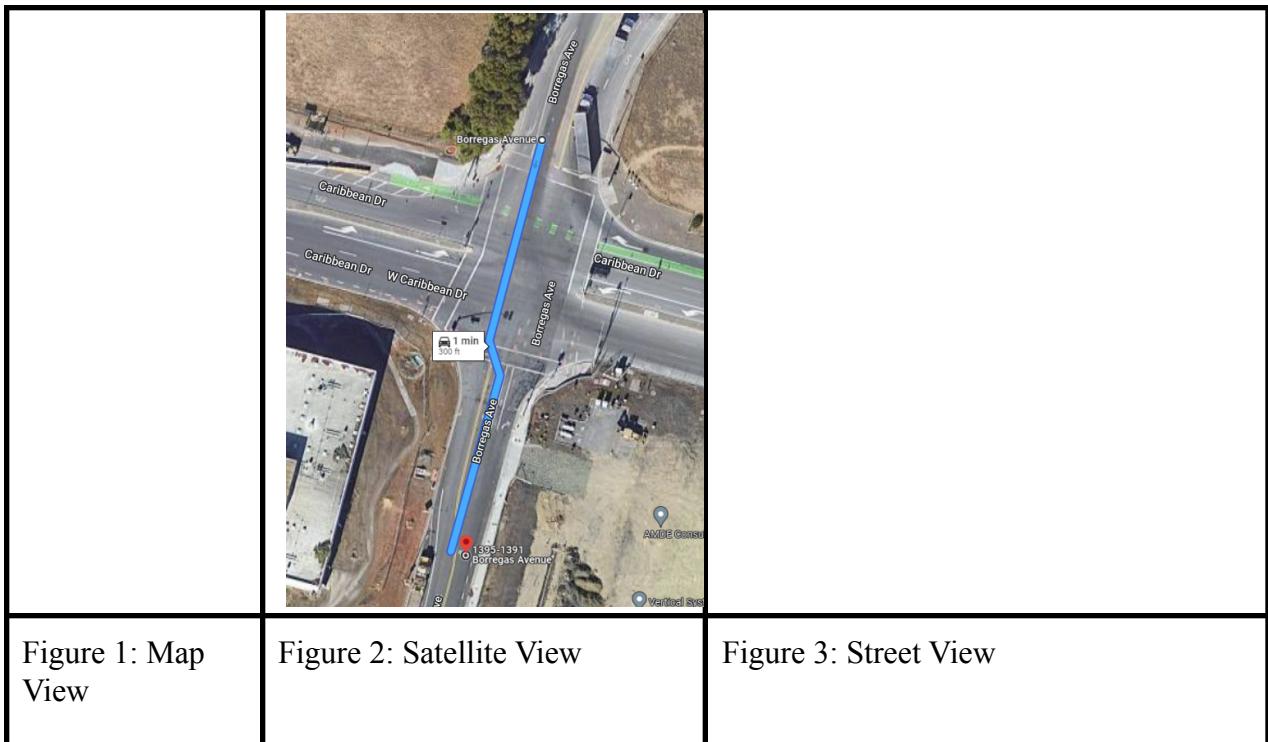
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Test Scenario-1: Traffic Light Test

Section 1 – AI Function Test Requirement Analysis

Section 1.1 - AI function test requirements

Table 1: Test Plan #1	
ID	AV Test-01
Creator	Sudha Vijayakumar
Date	Apr 22, 2022
Scenario Type	Drive across the traffic light intersection
Location	<p>Starting point: 1400 Borregas Ave, Sunnyvale, CA 94089 Destination: 1395 Borregas Ave, Sunnyvale CA 94089</p>
Route	<p>Total Distance: 305 ft Travel time: 1 min</p> <p>Directions 305 ft → Head south on Borregas Ave toward Caribbean Dr</p>
Map	Sunnyvale, CA
	 



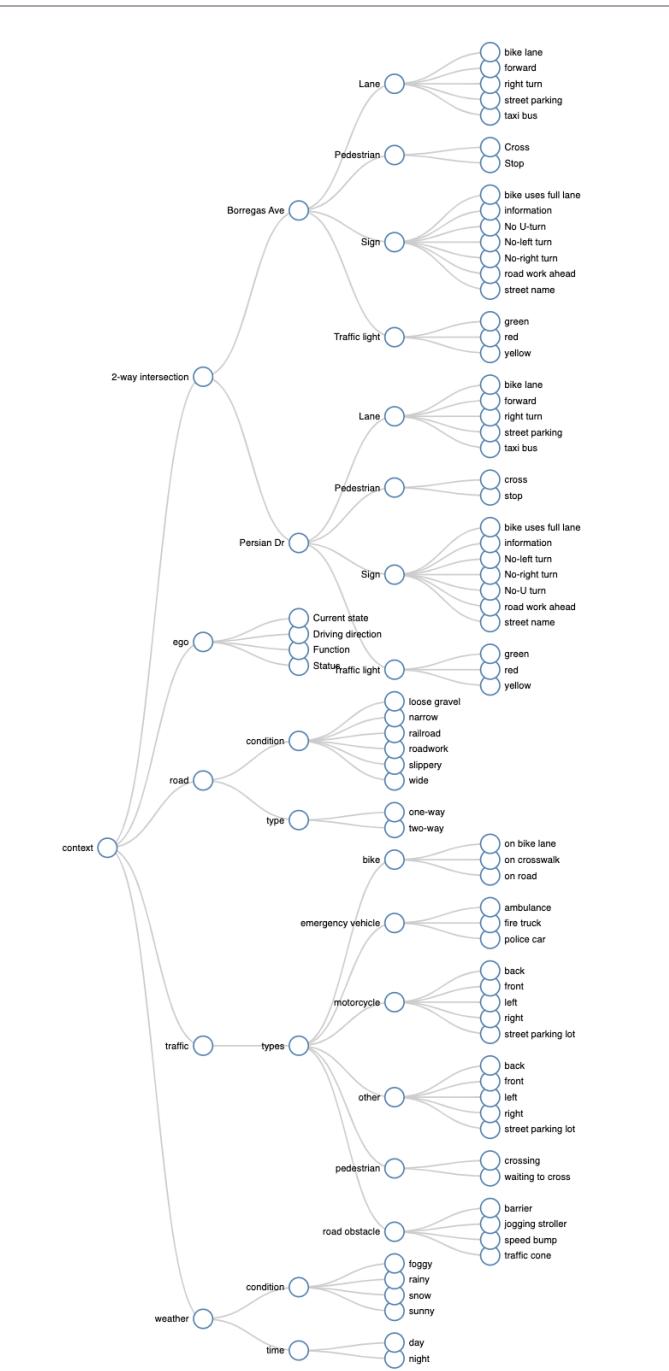
Section 1.2 - AI function test requirements modeling

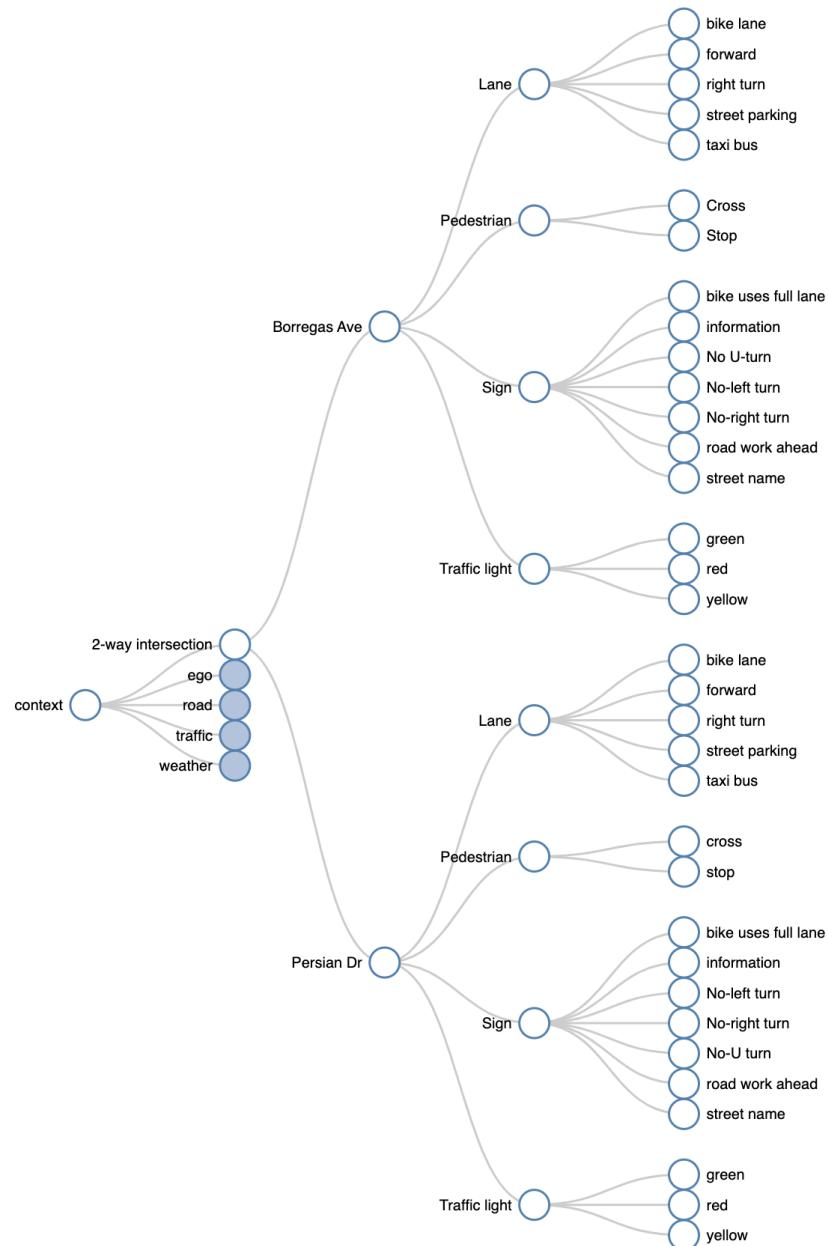
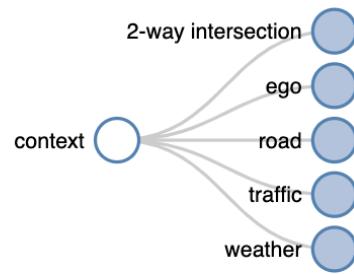
Table 1: Test Scenario #1	
ID	AV Test-01
Creator	Sudha Vijayakumar
Date	Apr 22, 2022
Scenario Type	Drive across the traffic light intersection
Location	<p>Starting point: 1400 Borregas Ave, Sunnyvale, CA 94089</p> <p>Destination: 1395 Borregas Ave, Sunnyvale CA 94089</p>

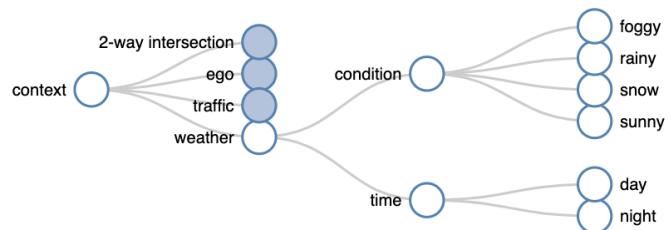
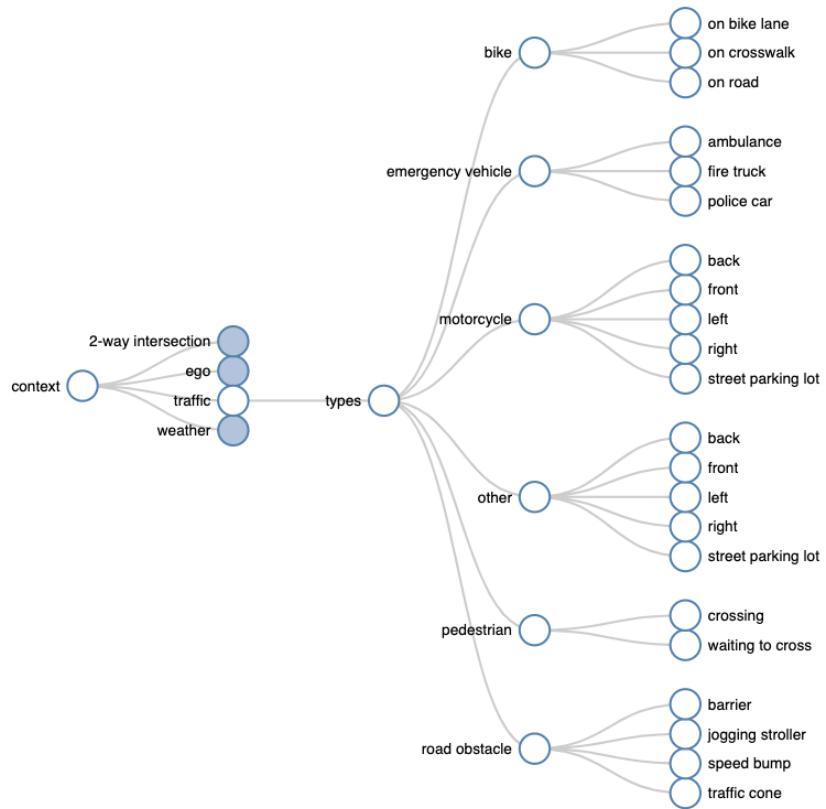
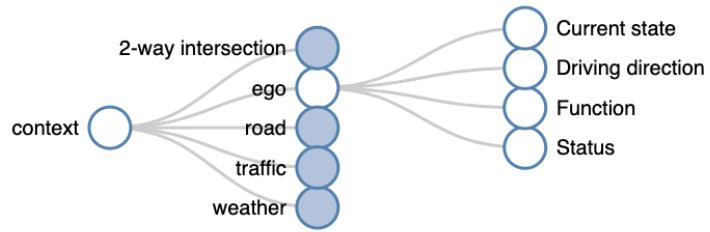
Route	Total Distance: 305 ft Travel time: 1 min Directions 305 ft → Head south on Borregas Ave toward Caribbean Dr				
Agent Configurations					
Vehicle Speed	Weather	# of other Vehicles	Other Vehicles Position	# of Pedestrians	
0mph - 45 mph	Morning with clear sunny weather	0 - 7 vehicles	Randomly generated	0	
Scenario Description	<ul style="list-style-type: none"> The vehicle is modeled to be driving from south bound from 1444 Borregas Ave, Sunnyvale, CA 94089 across Caribbean Dr. 				
Test Purpose	This is to test the AV ability to pass a basic driving skill.				
Initial Conditions	<ul style="list-style-type: none"> The time is in the morning with clear sunny weather. The vehicle is modeled to drive across the intersection of Borregas and Caribbean. The vehicle will need to obey the traffic signal. The vehicle needs to access all bounds and make a full stop before continuing. 				
Evaluation Metrics	<ul style="list-style-type: none"> AV proceeds as normal when seeing a green traffic light. 				
Event	Expected Response				
Traffic light is working properly and is green.	Continue to pass the intersection 1300 Borregas Ave, Sunnyvale, CA 94089 Sunnyvale Water Pollution Control Plant				

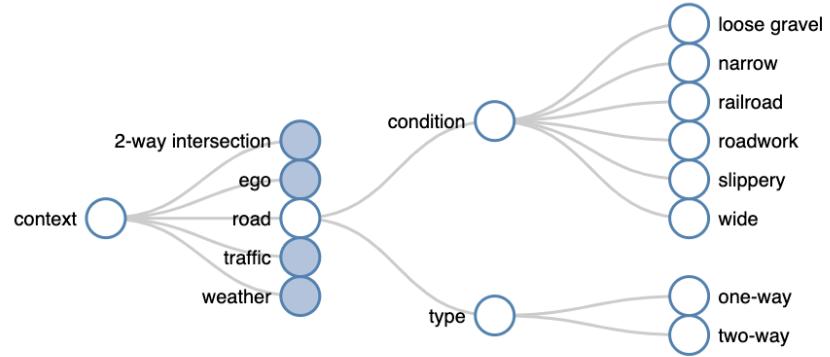
Section 2 – AI Test Modeling for Selected AI Features

Section 2.1 Context modeling for each selected AI-powered function/feature

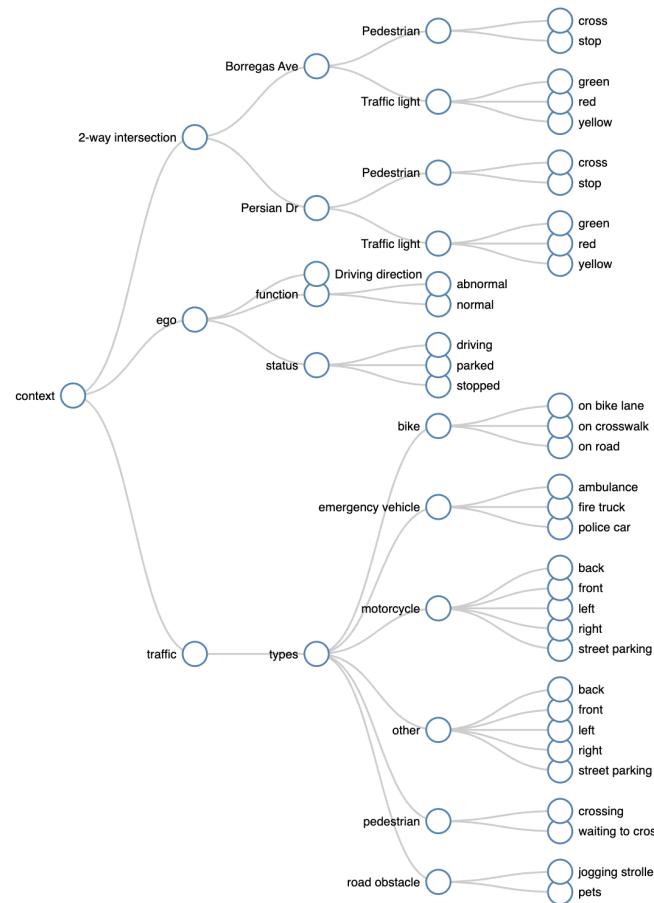




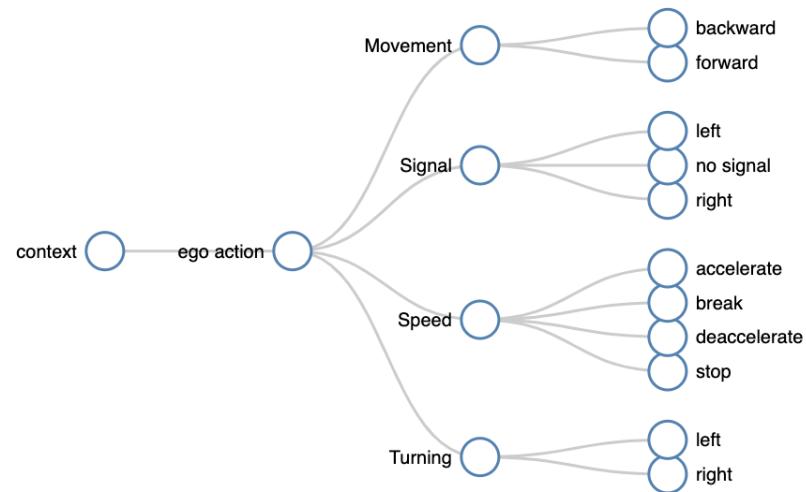




Section 2.2. AI-powered function input classifications



Section 2.3. AI-powered function output/event/action classifications



Section 2.4. AI-powered function classification decision tables

The table structure is as follows:

	id	weather	traffic	road	ego	info
1	1	condition	types	condition	Current state	Bay
2	2	condition	types	condition	Current state	Bay
3	3	condition	types	condition	Driving direction	Bay
4	4	condition	types	condition	Driving direction	Bay
5	5	condition	types	condition	Function	Bay
6	6	condition	types	condition	Function	Bay
7	7	condition	types	condition	Status	Bay

	id	traffic	ego	status	2-way intersection
1	1	types	Driving direction	Borregas Ave	2-way intersection
2	2	types	Driving direction	Persian Dr	2-way intersection
3	3	types	function	Borregas Ave	traffic
4	4	types	function	Persian Dr	ego
5	5	types	status	Borregas Ave	2-way intersection
6	6	types	status	Persian Dr	2-way intersection

Keywords:

- weather
- traffic
- road
- ego
- 2-way intersection
- traffic
- ego
- 2-way intersection

Section 2.4.1 Context Decision Table

Table #3

id	weather	traffic	road	ego	2-way intersection
1	condition	types	condition	Current state	Borregas Ave
2	condition	types	condition	Current state	Persian Dr
3	condition	types	condition	Driving direction	Borregas Ave
4	condition	types	condition	Driving direction	Persian Dr
5	condition	types	condition	Function	Borregas Ave
6	condition	types	condition	Function	Persian Dr
7	condition	types	condition	Status	Borregas Ave
8	condition	types	condition	Status	Persian Dr
9	condition	types	type	Current state	Borregas Ave
10	condition	types	type	Current state	Persian Dr
11	condition	types	type	Driving direction	Borregas Ave
12	condition	types	type	Driving direction	Persian Dr
13	condition	types	type	Function	Borregas Ave
14	condition	types	type	Function	Persian Dr
15	condition	types	type	Status	Borregas Ave
16	condition	types	type	Status	Persian Dr
17	time	types	condition	Current state	Borregas Ave
18	time	types	condition	Current state	Persian Dr
19	time	types	condition	Driving direction	Borregas Ave
20	time	types	condition	Driving direction	Persian Dr
21	time	types	condition	Function	Borregas Ave
22	time	types	condition	Function	Persian Dr
23	time	types	condition	Status	Borregas Ave
24	time	types	condition	Status	Persian Dr
25	time	types	type	Current state	Borregas Ave
26	time	types	type	Current state	Persian Dr
27	time	types	type	Driving direction	Borregas Ave
28	time	types	type	Driving direction	Persian Dr
29	time	types	type	Function	Borregas Ave
30	time	types	type	Function	Persian Dr
31	time	types	type	Status	Borregas Ave
32	time	types	type	Status	Persian Dr

Section 2.4.2 Input Decision Table

Table #4

id	traffic	ego	2-way intersection
1	types	Driving direction	Borregas Ave
2	types	Driving direction	Persian Dr
3	types	function	Borregas Ave
4	types	function	Persian Dr
5	types	status	Borregas Ave
6	types	status	Persian Dr

Section 2.4.3 Output Decision Table

Table #5

id	keywords
1	weather
2	traffic
3	road
4	ego
5	2-way intersection
6	traffic
7	ego
8	2-way intersection

Section 3 – AI Function Test Cases with Inputs/Expected Outputs

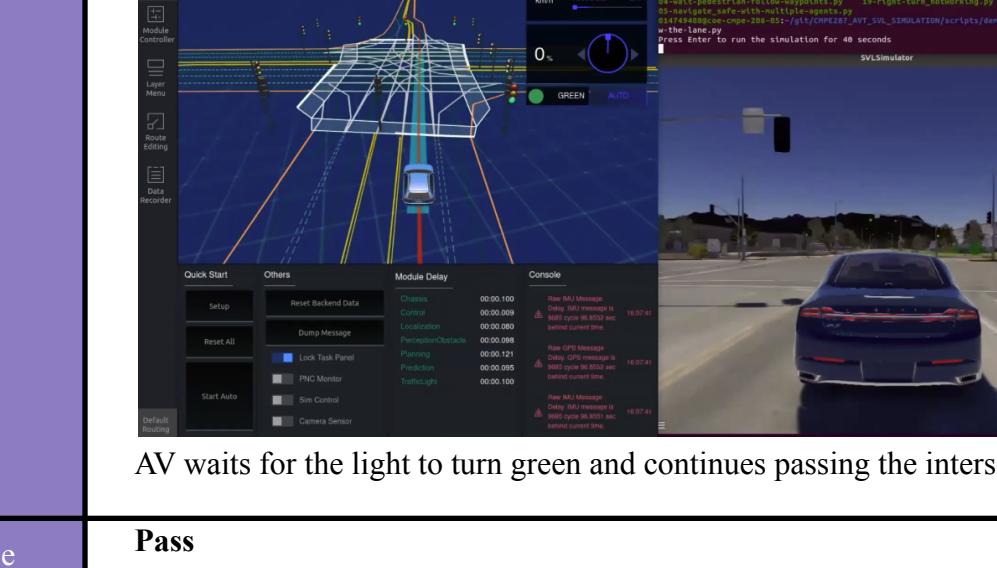
Section 3.1 Test data model



Section 3.2 Test case report

Table 1: Test Scenario #1	
ID	AV Test-01
Creator	Sudha Vijayakumar
Date	Apr 22, 2022
Scenario Type	Drive across the traffic light intersection

Location	<p>Starting point: 1400 Borregas Ave, Sunnyvale, CA 94089 Destination: 1395 Borregas Ave, Sunnyvale CA 94089</p>			
Route	<p>Total Distance: 305 ft Travel time: 1 min</p> <p>Directions 305 ft → Head south on Borregas Ave toward Caribbean Dr</p>			
Agent Configurations				
Vehicle Speed	Weather	# of other Vehicles	Other Vehicles Position	# of Pedestrians
0mph - 45 mph	Morning with clear sunny weather	0 - 7 vehicles	Randomly generated	0
Scenario Description	<ul style="list-style-type: none"> The vehicle is modeled to be driving from south bound from 1444 Borregas Ave, Sunnyvale, CA 94089 across Caribbean Dr. 			
Test Purpose	<p>This is to test the AV ability to pass a basic driving skill.</p>			
Initial Conditions	<ul style="list-style-type: none"> The time is in the morning with clear sunny weather. The vehicle is modeled to drive across the intersection of Borregas and Caribbean. The vehicle will need to obey the traffic signal. The vehicle needs to access all bounds and make a full stop before continuing. 			
Evaluation Metrics	<ul style="list-style-type: none"> AV proceeds as normal when seeing a green traffic light. 			
Expected Result	<ul style="list-style-type: none"> AV proceeds as normal when seeing a green traffic light at an intersection. 			



The screenshot shows the Apollo AV simulation interface. On the left, there's a navigation menu with options like Tasks, Module Controller, Layer Menu, Route Editing, and Data Recorder. The main area displays a 3D simulation environment where a blue Lincoln MKZ is stopped at a red traffic light. A heads-up display (HUD) in the center shows the vehicle's speed (8 km/h), brake and accelerator踏板 positions (both at 0%), and a circular indicator. To the right, a terminal window titled "KeyboardInterrupt" lists several Python script names, likely related to the simulation's logic. Below the terminal is a smaller window showing a street view of the intersection. At the bottom, a status bar indicates "SVLSimulator".

AV waits for the light to turn green and continues passing the intersection

Section 3.3 Test case Analysis

Table 1: Test Scenario #1				
ID	AV Test-01.1			
Creator	Sudha Vijayakumar			
Date	Apr 22, 2022			
Scenario Type	Drive across the traffic light intersection			
Location	<p>Starting point: 1400 Borregas Ave, Sunnyvale, CA 94089</p> <p>Destination: 1395 Borregas Ave, Sunnyvale CA 94089</p>			
Route	<p>Total Distance: 305 ft</p> <p>Travel time: 1 min</p> <p>Directions 305 ft → Head south on Borregas Ave toward Caribbean Dr</p>			
Agent Configurations				
Vehicle Speed	Weather	# of other Vehicles	Other Vehicles Position	# of Pedestrians
0mph - 45 mph	Raining Weather	0 - 7 vehicles	Randomly generated	0
Scenario Description	<ul style="list-style-type: none"> The vehicle is modeled to be driving from south bound from 1444 Borregas Ave, Sunnyvale, CA 94089 across Caribbean Dr. 			
Test Purpose	This is to test the AV ability to pass a basic driving skill.			
Initial Conditions	<ul style="list-style-type: none"> The time is in the morning with clear sunny weather. The vehicle is modeled to drive across the intersection of Borregas and Caribbean. The vehicle will need to obey the traffic signal. The vehicle needs to access all bounds and make a full stop before continuing. 			

Evaluation Metrics	<ul style="list-style-type: none"> AV proceeds as normal when seeing a green traffic light.
Expected Result	<ul style="list-style-type: none"> AV proceeds as normal when seeing a green traffic light at an intersection.
Actual Result	AV waits for the light to turn green and continues passing the intersection
Test Case Result	Pass

Table 1: Test Scenario #1

ID	AV Test-01.1			
Creator	Sudha Vijayakumar			
Date	Apr 22, 2022			
Scenario Type	Drive across the traffic light intersection			
Location	Starting point: 1400 Borregas Ave, Sunnyvale, CA 94089 Destination: 1395 Borregas Ave, Sunnyvale CA 94089			
Route	Total Distance: 305 ft Travel time: 1 min Directions 305 ft → Head south on Borregas Ave toward Caribbean Dr			
Agent Configurations				
Vehicle Speed	Weather	# of other Vehicles	Other Vehicles Position	# of Pedestrians
0mph - 25 mph	Sunny Weather	0 - 7 vehicles	Randomly generated	0

Scenario Description	<ul style="list-style-type: none"> The vehicle is modeled to be driving from south bound from 1444 Borregas Ave, Sunnyvale, CA 94089 across Caribbean Dr.
Test Purpose	This is to test the AV ability to pass a basic driving skill.
Initial Conditions	<ul style="list-style-type: none"> The time is in the morning with clear sunny weather. The vehicle is modeled to drive across the intersection of Borregas and Caribbean. The vehicle will need to obey the traffic signal. The vehicle needs to access all bounds and make a full stop before continuing.
Evaluation Metrics	<ul style="list-style-type: none"> AV proceeds as normal when seeing a green traffic light.
Expected Result	<ul style="list-style-type: none"> AV proceeds as normal when seeing a green traffic light at an intersection.
Actual Result	AV waits for the light to turn green and continues passing the intersection
Test Case Result	Pass

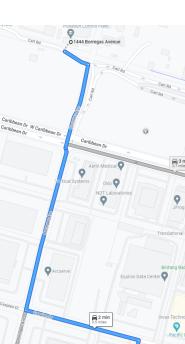
For Test Scenario #1, Ego was able to pass with a 100% score even with different test cases for the scenario.

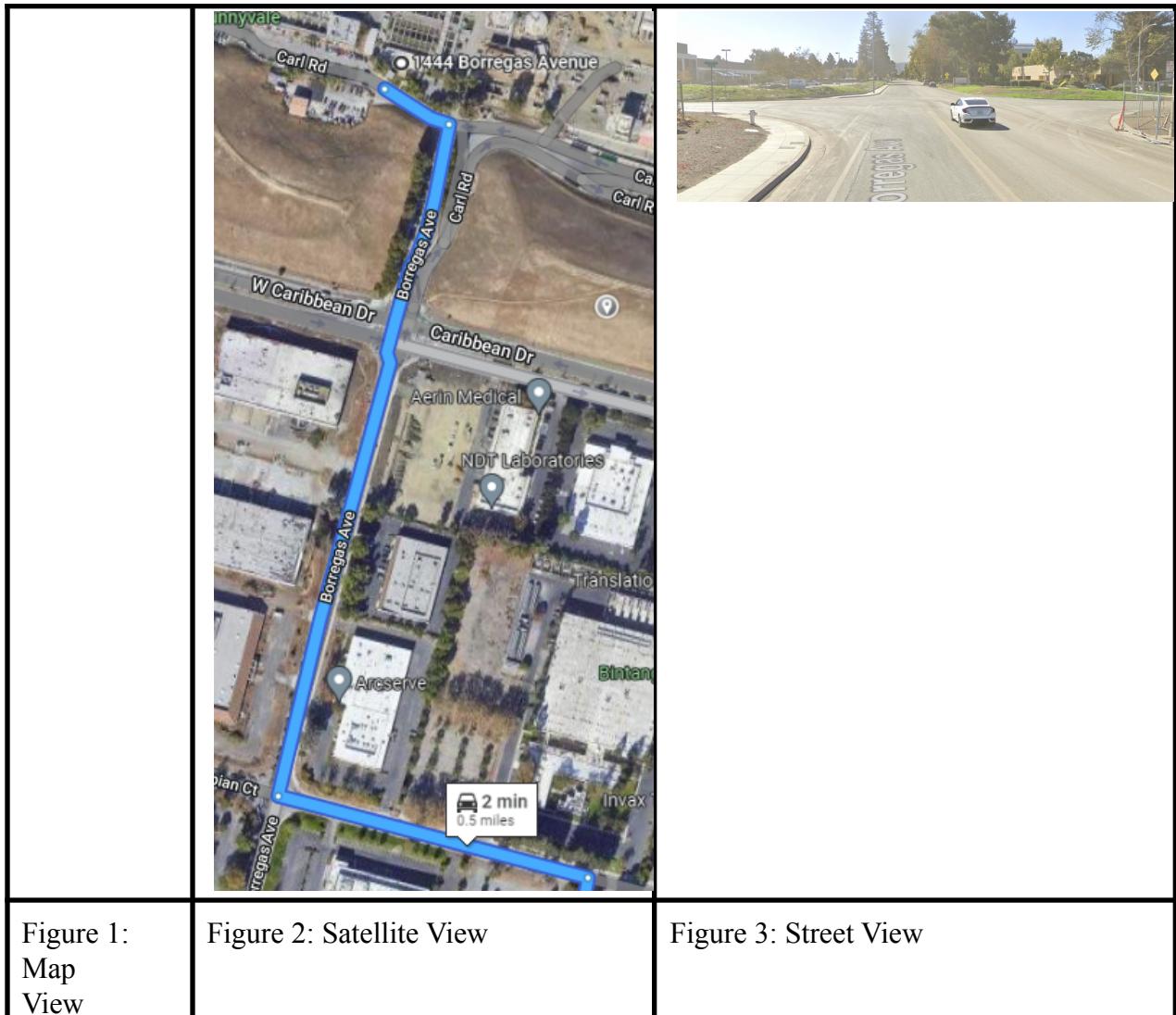
Test Scenario-2: End to End Navigation Test

Section 1 – AI Function Test Requirement Analysis

Section 1.1 - AI function test requirements

Table 6: Test Plan #2

ID	AV Test-02
Creator	Prit Lakhani
Date	Apr 24, 2022
Scenario Type	Can the EGO navigate a basic commercial block
Location	<p>Starting point: Starting point: 1400 Borregas Ave, Sunnyvale, CA 94089</p> <p>Destination: 270 Caspian Dr, Sunnyvale, CA 94089</p>
Route	<p>Total Distance: 0.5 miles</p> <p>Travel time: 2 min</p> <p>Directions 0.3 mi → Head Southbound on Borregas Ave 0.1 mi → Turn left onto Caspian Dr</p>
Map	Sunnyvale, CA
	Borregas Ave and Caribbean Dr
	
	Borregas Ave and Caspian Dr



Section 1.2 - AI function test requirements modeling

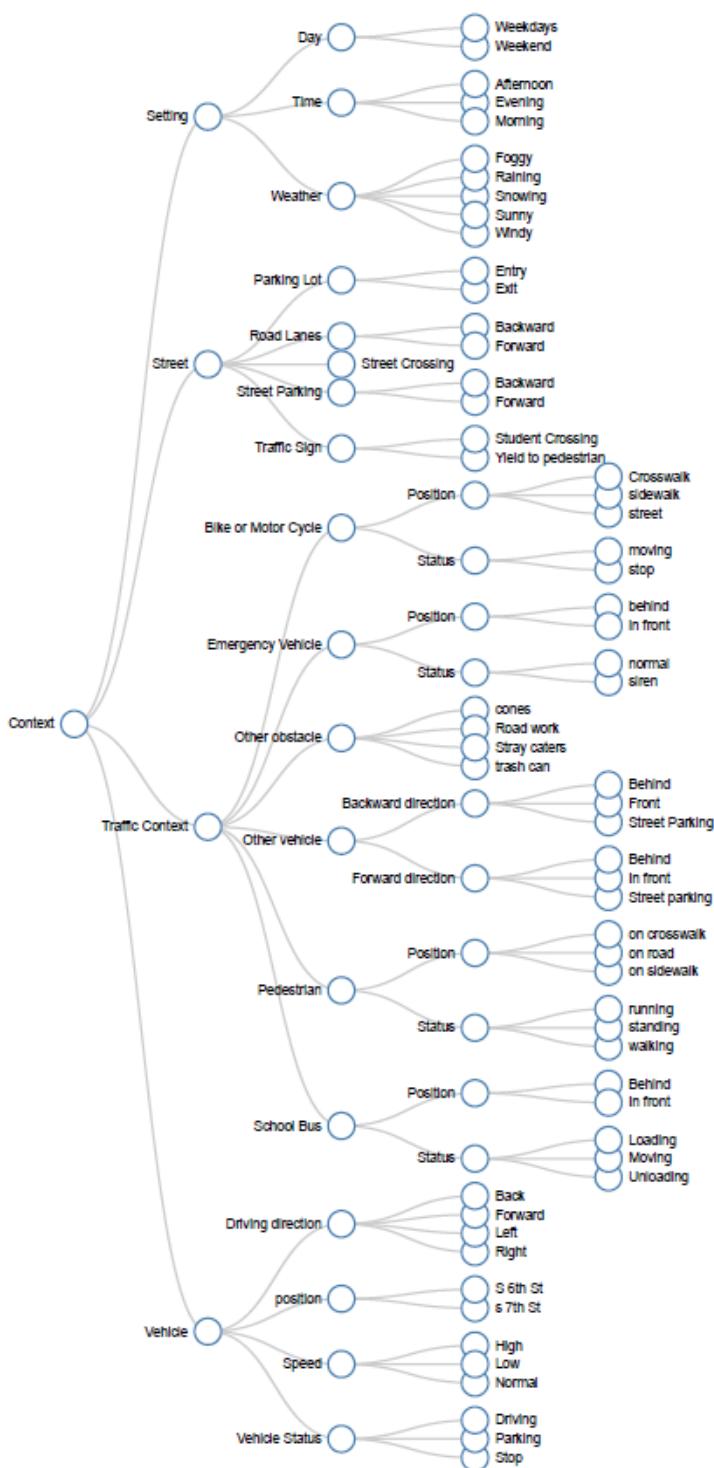
Table 6: Test Plan #2

ID	AV Test-02
Creator	Prit Lakhani
Date	Apr 24, 2022
Scenario Type	Can the EGO navigate a basic commercial block
Location	<p>Starting point: 1400 Borregas Ave, Sunnyvale, CA 94089</p> <p>Destination: 270 Caspian Dr, Sunnyvale, CA 94089</p>

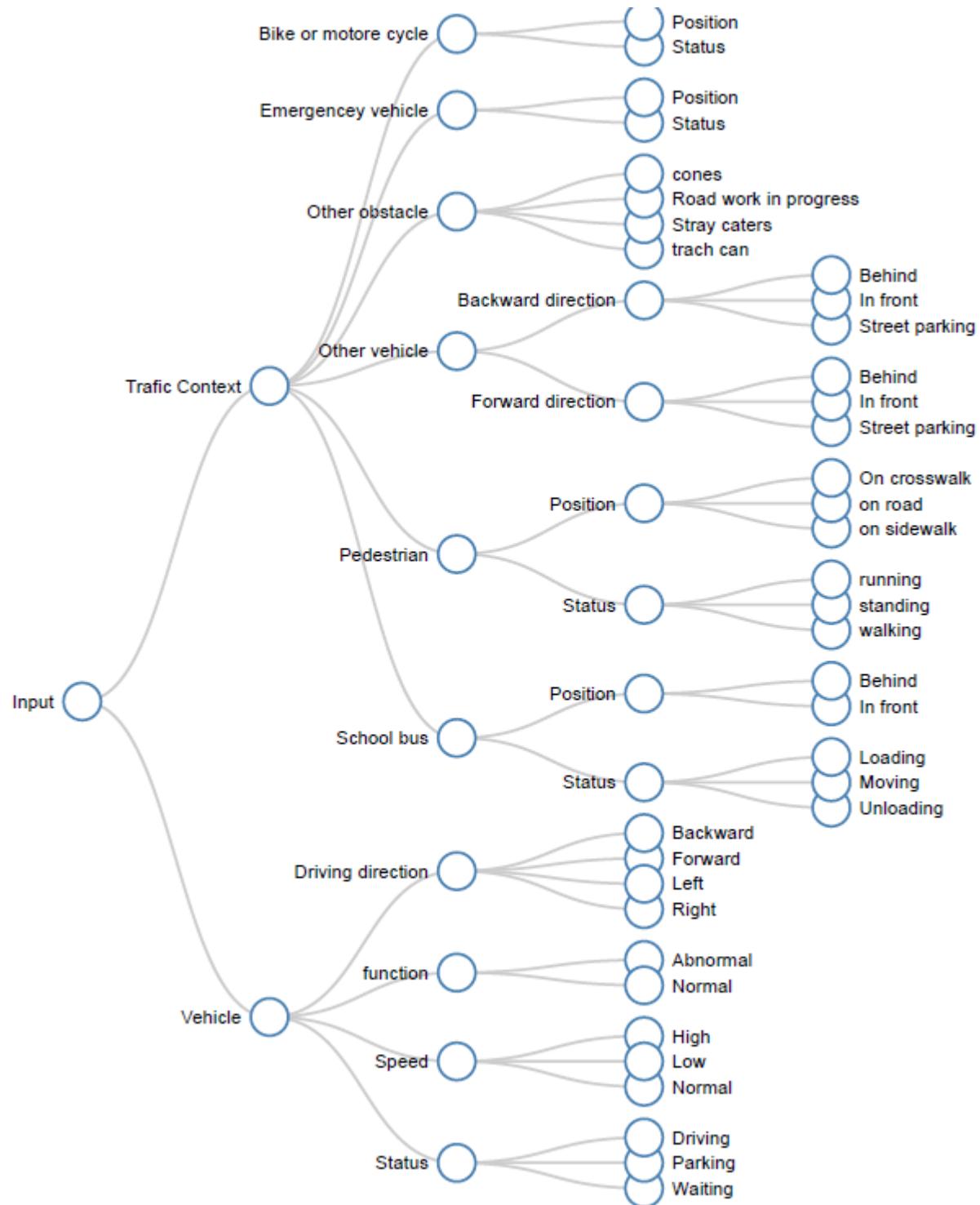
Route	<p>Total Distance: 0.5 miles Travel time: 2 min</p> <p>Directions 0.3 mi → Head Southbound on Borregas Ave 0.1 mi → Turn left onto Caspian Dr</p>				
Agent Configurations					
Vehicle Speed	Weather	# of other Vehicles	Other Vehicles Position	# of Pedestrians	
0mph - 45 mph	Morning with clear sunny weather	0 - 7 vehicles	Randomly generated	0	
Scenario Description	<ul style="list-style-type: none"> The vehicle is modeled to be driving and meet an intersection. AV proceeds to wait for the light and then turn left 				
Test Purpose	To test AV's ability to wait for light and knows how to turn left.				
Initial Conditions	<ul style="list-style-type: none"> The time is in the morning with clear sunny weather. The vehicle is modeled to drive across the intersection of Borregas and Caspian. The vehicle is driving and meets a red light. 				
Evaluation Metrics	<ul style="list-style-type: none"> AV needs to wait for red light to turn green and proceed to turn left. 				
Event	Expected Response				
AV needs to make a left turn	Continue to turn left onto Caspian Dr.				

Section 2 – AI Test Modeling for Selected AI Features

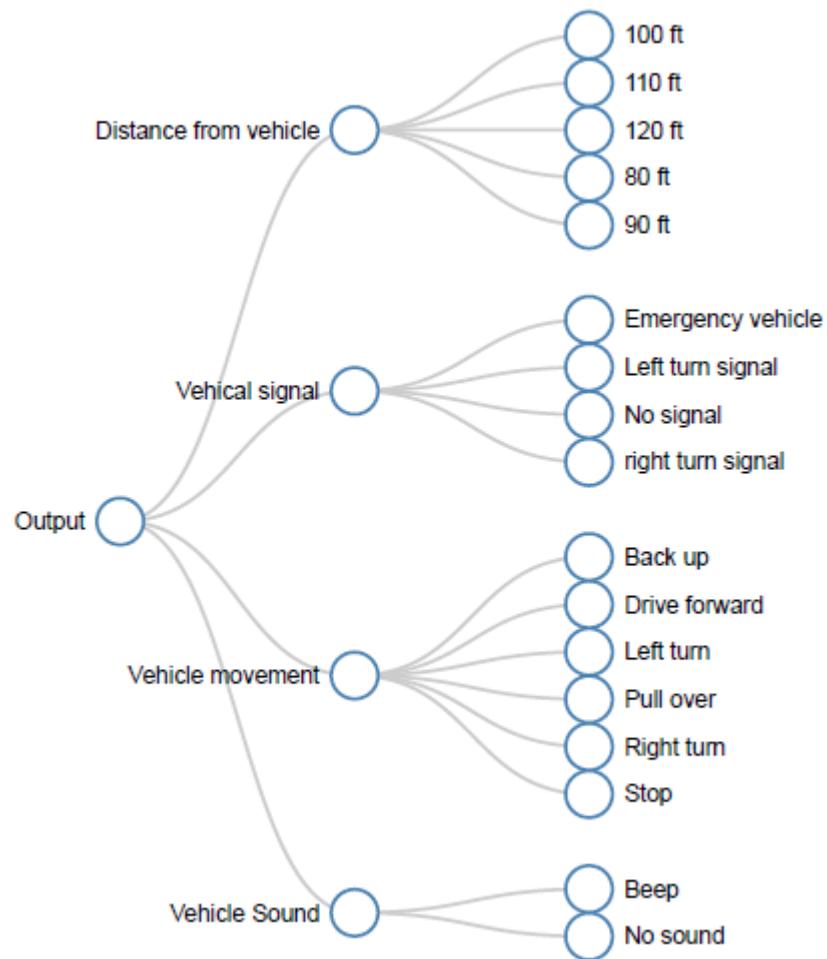
Section 2.1 Context modeling for each selected AI-powered function/feature



Section 2.2. AI-powered function input classifications



Section 2.3. AI-powered function output/event/action classifications



Section 2.4. Classification decision tables

Section 2.4.1 Context Decision Table

Table #9

Table Context				
Context	Setting	Time	Morning	
			Afternoon	
			Morning	
		Weather	Foggy	
			Raining	
			Snowing	
			Sunny	
			Windy	
	Street	Parking Lot	Entry	
			Exit	
		Road Lanes	Backward	
			Forward	
		Street Crossing		
		Street Parking	Backward	
			Forward	
		Traffic Sign	Yield to pedestrian	
	Traffic Context	Bike or motorcycle	Position	Crosswalk
				sidewalk
				street
		Status	moving	
				stop
		Emergency vehicle	Position	Behind

				in front
			Status	normal
				siren
Other obstacle			cones	
			Road works	
			Stray catters	
			Trash can	
Other vehicle		Backward direction	Behind	
			Front	
			Street Parking	
		Forward direction	Behind	
			Front	
			Street Parking	
	Pedestrian	Position	On crosswalk	
			On road	
			On sidewalk	
		status	running	
			standing	
			walking	
School bus		position	behind	
			In front	
		status	Loading	
			Moving	
			Unloading	
	Vehicle	Driving direction	back	
			forward	
			left	

		right	
position	S 6th St		
	S 7th St		
Speed	High		
	Low		
	Normal		
Vehicle Status	Driving		
	Parking		
	Stop		

Section 2.4.2 Input Decision Table

Table #10

Input	Traffic Context	Bike or motorcycle	Position	
		Emergency vehicle	Status	
	Other obstacle	Other obstacle	Position	
			Status	
	Other vehicle	cones		
		Road works		
		Stray caters		
		Trash can		
		Backward direction	Behind	

				Front
				Street Parking
		Forward direction		Behind
				Front
				Street Parking
	Pedestrian	Position		On crosswalk
				On road
				On sidewalk
		status		running
				standing
				walking
	School bus	position		behind
				In front
		status		Loading
				Moving
				Unloading
	Vehicle	Driving direction		backward
				forward
				left
				right
		position		S 6th St
				S 7th St
		Speed		High
				Low
				Normal
		Vehicle Status		Driving
				Parking

			Stop	
--	--	--	------	--

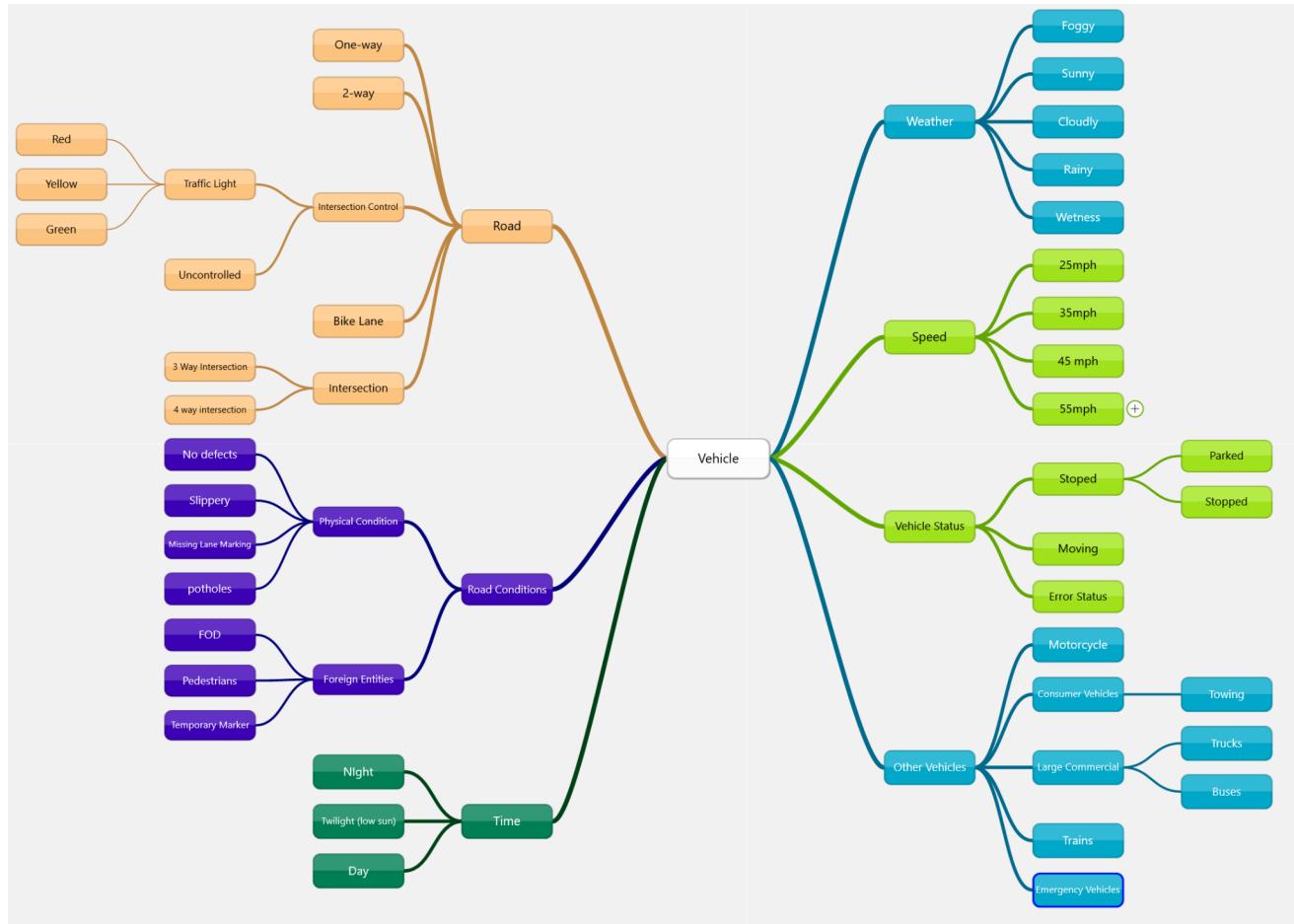
Section 2.4.3 Output Decision Table

Table #11

Output	Distance from vehicle	110 ft
		100 ft
		120ft
		80 ft
		90ft
	Vehicle Signal	Emergency Vehicle
		Left turn signal
		No signal
		Right turn signal
	Vehicle movement	Back up
		Drive forward
		Left turn
		Pull over
		Right turn
		Stop
	Vehicle sound	Beep
		No sound

Section 3 – AI Function Test Cases with Inputs/Expected Outputs

Section 3.1 Test data model

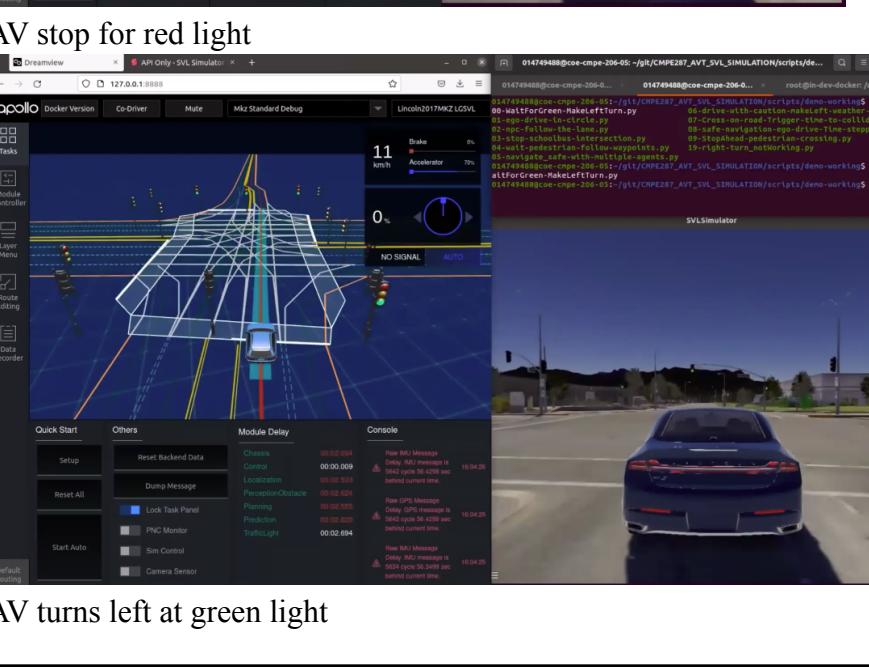


Section 3.2 Test case report

Table 6: Test Plan #2

ID	AV Test-02
Creator	Prit Lakhani
Date	Apr 24, 2022
Scenario Type	Can the EGO navigate a basic commercial block

Location	<p>Starting point: 1400 Borregas Ave, Sunnyvale, CA 94089</p> <p>Destination: 270 Caspian Dr, Sunnyvale, CA 94089</p>			
Route	<p>Total Distance: 0.5 miles</p> <p>Travel time: 2 min</p> <p>Directions</p> <p>0.3 mi → Head Southbound on Borregas Ave</p> <p>0.1 mi → Turn left onto Caspian Dr</p>			
Agent Configurations				
Vehicle Speed	Weather	# of other Vehicles	Other Vehicles Position	# of Pedestrians
0mph - 45 mph	Morning with clear sunny weather	0 - 7 vehicles	Randomly generated	0
Scenario Description	<ul style="list-style-type: none"> The vehicle is modeled to be driving and meet an intersection. AV proceeds to wait for the light and then turn left 			
Test Purpose	To test AV's ability to wait for light and knows how to turn left.			
Initial Conditions	<ul style="list-style-type: none"> The time is in the morning with clear sunny weather. The vehicle is modeled to drive across the intersection of Borregas and Caspian. The vehicle is driving and meets a red light. 			
Evaluation Metrics	<ul style="list-style-type: none"> AV needs to wait for the red light to turn green and proceed to turn left. 			
Expected Result	AV first stops at red light, and make a left turn at green light.			

Actual Result	 <p>AV stop for red light</p>
Test Case Result	 <p>AV turns left at green light</p> <p>Pass</p>

Section 3.3 Test case Analysis

For Test Scenario #2, Ego was able to pass with a 100% score even with different test cases for the scenario.

Table 6: Test Plan #2

AV Test-02.01	
ID	AV Test-02.01
Creator	Prit Lakhani
Date	Apr 24, 2022

Scenario Type	Can the EGO navigate a basic commercial block			
Location	Starting point: 1400 Borregas Ave, Sunnyvale, CA 94089 Destination: 270 Caspian Dr, Sunnyvale, CA 94089			
Route	Total Distance: 0.5 miles Travel time: 2 min Directions 0.3 mi → Head Southbound on Borregas Ave 0.1 mi → Turn left onto Caspian Dr			
Agent Configurations				
Vehicle Speed	Weather	# of other Vehicles	Other Vehicles Position	# of Pedestrians
0mph - 30 mph	Morning with foggy weather	0 - 7 vehicles	Randomly generated	0
Scenario Description	<ul style="list-style-type: none"> The vehicle is modeled to be driving and meet an intersection. AV proceeds to wait for the light and then turn left 			
Test Purpose	To test AV's ability to wait for light and knows how to turn left.			
Initial Conditions	<ul style="list-style-type: none"> The time is in the morning with clear sunny weather. The vehicle is modeled to drive across the intersection of Borregas and Caspian. The vehicle is driving and meets a red light. 			
Evaluation Metrics	<ul style="list-style-type: none"> AV needs to wait for the red light to turn green and proceed to turn left. 			
Expected Result	AV first stops at red light, and makes a left turn at green light.			

Actual Result	-AV stop for red light -AV turns left at green light
Test Case Result	Pass

Table 6: Test Plan #2

ID	AV Test-02.02			
Creator	Prit Lakhani			
Date	Apr 24, 2022			
Scenario Type	Can the EGO navigate a basic commercial block			
Location	Starting point: 1400 Borregas Ave, Sunnyvale, CA 94089 Destination: 270 Caspian Dr, Sunnyvale, CA 94089			
Route	Total Distance: 0.5 miles Travel time: 2 min Directions 0.3 mi → Head Southbound on Borregas Ave 0.1 mi → Turn left onto Caspian Dr			
Agent Configurations				
Vehicle Speed	Weather	# of other Vehicles	Other Vehicles Position	# of Pedestrians
0mph - 25 mph	Storm weather	0 - 7 vehicles	Randomly generated	0
Scenario Description	<ul style="list-style-type: none"> The vehicle is modeled to be driving and meet an intersection. AV proceeds to wait for the light and then turn left 			

Test Purpose	To test AV's ability to wait for light and knows how to turn left.
Initial Conditions	<ul style="list-style-type: none"> The time is in the morning with clear sunny weather. The vehicle is modeled to drive across the intersection of Borregas and Caspian. The vehicle is driving and meets a red light.
Evaluation Metrics	<ul style="list-style-type: none"> AV needs to wait for the red light to turn green and proceed to turn left.
Expected Result	AV first stops at red light, and makes a left turn at green light.
Actual Result	<p>AV stop for red light</p> <p>AV turns left at green light</p>
Test Case Result	Pass

Table 6: Test Plan #2

ID	AV Test-02.03
Creator	Prit Lakhani
Date	Apr 24, 2022
Scenario Type	Can the EGO navigate a basic commercial block
Location	<p>Starting point: 1400 Borregas Ave, Sunnyvale, CA 94089</p> <p>Destination: 270 Caspian Dr, Sunnyvale, CA 94089</p>
Route	<p>Total Distance: 0.5 miles</p> <p>Travel time: 2 min</p> <p>Directions</p> <p>0.3 mi → Head Southbound on Borregas Ave</p> <p>0.1 mi → Turn left onto Caspian Dr</p>

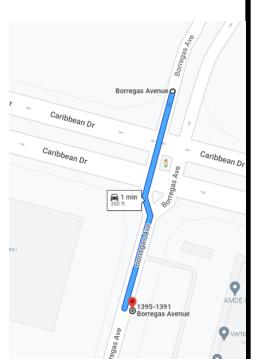
Agent Configurations				
Vehicle Speed	Weather	# of other Vehicles	Other Vehicles Position	# of Pedestrians
0mph - 25 mph	Morning with clear sunny weather	0 - 7 vehicles	Randomly generated	0
Scenario Description	<ul style="list-style-type: none"> The vehicle is modeled to be driving and meet an intersection. AV proceeds to wait for the light and then turn left 			
Test Purpose	To test AV's ability to wait for light and knows how to turn left.			
Initial Conditions	<ul style="list-style-type: none"> The time is in the morning with clear sunny weather. The vehicle is modeled to drive across the intersection of Borregas and Caspian. The vehicle is driving and meets a red light. 			
Evaluation Metrics	<ul style="list-style-type: none"> AV needs to wait for the red light to turn green and proceed to turn left. 			
Expected Result	AV first stops at red light, and makes a left turn at green light.			
Actual Result	<p>AV stop for red light</p> <p>AV turns left at green light</p>			
Test Case Result	Pass			

Test Scenario - 3: Collision and Emergency Braking Test

Section 1 – AI Function Test Requirement Analysis

Section 1.1 - AI function test requirements

Table 1: Test Plan #3

ID	AV Test-03
Creator	Huyen Nguyen
Date	Apr 22, 2022
Scenario Type	AV needs to know when to stop when seeing another vehicle ahead.
Location	<p>Starting point: 1400 Borregas Ave, Sunnyvale, CA 94089</p> <p>Destination: 1395 Borregas Ave, Sunnyvale CA 94089</p>
Route	<p>Total Distance: 305 ft</p> <p>Travel time: 1 min</p> <p>Directions 305 ft → Head south on Borregas Ave toward Caribbean Dr</p>
Map	Sunnyvale, CA
Figure 1: Map View	
Figure 2: Satellite View	
Figure 3: Street View	

Section 1.2 - AI function test requirements modeling

Table 1: Test Scenario #3

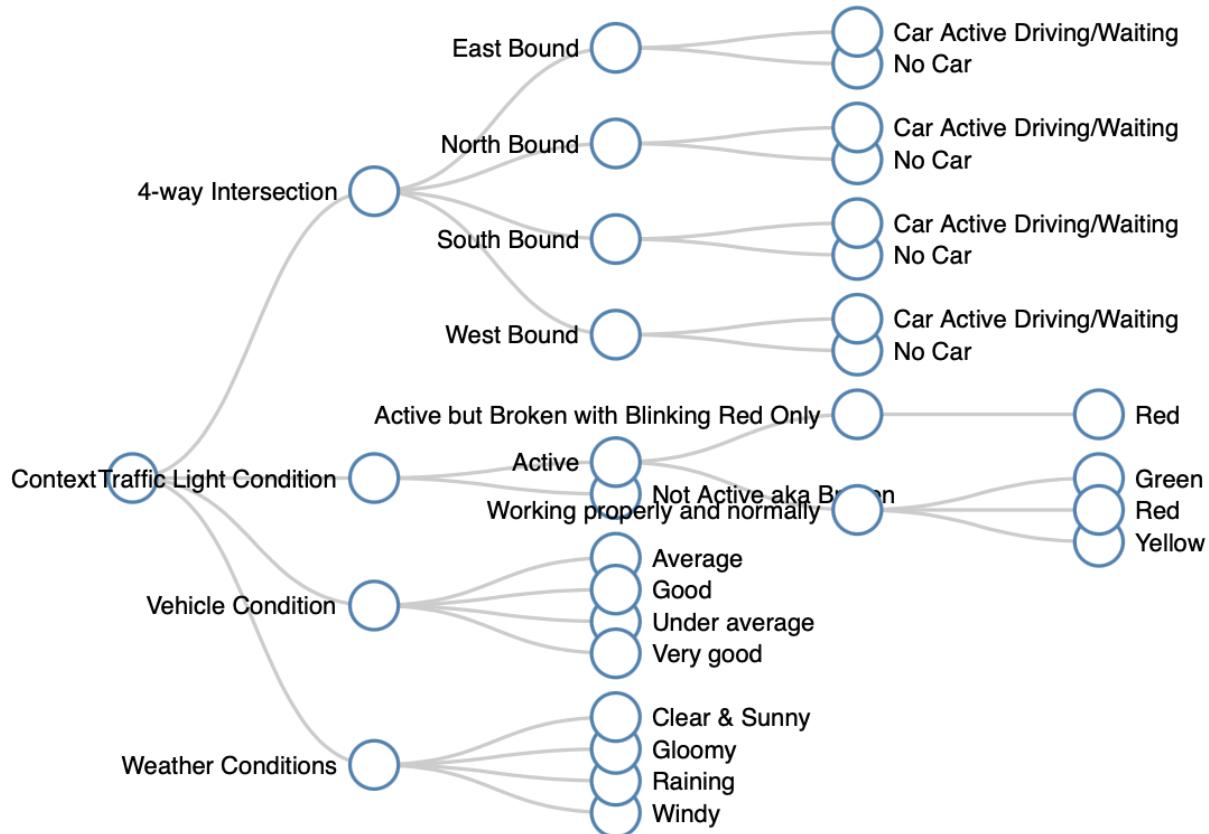
ID	AV Test-03
----	------------

Creator	Huyen Nguyen			
Date	Apr 22, 2022			
Scenario Type	AV needs to know when to stop when seeing another vehicle ahead.			
Location	Starting point: 1400 Borregas Ave, Sunnyvale, CA 94089 Destination: 1395 Borregas Ave, Sunnyvale CA 94089			
Route	Total Distance: 305 ft Travel time: 1 min Directions 305 ft → Head south on Borregas Ave toward Caribbean Dr			
Agent Configurations				
Vehicle Speed	Weather	# of other Vehicles	Other Vehicles Position	# of Pedestrians
0mph - 45 mph	Morning with clear sunny weather	0 - 7 vehicles	Randomly generated	0
Scenario Description	<ul style="list-style-type: none"> AV needs to know when to stop when seeing another vehicle ahead. 			
Test Purpose	This is to test the AV ability to pass a basic driving skill, which is to stop when seeing another vehicle.			
Initial Conditions	<ul style="list-style-type: none"> The time is in the morning with clear sunny weather. The vehicle is modeled to drive across the intersection of Borregas and Caribbean. There's another vehicle ahead, AV needs to stop completely. 			
Evaluation Metrics	<ul style="list-style-type: none"> AV needs to stop when seeing another vehicle ahead. 			
Event	Expected Response			

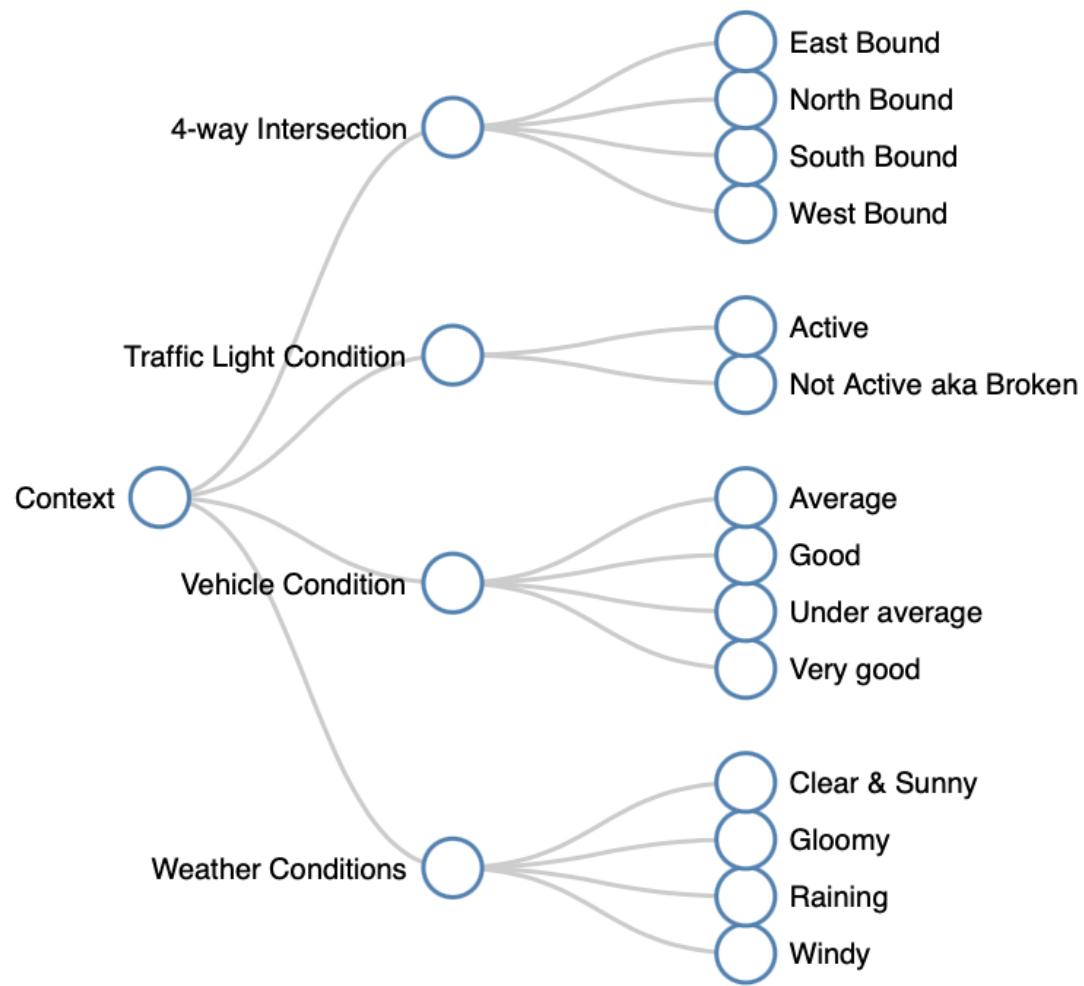
AV needs to stop when seeing another vehicle ahead	Stop for the vehicle ahead and then continue to pass the intersection 1300 Borregas Ave, Sunnyvale, CA 94089 Sunnyvale Water Pollution Control Plant
--	---

Section 2 – AI Test Modeling for Selected AI Features

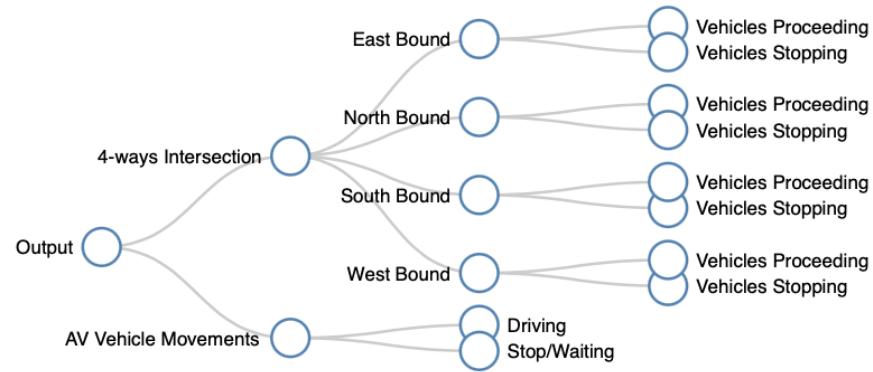
Section 2.1 Context modeling for each selected AI-powered function/feature



Section 2.2. AI-powered function input classifications



Section 2.3. AI-powered function output/event/actions classification



Section 2.4. AI-powered function classification decision tables

Section 2.4.1 Context Decision Table

Table #14

Context				Yes?
4-way Intersection	East Bound	Car Active Driving/Waiting		X
		No Car		
	North Bound	Car Active Driving/Waiting		X
		No Car		
	West Bound	Car Active Driving/Waiting		X
		No Car		
	South Bound	Car Active Driving/Waiting		X
		No Car		
	Traffic Light Conditions	Power On with Blinking Red Only	Red	X
		Working Properly	Green	
			Red	
			Yellow	
	Not Active			
Vehicle Conditions	Very Good			X
	Good			
	Average			
	Under Average			
Weather Conditions	Clear & Sunny			X
	Gloomy			
	Raining			
	Windy			

Section 2.4.2 Input Decision Table

Table #15

4-way Intersection	East Bound
	North Bound
	West Bound
	South Bound
Traffic Light Conditions	Active
	Not Active
Vehicle Conditions	Very Good
	Good
	Average
	Under Average
Weather Conditions	Clear & Sunny
	Gloomy
	Raining
	Windy

Section 2.4.3 Output Decision Table

Table #16

4-way Intersection	East Bound	Vehicles Proceeding
		Vehicles Stopping/Waiting
	North Bound	Vehicles Proceeding
		Vehicles Stopping/Waiting
	West Bound	Vehicles Proceeding
		Vehicles Stopping/Waiting
	South Bound	Vehicles Proceeding
		Vehicles Stopping/Waiting
AV Movements	Waiting/Stopping	
	Driving	

Section 3 – AI Function Test Cases with Inputs/Expected Outputs

Section 3.1 Test data model



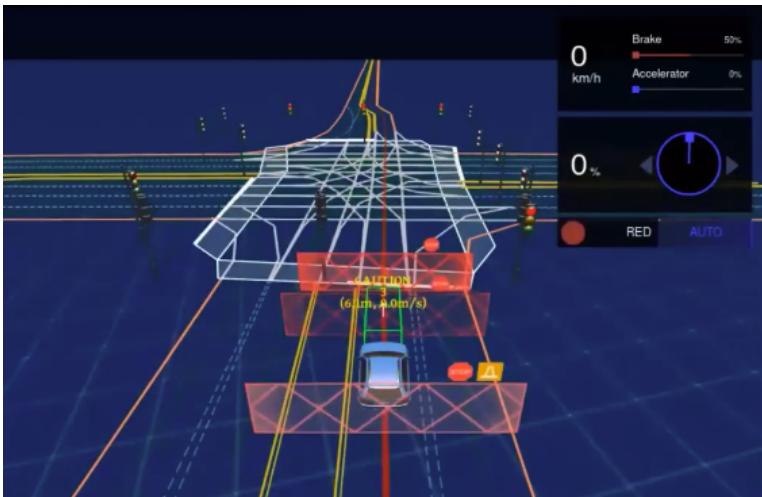
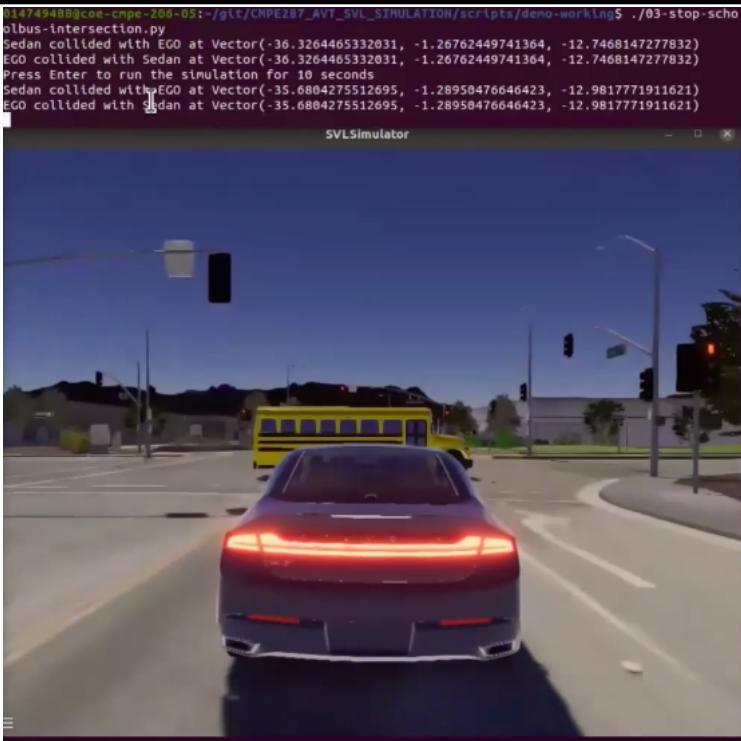
Section 3.2 Test case report

Table 1: Test Scenario #3

ID	AV Test-03
Creator	Huyen Nguyen
Date	Apr 22, 2022
Scenario Type	AV needs to know when to stop when seeing another vehicle ahead.

Location	<p>Starting point: 1400 Borregas Ave, Sunnyvale, CA 94089 Destination: 1395 Borregas Ave, Sunnyvale CA 94089</p>			
Route	<p>Total Distance: 305 ft Travel time: 1 min</p> <p>Directions 305 ft → Head south on Borregas Ave toward Caribbean Dr</p>			
Agent Configurations				
Vehicle Speed	Weather	# of other Vehicles	Other Vehicles Position	# of Pedestrians
0mph - 45 mph	Morning with clear sunny weather	0 - 7 vehicles	Randomly generated	0
Scenario Description	<ul style="list-style-type: none"> AV needs to know when to stop when seeing another vehicle ahead. 			
Test Purpose	<p>This is to test the AV ability to pass a basic driving skill, which is to stop when seeing another vehicle.</p>			
Initial Conditions	<ul style="list-style-type: none"> The time is in the morning with clear sunny weather. The vehicle is modeled to drive across the intersection of Borregas and Caribbean. There's another vehicle ahead, AV needs to stop completely. 			
Evaluation Metrics	<ul style="list-style-type: none"> AV needs to stop when seeing another vehicle ahead. 			
Expected Result	<p>AV needs to stop when seeing another vehicle ahead and not collide.</p>			

Actual Result



AV failed to stop when seeing the bus stop ahead and collided into it.

Test Case Result

Fail

Section 3.3 Test case Analysis

For Test Scenario #3, Ego wasn't able to pass anything with a 0% score even with different test cases for the scenario.

Table 1: Test Scenario #3				
ID	AV Test-03.1			
Creator	Huyen Nguyen			
Date	Apr 22, 2022			
Scenario Type	AV needs to know when to stop when seeing another vehicle ahead.			
Location	Starting point: 1400 Borregas Ave, Sunnyvale, CA 94089 Destination: 1395 Borregas Ave, Sunnyvale CA 94089			
Route	Total Distance: 305 ft Travel time: 1 min Directions 305 ft → Head south on Borregas Ave toward Caribbean Dr			
Agent Configurations				
Vehicle Speed	Weather	# of other Vehicles	Other Vehicles Position	# of Pedestrians
0mph - 45 mph	Morning with clear sunny weather	0 - 7 vehicles	Randomly generated	0
Scenario Description	<ul style="list-style-type: none"> AV needs to know when to stop when seeing another vehicle ahead. 			
Test Purpose	This is to test the AV ability to pass a basic driving skill, which is to stop when seeing another vehicle.			
Initial Conditions	<ul style="list-style-type: none"> The time is in the morning with clear sunny weather. The vehicle is modeled to drive across the intersection of Borregas and Caribbean. There's another vehicle ahead, AV needs to stop completely. 			

Evaluation Metrics	<ul style="list-style-type: none"> AV needs to stop when seeing another vehicle ahead.
Expected Result	AV needs to stop when seeing another vehicle ahead and not collide.
Actual Result	AV failed to stop when seeing the bus stop ahead and collided into it.
Test Case Result	Fail

Table 1: Test Scenario #3

ID	AV Test-03.2			
Creator	Huyen Nguyen			
Date	Apr 22, 2022			
Scenario Type	AV needs to know when to stop when seeing another vehicle ahead.			
Location	Starting point: 1400 Borregas Ave, Sunnyvale, CA 94089 Destination: 1395 Borregas Ave, Sunnyvale CA 94089			
Route	Total Distance: 305 ft Travel time: 1 min Directions 305 ft → Head south on Borregas Ave toward Caribbean Dr			
Agent Configurations				
Vehicle Speed	Weather	# of other Vehicles	Other Vehicles Position	# of Pedestrians

0mph - 25 mph	Morning with clear sunny weather	0 - 7 vehicles	Randomly generated	0
Scenario Description	<ul style="list-style-type: none"> AV needs to know when to stop when seeing another vehicle ahead. 			
Test Purpose	This is to test the AV ability to pass a basic driving skill, which is to stop when seeing another vehicle.			
Initial Conditions	<ul style="list-style-type: none"> The time is in the morning with clear sunny weather. The vehicle is modeled to drive across the intersection of Borregas and Caribbean. There's another vehicle ahead, AV needs to stop completely. 			
Evaluation Metrics	<ul style="list-style-type: none"> AV needs to stop when seeing another vehicle ahead. 			
Expected Result	AV needs to stop when seeing another vehicle ahead and not collide.			
Actual Result	AV failed to stop when seeing the bus stop ahead and collided into it.			
Test Case Result	Fail			

Table 1: Test Scenario #3

ID	AV Test-03.3
Creator	Huyen Nguyen
Date	Apr 22, 2022
Scenario Type	AV needs to know when to stop when seeing another vehicle ahead.
Location	<p>Starting point: 1400 Borregas Ave, Sunnyvale, CA 94089</p> <p>Destination: 1395 Borregas Ave, Sunnyvale CA 94089</p>

Route	Total Distance: 305 ft Travel time: 1 min Directions 305 ft → Head south on Borregas Ave toward Caribbean Dr				
Agent Configurations					
Vehicle Speed	Weather	# of other Vehicles	Other Vehicles Position	# of Pedestrians	
0mph - 45 mph	Raining	0 - 7 vehicles	Randomly generated	0	
Scenario Description	<ul style="list-style-type: none"> AV needs to know when to stop when seeing another vehicle ahead. 				
Test Purpose	This is to test the AV ability to pass a basic driving skill, which is to stop when seeing another vehicle.				
Initial Conditions	<ul style="list-style-type: none"> The time is in the morning with clear sunny weather. The vehicle is modeled to drive across the intersection of Borregas and Caribbean. There's another vehicle ahead, AV needs to stop completely. 				
Evaluation Metrics	<ul style="list-style-type: none"> AV needs to stop when seeing another vehicle ahead. 				
Expected Result	AV needs to stop when seeing another vehicle ahead and not collide.				
Actual Result	AV failed to stop when seeing the bus stop ahead and collided into it.				
Test Case Result	Fail				

Test Scenario - 4: Encounter a blocked route

Section 1 – AI Function Test Requirement Analysis

Section 1.1 - AI function test requirements

Table 17: Test Plan #4

Table 17: Test Plan #4	
ID	AV Test-02
Creator	Richard Ngo
Date	Apr 22, 2022
Scenario Type	Automatic Rerouting due to traffic conditions
Location	<p>Starting point: City of Sunnyvale Water Pollution Control Plant: 1444 Borregas Ave Sunnyvale, CA 94089</p> <p>Destination: United States Post Office on 209 E Java Dr, Sunnyvale, CA 94089</p>
Route	<p>Total Distance: 0.8 mile</p> <p>Travel time: 2 min</p> <p>Directions</p> <p>0.4 mi → Head south on Borregas Ave toward Caspian Dr 0.2 mi → Turn left onto East Java Dr. 0.2 mi → Make a U-Turn at Geneva Dr. Destination will be on the right at the corner of E Java Dr and Borregas Ave</p> <p>Alternative Route: 1.3 miles</p> <p>Travel Time: 3 min</p> <p>Directions</p> <p>62ft → Head south on Borregas Ave towards W Caribbean Dr. 0.2 mi → Turn left onto East Caribbean Dr. 0.4 mi → Turn right onto Geneva Dr 0.2 mi → Turn right onto E Java Dr Destination will be on the right at the corner of E Java Dr and Borregas Ave</p>
Map	Sunnyvale, CA



Section 1.2 - AI function test requirements modeling

Table 18: Test Plan #4

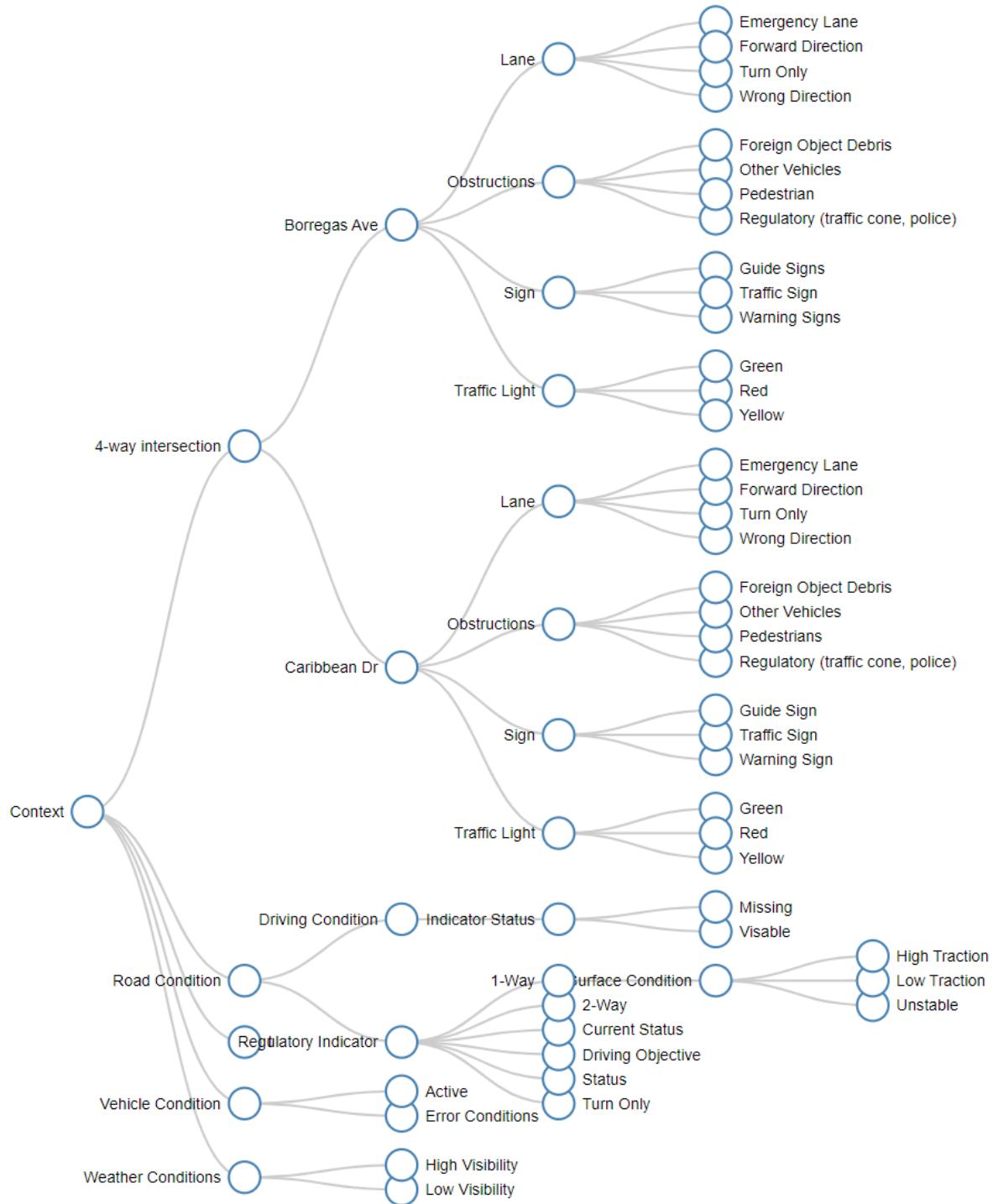
ID	AV Test-04
Creator	Richard Ngo
Date	Apr 22, 2022
Scenario Type	Automatic Rerouting due to traffic conditions
Location	<p>Starting point: City of Sunnyvale Water Pollution Control Plant: 1444 Borregas Ave Sunnyvale, CA 94089</p> <p>Destination: United States Post Office on 209 E Java Dr, Sunnyvale, CA 94089</p>
Route	<p>Total Distance: 0.8 mile</p> <p>Travel time: 2 min</p> <p>Directions</p> <p>0.4 mi → Head south on Borregas Ave toward Caspian Dr</p> <p>0.2 mi → Turn left onto East Java Dr.</p> <p>0.2 mi → Make a U-Turn at Geneva Dr.</p> <p>Destination will be on the right at the corner of E Java Dr and Borregas</p>

	<p>Ave</p> <p>Alternative Route: 1.3 miles Travel Time: 3 min</p> <p>Directions</p> <p>62ft → Head south on Borregas Ave towards W Caribbean Dr. 0.2 mi → Turn left onto East Caribbean Dr. 0.4 mi → Turn right onto Geneva Dr 0.2 mi → Turn right onto E Java Dr Destination will be on the right at the corner of E Java Dr and Borregas Ave</p>			
Agent Configurations				
Ego Speed	Weather	# of other Vehicles	Other Vehicles Position	# of Pedestrians
0mph - 45 mph	“high noon” daylight. Clear day	3 vehicles	In front and across the intersection on Borregas	0
Scenario Description		<ul style="list-style-type: none"> The vehicle is modeled to be driving south bound at the northernmost end of Borregas Ave near the sewage processing plant. The Vehicle is at the Intersection of Borregas and Caribbean Dr. The vehicle needs to continue southbound on Borregas to continue the journey There are vehicles at the other end of the intersection which appear to not be moving. 		
Test Purpose		This is to test the AV ability to determine if a route is inaccessible and automatically reroute to a different route		
Initial Conditions		Vehicle Spawn Location: <ul style="list-style-type: none"> Northernmost end of intersection between Borregas and Caribbean Dr. In the lane that is intending to go southbound on Borregas Ave. Weather <ul style="list-style-type: none"> It will be a clear day with the sun directly overhead. Road Conditions <ul style="list-style-type: none"> Roads are clear with no major defects in the lane markings Other Vehicle Spawn Locations <ul style="list-style-type: none"> 3 vehicle, starting from the southern end of Borregas on the western side (blocking the southbound traffic on Borregas) 		
Evaluation Metrics		Success Criterias: <ul style="list-style-type: none"> After a maximum of 15 minutes the vehicle should identify that the road is blocked ahead Vehicle should either prompt for alternative routes or make a left hand 		

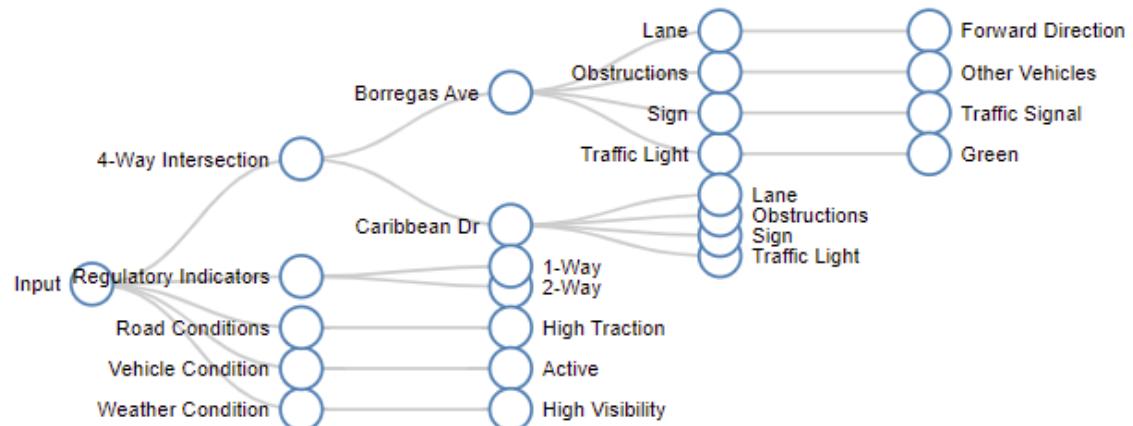
turn onto Caribeans to navigate around the obstacle.

Section 2 – AI Test Modeling for Selected AI Features

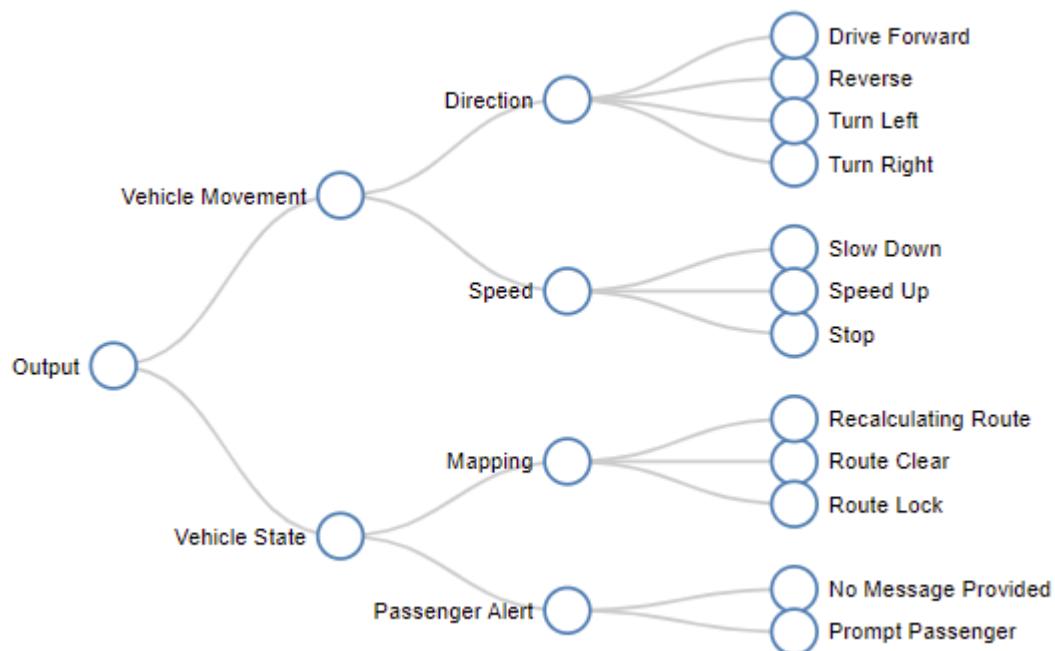
Section 2.1 Context modeling for each selected AI-powered function/feature



Section 2.2. AI-powered function input classifications



Section 2.3. AI-powered function output/event/action classifications



Section 2.4. Classification decision tables

Section 2.4.1 Context Decision Table

Table #19

Context			
4-way intersection	Borregas Ave	Lane	Emergency Lane Forward Direction Turn Only Wrong Direction
		Obstructions	Foreign Object Debris Other Vehicles Pedestrian Regulatory (traffic cone, police)
		Sign	Guide Sign Traffic Sign Warning Sign
		Traffic Light	Green Yellow Red
		Lane	Emergency Lane Forward Direction Turn Only Wrong Direction
	Caribbean Dr	Obstructions	Foreign Object Debris Other Vehicles Pedestrian Regulatory (traffic cone, police)
		Sign	Guide Sign Traffic Sign Warning Sign
		Traffic Light	Green Yellow Red
		Indicators Status	Missing Visible
		Turn Only Cross Traffic Parallel Traffic	
Road Condition	Surface Condition	High Traction Low Traction Unstable	
		Direction Heading Route	
		Active Inactive	
	High Visibility Low Visibility		

Section 2.4.2 Input Decision Table

Table #20

		Input		Input Parameters
4-way Intersection	Borregas Ave	Lane	Forward Direction Turn Option	Yes Yes
		Obstructions	Other Vehicles	Yes
		Sign		None
		Traffic Light	Green Yellow Red	Yes
		Lane	Forward Direction Turn Only	Yes
	Caribbean Dr	Obstructions	Foreign Object Debris	
		Sign	Guide Sign	
		Traffic Light	Green Yellow Red	
		Driving Condition	Indicators Status	Missing Visable
Road Condition	Regulatory Indicator	Turn Only		
		Cross Traffic		Yes
		Parallel Traffic		
	Surface Condition	High Traction		
		Low Traction		Yes
		Unstable		
Vehicle condition	Objective	Direction		Yes
		Heading		Yes
		Route		Yes
	Status	Active Inactive		Yes
Weather Condition	High Visibility			Yes
	Low Visibility			

Section 2.4.3 Output Decision Table

Table #21

Output		
Vehicle Movment	Direction	Drive Forward
		Turn left
		Turn Right
		Reverse
	Speed	Speed up
		Slow Down
		Stop
Internal State	Mapping	Route Lock
		Recalculating Route
		Route Clear
	Passenger Alert	Prompt Passenger
		No message provided

Section 3 – AI Function Test Cases with Inputs/Expected Outputs

Section 3.1 Test data model

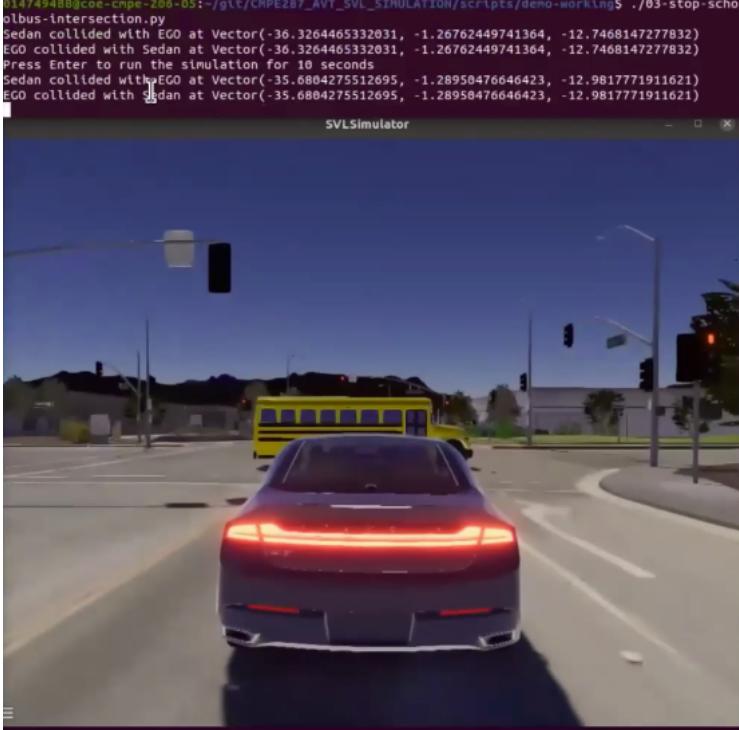
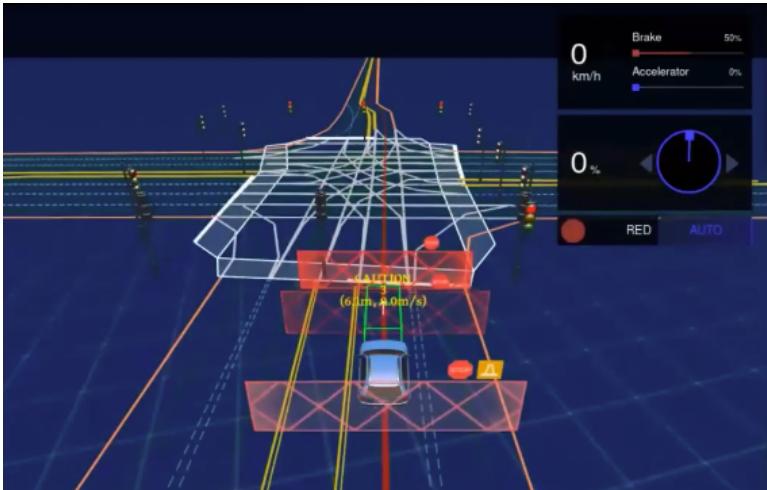


Section 3.2 Test case report

Table 18: Test Plan #4

ID	AV Test-04
Creator	Richard Ngo
Date	Apr 22, 2022
Scenario Type	Automatic Rerouting due to traffic conditions
Location	<p>Starting point: City of Sunnyvale Water Pollution Control Plant: 1444 Borregas Ave Sunnyvale, CA 94089</p> <p>Destination: United States Post Office on 209 E Java Dr, Sunnyvale, CA</p>

	94089			
Route	<p>Total Distance: 0.8 mile</p> <p>Travel time: 2 min</p> <p>Directions</p> <p>0.4 mi → Head south on Borregas Ave toward Caspian Dr 0.2 mi → Turn left onto East Java Dr. 0.2 mi → Make a U-Turn at Geneva Dr. Destination will be on the right at the corner of E Java Dr and Borregas Ave</p> <p>Alternative Route: 1.3 miles</p> <p>Travel Time: 3 min</p> <p>Directions</p> <p>62ft → Head south on Borregas Ave towards W Caribbean Dr. 0.2 mi → Turn left onto East Caribbean Dr. 0.4 mi → Turn right onto Geneva Dr 0.2 mi → Turn right onto E Java Dr Destination will be on the right at the corner of E Java Dr and Borregas Ave</p>			
Agent Configurations				
Ego Speed	Weather	# of other Vehicles	Other Vehicles Position	# of Pedestrians
0mph - 45 mph	“high noon” daylight. Clear day	3 vehicles	In front and across the intersection on Borregas	0
Scenario Description	<ul style="list-style-type: none"> The vehicle is modeled to be driving south bound at the northernmost end of Borregas Ave near the sewage processing plant. The Vehicle is at the Intersection of Borregas and Caribbean Dr. The vehicle needs to continue southbound on Borregas to continue the journey There are vehicles at the other end of the intersection which appear to not be moving. 			
Test Purpose	This is to test the AV ability to determine if a route is inaccessible and automatically reroute to a different route			
Initial Conditions	<p>Vehicle Spawn Location:</p> <ul style="list-style-type: none"> Northernmost end of intersection between Borregas and Caribbean Dr. In the lane that is intending to go southbound on Borregas Ave. <p>Weather</p>			

	<ul style="list-style-type: none"> It will be a clear day with the sun directly overhead. <p>Road Conditions</p> <ul style="list-style-type: none"> Roads are clear with no major defects in the lane markings <p>Other Vehicle Spawn Locations</p> <ul style="list-style-type: none"> 3 vehicle, starting from the southern end of Borregas on the western side (blocking the southbound traffic on Borregas)
Evaluation Metrics	<p>Success Criterias:</p> <ul style="list-style-type: none"> After a maximum of 15 minutes the vehicle should identify that the road is blocked ahead Vehicle should either prompt for alternative routes or make a left hand turn onto Carriebans to navigate around the obstacle.
Expected Result	Automatic Rerouting due to traffic conditions
Actual Result	<pre>01474948@coe-cmpe-206-05:~/git/CMPE287_AVL_SVL_SIMULATION/scripts/demo-working\$./03-stop-schoolbus-intersection.py Sedan collided with EGO at Vector(-36.3264465332031, -1.26762449741364, -12.7468147277832) EGO collided with Sedan at Vector(-36.3264465332031, -1.26762449741364, -12.7468147277832) Press Enter to run the simulation for 10 seconds Sedan collided with EGO at Vector(-35.6804275512695, -1.28958476646423, -12.9817771911621) EGO collided with Sedan at Vector(-35.6804275512695, -1.28958476646423, -12.9817771911621)</pre>  

	AV failed to reroute when encountering traffic condition.
Test Case Result	Fail

Section 3.3 Test case Analysis

For Test Scenario #4, Ego wasn't able to pass anything with a 0% score even with different test cases for the scenario.

Table 18: Test Plan #4	
ID	AV Test-04.1
Creator	Richard Ngo
Date	Apr 22, 2022
Scenario Type	Automatic Rerouting due to traffic conditions
Location	<p>Starting point: City of Sunnyvale Water Pollution Control Plant: 1444 Borregas Ave Sunnyvale, CA 94089</p> <p>Destination: United States Post Office on 209 E Java Dr, Sunnyvale, CA 94089</p>
Route	<p>Total Distance: 0.8 mile</p> <p>Travel time: 2 min</p> <p>Directions 0.4 mi → Head south on Borregas Ave toward Caspian Dr 0.2 mi → Turn left onto East Java Dr. 0.2 mi → Make a U-Turn at Geneva Dr. Destination will be on the right at the corner of E Java Dr and Borregas Ave</p> <p>Alternative Route: 1.3 miles Travel Time: 3 min</p> <p>Directions 62ft → Head south on Borregas Ave towards W Caribbean Dr. 0.2 mi → Turn left onto East Caribbean Dr. 0.4 mi → Turn right onto Geneva Dr</p>

	0.2 mi → Turn right onto E Java Dr Destination will be on the right at the corner of E Java Dr and Borregas Ave				
Agent Configurations					
Ego Speed	Weather	# of other Vehicles	Other Vehicles Position	# of Pedestrians	
0mph - 45 mph	"high noon" daylight. Clear day	3 vehicles	In front and across the intersection on Borregas	0	
Scenario Description	<ul style="list-style-type: none"> The vehicle is modeled to be driving south bound at the northernmost end of Borregas Ave near the sewage processing plant. The Vehicle is at the Intersection of Borregas and Caribbean Dr. The vehicle needs to continue southbound on Borregas to continue the journey There are vehicles at the other end of the intersection which appear to not be moving. 				
Test Purpose	This is to test the AV ability to determine if a route is inaccessible and automatically reroute to a different route				
Initial Conditions	<p>Vehicle Spawn Location:</p> <ul style="list-style-type: none"> Northernmost end of intersection between Borregas and Caribbean Dr. In the lane that is intending to go southbound on Borregas Ave. <p>Weather</p> <ul style="list-style-type: none"> It will be a clear day with the sun directly overhead. <p>Road Conditions</p> <ul style="list-style-type: none"> Roads are clear with no major defects in the lane markings <p>Other Vehicle Spawn Locations</p> <ul style="list-style-type: none"> 3 vehicle, starting from the southern end of Borregas on the western side (blocking the southbound traffic on Borregas) 				
Evaluation Metrics	<p>Success Criterias:</p> <ul style="list-style-type: none"> After a maximum of 15 minutes the vehicle should identify that the road is blocked ahead Vehicle should either prompt for alternative routes or make a left hand turn onto Caribbean to navigate around the obstacle. 				
Expected Result	Automatic Rerouting due to traffic conditions				
Actual Result	AV failed to reroute when encountering traffic condition.				

Test Case Result	Fail
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Table 18: Test Plan #4	
ID	AV Test-04.2
Creator	Richard Ngo
Date	Apr 22, 2022
Scenario Type	Automatic Rerouting due to traffic conditions
Location	<p>Starting point: City of Sunnyvale Water Pollution Control Plant: 1444 Borregas Ave Sunnyvale, CA 94089</p> <p>Destination: United States Post Office on 209 E Java Dr, Sunnyvale, CA 94089</p>
Route	<p>Total Distance: 0.8 mile</p> <p>Travel time: 2 min</p> <p>Directions</p> <p>0.4 mi → Head south on Borregas Ave toward Caspian Dr 0.2 mi → Turn left onto East Java Dr. 0.2 mi → Make a U-Turn at Geneva Dr. Destination will be on the right at the corner of E Java Dr and Borregas Ave</p> <p>Alternative Route: 1.3 miles</p> <p>Travel Time: 3 min</p> <p>Directions</p> <p>62ft → Head south on Borregas Ave towards W Caribbean Dr. 0.2 mi → Turn left onto East Caribbean Dr. 0.4 mi → Turn right onto Geneva Dr 0.2 mi → Turn right onto E Java Dr Destination will be on the right at the corner of E Java Dr and Borregas Ave</p>
Agent Configurations	

Ego Speed	Weather	# of other Vehicles	Other Vehicles Position	# of Pedestrians
0mph - 25 mph	“high noon” daylight. Clear day	3 vehicles	In front and across the intersection on Borregas	0
Scenario Description	<ul style="list-style-type: none"> The vehicle is modeled to be driving south bound at the northernmost end of Borregas Ave near the sewage processing plant. The Vehicle is at the Intersection of Borregas and Caribbean Dr. The vehicle needs to continue southbound on Borregas to continue the journey There are vehicles at the other end of the intersection which appear to not be moving. 			
Test Purpose	This is to test the AV ability to determine if a route is inaccessible and automatically reroute to a different route			
Initial Conditions	<p>Vehicle Spawn Location:</p> <ul style="list-style-type: none"> Northernmost end of intersection between Borregas and Caribbean Dr. In the lane that is intending to go southbound on Borregas Ave. <p>Weather</p> <ul style="list-style-type: none"> It will be a clear day with the sun directly overhead. <p>Road Conditions</p> <ul style="list-style-type: none"> Roads are clear with no major defects in the lane markings <p>Other Vehicle Spawn Locations</p> <ul style="list-style-type: none"> 3 vehicle, starting from the southern end of Borregas on the western side (blocking the southbound traffic on Borregas) 			
Evaluation Metrics	<p>Success Criterias:</p> <ul style="list-style-type: none"> After a maximum of 15 minutes the vehicle should identify that the road is blocked ahead Vehicle should either prompt for alternative routes or make a left hand turn onto Caribbean to navigate around the obstacle. 			
Expected Result	Automatic Rerouting due to traffic conditions			
Actual Result	AV failed to reroute when encountering traffic condition.			
Test Case Result	Fail			

Table 18: Test Plan #4

ID

AV Test-04.1

Creator	Richard Ngo			
Date	Apr 22, 2022			
Scenario Type	Automatic Rerouting due to traffic conditions			
Location	<p>Starting point: City of Sunnyvale Water Pollution Control Plant: 1444 Borregas Ave Sunnyvale, CA 94089</p> <p>Destination: United States Post Office on 209 E Java Dr, Sunnyvale, CA 94089</p>			
Route	<p>Total Distance: 0.8 mile</p> <p>Travel time: 2 min</p> <p>Directions</p> <p>0.4 mi → Head south on Borregas Ave toward Caspian Dr 0.2 mi → Turn left onto East Java Dr. 0.2 mi → Make a U-Turn at Geneva Dr. Destination will be on the right at the corner of E Java Dr and Borregas Ave</p> <p>Alternative Route: 1.3 miles</p> <p>Travel Time: 3 min</p> <p>Directions</p> <p>62ft → Head south on Borregas Ave towards W Caribbean Dr. 0.2 mi → Turn left onto East Caribbean Dr. 0.4 mi → Turn right onto Geneva Dr 0.2 mi → Turn right onto E Java Dr Destination will be on the right at the corner of E Java Dr and Borregas Ave</p>			
Agent Configurations				
Ego Speed	Weather	# of other Vehicles	Other Vehicles Position	# of Pedestrians
0mph - 45 mph	Raining day with unclear view	3 vehicles	In front and across the intersection on Borregas	0
Scenario Description	<ul style="list-style-type: none"> The vehicle is modeled to be driving south bound at the northernmost end of Borregas Ave near the sewage processing plant. The Vehicle is at the Intersection of Borregas and Caribbean Dr. The vehicle needs to continue southbound on Borregas to continue the 			

	<p>journey</p> <ul style="list-style-type: none"> • There are vehicles at the other end of the intersection which appear to not be moving.
Test Purpose	This is to test the AV ability to determine if a route is inaccessible and automatically reroute to a different route
Initial Conditions	<p>Vehicle Spawn Location:</p> <ul style="list-style-type: none"> • Northernmost end of intersection between Borregas and Caribbean Dr. In the lane that is intending to go southbound on Borregas Ave. <p>Weather</p> <ul style="list-style-type: none"> • It will be a clear day with the sun directly overhead. <p>Road Conditions</p> <ul style="list-style-type: none"> • Roads are clear with no major defects in the lane markings <p>Other Vehicle Spawn Locations</p> <ul style="list-style-type: none"> • 3 vehicle, starting from the southern end of Borregas on the western side (blocking the southbound traffic on Borregas)
Evaluation Metrics	<p>Success Criterias:</p> <ul style="list-style-type: none"> • After a maximum of 15 minutes the vehicle should identify that the road is blocked ahead • Vehicle should either prompt for alternative routes or make a left hand turn onto Caribbeans to navigate around the obstacle.
Expected Result	Automatic Rerouting due to traffic conditions
Actual Result	AV failed to reroute when encountering traffic condition.
Test Case Result	Fail

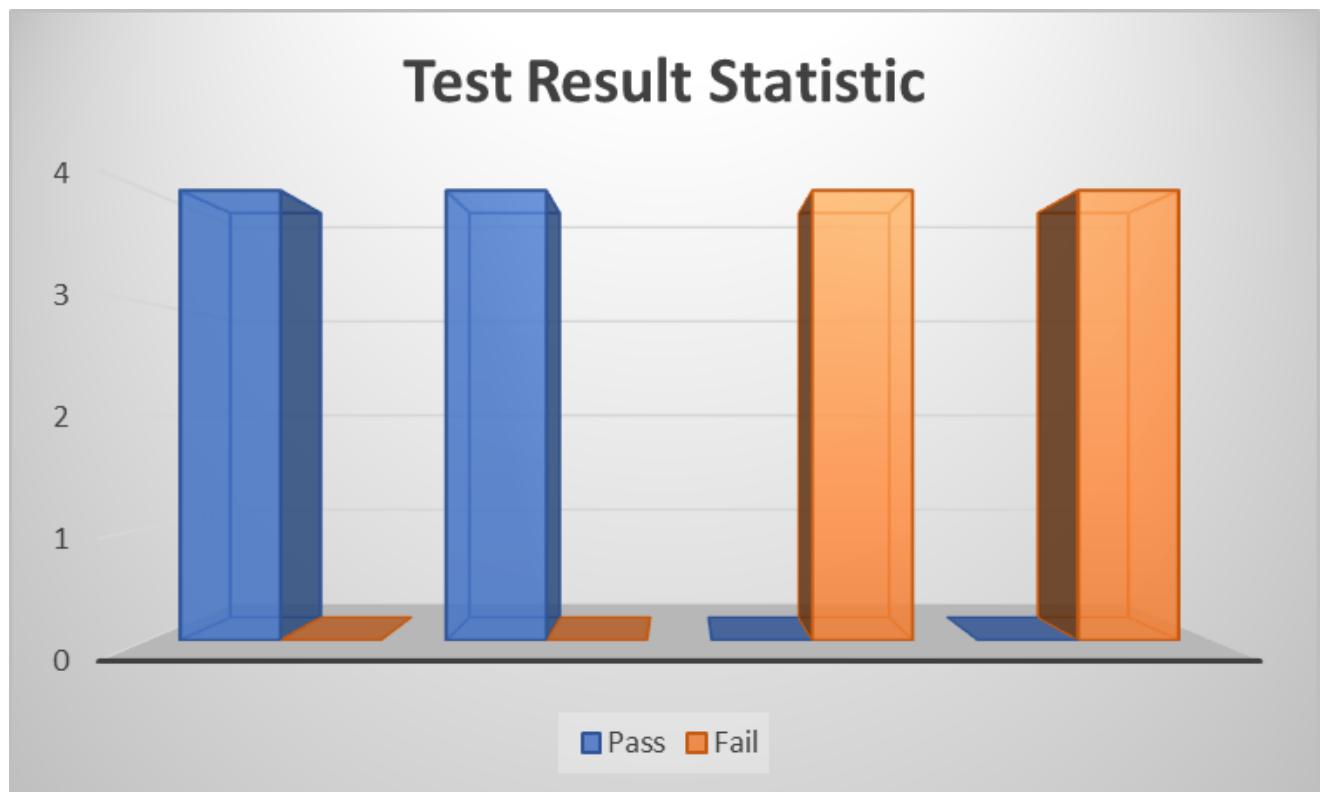
Section # 4 - AV Test Results and Test Criteria

4.1. AV Test Model-Based Test Result Analysis, test complexity, and test result statistics

4.1.1. Test Complexity

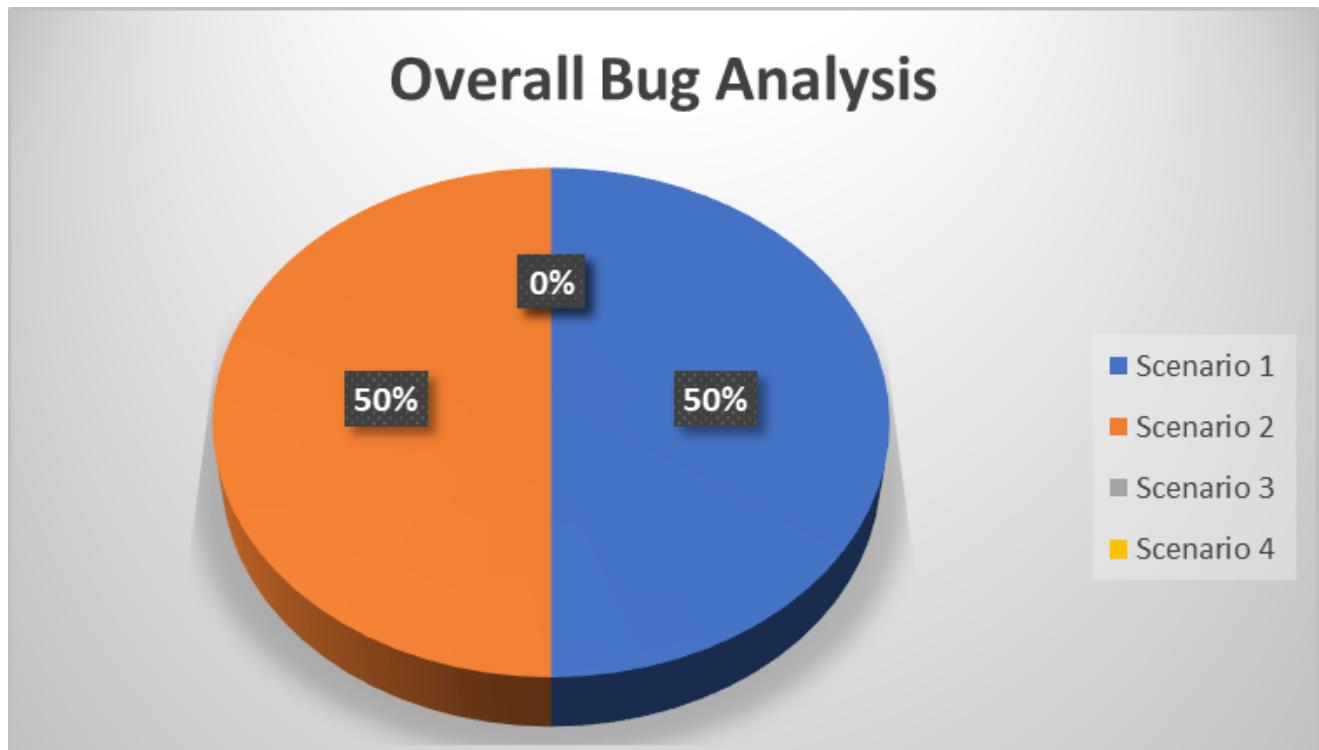
Test complexity of each scenario is different. It is determined by the complexity of the context tree and input tree.

Test Complexity	Weather+Time	EGO Vehicle	Other Vehicle	Pedestrian	Traffic light	Intersections Direction	Test Complexity
Scenario 1	2+2	1	-	-	-	4	12
Scenario 2	2+2	1	4	1	1	(4)^2	256
Scenario 3	2+2	1	2	-	-	-	8
Scenario 4	2+2	1	1	-	1	4	16



4.2 AI Function bug analysis

4.2.1 Overall Bug Analysis



Scenario 1	Drive across the traffic light intersection.
Scenario 2	Drive across 1 intersection and make a left turn
Scenario 3	Collision test
Scenario 4	Spawn a car in front of traffic blockage

In conclusion, from all the generated test cases, the scenario that presented the highest percentage of test failures were Scenarios 3 and 4. While the scenario with the least failures was Scenario 1 and Scenario 2.

4.2.2 AV Bug Analysis per Category

4.2.2.1 Ego Vehicle

Two out of four scenarios which are scenario 3 and scenario 4 failed completely due to Apollo's slow response time and inability to navigate in a complex environment.

4.2.2.2 Traffic Context

Due to failure of the Ego to recognize dynamic traffic patterns it could not stop in time and collided with another vehicle in Scenario 3. In addition to this the dynamic routing also has issues as it could not navigate around stalled vehicles.

4.2.2.3 Static Objects

Like the traffic context, we can infer that Apollo AI cannot handle a new static object appearing. Such as the stalled vehicle which would be considered a new static object.

4.3 AI function test quality assessment

4.3.1 AV Test Quality Assessment

Due to the contextual nature of the problem, we decided to use the category partition testing method. We subdivide the domains into subcategories such that we can test multiple items at a time. We have also included several “sanity” tests which contain only one category to better isolate failures in each subcategory. Unfortunately due to the limitation of the simulator we were forced to isolate our tests to a commercial block of Sunnyvale, California.

4.3.2 Test Criteria

- We attempt to select at least one external factor based upon our test model presented in each of the subsection 3.3 in the report above

4.3.3 Test Coverage

- All combinations of the test model were covered within the testing.
- Restrictions due to the simulator constraints unfortunately had to restrict the total model.
- External testing, such as updating routing was also included that was not part of a standard vehicle model