AutoAuto Challenges

AutoAuto challenges are hands-on, project-based learning opportunities for teams of students to learn and compete using AutoAuto hand-held autonomous cars. In these challenges, students will be exposed to high-demand industry skills such as Python programming, Machine Learning, Data Science, and Artificial Intelligence (AI) through the application of self-driving cars in various competition settings.

Tournament Overview

The tournament using AutoAuto cars combines multiple challenges geared for students and student teams of different ages and skill levels. Teamwork, problem-solving skills, time management, precision planning, and pre-rehearsal should be on display at the tournament. Student teams move from one challenge to the next. Each station is facilitated by one or two guides / judges that will explain the rules of each challenge and facilitate the competing teams through each challenge, making sure rules are kept, scores are documented, and students are engaged and having fun. Ultimately, however, students should have fun while showing off their programming, robotics and STEM knowledge.

Role swap

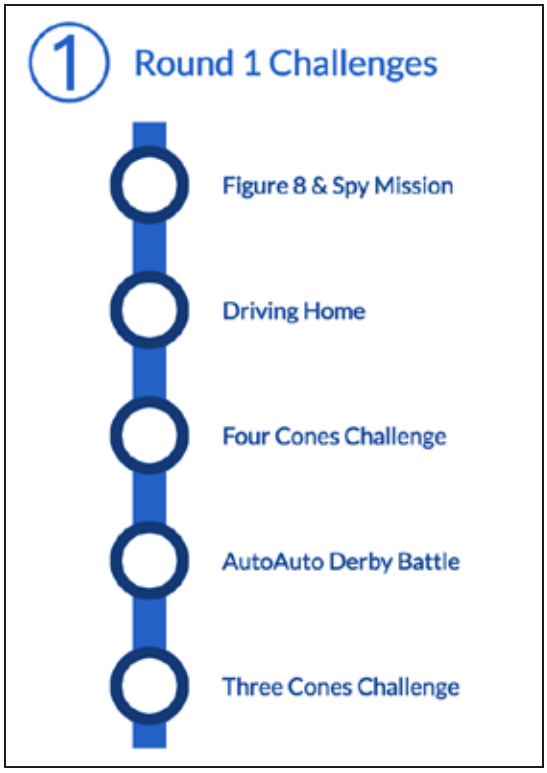
The judge may switch roles on the spot, i.e. that an engineer for the current challenge would be the programmer for the next challenge.

Scores

The tournament should involve brackets and a scoring system that rewards the winning teams for their accomplishments. Moving through brackets is highly motivating for student teams. At the end, winning teams are awarded a trophy and/or prize that the student will be proud to own. The point of the prizes is to recognize student achievement for their computer science, robotics and STEM knowledge and skills. Prizes could be donated by local businesses, the tournament organizer, by participating schools, etc.

Challenges Lineup

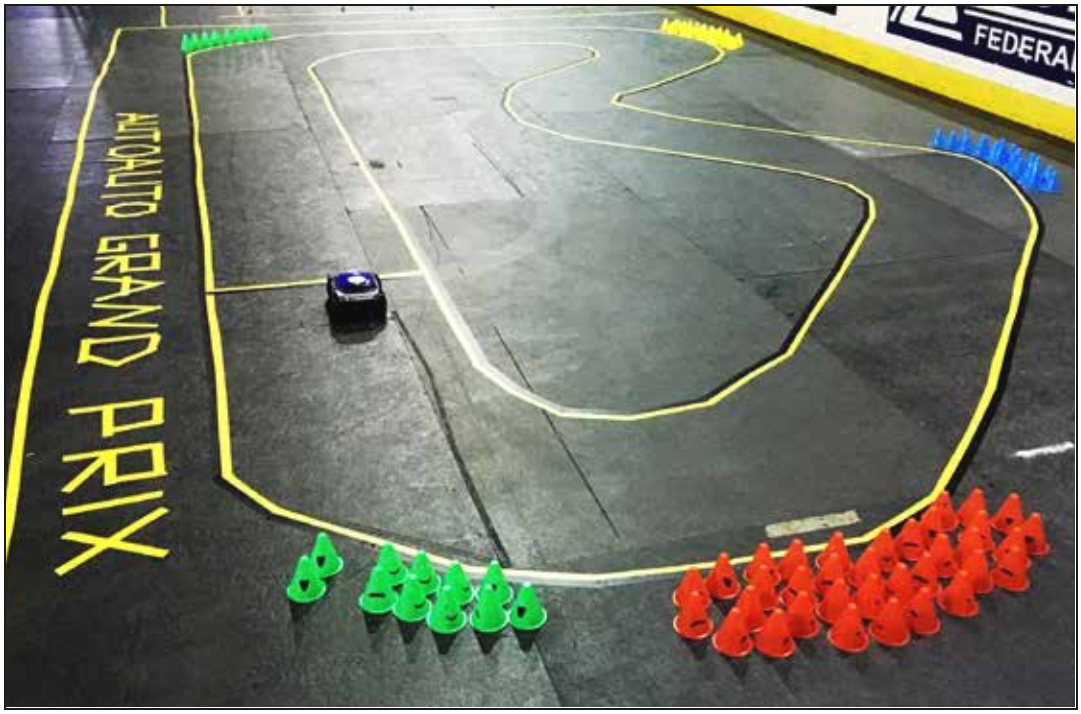
Challenges include three rounds, as shown below. While participating students can be given access to select challenges before the tournament for their own preparation, we do not recommend sharing with students the entire 2020 tournament lineup before the event starts, as students should be exposed to some on-the-spot challenges that they have not yet encountered or prepared for.



We recommend that some challenges from the lineup above should require planning, preparation, and pre-rehearsal that the student teams would undergo well before the event. Teams would come to the event having planned and pre-rehearsed challenges, and this could be a timed event. For example, the students could plan and design their city beforehand in their schools and then have a set amount of time to recreate it and then execute their programming of the AutoAuto cars to navigate and accomplish tasks within their smart city.

Setup

The tournament organizers decide on which challenges to offer student teams. These decisions are based on 1) how much space is available, 2) the number of computers and cars that are available, 3) the number of available guides and judges.



- At a minimum, you should have four rolls of 1” 60 yd masking or gaffer’s tape, in two colors that would contrast from each other and with the floor.
- Use as many traffic cones and pedestrian figurines as you have available.
- We recommend having about 12 - 16 cars (with 12 extra batteries), 12 - 14 laptop computers, and 5 - 10 guides/judges.
- Setting up ahead of time 2 - 4 challenge stations is recommended. Most of those stations can be reused for other challenges along the course of a day or two days of tournament. It may take 20 mins to one hour to set up each station.

Stations

Station One

Station One serves as a warm-up zone and is recommended if there are students who have not used the cars previously, or if there are elementary students competing. This station supports up to five groups competing at the same.

Challenges hosted

- 2 x Figure-8 challenges
- 2 x Mini spy missions
- 2 x Driving Home challenges
- 1 x Four cones challenge

Later on the day, or on the second day, this can also be the station for

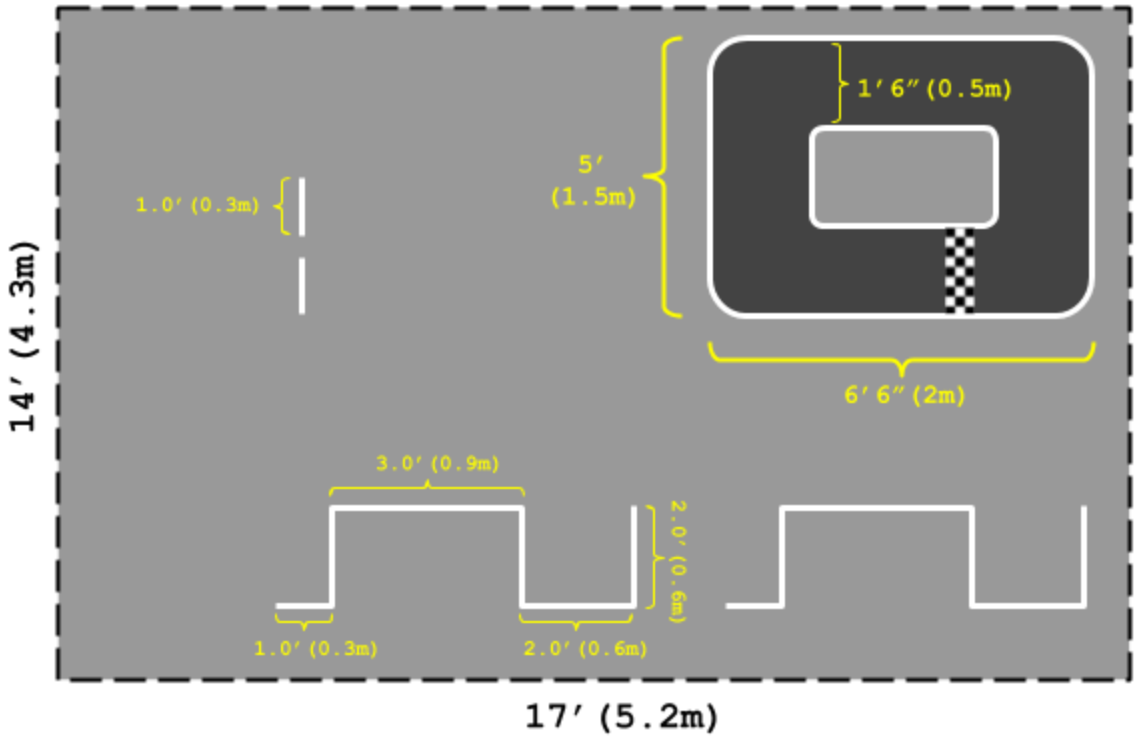
- Three Cones Challenge
- Car challenges with for loops
- Smart City Challenge

Materials

- 1 - 2 rolls of tape
- 4 - 14 traffic cones
- 4 - 8 figurines
- 2 - 4 stop signs.
- 3 - 5 cars
- 3 - 5 laptop computers
- 3 - 10 chairs
- 1 - 3 tables

Setup

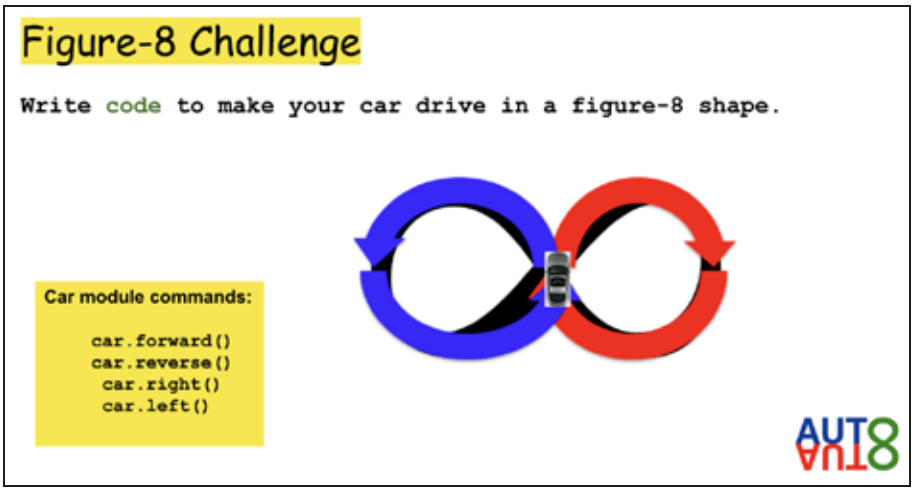
The setup for this station can be built in a similar way as illustrated. If you don’t have much space, you can choose to have only one of each challenge set.



Challenges Highlights

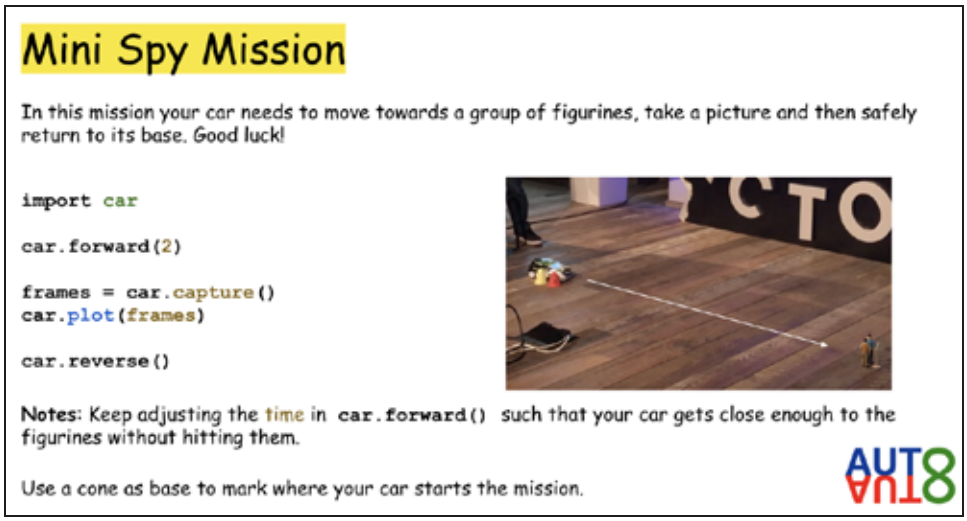
Figure-8 challenge

This is the first challenge where students start practicing **problem-solving skills** by making their cars drive in a figure-8 shaped path, using the commands they have available.



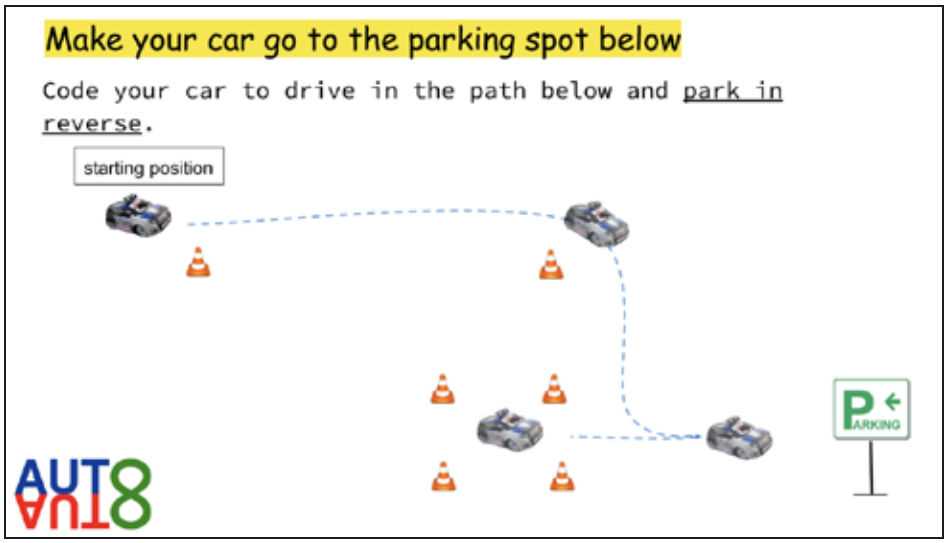
Mini Spy Mission

Students will be challenged to code the car camera to take pictures, in a spy mission.



Driving Home

Here students need to code their car with precision in order to make it drive home and reverse park successfully.



Station Two

Station Two is recommended for **3rd graders and up**. This station should use a bracket system and have two to four groups competing in each of the first two rounds. Up to eight teams competing in the same championship.

Challenges hosted:

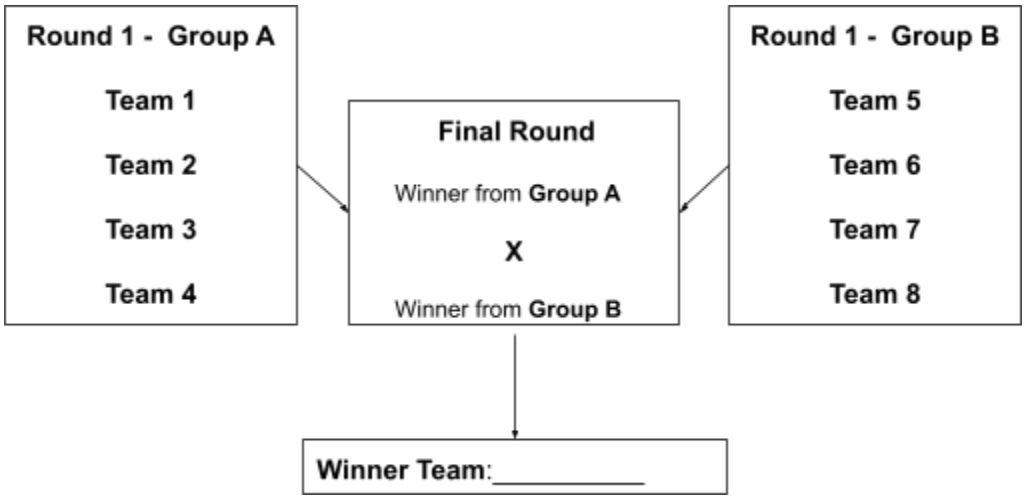
- AutoAuto Derby Battle

Later on the day, or on the second day, this can also be the station for

- Autonomous Rescue Mission
- Smart City Challenge

AutoAuto Derby Battle

In each championship, there should be two first rounds and one final round happening right after. A new championship may start again right after.

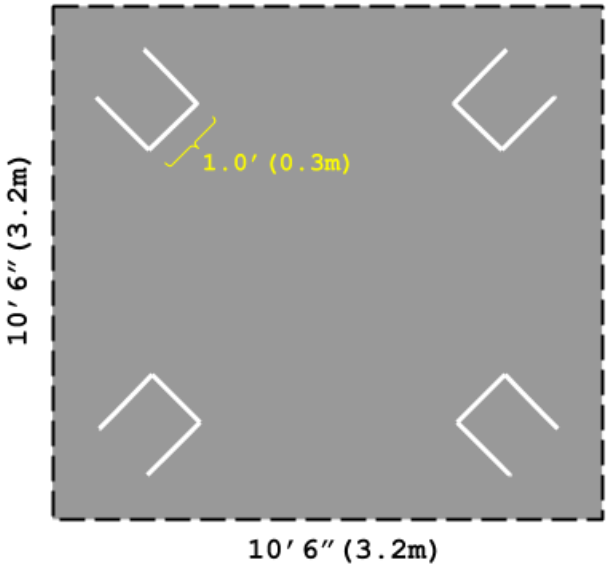


Materials

- 1 - 2 rolls of tape
- Mini post-it
- 2 - 4 cars
- 2 - 4 laptop computers
- 2 - 8 chairs

Setup

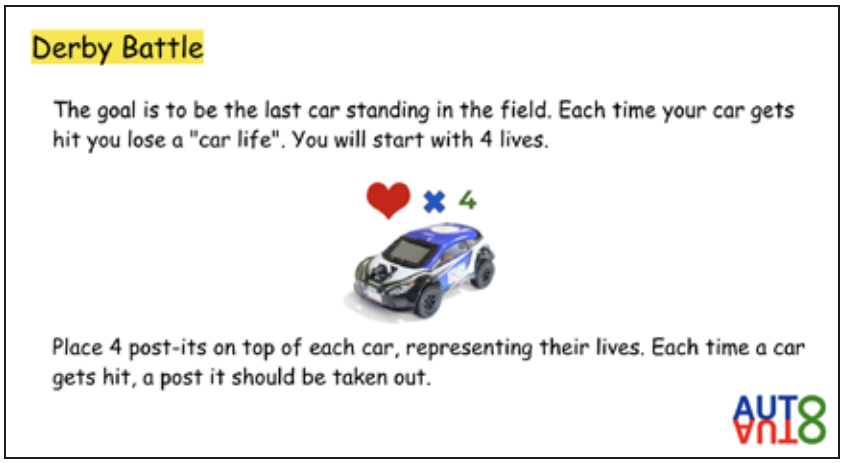
Station Two can be built in a similar way as illustrated.



Challenges Highlights

AutoAuto Derby Battle

In this challenge teams will need to write code to keyboard control their cars to avoid being hit and to hit other team's cars in order to win the game.



Autonomous Rescue Mission

In this mission students should write code to safely rescue civilians, bringing them to a hospital. They should also avoid contaminated zones while sending their cars autonomously to those locations. Students will be navigating the rescue zone using the cars camera by programming their cars to stream live images. Advanced students will be challenged with:

- Parallel programming.
- Setting up technology systems that utilizes a virtual reality headset such as the $15 cardboard Google smartphone-based headset to navigate the rescue zone.
- Design 3D printing accessories to best rescue the civilian figurines.

Station Three

Station Three is recommended for 6th graders and up. This station should use a bracket system for the first challenge and have two groups competing in each of the first two rounds. Up to four teams competing in the same championship.

Challenges hosted

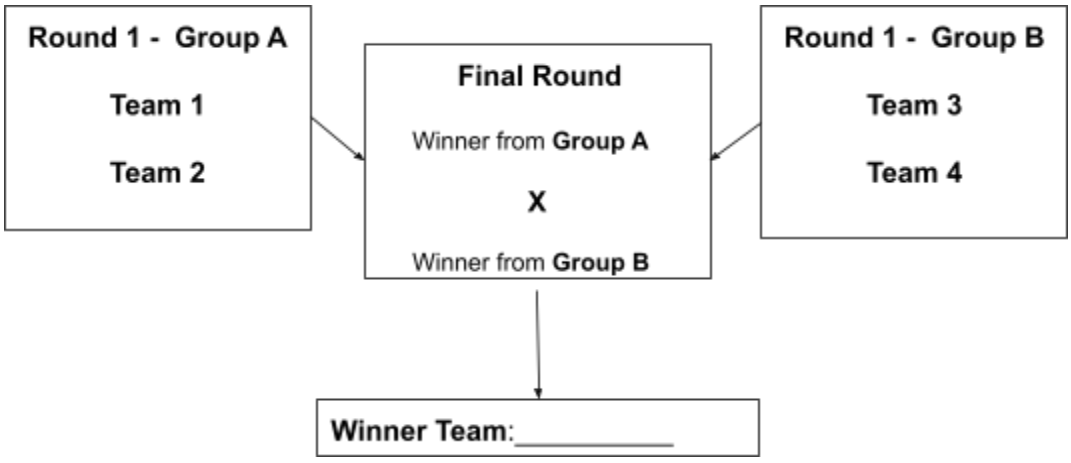
- Minefield Race

Later on the day, or on the second day, this can also be the station for

- Smart City Challenge

Minefield Race

In each championship, there should be two first rounds and one final round happening right after. A new championship may start again right after.

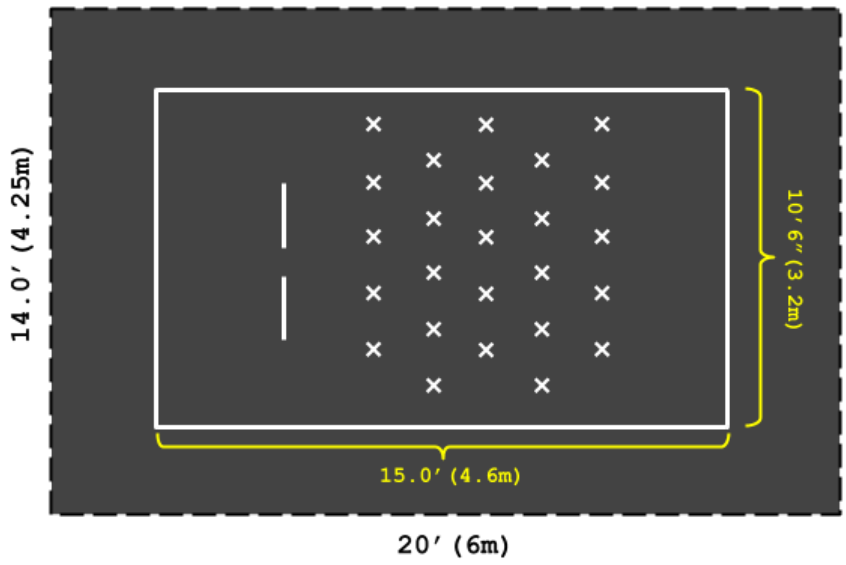


Materials

- 1 - 2 tapes
- 24 - 36 figurines
- 12 stop signs (optional)
- 2 cars
- 2 laptop computers
- 2 - 4 chairs

Setup

Station three should be built in a similar space as illustrated. The pedestrian figurines are placed in equal spacing with taped marks 2 feet (.6M) apart from each other. The subsequent line of figurines should be shifted in comparison to the previous line.



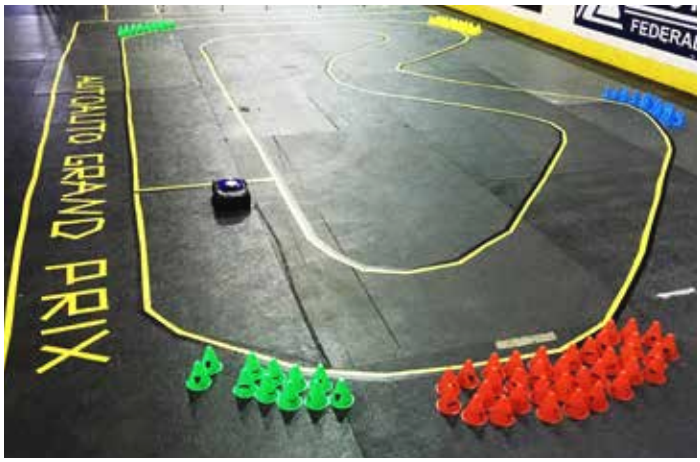
Challenge Highlights

The Minefield Race

The goal of this challenge is for the student's car to navigate through the "minefield" of pedestrians without hitting any of them!
Build an object-avoidance algorithm, using Computer Vision and Machine Learning, to successfully go through the minefield without hitting any pedestrians.
Advanced students will be challenged to write code to detect and respond to stop signs as well.

Station Four

Station Four is recommended for **1st graders and up**. For the Grand Prix this station should use a bracket system and have two to four groups competing in each of the rounds. Up to four teams competing in the same championship. This station should also have a different scoring system for the advanced challenges involving racing the cars.



Challenges hosted:

- **AutoAuto Grand Prix**

Later on the day, or on the second day, this can also be the station for

- Smart City Challenge

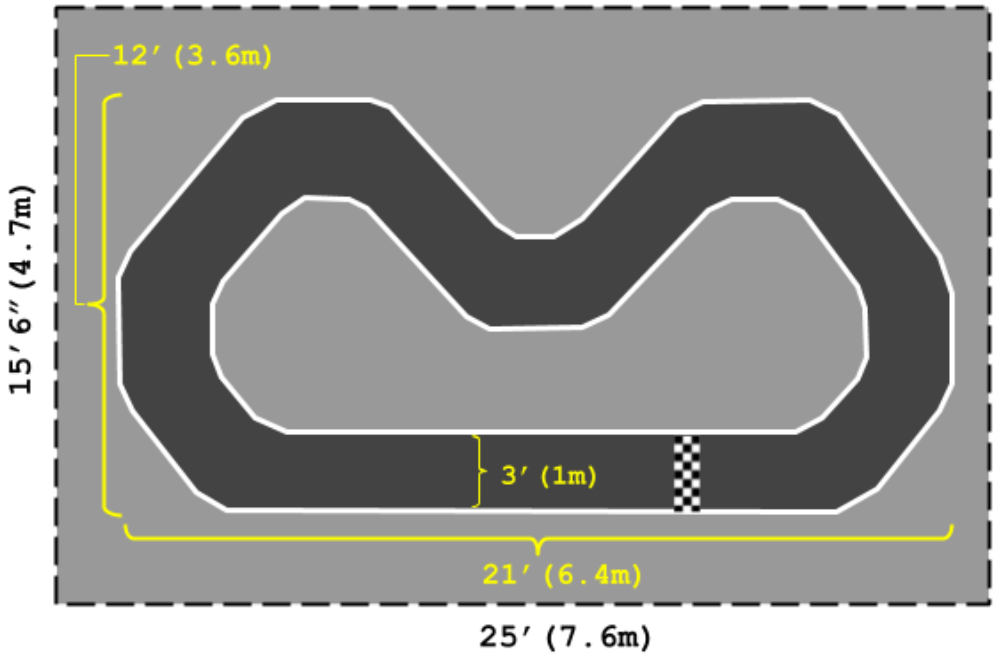
AutoAuto Grand Prix

In each championship, two to three cars could race at the same time and teams could also split apart on the initial bracket for better odds of winning.

Materials

- 2 - 3 rolls of tape
- 3 - 4 cars
- 2 - 3 remote controllers
- 25 - 30 traffic cones

Grand Prix Setup



The Grand Prix circuit can be built in a similar way as illustrated. This should allow for two or three cars to race at the same time. The starting point should be located at the beginning of the straight. The track should include groups of colorful traffic cones at the end of curves for a dramatic effect when the cars leave the track and crash into them.

Challenges Highlights

AutoAuto Grand Prix

Teams control the cars RC-style with handheld controllers; they can race each other inside the Grand Prix circuit. Cars can attempt to overtake one another and cause the other car to leave the track and even crash into cones to the delight of the spectators.

Advanced students will be also challenged with:

- Network programming cars to communicate in between them.
- Programming the controllers to add special features such as a boost button to be able to speed up for a few seconds.
- Building their own remote controllers.

Tournament Remarks

Ongoing "auxiliary challenges" could be happening on the side for additional skill-building, qualifying for bigger contests, etc. The idea is to keep all students engaged during downtime. For example, a shark tank-like competition where students would come up with a tech company idea and pitch their novel innovation to the judges.

Open or Modified category. One contest could involve the teams presenting a modified AutoAuto car that teams could design to accomplish exotic, advanced tasks. These may be considered for inclusion in future year tournaments and the winning teams are given a special award or recognition for the most innovative modifications to the car, e.g. mods that utilize the open ports on the car's computer, voice-commands, 3-D printable mods to the car, etc. AutoAuto cars have a high ceiling and offer the potential for creative modifications. This could be tied into the tournament in order to unleash the creative innovation of the students.

Main judges should undergo training before the event if possible. Training will be provided via a video call, or in person, if possible.