

2025 ACC Self-Driving Competition

Competitor Guide for Stage 2 and 3



ACC SELF-DRIVING COMPETITION

In recent years, Self-Driving has become increasingly prevalent around the world. With the advent of Self-Driving cars hitting the roads, the demand for research behind Self-Driving is at an all-time high and algorithms need to be validated for safety and reliability. There are an infinite number of situations encountered daily by drivers that can vary drastically. An algorithm needs to be able to identify the scenario and accurately respond with a correct behavior. At their core, Self-Driving cars excel or are held back in their capacity for autonomy by their knowledge and understanding of the state of the environment surrounding the car. The ACC competition presents a great opportunity to showcase world-class driving algorithms running in a safe and approachable manner at a 1/10th scale.

Competition Outline

Welcome to the 2025 ACC Self-Driving Car Student Competition Stage 2 and 3 powered by Quanser! Congratulations on making it to the second and third stages! The competition details are outlined below.

Stage	Description	Date
Stage 3 (In-person Event)	Physical Implementation	May 1 – July 6
	Check In and Setup	July 7 (morning)
	Practice Session 1	July 7 (evening)
	Practice Session 2	July 8 (morning)
	Phase 0	July 8 (evening)
	Phase 1	July 9 (morning)
	Phase 2	July 9 (afternoon)
	Awards Ceremony	July 9

Table 1: Competition Schedule.

The phases will be described further in the Competition Structure section.

➤ Stage 2 Objective

Each team will have access to a QCar 2 and will implement the algorithm they developed in Stage 1 on the physical hardware.

All teams who were chosen to advance to Stage 2 will also advance to Stage 3. Stage 3 will be held in Denver, Colorado, USA. During Stage 2, teams will need to prepare to travel to the American Controls Conference, which will involve the following:

- Obtaining VISAs to The United States of America.
- Getting your team's QCar 2 to the venue.

➤ Stage 3 Objective

Stage 3 is the in-person event and will determine the winner of the 2025 ACC Self-Driving Car Competition. The event will be held in Denver, Colorado at the American Controls Conference.

The objective of the competition will be to maximize the amount of money earned by completing taxi rides within a certain amount of time. All teams will be given a .txt file that contains the different rides they can attempt. Rides can have multiple stops, which will add complexity. Teams will earn more money for more complex rides.

The first coordinate in a ride will always be the Pickup location. Teams must indicate a pickup by changing the QCar 2 LED strip to **Blue** and wait for clearly stop at the pickup location.

The last coordinate in a ride will always be the Drop Off location. Teams must indicate a drop off by changing the QCar 2 LED strip to **Yellow** and clearly stop at the drop off location.

Any coordinates in a ride that aren't the first and last coordinates will be a Stop. Teams must indicate a stop by changing the QCar 2 LED strip to **Red** and clearly stop at the stop location.

When driving between any coordinates, teams must change their LED strip to **Green**.

The sequence of a single ride will consist of the following:

1. The QCar 2 will start in the Taxi Hub Area with **Magenta** LEDs and must be clearly stopped.
2. Teams will need to write down the ride number they are attempting and show the judges. A whiteboard or other device will be provided.
3. Teams will need to navigate to the pickup location with their LEDs **Green**.
4. Once the QCar 2 has arrived at the pickup location, it must clearly stop and change the onboard LED strip to **Blue**.
5. If there are any stops in the ride, teams will need to navigate to the stop location with **Green** LEDs, then come to a clear stop at the stop location and change the LED strip to **Red**.
6. For the final coordinate, teams will need to navigate to the drop off location with **Green** LEDs, then come to a clear stop at the drop off location and change the LED strip to **Yellow**.
7. Once the drop off has been completed, teams will need to navigate back to the Taxi Hub Area with **Green** LEDs, come to a clear stop, and change their LEDs to **Magenta** to signal the end of the ride.

Once all the above steps have been completed, the judges will mark down the successful completion of a ride. The team will receive a preset dollar amount for the completion of the ride. The team will also receive a rating for the ride based on whether they followed the rules of the road correctly. Infractions will lower the rating the team receives. Please refer to the Ratings section for details.

If the team feels they want to restart the ride or they think they have received too many infractions, they can pick up their QCar 2 and place it back in the Taxi Hub Area. Any time a team touches their QCar 2, it will disqualify that ride, and they must place it back in the Taxi Hub Area.

Teams may repeat the same ride number as many times as the wish. Only the best rated, completed ride for a specific ride number will contribute towards the total money earned. Any lower rated rides for the same ride number will be discarded.

➤ Ratings

Ratings will be given after every ride completion. The ride rating will be out of 5 stars. All rides will start with a 5-star rating and stars will be deducted based on the following table:

Note: This table is subject to change and should only be used as a guideline for things to avoid. The judges reserve the right to make changes as needed.

Infraction	Description	Star Deduction
Minor Lane Departure	Drives over line/sidewalk briefly and by less than approximately 1 car width as determined by the judge	1

Infraction	Description	Star Deduction
Major Lane Departure	Drives over line/sidewalk by for a significant amount of time and by less than 1 car width as determined by the judge	2
Disqualifying Lane Departure	Drives over line/sidewalk by more than 1 car width	5
NOTE: If there is an obstacle blocking a lane. The QCar 2 may enter oncoming traffic to avoid the obstacle. The QCar 2 may not go off road.		
Does not full stop at a stop sign	Wheels do not come to a full stop at the stop sign	2
Does not stop at a stop sign	Does not slow down or minimally slows down for the stop sign	2
Stops over the white line for a stop sign	Front wheels are on or in front of the white line	1
Stops over the white line or in a cross walk for the traffic lights	Front wheels are on or in front of the white line or the front wheels are in the crosswalk	1
Does not stop at a traffic light	Goes through a red light	2
Cone Collision	Collides with a cone	2
Obstacle Collision	Collides with an object that is not a cone	5
Failure to yield	Fails to yield at a yield sign when the car doesn't have the right of way	2
Incorrect QCar 2 LED Strip colour (per infraction)	Fails to change QCar 2 LED strip to the correct colours laid out in the Stage 3 Objective section	1
Failure to stop in the correct area for a pick-up, stop, or drop-off	A mark zone will show where the stopping locations are for a pick-up, stop, and drop-off. Failure to stop within that zone is a penalty.	1

Table 2: Infractions and resulting penalty.

For timings, approximate distances and speeds judges will be using their own judgement. All decisions made by the judges in the moment will be final unless overruled by another judge. Please respect their decisions.

🚦 Scoring

The scoring will consist of 2 parts, the value of the ride and the rating received for the ride. Each ride will have a dollar value associated with it depending on the complexity. This dollar value will be multiplied by the number of stars received in the rating for the ride. Here are some examples:

Formula:

$$\text{Ride Value} * \text{Rating} = \text{Total Money Earned}$$

Ride #	Ride Value	Rating (Stars)	Total Money Earned
1	\$3	3	\$9
4	\$2	5	\$10
8	\$5	0	\$0

Table 3: Example scoring

The judges will be keeping track of the completed rides and the rating received for that ride.

➤ Competition Structure

There will be 3 phases for the competition portion. They are outlined in the table below:

Phase	Description
Phase 0	This is a trial phase for the competition. The competition roadmap will be set up and teams will complete their run. Judges will score each team, and all the teams will be ranked. The higher the rank a team receives in Phase 0, the later they will go in Phase 1.
Phase 1	This will be an elimination phase. Teams will complete their run and receive scores from the judges. The top 3 teams will move on to Phase 2.
Phase 2	This is the final phase and will determine the winner of the competition. Teams will complete their run and receive scores from the judges. The team with the highest score will win!

During each phase of the competition teams will get 1 run. 1 run will consist of a 5-minute time period to complete as many rides as possible.

During each of the phases in the competition, the signs can be moved around, and obstacles may be placed on the map. Changes to the map will be made based on the skill level of the participants. Slight adjustments to the rules may be made to make the competition fairer.

➤ Software Guidelines

All software will be allowed on the QCar 2, but the development team will only be supporting using ROS2 and the supplied Docker containers.

If you decide to install/upgrade packages in the native OS on the QCar 2, it is possible to cause irreparable damage to the OS. The latest operating system installed on the Quanser QCar 2 is a customized version of Linux for Tegra from JetPack 5.1.4. Please refer to the Software section [here](#) if you plan on doing this.

➤ Supporting Documentation

All technical documentation will be hosted on the [Github](#)

➤ Competition Roadmap:

Figure 2 shows the competition roadmap and dimensions. Note that this has not been shipped with the package sent out to students.

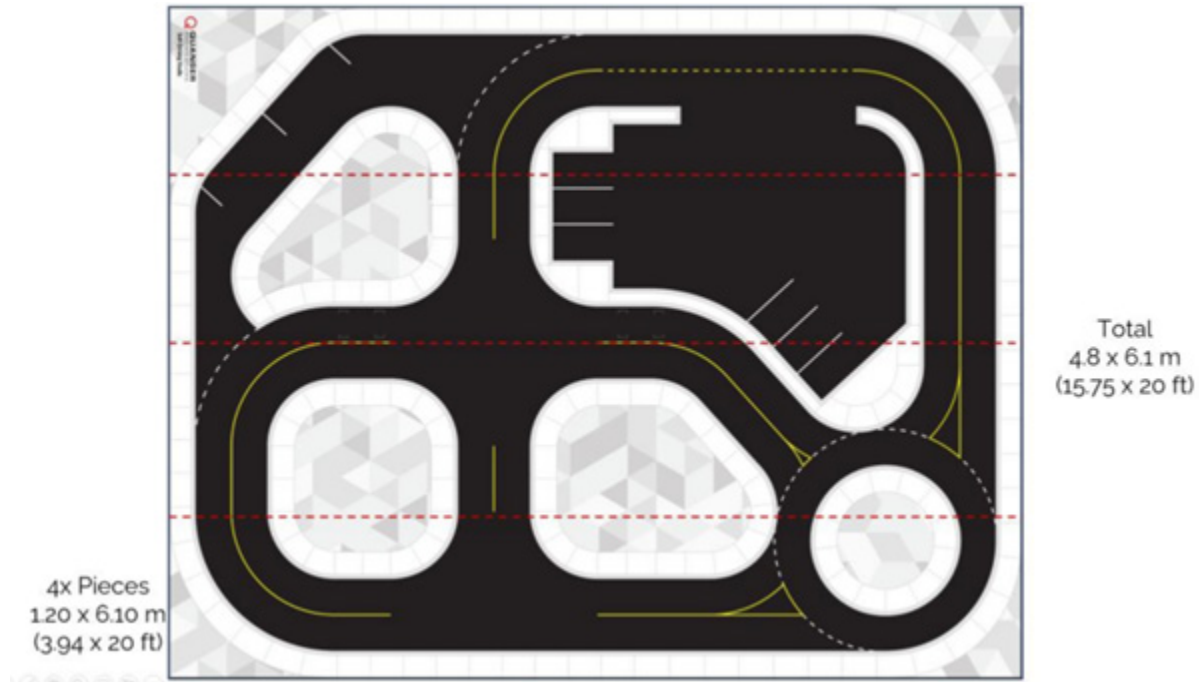


Figure 2: Dimensions of the Competition Roadmap.

A PDF has been included in the competition resources that can be used to print the mat.

Students may also use the virtual competition roadmap since all dimensions are 1:1 with the real world. You can use the coordinate helper in Quanser Interactive Labs to measure distances:



Figure 3: Using coordinate helper in Quanser Interactive Labs.

➤ **Competition Stop Sign:**

The competition stop sign is a **regular octagon with side lengths 25.5mm**. Here is a picture of the stop sign that will be used in the competition:



Figure 4: Stop sign that will be used in competition.

Please keep in mind that Quanser may alter the aspects of the stop sign including height, dimensions, or colour.

➤ **Competition traffic light:**

The competition traffic light is a 58mm by 120mm rectangle raised about 40cm off the ground. Here is a picture of the traffic light that will be used in competition:



Figure 5: Traffic Light that will be used in competition.

Please keep in mind that Quanser may alter the aspects of the traffic light including height, dimensions, or colour.

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