2024 Alabama Robotics Competition
The Impossible Chocolate Mission

This year's contest requires each team to thwart the attempt of an evil candy hater who has taken over the local town's chocolate factory. You must complete three tasks that require programming your robot to be controlled autonomously.

Competition Rules and Problems

The following pages describe each event and give 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. Teams <u>do not</u> have to start with problem #1.
6. Some problems have disqualification measures (*e.g.,* going off the playing field, touching an obstacle).
7. Each event must be completed within a designated time limit to receive points.
8. All courses will have a designated starting area.
    - A contestant must start their robot with the robot completely within the starting area.
    - The robot may face any direction when starting.
9. Students may not touch or remotely control the robot other than to place and start the robot initially.
10. After a robot is started, the contestant's turn begins. Once the start has commenced, there is no redo, and a team must get back in line if they want to try again.
11. A team may try each course multiple times, but there is a <u>maximum of three (3) tries per problem</u>.
    - Teams must start at the back of the line for each new attempt.
    - <u>Each team may only be in line for one event at a time</u>. It is not permissible to spread team members across multiple lines at any specific time.
    - 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.
    - <u>Each team may attempt each problem only three times</u>; the best of the top three scores will be used in computing a team's score for each problem. A practice round is also provided.
    - 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).
    - A practice round is also provided. Measurements on each field are 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).

Avoid the Lasers

An evil villain has taken over your town's chocolate factory. You have the impossible mission of breaking into the factory and restarting the chocolate machine. Your 1st step is to get past the factory's opening hallway of laser detectors.

Goal: Navigate your robot through the hallway of lasers to remain undetected. Your goal is to reach the door at the end of the hallway without touching any of the obstacles (e.g., bricks or pylons).

**Problem:** The field contains the following features:
1. Starting point at the right side of the hallway (see "X" on diagram).
2. A narrowing corridor of laser-focused obstacles (bricks) followed by a short maze of walls (pylons).
3. An area in the upper-left of the playing field that represents the door that leads to the chocolate room.

Robot Movement:
*   Your robot should navigate to the door (upper-left area of the field) without touching any of the obstacles.
*   Your robot must begin at the starting location ("X") and end at the door location (upper-left).

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:
    o   If you pass the initial narrow hallway of lasers (bricks), you will receive 25 initial points.
    o   When your robot touches the end space, you receive the full 100 points for the problem.
*   The attempt is over if:
    o   Your robot goes off of the playing surface or if your robot hits any of the bricks or pylons while moving. Turn ends immediately with a score of 0 (even if the initial 25 points were awarded – going off the field is a final result of 0 points).
    o   Your robot touches the end space without hitting any obstacles, you receive the full 100 points and the turn ends.
    o   60 seconds have expired before reaching the end space. In such a case, the score is either 0 or 25, based on whether the robot passed the initial narrow hallway.
*   Score possibilities for each round are: 0, 25, 100.

Problem 1
96"*72"
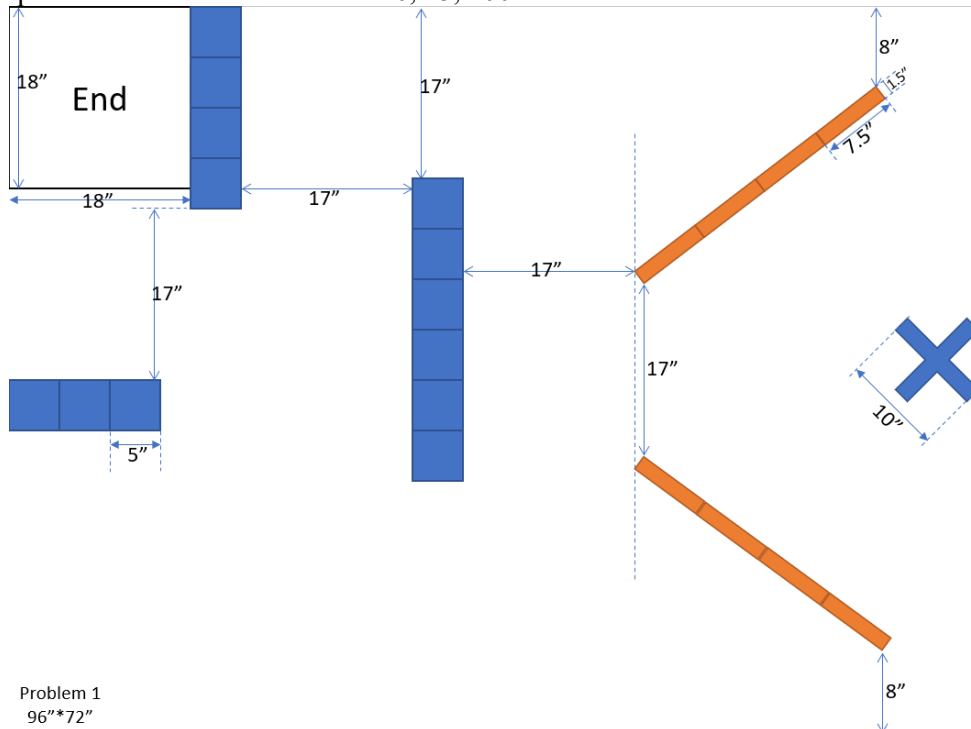
Open Sesame

The evil villain has changed the lock on the door that leads to the chocolate room. You must "pick" the lock by moving your robot over the various lock pins and then turn the door handle by moving your robot to the end location.

Goal: Your robot will start at the bottom-right of the field and move over the various pin locations of the lock to determine which pins need to be picked. You will then move to the ending area to turn the door handle.

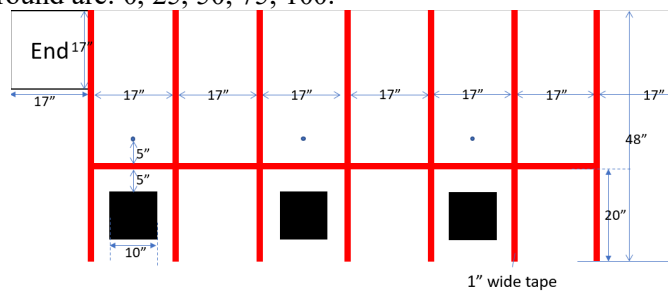**Problem**: The field contains the following features:
1. Starting area in the bottom-right ("X") and ending destination in the upper-left (see diagram).
2. 6 pin slots of the lock with 3 **randomly placed** 10in squares. You must move your robot into each slot and determine if the pin needs to be picked by determining if the square is present.

Robot Movement:
- Your robot must move from the start to each of the 6 slots. If the slot has a black square, your robot must then move forward past the red horizontal line in front of it, and then back out of the slot.
- After searching the slots for the 3 randomly placed squares and picking the lock (by moving over the horizontal red line), your robot must then go to the ending area to turn the door handle.

Scoring:
- No points are awarded if the robot leaves the playing field or if the robot touches a vertical red line (horizontal red lines are ok). In such a case, the turn will end with a score of 0.
- Points are awarded as follows:
  - For each black square that is identified, your robot must move forward past the horizontal red line in front of it for 25 points. No points are awarded unless part of the robot goes past the red horizontal.
  - If your robot touches the end space, you receive 25 points added to your total and the turn ends. A robot could elect to go straight to the ending area without identifying a square and receive 25 points.
- Points are deducted as a penalty as follows:
  - For each horizontal red line that is crossed in error (i.e., no black square in front), 25 points are deducted.
- The attempt is over if:
  - Robot goes off the playing surface or touches a vertical red line. 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 pins in the lock that were identified (25 points each) plus 25 points for reaching the destination, minus any misidentified pins (25 points each).
  - 60 seconds have expired before reaching the end destination. In such a case, the score for the round is the sum of every pin location that was identified correctly (25 points each) minus any penalties.
- Score possibilities for each round are: 0, 25, 50, 75, 100.

End 17"

17" | 17" | 17" | 17" | 17" | 17" | 17" | 17"

48"

5"

5"

20"

10"

1" wide tape

Problem 2
144"*96"

10"

Save the Chocolate

Now that you are in the main room, you need to add chocolate to the machine! There are 4 cocoa balls outside of the machine. The quality of the chocolate depends on how close you can place the balls to the center of the machine.

Goal: Move your robot to push the cocoa balls into the machine. Each location of the machine can produce a different quality of chocolate. You want to be the hero who produces the best chocolate in the world!

Problem: There are two fields on one playing surface. Each field contains the following features:
1. Starting area ("+") at the end of the field.
2. A "bullseye" representing the various quality layers of the chocolate machine.
3. Four cocoa balls (ping pong balls) that are placed in specific locations outside of the machine.

Robot Movement:
- Your robot must move from the starting location ("+") and push balls over the playing surface, with the goal of moving as many balls as possible into the orange center of the machine.
- The entire playing field is open for navigation (except for the bricks on the side), but the <u>final score can only be calculated at a time when all 4 balls are at rest</u>.

Scoring:
- No points are awarded if the robot leaves the playing field or touches a brick that separates the two fields. In such cases, the turn will end with a score of 0. However, a ball may go off the field or bounce off the bricks.
- Points are awarded as follows:
  - Each ball that ends in the orange center of the machine earns 25 points.
  - Each ball that ends in the inner white area of the machine earns 20 points.
  - Each ball that ends in the blue area of the machine earns 10 points.
  - Any ball that is outside of the machine (including those that go off the playing field) earns 0 points.
- The attempt is over if:
  - Your robot goes off of the playing surface or your robot hits a brick. Turn ends immediately with a score of 0. A ball may go off field or hit a brick without consequence, but the robot must remain on the field.
  - Before 60 seconds: If all balls are no longer moving, the team leader may call "Time" if they want to stop the round (pick up the robot) and compute the score based on the current configuration of balls.
  - Over 60 seconds: The robot must be picked up from the surface. After all balls have stopped moving, the final score will be computed from the final configuration.
- Total score possibilities vary greatly: 0, 10, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, 90, 95, 100.