

Regional Autonomous Robotics Circuit Competition I

- 1 Challenge
 - Sumo Challenge
- Separate awards for each category
 - NXT
 - Boe-Bot

General Rules

- All work must be completed by students.
- No more than 6 students per team
- No more than 6 teams per school
- Students may change the software between the rounds.
- Teams can only use a single robot during the event.
- Only official unmodified Lego pieces found on the 9648, 9797 and 9695 LEGO MINDSTORMS kits may be used for NXT division
- The NXT and Boe-Bot platform may be used during competition but there will not be a match between an NXT bot and a Boe-Bot.

Overview

Two self-controlled robots are placed in a ring. The robots try to avoid getting out or avoid being pushed out by the opponent robot. The first robot that touches outside of the ring loses the round.

The first robot to win two rounds, wins the match. Different robots compete one-on-one against each other throughout the contest. The robot that wins the most matches wins the contest.

Robots

- Autonomous Sumo robots are self-propelled and self-controlled, without tethers.
- After positioning and starting the robot, no remote control, power, positioning, or other help can be provided. The robot must care for itself until the round ends.

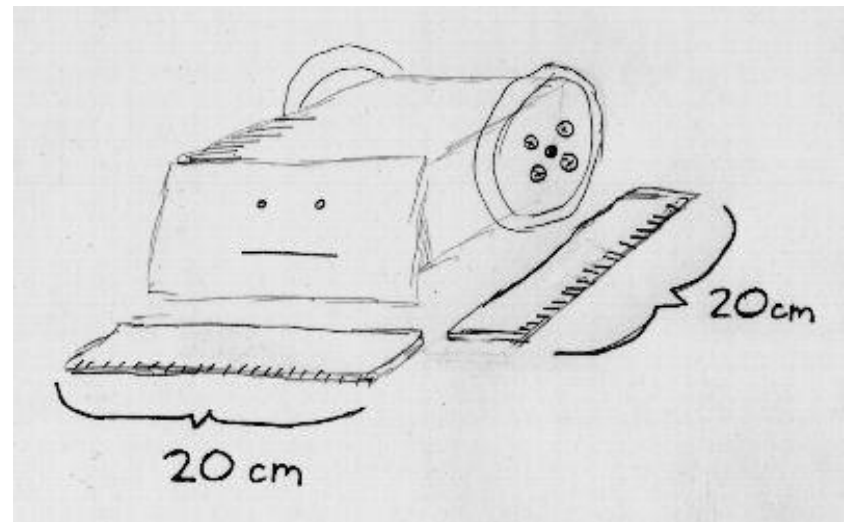
Mass

- Boe-Bot based Sumo robots may have a mass of 500 grams (1.1 pounds) or less and NXT based Sumo robots may have a mass of 1000 grams (2.2 pounds) or less.
- Lift can't reduce the robot below the required limit because the limit is specified in mass (universal constant) rather than weight (gravity component). For example, a helium-filled balloon can't be used to lighten a robot during weigh in.
- Because this is a pushing contest, it is to the robot's advantage to be as heavy as possible. Boe-bots may add extra weights or washers to increase the robot's mass to the maximum amount but NXT robots must only use official LEGO parts from the authorized kits.

Dimensions

- Sumo robots for all divisions may be 20 centimeters (7.87 inches) or less in width and 20 centimeters (7.87 inches) or less in depth.
- There is no height limit to either class. Also, as soon as movement is allowed in a round the robot may then twist, fall, or expand without size limits.

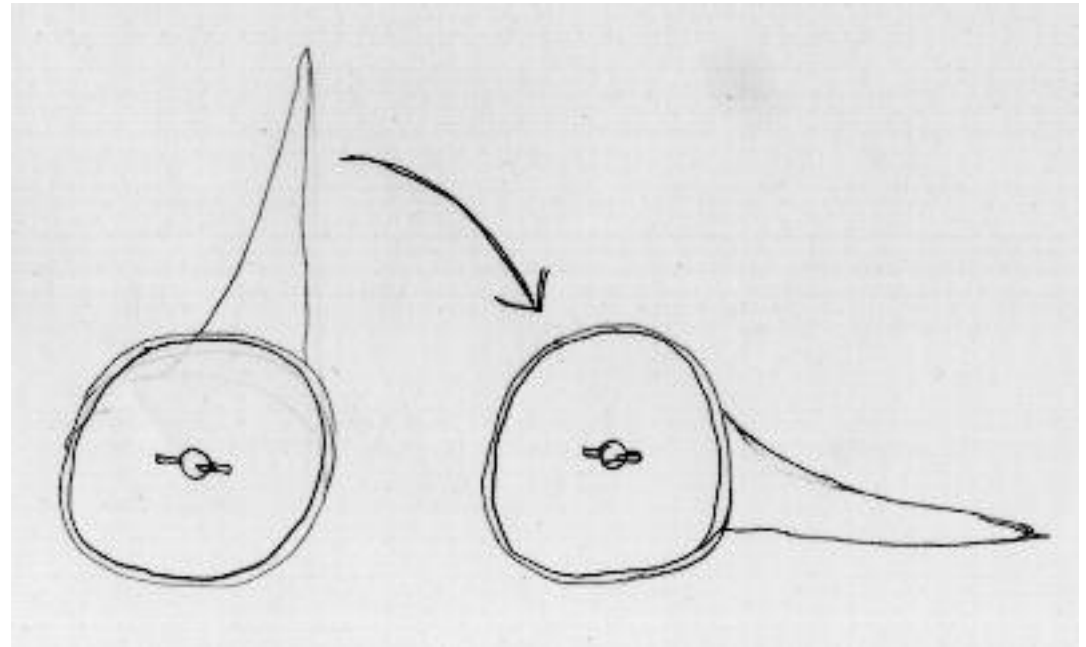
At the start of each round, Sumo robots must not exceed the specified width and depth.



Taking Advantage of Height

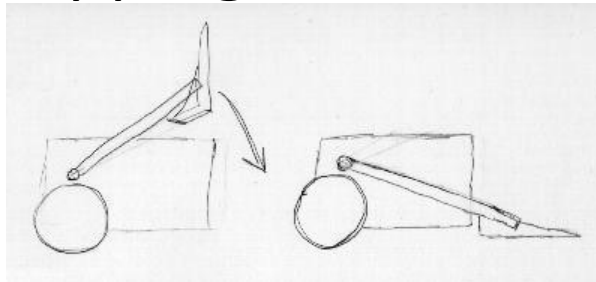
- The lack of a height limit is important to some builders, as they may stack up electronics, motors, and other parts that wouldn't otherwise fit.

A side view of a Sumo robot that falls to position a scoop horizontally



Taking Advantage of Height

- The lack of a height limit combined with the ability to change orientation during a round provides for creative opportunities.
- Crafty inventors build tall scoops atop their robots. The robots then fall down to make themselves longer than would be initially allowed.
- Some robots tip only their scoops into position, rather than dropping the entire robot.



Harmlessness



- At all times, robot behavior must be non-offensive, non-destructive, and non-harmful to humans, robots, and the facilities. This is an immutable principle, even if the behavior is unintentional or not by design.
- During inspection (and at any time during the event), the judges may require safety changes or other modifications to meet the harmlessness requirement. Harmful robots are either not allowed to compete at all or are later disqualified if potential harmful issues are proven or revealed in battle.
- Judges also examine to see if a robot's design is sufficient to survive the expected pushing, shoving, and physical rigors of competition. Suggestions may be made to avoid damage to the robot. A weak robot is usually allowed to compete at its own risk.
- During the contest, the judge must determine if a robot's failure was due to its own lack of durability. Failures due to exposed wires or unsecured or flimsy parts shall be the responsibility of the robot with such weaknesses.

Harmlessness continued

- At all times, Sumo Robots must not:
 - Emit smoke or fire
 - Leak, stain, or soil
 - Disperse powder, grit, or grime
 - Spray, throw, or use projectiles
 - Jam, shock, or electromagnetically interfere
 - Snare, entangle, or employ nets/rope
 - Scratch, gouge, or scrape
 - However, as for the last point, naturally some damage occurs from scoops, changes in starting orientation, and from the battles themselves. This is expected and acceptable to any reasonable extent.
- Another rule: Sumo Robots must not fly or generate lift to isolate themselves from the ring surface.
- The "no-fly" rule isn't intended to prevent a robot from having a floating portion (such as a camera, sensor, flag, or distraction) nor to prevent jumping or other interesting behavior. The robot qualifies as long as a major portion of the robot is generally available to be pushed out by the opponent robot.

The Ring

- The Robot Sumo ring is a 4'x4' melamine board (shower board) with a 36" diameter circle border.
- The circular ring border will be made from $\frac{3}{4}$ " black electrical tape. The inside of the ring will remain the shiny white surface of the melamine board. Two starting lines in the middle are $\frac{3}{4}$ " blue painter's tape. All areas enclosed by the electrical tape circle are "in" bounds.
- An external area of at least 100 centimeters (3.3 feet) of empty space exists around the ring. This space must not contain any people, objects, lights, or anything else that would distract or interfere with the robots.
- Any space outside of the enclosed circle will be considered "out" of bounds.

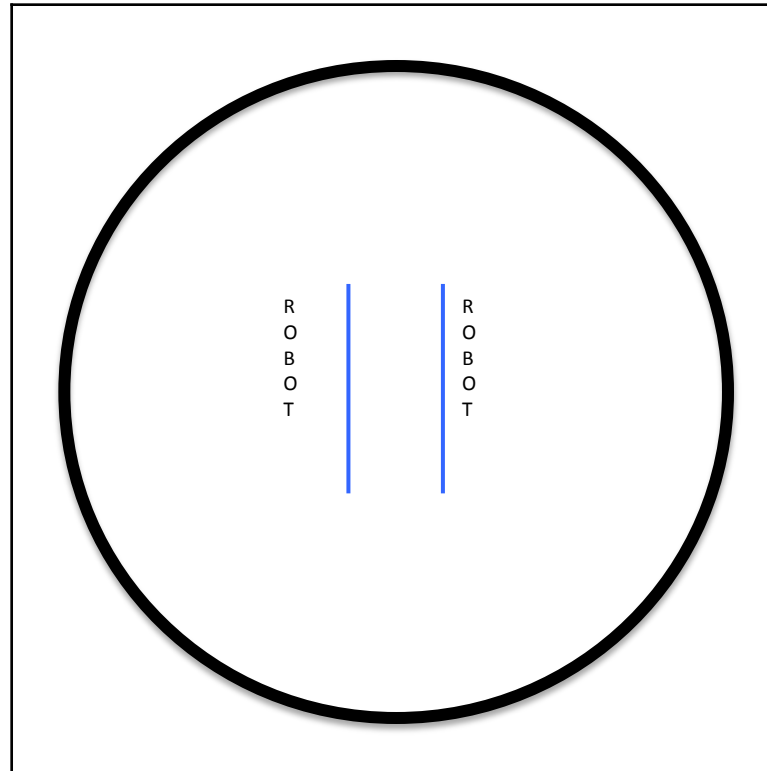
Edge Sensors

- A surprising number of Sumo robots drive out of the ring without even being pushed. A well designed and built Sumo robot should be able to navigate the ring indefinitely without going “out” of bounds.
- The flat black electrical tape contrasts with the gloss white center inside of the ring so that a robot can easily use a light sensor to detect the edge.
- Physical switches or sensors are not advisable.

The Contest

- Sumo rings will be brought by the contest organizers and set up in advance. Contestants will have access to these rings to inspect the surfaces and calibrate sensors for colors and lighting. Robots should be prepared to accept significant variations in Sumo ring quality and lack of ring adherence to specifications.
- A projector will be used to provide a good view for the audience.
- Competitors and audience members are expected to remain polite, sportsmanlike, and considerate at all times. Good cheers, encouragement, and applause for all competitors are very much appreciated.

RARC Sumo Challenge 2011



- The Lego Sumo board will be a 4 ft x 4 ft melamine board (Shower board) with $\frac{3}{4}$ inch black electrical tape border as shown by the solid black line placed around a 36 inch diameter circle.
- Robots must start behind the 6 inch blue starting lines (1 inch blue painter's tape)
- The blue tape is placed 1 inch off center for a total of 2 inches apart. Each end is 3 in. off center.
- Timer starts on "go."
- Robots must NOT move until 5 seconds after the start button is pressed.
- Timer stops at 90 seconds.

Inspection

- Each robot will be measured and inspected to verify qualification.
- To avoid arguments over analog needle interpretation, a digital scale will be used for determining mass. Allow for a little free weight that can be added or removed in case your school scale doesn't match the tournament's scale.
- For width and depth, a carefully measured box will be placed over the robot. Actually, the box is more of a tube really, because it is missing the top and bottom. The box avoids arguments over ruler interpretation, because the robot qualifies if the robots fits in the box.
- The robot must start each round of the contest in an orientation and physical position that would fit in the box. It would be unfair to measure the robot in one position (sticking out of the top of the box) but then manually rotate the robot to an unqualified length before beginning a match.
- The robot will be inspected to be sure it is non-damaging and generally safe.

Playoffs

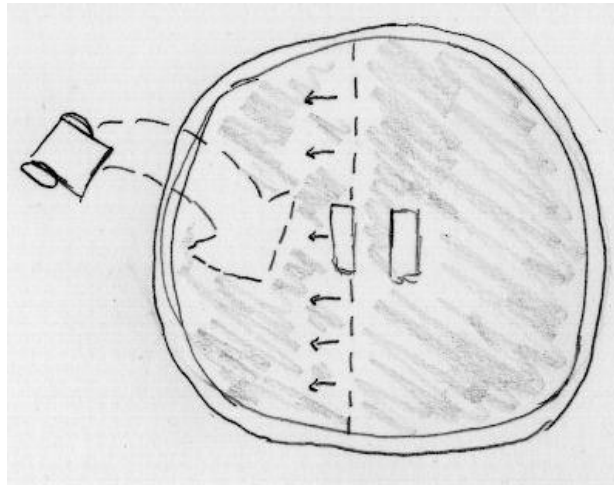
- Depending on how many robots participate, the organizers will choose from a different elimination methodologies. A few popular methods are presented here, but obviously creative variations can be designed to meet the needs of the contest.
 - Single Elimination: Upon losing a match, the robot is out of the contest. This is the harshest method and least likely to convincingly determine winners. It also means half the participants get to compete only once.
 - Double Elimination: Upon losing two matches, the robot is out of the contest. This is common practice when a large number of robots are entered.
 - Round Robin: Each robot faces each other robot (one at a time) in a match.
 - Heats: The robots are divided into smaller groups and a method above is used within each group to organize one-on-one matches. The winners of each group advance.

Match

- The robot must be ready at the appointed times. Contest organizers may grant reasonable leeway, but a referee may declare a round or entire match lost if a robot isn't punctually prepared to compete.
- Throughout the contest, the algorithms (programming), settings, and components on the robot can be shaped, angled, or configured differently for facing each opponent and being placed in different starting positions. However, these changes must bear in mind appointed time constraints and class restrictions.

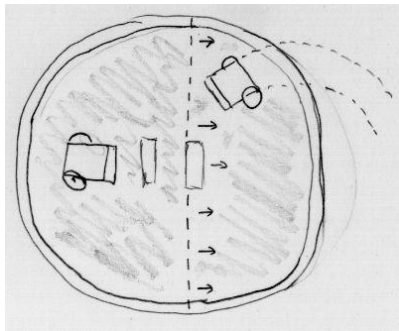
Positioning

- The better-ranked robot or the robot that just won the prior round is positioned first.
- The team member may place his or her robot in any position, angle, or location on the ring except that no portion of the robot may cross the extended starting line nearest the contestant. The robot must fit within the required starting dimensions of 20 cm x 20 cm.



Positioning Continued

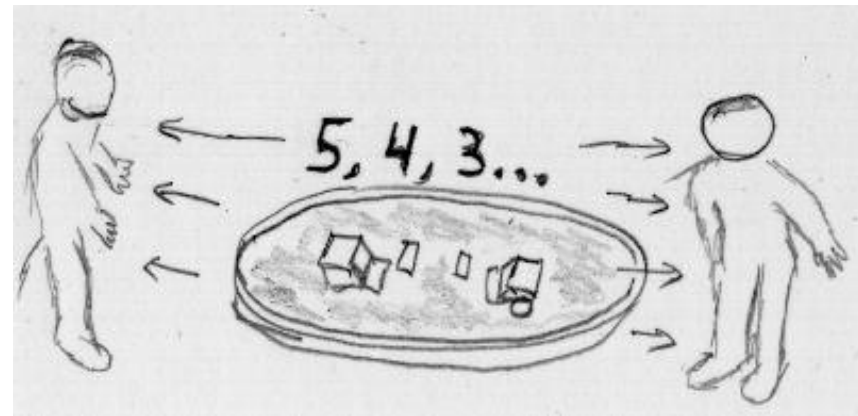
- The lesser-ranked robot or the robot that just lost the prior round is positioned second.
- It is an advantage to be the second contestant to place a robot in the ring, so one shouldn't forget or dismiss this opportunity. By placing the second robot out of the direct line of sight, at sideswiping angle, or closer/further to the first robot, it may be possible for the second robot to gain a quick victory.
- Depending on who wins this round, the order may change in which the robots are placed next round.
- The second contestant may place his or her robot in any position, angle, or location on the ring except that no portion of the robot may cross the extended starting line nearest the contestant.
- By the way, after the initial placement of the first robot, it isn't permissible to alter its starting position. Even though this may be desired in reaction to the placement of the second robot!



Ready? Set? Go!

- A robot must start by the press of a button. The robot must wait 5 seconds before any movement although the robot can generate any sound and/or display before or during movement.
- Opposite team members place their fingers on their robot's starting buttons and await the referee's signal. If a problem is encountered before the referee says, "go", a contestant may alert the referee, without penalty, that the robot isn't ready.

Leave the exterior space after pressing the start button



Clear Exterior

- Upon pressing the start buttons, the contestants immediately leave the exterior area around the ring. During the round, all people and objects must be kept out of the ring and exterior area to avoid distracting the robots or altering the outcome.
- Upon pressing the start buttons, each robot must not move at all for five seconds. However, countdown lights, buzzers, sounds, or other entertaining motionless activity is encouraged.

No Start and False start

- During the countdown, if the contestant notices their robot has failed to start its countdown, the contestant may alert the referee and halt the countdown. Both robots are reset to start the round over.
- The contestant is given a warning. A second warning of any kind in a single round results in the robot losing that round.
- If a robot begins moving during the five-second period, the robot has committed a false start. A warning is issued and both robots are reset to start the round over.
- A second warning of any kind in a single round results in the robot losing that round.
- Designers may be tempted to program a countdown timer that is shorter than the five seconds required. However, referees and competitors quickly catch this, which results in warnings followed by round loss after round loss for the cheat.

Out, Not Out

- A robot loses a round when any portion (including touch sensors, whiskers, scoops, or skirts) of the robot touches outside of the ring. It doesn't matter if the robot falls out on its own or is pushed out.
- The first robot touching outside of the ring loses, even if the second robot subsequently touches outside of the ring. If the referee determines that both robots touched outside of the ring at the same time, the round is nullified and started over.
- If any piece of the robot, no matter how small or even if detached, touches outside of the ring, the robot is considered out. For example, if a nut drops off a robot within the ring, the robot doesn't immediately lose. However, if the nut is then pushed out or rolls out, the robot loses.
- If a robot lands outside the ring atop a whisker, scoop or any portion of the opponent robot, the opponent robot is out. This is consistent with the policy that the robot that touches outside first is out, even if the second robot subsequently touches outside the ring.
- Starting to fall or breaking the plane of the ring isn't considered out. Some portion of the robot must actually touch outside the ring.

End of Round, End of Match

- At the end of a round, the contestants retrieve their robots and prepare them for the next round.
- The first robot to win two rounds, wins the match.
- This means there can be as few as two very quick rounds to win a match. Or there can be as many as three, three-minute rounds (not counting restarts). In the latter case, each robot must have won a round to force the third-round tiebreaker.
- Of course, a match may also end if a contestant or robot is disqualified or otherwise unable to complete.
- At the end of the match leave the ring area to prepare their robots for any additional matches in the contest.

Spirit

- Based on fair competition, Robot Sumo encourages friendships and the exchange of ideas, showcases accomplishments, advances robotics, and seeds interest in future generations of robot builders.
- The rules are designed to support those principles. But, a written document is unable to cover all the circumstances and conditions of an event. The referee and contest organizers have complete discretion to interpret and alter these rules, at any time, to meet the intended spirit of the games.
- Whenever reasonably possible, referees should provide helpful explanations and opportunities for correction to allow even novice contestants every chance to participate and have an enjoyable experience. When disagreements arise, participants and spectators should be flexible and remain respectful.
- Referees and contest organizers have the right to determine the penalties for violations as they occur, on a case-by-case basis. Penalties can range from nothing, requesting a change in behavior, warnings, round loss, match loss, to disqualification or even physical removal.

Rule Evolution

- The rules will evolve to support novel designs, intelligent techniques, and quality engineering.
- Rule variations will be published well in advance to allow robot builders to design options or reconfigurable robots to meet multiple rule sets.