The Translation of Chinese Traffic laws

A. The detailed Traffic Laws

1) Traffic Rule 0 – Article 38:

a) The Original Rule: Article 38: Motor vehicle signal lights and non-motor vehicle signal lights indicate:

(1) When the green light is on, vehicles are allowed to pass, but turning vehicles shall not hinder the passing of straight vehicles and pedestrians that are being released.
(2) When the yellow light is on, vehicles that have crossed the stop line can continue to pass;
(3) When the red light is on, vehicles are prohibited from passing. When the red light is on, vehicles turning right can pass without hindering the passage of vehicles or pedestrians.

b) STL Formula:

(1)

$$G((trafficLightAhead.color = green \vee trafficLightAhead.direction.color = green) \wedge (stoplineAhead(realvalue) \vee junctionAhead(realvalue)) \wedge (\neg PriorityNPCAhead \vee \neg PriorityPedsAhead) \implies F[0, realvalue](speed > realvalue))$$

(2)

$$G(((trafficLightAhead.color = yellow \vee trafficLightAhead.direction.color = yellow) \wedge \neg stoplineAhead(realvalue) \implies F[0, realvalue](speed > realvalue)) \wedge ((trafficLightAhead.color = yellow \vee trafficLightAhead.direction.color = yellow) \wedge stoplineAhead(realvalue) \implies F[0, realvalue](speed < realvalue)))$$

(3)

$$G((trafficLightAhead.color = red \vee trafficLightAhead.direction.color = red) \wedge direction \neq right \wedge (stoplineAhead(realvalue) \vee junctionAhead(realvalue)) \implies F[0, realvalue](speed < realvalue)) \wedge G((trafficLightAhead.color = red \vee trafficLightAhead.direction.color = red) \wedge direction = right \wedge \neg PriorityNPCAhead \wedge \neg PriorityPedsAhead \wedge (stoplineAhead(realvalue) \vee junctionAhead(realvalue)) \implies F[0, realvalue](speed > realvalue))$$

2) Traffic Rule 1 – Article 40:

a) The Original Rule: Article 40: Lane signal lights indicate:

(1) When the green arrow light is on, allow vehicles in the lane to pass in the direction indicated;
(2) When the red cross-shaped light or arrow light is on, vehicles in the lane are prohibited from passing.

b) STL Formula:

(1)

$$G(trafficLightAhead.direction.color = green \wedge (stoplineAhead(realvalue) \vee junctionAhead(realvalue)) \implies F[0, realvalue](speed > realvalue))$$

(2)

$$G(trafficLightAhead.direction.color = red \wedge (stoplineAhead(realvalue) \vee junctionAhead(realvalue)) \implies F[0, realvalue](speed < realvalue))$$

Noted:Not applicable at now stage, because the map doesn't support this kind of traffic lights.

3) Traffic Rule 2 – Article 41:

a) The Original Rule: Article 41: The direction of the arrow of the direction indicator light indicates left, up, and right to turn left, go straight, and turn right respectively.

b) STL Formula: Has been implied in Traffic Rule 1 – Article 40.

4) Traffic Rule 3 – Article 42:

a) The Original Rule: Article 42: The flashing warning signal light is a yellow light that continues to flash, reminding vehicles and pedestrians to pay attention when passing through, and pass after confirming safety.

b) STL Formula:

$$G(((trafficLightAhead.color = yellow \wedge trafficLightAhead.blink) \vee (stoplineAhead(realvalue) \vee junctionAhead(realvalue)) \implies F[0, realvalue]((speed < realvalue)\ U \neg NearestNPC(realvalue)))$$

5) Traffic Rule 4 – Article 43:

a) The Original Rule: Article 43: When two red lights flash alternately or one red light is on a road and railway intersection, it means that vehicles and pedestrians are prohibited; when the red light is off, it means that vehicles and pedestrians are allowed to pass.

b) STL Formula:

$$G((trafficLightAhead.color = red \wedge specialLocationAhead.type = Railway\_J \wedge specialLocationAhead(realvalue) \implies F[0, realvalue](speed < realvalue))U (trafficLightAhead.color \neq red \wedge specialLocationAhead.type = Railway\_J \implies F[0, realvalue](speed > realvalue)))$$

Note:The blinking property exists in the information we get from bridge, so it's possible to represent it. But this rule is hard to customize experiments.

6) Traffic Rule 5 – Article 44:

a) The Original Rule: Article 44: Where there are two or more motorized lanes in the same direction on the road, the left side is the fast lane and the right side is the slow lane. Motor vehicles traveling in a fast lane shall drive at the speed specified in the fast lane, and those that have not reached the speed specified in the fast lane shall drive in a slow lane. Motorcycles should drive in the rightmost lane. If there are traffic signs indicating the driving speed, drive at the indicated driving speed. When a motor vehicle in a slow lane overtakes the preceding vehicle, it can borrow the fast lane to drive. Where there are two or more motor vehicle lanes in the same direction on the road, the motor vehicle that changes lanes shall not affect the normal driving of the motor vehicle in the relevant lane.

b) STL Formula:

$$G(currentLane.number \geq 2 \implies (speed \geq speedLimit.lowerLimit \wedge speed \leq speedLimit.upperLimit)) \wedge G(isChangingLane \wedge currentLane.number \geq 2 \implies \neg PriorityNPCAhead)$$

7) Traffic Rule 6 – Article 45:

a) The Original Rule: Article 45: Motor vehicles must not exceed the speed indicated by the speed limit signs and markings on the road. On roads without speed limit signs and markings, motor vehicles shall not exceed the following maximum speeds.

(1) For roads without a road centerline, urban roads are 30 kilometers per hour, and highways are 40 kilometers per hour;
(2) For roads with only one motor vehicle lane in the same direction, 50 kilometers per hour for urban roads and 70 kilometers per hour for highways

b) STL Formula:

$$G(speed \geq speedLimit.lowerLimit \wedge speed \leq speedLimit.upperLimit)$$

8) Traffic Rule 7 – Article 46:

a) The Original Rule: Article 46: When a motor vehicle encounters one of the following conditions, the maximum speed shall not exceed 30 kilometers per hour, and the maximum speed of tractors, battery vehicles, and wheeled special machinery vehicles shall not exceed 15 kilometers per hour:

(1) When entering or leaving a non-motorized vehicle lane, passing through a railway crossing, a sharp curve, a narrow road, or a narrow bridge;
(2) When turning around, turning, or descending steep slopes;
(3) In case of fog, rain, snow, sand dust, hail, the visibility is within 50 meters;
(4) when driving on icy and muddy roads;
(5) When towing a malfunctioning motor vehicle.

b) STL Formula:

(1)

$$G((specialLocationAhead.type = Railway_J \vee specialLocationAhead.type = SharpTurn \vee specialLocationAhead.type = NarrowBridge \vee specialLocationAhead.type = NarrowRoad) \wedge specialLocationAhead(realvalue) \implies speed \leq 30)$$

(2)

$$G((direction \neq forward) \vee isTurningAround \implies speed \leq 30)$$

(3)

$$G((Weather.rain \geq 0.5 \vee Weather.fog \geq 0.5 \vee Weather.snow \geq 0.5) \wedge Weather.visibility \leq 50 \implies speed \leq 30)$$

Note: API may pose a problem when including Weather.visibility but could be done using a combination of the (currently) available APIs.

9) Traffic Rule 8 – Article 47:

a) The Original Rule: Article 47: When a motor vehicle is overtaking, it shall turn on the left turn signal in advance, change the use of far and low beam lights, or honk the horn. On a road with no center line of the road or with only one motor vehicle lane in the same direction, when the vehicle in front meets the vehicle behind and sends an overtaking signal, if conditions permit, the speed should be reduced and the road should be made to the right. After confirming that there is a sufficient safety distance, the following vehicle should pass from the left side of the vehicle in front, and after pulling the necessary safety distance from the overtaken vehicle, turn on the right turn signal and drive back to the original lane.

b) STL Formula:

$$G(isOverTaking \implies turnSignal = left \wedge (F[-realvalue,\ realvalue](hornOn) \vee (highBeamOn \wedge (highBeamOn \implies F[0,\ realvalue](lowBeamOn))) \vee (lowBeamOn \wedge (lowBeamOn \implies F[0,\ realvalue](highBeamOn)))) \wedge F[0,\ realvalue]((turnSignal = right \wedge isChangingLane \implies NearestNPC(realvalue) \wedge isChangingLane))$$

10) Traffic Rule 9 – Article 48:

a) The Original Rule: Article 48: On roads without central isolation facilities or without a central line, motor vehicles come in opposite directions. The following regulations should be observed when driving:

(1) Slow down and keep to the right, and keep a necessary safe distance from other vehicles and pedestrians;
(2) On a road with obstacles, the side with obstacles shall go first; but when the side with obstacles has entered the road with obstacles and the side with obstacles has not, the side with obstacles shall go first;
(3) On a narrow slope, the uphill side goes first; but when the downhill side has reached halfway and the uphill side is not uphill, the downhill side goes first;
(4) On the narrow mountain road, the side that does not rely on the mountain shall go first;
(5) At night meeting vehicles should switch to low beam lights 150 meters away from the oncoming vehicle in the opposite direction, and should use low beam lights when meeting vehicles on narrow roads, narrow bridges and non-motorized vehicles.

b) STL Formula: Note: This rule is hard to describe, because it's vague. But the user can customize it with the provided APIs. The experiments can not be conducted due to the limit of maps.

11) Traffic Rule 10 – Article 49:

a) The Original Rule: Article 49: Motor vehicles shall not make U-turns at locations where there are signs or markings forbidden to turn or turn left, and at railway crossings, crosswalks, bridges, sharp bends, steep slopes, tunnels or road sections prone to danger. Motor vehicles can make U-turns where there is no prohibition of turning or left-turning signs or markings, but it shall not hinder the passage of other vehicles and pedestrians in normal driving.

b) STL Formula:

$$
\begin{aligned}
&G(noUTurnSignAhead \vee \\
&specialLocationAhead.type = Railway\_J \vee \\
&crosswalkAhead \neq None \vee \\
&specialLocationAhead.type = Bridge \vee \\
&bspecialLocationAhead.type = SharpTurn \vee \\
&specialLocationAhead.type = SteepSlope \vee \\
&specialLocationAhead.type = Tunnel \\
&\implies isturnAround = False) \wedge \\
&G(noUTurnSignAhead \vee PriorityNPCAhead \vee \\
&PriorityPedsAhead \implies isturnAround = False)
\end{aligned}
$$

12) Traffic Rule 11 – Article 50:

a) The Original Rule: Article 50: When a motor vehicle is reversing, the situation behind the vehicle shall be ascertained and the vehicle shall be reversed after confirming that it is safe. Do not reverse in railway crossings, intersections, one-way roads, bridges, sharp bends, steep slopes, or tunnels.

b) STL Formula:

$$
\begin{aligned}
&G(PriorityNPCAhead \vee crosswalkAhead(realvalue) \\
&\implies gear \neq REVERSE)
\end{aligned}
$$

13) Traffic Rule 12 – Article 51:

a) The Original Rule: Article 51: Motor vehicles passing through intersections controlled by traffic lights shall pass in accordance with the following regulations:

(1) At an intersection with a guide lane, drive into the guide lane according to the required direction of travel;
(2) Those who are preparing to enter the roundabout let motor vehicles already in the intersection go ahead;
(3) When turning to the left, turn to the left of the center of the intersection. Turn on the turn signal when turning, and turn on the low beam when driving at night;
(4) Pass in turn when encountering a release signal;
(5) When the stop signal is encountered, stop outside the stop line in turn. If there is no stop line, stop outside the intersection;
(6) When turning right when there is a car in the same lane waiting for the release signal, stop and wait in turn;
(7) At intersections with no direction indicator lights, turning motor vehicles let straight vehicles and pedestrians go first. Right-turning motor vehicles traveling in the opposite direction let left-turning vehicles go first.

b) STL Formula:

(3)

$$
\begin{aligned}
&G(((trafficLightAhead.color = Green \vee \\
&trafficLightAhead.left.color = Green) \wedge \\
&direction = left \wedge Time \leq 20:00 \wedge time \geq 7:00 \\
&\implies turnSignal = left) \wedge \\
&((trafficLightAhead.color = Green \vee \\
&trafficLightAhead.left.color = Green) \wedge \\
&direction = left \wedge \\
&(time \geq 20:00 or time \leq 7:00) \\
&\implies turnSignal = left \ \wedge \ lowBeamOn))
\end{aligned}
$$

(4)

$$
\begin{aligned}
&G((trafficLightAhead.color = Green \vee \\
&trafficLightAhead.direction.color = Green) \wedge \\
&(\neg NPCAhead(realvalue) \vee \\
&((NPCAhead(realvalue) \implies \\
&F[0, realvalue](NPCAhead.speed > realvalue)) \wedge \\
&(NPCAhead(realvalue))) \\
&\implies F[0, realvalue](speed > realvalue))
\end{aligned}
$$

(5)

$$
\begin{aligned}
&G((trafficLightAhead.color = Red \vee \\
&trafficLightAhead.direction.color = Red) \wedge \\
&(stoplineAhead(realvalue) \vee \\
&junctionAhead(realvalue) \vee NPCAhead(realvalue)) \\
&\implies F[0, realvalue](speed < realvalue))
\end{aligned}
$$

(6)

$$
\begin{aligned}
&G(F[0, realvalue](NPCAhead.speed < realvalue) \wedge \\
&direction = right \wedge NPCAhead(realvalue) \\
&\implies F[0, realvalue](speed < realvalue))
\end{aligned}
$$

(7)

$$G(signalAhead = Common \wedge (direction = right \vee direction = left) \wedge (PriorityNPCAhead \vee PriorityPedsAhead) \implies F[0, realvalue](speed < realvalue))$$

14) Traffic Rule 13 – Article 52:

a) The Original Rule: Article 52: When a motor vehicle passes through an intersection that is not controlled by traffic lights or commanded by traffic police, in addition to complying with the provisions of Article 51 (2) and (3), it shall also comply with the following provisions:

(1) If there are traffic signs and markings, let the party with priority to go first;
(2) If there is no traffic sign or marking control, stop and look at the intersection before entering the intersection and let the traffic on the right road go first;
(3) Turning motor vehicles let straight vehicles go first;
(4) A right-turning motor vehicle driving in the opposite direction will let the left-turning vehicle go first.

b) STL Formula:

(2)-(4)

$$G(signalAhead = None \wedge junctionAhead(realvalue) \implies F[0, realvalue](speed < realvalue\ U\ (\neg PriorityNPCAhead)))$$

15) Traffic Rule 14 – Article 53:

a) The Original Rule: Article 53:

(1) When a motor vehicle encounters a traffic jam at an intersection ahead, it shall stop and wait in turn outside the intersection and shall not enter the intersection.
(2) When a motor vehicle encounters a motor vehicle in front of the vehicle parked in a queue or is driving slowly, it shall be queued in sequence, and shall not pass through or overtake from both sides of the vehicle in front and shall not park and wait in the area of crosswalks or mesh lines.
(3) When a motor vehicle is at an intersection or road section with reduced lanes, if there is a motor vehicle in front of the vehicle parked in a queue or driving slowly, one vehicle in each lane shall alternately drive into the intersection or road section with reduced lanes.

b) STL Formula:

$$G(isTrafficJam \wedge NPCAhead(realvalue) \vee junctionAhead(realvalue) \implies F[0, realvalue](speed < realvalue))$$

16) Traffic Rule 15 – Article 57:

a) The Original Rule: Article 57: Motor vehicles shall use turn signals in accordance with the following provisions:

(1) When turning left, changing lanes to the left, preparing to overtake, leaving a parking place or turning around, the left turn signal shall be turned on in advance;
(2) When turning right, changing lanes to the right, driving back to the original lane after overtaking, or stopping by the side of the road, the right turn signal should be turned on in advance.

b) STL Formula:

(1)

$$G(direction = left \implies turnSignal = left)$$

(2)

$$G(direction = right \implies turnSignal = right)$$

17) Traffic Rule 16 – Article 58:

a) The Original Rule: Article 58: When a motor vehicle is driving at night without streetlights, poor lighting, or low visibility conditions such as fog, rain, snow, sand, hail, etc., it shall turn on the headlights, position lights and rear position lights, but when the vehicle behind and the vehicle in front driving in the same direction are driving at close distances, the high beam shall not be used. When a motor vehicle is driving in a foggy day, the fog lights and hazard warning flashes should be turned on.

b) STL Formula:

$$G((((\neg streetLightOn \wedge (Time \geq 20:00 \vee Time \leq 7:00)) \vee (Weather.rain \geq 0.5 \vee Weather.fog \geq 0.5 \vee Weather.snow \geq 0.5)) \wedge \neg NPCAhead(realvalue) \implies highBeamOn) \wedge (NPCAhead(realvalue) \implies \neg highBeamOn) \wedge (Weather.fog \geq 0.5 \implies fogLightOn \wedge warningFlashOn))$$

18) Traffic Rule 17 – Article 59:

a) The Original Rule: Article 59: When a vehicle passes sharp bends, slopes, arch bridges, crosswalks or intersections without traffic lights at night, it shall alternately use far and near lights. When a motor vehicle is approaching sharp bends, the top of a ramp and other road sections that affect the safe sight distance, as well as overtaking or in an emergency, the vehicle should slow down and honk the horn.

b) STL Formula:

$$G(((specialLocationAhead.type = SharpTurn \wedge specialLocationAhead(realvalue)) \vee (specialLocationAhead.type = SteepSlope \wedge specialLocationAhead(realvalue)) \vee (specialLocationAhead.type = ArchBridge \wedge specialLocationAhead(realvalue)) \vee crosswalkAhead(realvalue) \vee (signalAhead \neq None \wedge stoplineAhead(realvalue))) \wedge (Time \geq 20:00\ or\ Time \leq 7:00) \implies ((highBeamOn \wedge (highBeamOn \implies F[0,\ realvalue](lowBeamOn))) \vee (lowBeamOn \wedge (lowBeamOn \implies F[0,\ realvalue](highBeamOn))))) \wedge G((specialLocationAhead.type = SharpTurn \wedge specialLocationAhead(realvalue)) \vee isOverTaking \implies (\neg F[0,\ realvalue](brake \leq realvalue)) \wedge hornOn)$$

19) Traffic Rule 18 – Article 62:

a) The Original Rule: Article 62: Driving a motor vehicle shall not have the following behaviours:

(4) Turn off the engine or slide in neutral when descending a steep slope;

(8) Honk horns in areas or road sections where honking is prohibited.

b) STL Formula:

(4)

$$G(specialLocationAhead.type = slope \wedge specialLocationAhead(realvalue) \implies engineOn \wedge gear = DRIVE)$$

(8)

$$G(\neg honkingAllowed \implies \neg hornOn)$$

20) Traffic Rule 19 – Article 64:

a) The Original Rule: Article 64: When a motor vehicle is passing a Manshui Road or Manshui Bridge, it shall stop and check the water conditions, and after confirming safety, pass at low speed. Not suitable for ego.

b) STL Formula:

$$G(specialLocationAhead.type = FloodRoad \vee specialLocationAhead.type = FloodBridge \implies F[0, realvalue](speed < realvalue \wedge toManual))$$