

The ECE 1882 Competition Spring 2013 “LEGOball”

Due Dates

Navigation Trial: November 5, 2013

Beat-the-Brick: November 14 and 19, 2013

Competition Week: November 19, 2013 & November 21, 2013

Introduction

The challenge for this semester is a head-to-head competition that involves moving, sorting, and precise handling of red and blue LEGO balls. The overall goal of this game is to collect as many of your own team’s LEGO balls in your base area and move your opponent’s LEGO balls off the course. These LEGO balls will be spread across the competition arena for your robot to manipulate.

This challenge has three stages. The first stage will occur on November 5th. During this time each team will demonstrate that its robot can navigate the course in a prescribed manner and finish in their base area. Grading will be based on how well the robot can navigate the course. The second stage will occur on November 19 and is referred to as the “beat-the-brick” competition. At this time your robot will try to get as many points as possible on the course; however, there will be no opposing robot on the field. Most of your “competition grade” for will be determined by your beat-the-brick performance. Finally, during the last week of classes, the culminating final “competition” will occur, where teams will compete in a double elimination bracket to determine 1st, 2nd, and 3rd place winners. The top three teams will get extra points added to their beat-the-brick competition score.

A rough top-view illustration of the playing surface appears in Figure 1. Please note that you should not expect a perfect competition board environment. Just as in a real environment, there will be surface blemishes, unlevel areas, board misalignments, and random bumps and scrapes. These imperfections may be due to construction or material defects. These imperfections are a part of the challenge, and will *not* be corrected during the competition period.

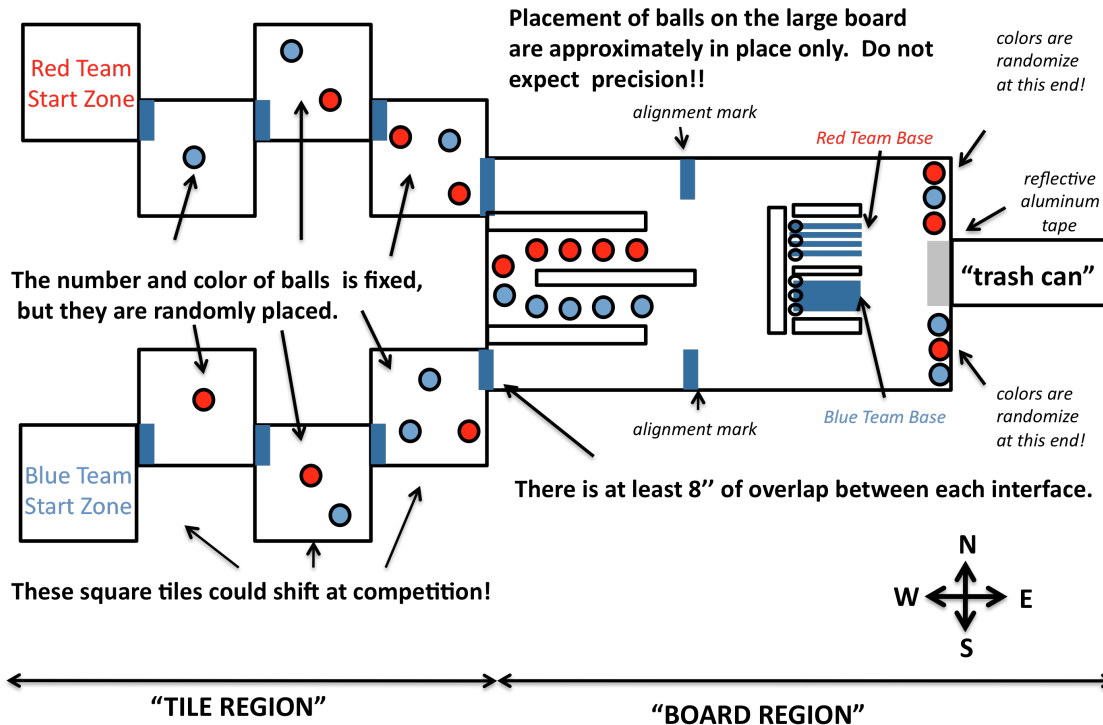


Figure 1: This figure depicts the playing surface of the challenge. There are two distinct regions of the field – the tile region and the board region.

The Navigation Trial

Ten percent of your grade will be determined by the “navigation trial.” The goal of the navigation trial will be to ascertain how well your robot can navigate both the tile region and the board region. The point values associated with how far the robot travels during this navigation trial are given in Table 1. Please note that the alignment mark is labeled on the board region in Figure 1.

Navigation Trial Details

- The robot must start anywhere within the start zone (Figure 1). A team can choose to start from either the blue or red team start zone.
- The contestants will have 60 seconds to place their machines on the game board from the time the judges call them to set up.
- The trial will be started manually when a whistle is blown; at that point you may press the start button on your NXT brick.
- If the robot falls off the course (and stays off the course), the robot will be handed to the team owning the robot. The offending team may restart the robot anywhere within the start area, but will suffer 2-point penalty. A team may choose not to restart the robot in which case they will not incur this penalty, but the trial will be over.

- Each team will be given at least two times to complete the navigation trial, and the official grade will be the *average* of the two scores.

Action	Points Earned
After stopping in base, played a sound	10 points
Robot stopped in base area	10 points
Robot reached base area	10 points
Made it through the maze	10 points
Acknowledged alignment mark with sound	10 points
Made it to the alignment mark	10 points
Made it to the big board	10 points
Made it to 3 rd tile	10 points
Made it to 2 nd tile	10 points
Made it to 1 st tile (after start tile)	10 points

↑
suggested order of operation

Table 1: This table summarizes the actions required for navigation trial and the points associated with each action.

The Competition

During the competition, you must generally put your color balls in your base area, and knock the opponents balls off the course. The points associated with specific actions are summarized in Table 2.

Action	Points
Your team's ball in your base, but <i>not</i> on a large tire	5
Your team's ball in your base, <i>and</i> on a large tire	10
Your team's ball somewhere on the course, but not in base	2
Your opponent's ball somewhere on the course (i.e. not carpet or trash can)	-2
Putting opponent's ball in the "Trash Can"	5
Return-to-start penalty (touching the robot)	-2

Table 2: Actions needed to gain points during the competition.

As the robot navigates the course there will be balls spread in both the "tile region" and the "board region." The balls in the tile region will be fixed in number and color type as

indicated in Figure 1, but the *locations* will be randomized after every match. You can be guaranteed that the balls will be at least 3” from the corner of the tile or the blue tape. In the board region, the balls will be *approximately* in the general area indicated in Figure 1. Do not expect precision placement, and in fact plan for some local randomness in their locations. The balls on the far east side of the board (i.e., near the “trash can”) will be in the approximate position as indicated in Figure 1, but the color arrangements will be randomized before every match. Once play begins, balls may only be touched by the robots. Balls that topple off their stands during the competition will not be moved by either the judges or competitors.

Good strategy, prudent decision-making during the match, skillful handling of the balls, and, *especially*, reliability will be important your success!

Period of Play

- A single match will be capped at 10 minutes, and each team has to accumulate as many points as possible during this time. A team’s final score will be based on the condition of the competition course *at the end* of the 10 minutes. For example, if a robot places a ball in base at some point, it must still be in base at the end of the match in order for the team to be awarded points for it.
- Robots can be reset and started again at the start position, but there will be a 2-point penalty (as seen in Table 2) for this course of action.
- Robot interaction is allowed in limited form and is discussed in the next section, which is entitled “Robot Rules of Engagement.”
- Teams will flip a coin to win the right to choose either the red team or the blue team during the competition.
- The robot must start anywhere within the starting zone as indicated in Figure 1. The team will have 60 seconds to place their robot and accessory objects on the game board from the time the judges call them to set up.
- The game will be started manually when a whistle is blown; at that point you may press any button on your NXT brick to start your robot.
- The game ends when the instructor blows the whistle at the 10-minute mark or if the instructor feels that the condition of the course will not change for the remaining elapsed time.
- If a team touches their robot, they will incur a 2-point penalty and be required to restart their robot anywhere within the start area.
- If a return-to-start penalty is awarded and the robot is in “loose” contact with a ball, the ball will stay where it is. However, if a ball or balls are securely connected to the robot as it is picked up, the ball(s) and robot will be returned to the start zone.
- While in the start zone, teams are allowed to move or manipulate their robots, including the option of selecting a different program, without penalty. This also applies to the objects that are connected to it that it has acquired during the

competition. This rule applies both at the start of the period of play and at any time the robot returns to the start zone. Once the team is planning to restart, however, they can only do this by pressing one of the buttons on the NXT unit.

Robot Rules of Engagement

- Brief and slight interaction of the robots will be allowed. The interpretation of “brief and slight” will be at the discretion of the instructor.
- If the robots become entangled during the competition, the robots will be separated by the instructor in two possible ways:
 1. Instructor will separate robots by a reasonable distance in the region at which the two robots became entangled. A team can opt for a return-to-start-position reset without penalty as well.
 2. If local separation causes continued entanglement or if the instructor feels that separation puts one team at an unfair advantage, then *both* robots are restarted in their respective starting zone.
- If robot damage occurs and the robots are not entangled, then the robot that is damaged will be given the opportunity to restart at the start zone. No return-to-start-zone penalty will be given.
- If there are stray robot parts on the course, either team can request that they be removed. This does not include the rubber rings holding the balls or the thicker rubber tires that are on the course.

Beat-the-Brick Competition

During the beat-the-brick competition that will be held on November 14 and 19, your team’s robot will be allowed to compete on the course *without an opposing team*. All regular robot rules will apply, and the team will be given 10 minutes to accumulate as many points as possible. You will be given at least 2 trials during this beat the brick competition, and, unlike the navigation trials, your final score will be the *best of your two scores*. Your grade on this portion will be determined according to Table 3. Please note that your grade is also partially impacted by the head-to-head competition that will occur during the following week on November 19rd and 21th.

Action	Grade on Challenge
Highest team score in beat-the-brick	90
Other teams	$(\text{team score}/\text{highest score}) * 90$
1 st place during competition week	+ 10 points added to final beat-the-brick grade
2 nd place during competition week	+ 8 points added to final beat-the-brick grade
3 rd place during competition week	+ 5 points added to final beat-the-brick grade

Table 3: This table summarizes the grading rubric for the beat-the-brick competition.

Rules

Judging

- Contestants should ask the instructor about possible designs or strategies that may be questionable under any of the rules.
- Contest rules and procedures, or even the game, may have to be altered during the semester. As much notice as possible will be given.
- The judges are the instructors and any others he or she may designate.
- The judges may alter or eliminate any rule, or add rules, at any time.
- The judges will decide any discrepancies during the match.
- The judges reserve the right to add ways to score points or to add features to the board to make game play easier. Teams will have sufficient warning of any such changes.
- All decisions of the judges are final.

Robot Structure

Your robot must be constructed using the parts in your kit with exceptions as detailed below. All kits contain exactly the same components. Some parts in the NXT kit are considered tools (e.g., the plastic parts container and its trays) and may not be used on the robot.

The dimension of the robot may not exceed 12 x 12 x 12 inches at the start of each round. Robots may, however, expand once the round has begun.

We have kits of extra parts that teams may check out to use. Parts lists will be posted in the classroom. We have one extra-parts kit for every two teams, so teams will be limited to half of the parts in the extra parts kit. Your instructor or TA can check out parts to you upon request. You may use your own personal LEGO parts provided that the same parts, except perhaps in a different color, are contained in these bins of extra parts. No other LEGO parts or NXT sensors/motors from any source may be used, *with two exceptions: a team may request and check out a second light sensor and/or a compass sensor, if requested.*

Only LEGO parts and connectors may be used as robot structure. All structurally separate parts of the robot must be connected by LEGO beams, plates, axles, etc., specifically, **not** by rubber bands, LEGO chain links, or track. Rubber bands may be used to provide stored energy, but not as primary structural elements or as linking elements between LEGO parts. LEGO pieces may not be glued together or altered in any way.

Accessory Objects

The team may build and/or use any accessory structures or objects constructed from LEGOs, but these objects may only be placed or used in the start zone only. Once placed, they cannot be moved or touched by the team. The team should consult with the judges if they wish to use any other materials or resources for accessory construction. For example, teams may also use 2x4 wooden boards that are in the classroom if they so desire.

Team Conduct

- Teams are encouraged to seek advice and help from any source, but the design, robot construction, and control code must be exclusively their own work.
- All entries must be solely controlled by the NXT brick. Human intervention once the game begins must follow the rules stated above. Remote control is not allowed. A robot that is illegally touched by a team member during a game will be disqualified for that round. Also, team members touching the game board during play risk disqualification of their robot.
- Teams may qualify only one robot, and only one robot may play in the final round. Significant changes in robot structure or code following qualification must be approved by the judges.
- Contestants may not alter the essential structure of their entry, or add/subtract significant parts, once the competition has begun, but may repair broken components between rounds if time permits.
- Teams may possess only one NXT brick at any one time.
- Teams may use other programming environments to develop their software. However, after the competition, their NXT brick must be returned with the LEGO-authorized firmware installed.

- No parts or substances may be deliberately dumped, deposited, or otherwise left to remain on the game board surface. A machine that appears to have been designed to perform such a function will be disqualified. Pieces that accidentally fall off robots may be removed from the board during a game by a judge at his discretion.
- No adhesives or sticky substances (such as tape) may be applied to any part of the game board or to a game piece (ball, boundary, other robot, etc.).
- Any machine that appears to be a safety hazard will be disqualified from the competition.