



## **FIRA 2025 - FIRA Challenge - Autonomous Cars Simulation (U19/Pro) - Laws of the game**

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### **Abstract of the competition**

The purpose of the FIRA Autonomous cars race Competition is to encourage researchers to develop and work in this field. Due to the spread of Coronavirus and the problems of holding competitions in person, the National Robotics Committee of the Islamic Republic of Iran, FIRA, will hold this attractive league for researchers this year as a simulation and online. The Autonomous cars League includes two separate sections, race and urban driving.

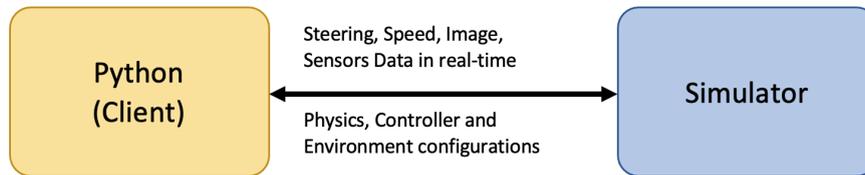
### **[FAC-1] Autonomous car league scenario**

In the Autonomous cars League, the car must automatically use intelligent driving in both urban and driving environments. In the Autonomous cars League, in both environments, the car uses image processing, distance sensors information, and traffic signs to drive automatically.

### **[FAC-2] Simulator**

Participants can download and run the simulator software according to the operating system from the competition website. Details of the simulation environment and supported programming languages are available on the competition website. The

performance of the autonomous cars will be judged automatically in the simulator environment, and the full video of the race send to the technical committee.



### **[FAC-3] Competition structure**

The competition consists of two preliminary and final stages, and according to the scores obtained in the preliminary stage, some teams will advance to the final stage. The scores obtained in the preliminary stage will be eliminated by entering to the final stage, and the teams that have received permission, enter the final stage with zero scores.

The competition consists of two parts, each of which has its scoring method, and the score of each team will be the total score earned in both sections.

The first part of the competition will be the Autonomous Race, in which the car in the simulator environment must automatically pass the race track one or more laps. The second part of the competition is called Autonomous Urban Driving, in which the car must perform specific tasks, such as driving according to the traffic signs. Both sections will be introduced in more detail below. Participants can participate in one or both league sections.

### **[FAC-4] Race competition**

1. In the race competition section, the car must automatically pass the checkpoints placed on the road.
2. The number of remaining and earned checkpoints is indicated by the simulator.
3. In this section, each team will have a specific time and at this time can only start the match once. (Before the match starts, teams have a short time to check the execution of their code in the refereeing system)
4. The color of the road lines in the race competition (yellow-white).
5. Checkpoints are marked with colored lines along the road.

6. Depending on the stage, there may be obstacles on the street, and if the car hits them, the competition will end.

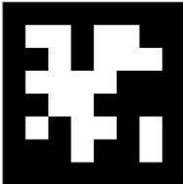
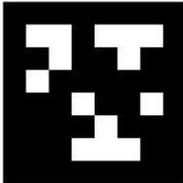


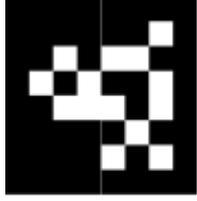
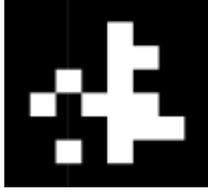
Figure 1: A Screenshot of the simulator.

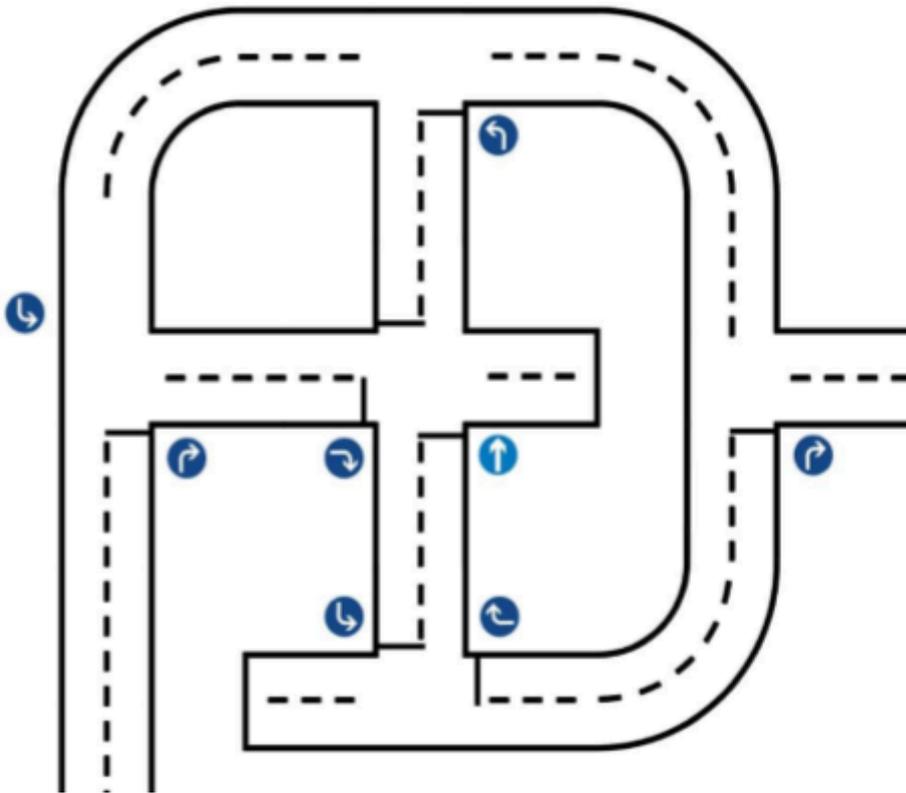
### [FAC-5] Urban competition

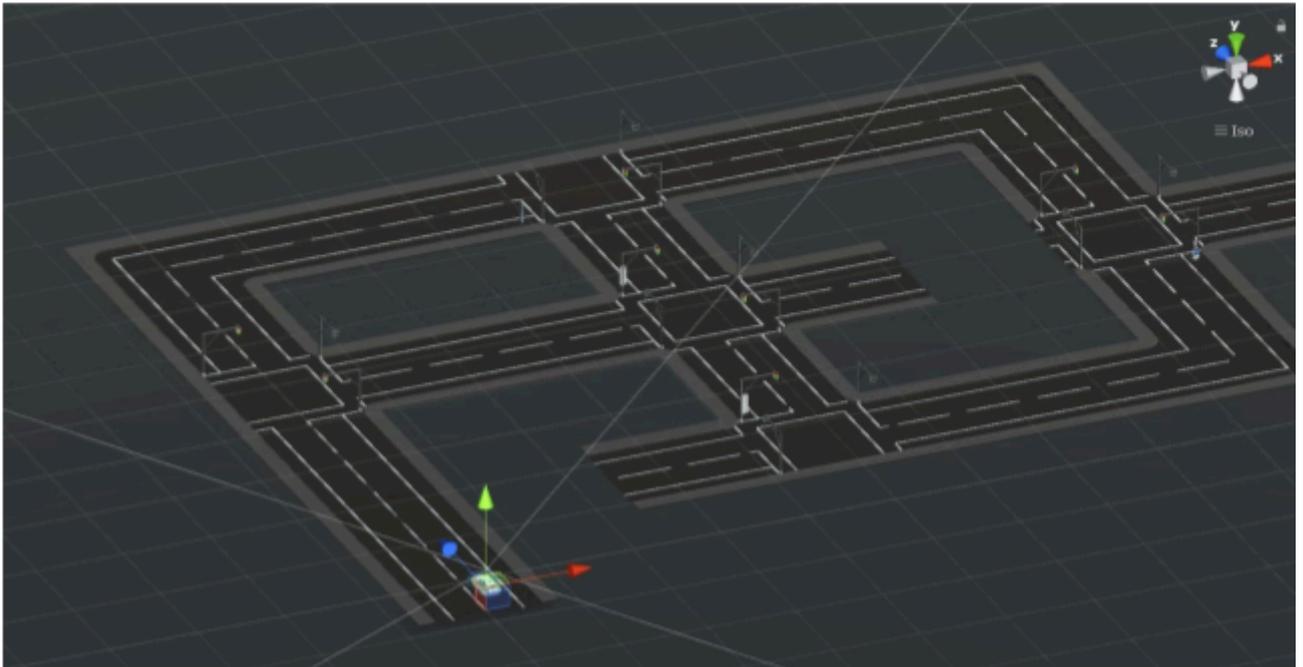
1. In urban driving competitions, the car must be driven automatically in the urban environment by traffic signs, street lanes, pedestrian lanes, and other environmental information.
2. The color of street lines in the urban environment is white.
3. There are many checkpoints on the streets. Every wrong car decision will cause you to lose points, described in detail in the scoring model.
4. In this part of the match, each team has a specific time and **can start the match only once**. (Before the match starts, teams have a short time to check the execution of their code in the refereeing system.)

5. There are traffic signs and tags at intersections, and failure to correctly identify each will fail to continue and loss of subsequent checkpoints.
6. At the intersections, there are horizontal lines that indicate reaching the crossroads.
7. At the intersection, the car must stop for at least 3 seconds and then continue moving.

Sign Name	Sign Picture	Sign Marker	Car Decision
No Entry			Should not enter the street which has this sign in the beginning of it.
Dead End			Should not enter the street which has this sign in the beginning of it.
Proceed Right			Should choose the road on the right of the junction
Proceed Left			Should choose the road on the left of the junction.
Proceed Forward			Should proceed forward.

<p>Stop</p>			<p>Should stop (this is the destination).</p>
<p>Start the tunnel (after 2023)</p>			<p>The lighting conditions change and the car's headlights have to be turned on.</p>
<p>The end of the tunnel (after 2023)</p>			<p>End of tunnel and turn off car lights</p>





8. The car must start by announcing the start of the race of the simulator and stop by following the traffic signs at the destination where the "stop" sign is located.

9. There is at least one checkpoint between the two intersections, and any wrong decision at the crossroads will deduct points, and the car will not be able to continue competing.
10. The car must move between street lines (in the right lane) unless it exits the right lane to avoid an obstacle. (In the new version of the simulator, to earn checkpoints, the car must be in the correct line)
11. Depending on the stage, there may be obstacles on the street, and if the car hits them, the competition will end.



### **[FAC-6] Virtual competitions**

- Before each match and at the time set by the referee, the teams are required to send their final project file to the technical committee. The teams' evaluation in each competition will be based on the latest files submitted until the appointed time. The received files will not be accepted after this time.
- All of the competitions will be broadcast live on some social media, and teams can watch the competitions.
- Details on how to hold the tournament will be announced to the teams in the coming days. Please follow the next announcements.
- Each team must nominate one person as a leader to the technical committee to submit the files for each round.

### [FAC-7] Autonomous Race Scoring Model

During the race part, a score will be calculated based on the total time ( $T_{total}$ ) and the number of checkpoints gained (cp). Total time is the sum of the time taken for the car to complete the track or pass some checkpoints and other penalties that will be added to total time depending on how well the car has followed the track autonomously. The penalties table is shown below:

Penalty Definition	Penalty Time
Skipped checkpoint (each)	$+ 0.5 * \frac{T_{stage}}{\text{Number of all checkpoints}}$ (s)

A score of this part is calculated using the following formula:

$$S_{AR} = (1 + \max\{\frac{T_{stage} - T_{total}}{T_{stage}}, 0\}) * 35 * cp$$

The stage time ( $T_{stage}$ ) is the amount of time each team has to do the race in each stage which will vary between preliminary and final stage. **For example, if a team is given 200 seconds and can finish the competition in 100 seconds and not lose any checkpoints (for example, if it scores 14 checkpoints), it will receive 735 points.**

### [FAC-8] Autonomous Urban Driving Scoring Model

In this part, cars have to start from a starting point and navigate in the streets according to the signs and reach the destination point. Each checkpoint reached by car has 60 points. The sum of these points minus the sum of the penalty points each car received during its navigation will be the score of this part. The penalty points table is shown below:

Penalty Definition	Penalty Points
No stop injunction	-10
The incorrect decision injunction	-30
Incorrect lane change (once between two junctions)	-20

$$S_{AUD} = \{60 * (\text{number of checkpoints})\} - (\text{sum of penalty points})$$

If the two teams' scores are the same in this section, the team that finishes in a shorter time will win.

Wrong decisions at the crossroads and choosing the wrong path will be considered as finishing the round.

### **[FAC-9] Total Score**

The total score is the sum of the autonomous racing and autonomous urban driving scores:

$$S_T = S_{AR} + S_{AUD}$$

### **Notes:**

- The finish line is considered a checkpoint.
- The car must be entirely inside the road while passing a checkpoint; otherwise, the checkpoint will be considered a miss.
- The scores of each part can not become negative.
- If the car hits an obstacle, the run is considered finished. If the car gets out of the road in an urban environment, it will be considered as a collision with the road barrier and the round will be finished.
- The total time of autonomous race competition is determined so that the maximum points obtained in the autonomous race competition and Autonomous Urban Driving competition are approximately the same.
- After the judgment of the final stage and determining the top teams, they are required to send the codes and algorithms to the technical committee. After reviewing the codes and algorithms by the technical committee, the final teams will be determined.
  
- Teams can participate in one or both sections and be ranked.
  
- The round ends when the participant notifies the referee that the match is over or the car hits an obstacle.

### **[FAC-10] Technical and video documents**

Each team has to send a technical document as well as a Video from their car in the simulator environment. The technical document should contain information about codes and algorithms.