THE UNIVERSITY OF ALABAMA® | College of Engineering Computer Science

2023 Alabama Robotics Competition

Kachow! Start your engines!

This year's contest takes us back to the little town of Radiator Springs. You will help Lightning McQueen and his friends with three tasks that require you to autonomously control your robot.

Competition Rules and Problems

The following pages describe each event and an overview of how points are scored. The overall ranking for the awards ceremony is determined by the total of all three events. A tie-breaker is determined by the earliest clock time that the last set of points was earned. Each event will have two separate playing field instances to improve waiting time.

General Scorekeeping Rules

These rules are in addition to the rules available at http://outreach.cs.ua.edu/robotics-contest/rules.html.

1. The contest consists of 3 obstacle course problems that students can attempt through 2:30pm.
2. Each challenge is worth a maximum of 100 points.
3. The overall team score is the sum of all three scores (for a total possible score of 300). Ranking will be based on the overall combined score from the individual challenges.
4. The contest courses and associated problems will not be revealed until the beginning of the contest.
5. Teams may work on any problem in any order.
6. Some problems have disqualification measures (*e.g.,* going off the playing field, pushing an obstacle).
7. Each event must be completed within 60 seconds to receive points.
8. All courses will have a designated starting area.
    1. A contestant must start their robot with the robot completely within the starting area.
    2. The robot may face any direction when starting.
9. Students may not touch or remotely control the robot other than to initially place and start the robot.
10. After a robot is started, the contestant's turn begins. There is no redo once the start has commenced and a team must get back in line if they want to try again.
11. A team may try each course multiple times (maximum of 5 tries per problem).
    1. Teams must start at the back of the line for each new attempt.
    2. Each team may only be in line for one event at a time. It is not permissible to spread team members across multiple lines at any specific time.
    3. When multiple attempts are made for a specific obstacle course, the best score and earliest time of all attempts will be used in computing the overall score.
    4. Each team may attempt each problem only five times; the best of the top five scores will be used in computing a team's score for each problem.
    5. Teams may modify their programs and robot before making additional attempts to improve their score. Robots may not be altered such that there is a size violation (13in x 13in x 13in).
    6. Measurements on each field is allowed for 60 seconds per turn in line (students may only measure during this time, and then go back to the end of the line or their desk when done).

Tractor Tipping: Don't Wake up Frank!

Lighting McQueen has found himself in another tractor tipping adventure with Mater. Can you help him get out of this situation without waking up Frank?

Goal: Navigate Lighting back to the farm gate past each tractor without waking them up. Along the way, knock over a few bales of hay for fun to score points!

Problem: The field contains the following features:

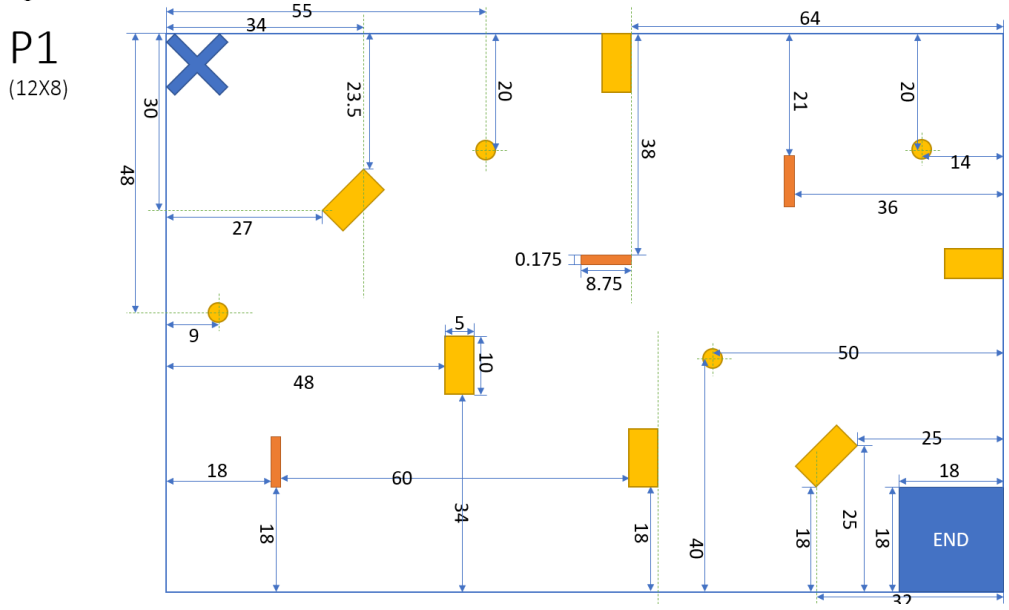
1. Staring point at the top left and the end at the bottom right (see diagram).
2. 6 large Tractors (bricks), 3 small Tractors (pylons), and 4 bales (balls) are on the playing surface.
3. Bales can be touched to score points, but **must not roll and hit a tractor.**

Robot Movement:

- Your robot should navigate to touch as many bales as possible, but avoid any tractors.
- Lightning (your robot) must begin at the starting location and end at the ending location.

Scoring:

- No points are awarded if the robot leaves the playing field. In such a case, the turn will end with a score of 0.
- Points are awarded and deducted as follows:
    - For each bale of hay (ball) that your robot touches, you receive 20 points (80 points total). You may only receive points once per bale of hay (touching a ball multiple times does not give extra points).
    - When your robot touches the end space, you receive 20 points added to your total and the turn ends.
    - Every time your robot or a bale (ball) comes into contact with a tractor (large or small), 10 points are deducted from your score (it is possible for a single bale of hay to hit multiple robots to lose points on each illegal tractor touch).
    - If your score for a turn is < 0 (too many tractor hits), it will be reported to the scoring table as 0.
- The attempt is over if:
    - Your robot goes off of the playing surface. Turn ends immediately with a score of 0.
    - If your robot touches the end space, you receive 20 points added to your total and the turn ends.
    - 60 seconds have expired before reaching the end space. In such a case, the score for the round is the sum of every bale that has been touched minus any deductions for tractor touches.
- Score possibilities for each round are: 0, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100.



Obey the Stop Signs!

Lightning wants to take a leisurely stroll through downtown Radiator Springs. Help him to obey the city stop signs so that he does not get a ticket for a traffic violation!

Goal: Your robot will start at one end of the street and encounter four stop signs before reaching the end destination.

Problem: The field contains the following features:

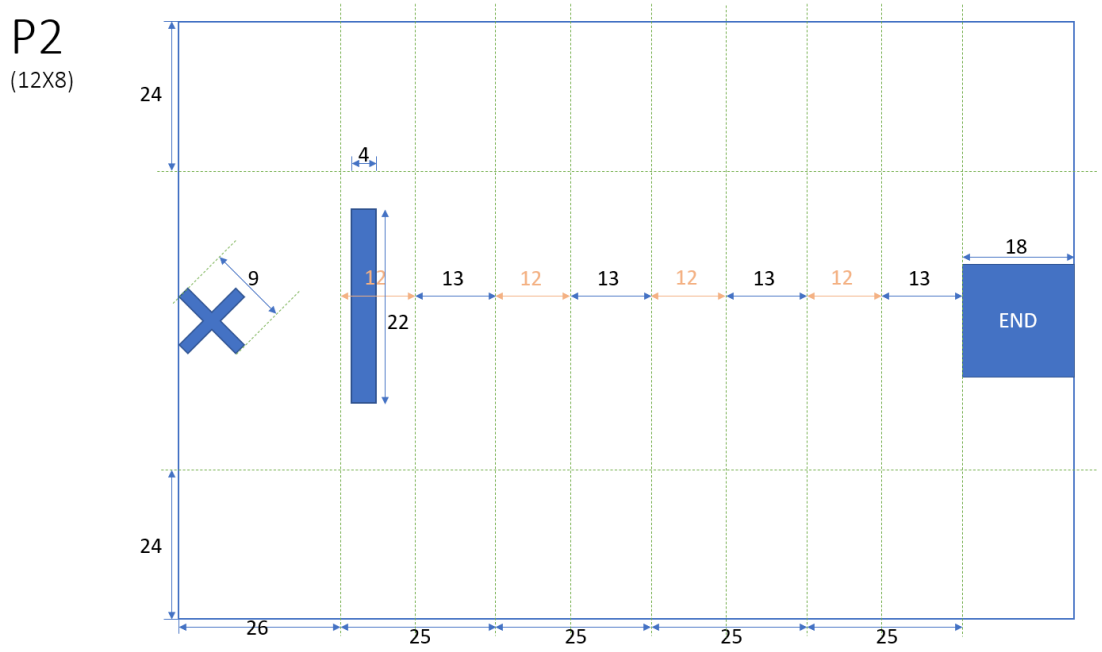
1. Starting area in the middle left and ending destination on the middle right (see diagram).
2. 4 randomly placed stop signs, represented as 22x4 strips of black paper in the center of the field.

Robot Movement:

- Your robot must move from the start to the end destination. For every stop sign that is encountered, your robot must pause for 3 seconds while partially over top of the black strip before moving to the next location. Movement progress flows from left to right.
- Each stop sign may be slippery due to an oil spill. If your robot slightly changes direction or gets caught on the black surface, that is considered a part of the play and no restart will be given.

Scoring:

- No points are awarded if the robot leaves the playing field. In such a case, the turn will end with a score of 0.
- Points are awarded as follows:
  - For each stop sign that is identified and results in a 3-second pause, 20 points will be awarded.
  - If your robot touches the end space, you receive 20 points added to your total and the turn ends.
- The attempt is over if:
  - Your robot goes off of the playing surface. Turn ends immediately with a score of 0.
  - Your robot makes it to the end destination. In such a case, the score is equal to the number of total stop signs obeyed (20 points each) plus 20 points for reaching the destination.
  - 60 seconds have expired before reaching the end destination. In such a case, the score for the round is the sum of every obeyed stop sign (20 points each).
- Score possibilities for each round are: 0, 20, 40, 60, 80, 100.



Driving for Uber

Lightning has accumulated many traffic violations and must pay for his tickets. He decides to become the first Uber driver in Radiator Springs in order to earn money to pay off his fines.

Goal: Lightning must successfully park at a customer's parking space at their home. After delivering two customers to their destination, he then drives to an end location to meet Sally and Mater.

Problem: The field contains the following features:

1. Starting area in the middle left and ending destination in the middle right (see diagram).
2. Two parking spaces that are marked by sequential pylons on each side of the playing field.

Robot Movement:

- Your robot must move from the start to the end destination. You may attempt 0 or more of the parking drop-offs to receive points before heading to meet Sally and Mater.
- The entire playing field is open for navigation, but parking points are only scored when an attempt is made for the full robot to be placed within the boundary of the parking lines (pylons).

Scoring:

- No points are awarded if the robot leaves the playing field or touches a pylon. In such cases, the turn will end with a score of 0.
- Points are awarded as follows:
    - For each drop-off where your robot parks completely within the parking space by going "head first," you receive 30 points; for each parking drop-off that goes "rear first," 40 points are awarded.
    - The points are only awarded if the robot body (excluding any wires) is **completely** within the parking space. No points are awarded if the robot is only partially in the parking area.
    - Points can not be earned by parking in the same location twice.
    - If your robot touches the end space, you receive 20 points added to your total and the turn ends.
- The attempt is over if:
    - Your robot goes off of the playing surface or your robot hits a pylon while parking. Turn ends immediately with a score of 0.
    - Your robot makes it to the end destination. In such a case, the score is equal to the number of completed customer drop-offs (40 or 30 points per successful drop-off) plus 20 points for reaching the destination.
    - 60 seconds have expired before reaching the end destination. In such a case, the score for the round is the sum of every successful drop off before time expired (40 or 30 points per successful drop-off).
- Score possibilities for each round are: 0, 20, 30, 40, 50, 60, 70, 80, 100.

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