

Botball 2004 Collegiate Botball Game Review



Rules Update History

- 11/15/2003 Game rules first released
- 2/16/2004 PVC dimensions corrected
- 4/7/2004 erroneous references to "foul lines" removed from rules
- 5/3/2004 minor typo corrections to slides #11 and #25
- 5/26/2004 Added measurements to arena drawing



Robot Construction Rules

1. Robots may be made out of any purely mechanical piece or pieces of Lego and any or all of the items on electronics parts list except wrapping or packing material; the charger; download cables and interface electronics
2. You may add 36 square inches of paper (max 20lb) or foil. The paper/foil may only be held in place through the use of Lego and other kit parts (no glue or tape). **Paper may only be colored black or white.**
3. You may add 36 inches of thread or line or cable (max diameter 1mm), for use **ONLY** as tensile elements in winches and pulleys
4. Soda straws, paper, electrical tape and/or foil may be used as light guides for the sensors (light guides may be attached by glue or tape, but cannot be used structurally or for manipulation). Light guide materials are in addition to the allowable parts.



Robot Construction Rules (2)

5. Glue and tape may only be used for attaching non-Lego sensors, servos and motors to the robot. Never glue Lego to Lego. No glue or tape may be applied to paper!
6. No more than one piece of LEGO may be glued to any of the sensors. The servos & modified gear motor can have up to 7 pieces attached: one to each side and one to the effector plate. Sensors that come from KIPR with one LEGO piece attached may have one additional piece glued on, if desired
7. All robots must start themselves when the game light goes on. Robots must stop themselves within 90 seconds after game start
8. Robots must fit in starting box 15”L x 12”W x 12”H



Robot Construction Rules (3)

9. Each robot kit contains two computers/power sources
10. If two robots are made from a single kit, they represent a single tournament entry
11. Two robots from a single kit must together fit within the size constraints
12. Two processors may exist on a single robot
13. It is not necessary to use all the parts in a kit



Robot Construction Rules (4)

14. No electrical modifications may be made to either processor, any sensors or any motors
15. No wire extensions may be used except those provided in the kits (foil may **not** be used as wire!)
16. No external communications may be used during tournament play:
 - No external IR transmitters may be used
 - The serial cable and interface boxes may not be used during tournament play
 - Communications between a single team's robots is allowed



Robot Construction Rules (5)

17. You may trim the connector potting material as needed to ease insertion or mounting of sensors
18. You may file or sand the mounting holes on the HB box to ease mounting of Lego parts to the box
19. You may use wire ties to neaten up the wiring on your robot (cannot have any structural role)
- 20. Servo accessories, grommets, screws, etc may only be used to mount an effector plate (servo horn) to the servo, a piece of Lego to the horn, or lego to the servo (one piece per face). Only one servo horn may be used per servo.**
21. Servo horns may be trimmed to facilitate mounting to a Lego piece



Robot Construction Rules (6)

22. Robot teams can have a maximum of 4 independent structures on the field
- All components together must fit in the starting box **without any external restraint**
 - Each piece must be large enough so that it does not, in the judges opinion, constitute a jamming hazard.
 - Examples of structures include: robots, barricades, detachable baskets, etc.



Robot Construction Rules (7)

23. Lego parts cannot be physically modified except for:

- Pneumatic tubing can be cut to desired lengths
- Lego straws and accordion tubes may be trimmed to desired lengths
- Lego pieces being glued to a non-lego part may be sanded or trimmed on the surface being glued to ease attachment

24. Each robot must have a name approved by an adult team leader (G rated) before the tournament



Arena Construction Tools

- **Straight edge**
- **Paper grocery bag, cut off to make a ping-pong ball painting chamber**
- **Measuring tape or other rule**
- **Pencil**
- **Rubber mallet (for PVC)**
- **Scissors**
- **PVC pipe cutter** (a simple ratcheting knife that cuts PVC both cleanly and accurately)
- **Plastic handle for paint cans (Home Depot)**
(keeps paint off fingers and reduces spatter)

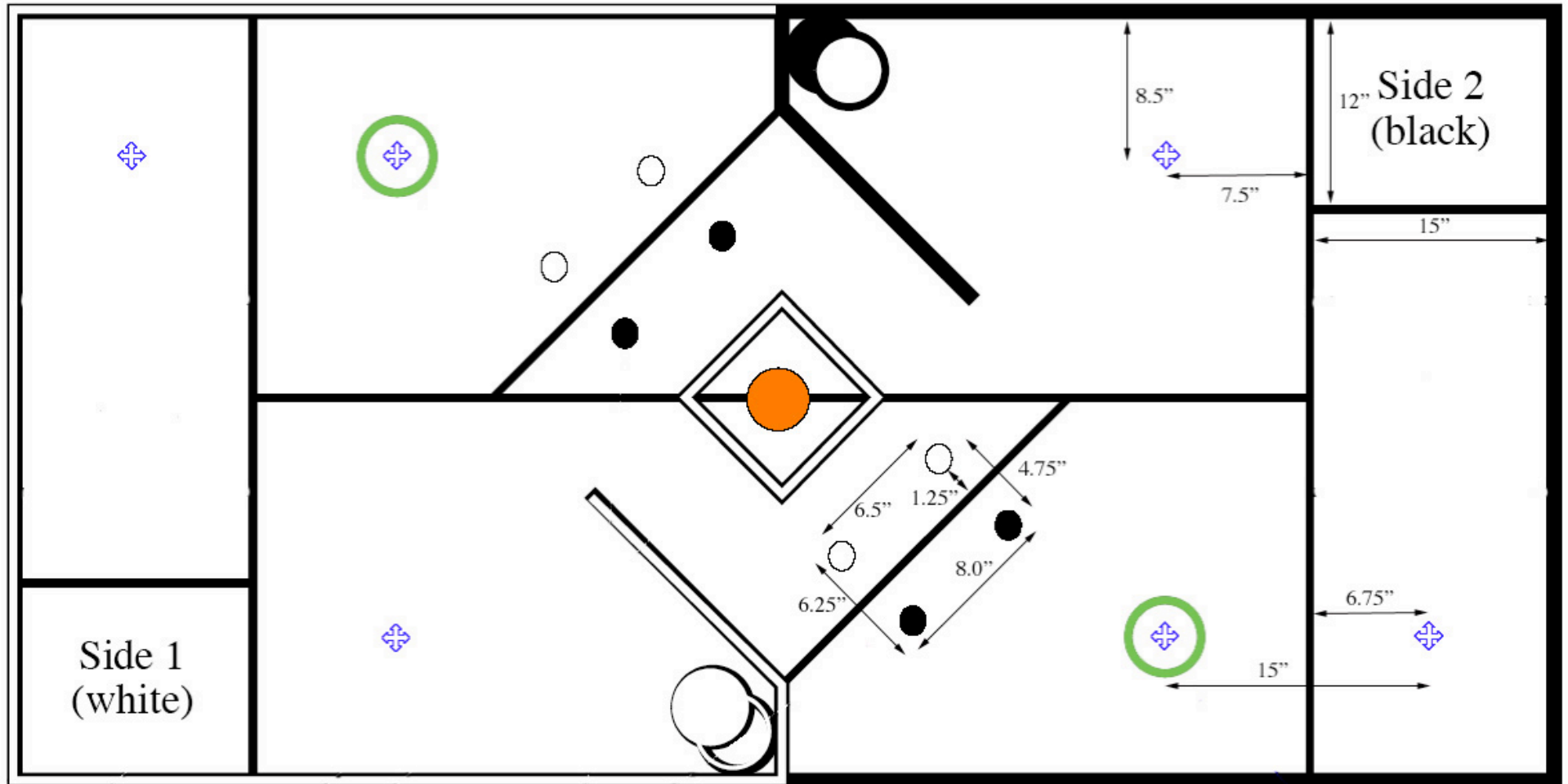


Arena Construction

- 1" PVC pipe (approx 1 5/16" OD)
 - 2 – 45" A (1 black 1 white)
 - 4 – 45.75" B (2 black 2 white)
 - 2 – 5.25" C (1 black 1 white)
 - 2 – 17" D (1 black 1 white)
 - 4 – 4 3/4" E (all black)
- 8 90 degree PVC 1" corners (2 black 6 white)
- 2 PVC 1" Ts (1 black 1 white)
- 2 PVC 1" 45° connectors (1 black 1 white)
- 2 PVC 4" connectors) (both flat green)
- 2 PVC 4" 45° connectors (1 black 1 white)
- 12 black ping pong balls
- 12 white ping pong balls
- 1 POOF brand 4" orange, foam ball
<http://www.poof toys.com/toys/catalog/cat3/catalog.asp?action=catv&catid=40>
 (UPC 83568 02400) available at Wal-Mart
- 4 black painted TP tubes (note, painted TP tubes are stiffer than unpainted)
- 4 white painted TP tubes
- 1 4'x8' tile board
- 3/4" black electrical tape for corner zone, start box and lines
- 2 60W lamps



Game Board Layout



Green baskets will be positioned symmetrically just before game start on a randomly chosen blue cross mark.

Arena Construction (cont)

- TP are easily painted
 - Clean with a light application of mineral spirits to remove/smooth glue residue
 - Let dry overnight and spray paint
- Tournament PVC (with the exception of nests and connectors) will be covered with Black or White cloth tape, not painted



Game Board Setup

- The starting box is a 12" x 15" rectangle at the right hand corner of each end. It makes up a portion of the endzone
 - the starting box is 12" W x 12" H x 15"L
- The starting boxes and end zones are determined by the inside edges of the tape and the PVC pipe
- The center line of the field is not marked.
- The official board will have pencil marks for the corners of the nest and for each of the 8 TP tubes and PVC baskets. 3 balls of matching color are in each TP tube.
- All measurements on official boards will be as specified within +/- 1/4 inch. Deal with it.



Black Scoring Summary

	Black Ping Pong Balls	Black Tubes	Nest	Foam Ball
Black Basket	5	-----	-----	30
Nest	5	5	Nest points for black team triple if nest is in white endzone	-----
Black End Zone	0	-----		10
Green basket on white side	-----	-----	-----	-----
Green basket on black side	10	-----	-----	50



White Scoring Summary

	White Ping Pong Balls	White Tubes	Nest	Foam Ball
White Basket	5	-----	-----	30
Nest	5	5	Nest points for white team triple if nest is in black endzone	-----
White End Zone	0	-----		10
Green basket on black side	-----	-----	-----	-----
Green basket on white side	10	-----	-----	50



Game Rules & Scoring

- After "Hands-Off" and moments before the starting lights come on, the green baskets are placed symmetrically on the board on corresponding randomly selected locations.
- Each team scores points by:
 - placing their ping pong balls in one of the scoring areas (matching color basket, green basket on their side, nest)
 - placing tubes in the nest
 - placing the foam ball in their endzone or their color basket or a green basket on their side of the board
 - extra points can be earned by placing the nest (containing a team's ping pong balls and tubes) in the other team's endzone
 - green baskets only score points for the team whose side it is on at the end of the game



Scoring: Ping Pong Balls

- A. Ping Pong Balls count for 5 pts:
 - if their centers are within the vertical projection of the inside of the nest (and the nest is not in the opposing team's endzone)
 - if their centers are contained within the matching color basket.
- B. Ping Pong Balls count for 10 pts if their centers are contained within a green basket located on that team's side of the board
- C. Ping Pong Balls count for 15 pts if their centers are contained within the vertical projection of the nest and the nest is in the opposing team's endzone.
- D. Ping Pong balls (if they are in a scoring position) score only for the team of that color



Scoring: Tubes

- A. Tubes count for 5 pts if any part of them is over the vertical projection of the inside of a nest and that nest is not in the opposing team's endzone.
- B. Tubes count for 15 pts if any part of them is over the vertical projection of the inside of the nest and the nest is in the opposing team's endzone
- C. Tubes score for the team that matches the color of the tube



Scoring: PVC Nests

- A. Nests do not score points
- B. Black and white objects in a nest's vertical projections score points of:
 - 1. 5pts each, or
 - 2. 15pts each if the nest is in an endzone and that piece is of the opposing side from that of the endzone



Scoring: Foam Balls

- A. The foam ball scores 10pts if any part of it is over the vertical projection of a team's endzone. The points go to the team whose color matches that of the endzone.
- B. Foam Balls count for 30pts if any part of it is contained in the inside of a colored basket (black or white) and the points go to the team whose color matches that of the basket.
- C. Foam Balls count for 50pts if any part of the foam ball is contained within a green basket. The points go to the team on whose side the majority of the green basket lies.
- D. Foam Balls that satisfy requirements for more than one of A, B, or C will be scored for the one category that gives the most points.



Tie Breaking

Tie breaking (in order):

1. The team with the most green baskets on their side
2. Team with the most points in their colored basket
3. The team with the most ping pong balls on the playing field outside of tubes
4. The team with the orange ball in scoring position
5. The team **WITHOUT** the majority of the nest on their side (if the nest was moved during game play)
6. The team who has a robot with a power switch closest to the nest.



Seeding/Performance Rounds

- S/P Rounds take place before the double elimination
- S/P rounds consist of best two out of three, unopposed rounds.
- All teams play Black-ball side
- Scoring = (black score) - (white score)/2
- Scores of less than -1 will be counted as -1
- Passing on a round gives a score of -1 for that round
- Seed Score = average of best two rounds



Double Elimination Tournament

- A team is out of the tournament when it has lost two games
- Initial matches are decided by seeding round using an "equitable draw"
- Matches are arranged using KIPR tournament software
- Judges' decisions are final



Double Elimination

- A team's robot must have broken the border of the starting box sometime during the 90 seconds of game play (or have attempted to do so but been prevented by the other team's robots) in order to win that round. In other words, even if your opponent scores more points for your side than they do for their own, if your robots never break the bounds of your starting box during game play, you will lose the round. If a team has two robots, only one is required to break the bounds of the starting box.
- If neither team's robot's break the starting box bounds during game play, the round will be replayed once. If neither team moves out of the starting box during the replay, the round will be decided by coin flip.
- At least one robot from a team must be outfitted and programmed to respond to the starting light. A robot team that operates exclusively on a timer triggered by a hand operated switch is not allowed and will automatically cause that team to forfeit that round.



Tournament Logistics

- No part of any coach, mentor, teacher, etc, is allowed over the vertical projection of the outer edge of the pit area (with the exception of tournament staff)
- Once teams register for the tournament, the role of teachers, parents and mentors should be high-level coaching & cheerleading.
- Robots may only leave the pit to go to the game tables
- Teams will know their side assignment (black or white) at least 3 minutes before the match
- Up to 2 students from a team bring the robot to the tournament table and set it up



Tournament Logistics (2)

- Teams shake hands and visually inspect each other's robots before calibration.
- If either team wants to challenge the validity of the robots they are facing, they have to do it then.
- Teams can bring the list of parts to the table to aid in the inspection.
- Inspection is limited to a max of 1 minute unless a specific challenge is made.
- Challenges have to be of the form:
 - That robot has too many X, or
 - That robot has glue where glue is not allowed.
- Judges will be the final arbiter.
 - Judges can dismiss what they believe to be spurious challenges
 - Teams found in violation will (unless the judge decides there have been extenuating circumstances) forfeit that round.
 - In no case will a robot that is determined before the beginning of the round to be in violation of the construction rules be allowed to play while in that state.



Tournament Logistics (3)

- The green baskets will be placed on the board for calibration purposes
- The starting lights (located directly behind the starting boxes) are on for calibration, then turned off for final calibration
- When both teams are ready or judges decide adequate time has been allowed for calibration, robots are activated and then -- Hands off!
- After Hands off, the **judges will place the green baskets in their final positions**
- After Hands off, no part of a team's robot(s) may leave the starting box until the starting lights turn on
 - If this happens, the judges will call a fault on the team
- If a team receives a 2nd fault in a round, they forfeit the round



Tournament Logistics (4)

- When the starting lights turn on the robots must autonomously start
- Lights will remain on for 5 seconds, turn off for 55 seconds and turn back on for the final 30 seconds of the round, flashing the last 5 seconds
- Once the starting lights have lit, the round counts unless a judge rules outside interference.



Tournament Logistics (5)

- Robots may NOT send reprogramming commands before, during or after a round.
- Teams cannot use infrared links to program their robots within 10 yards of the game board
- Robots must cut power to their motors and turn off or stop issuing motion commands to servos by the end of the round or the judges may zero their score for that round (ties in this case are decided by the judge based on performance during the round)
- Scoring is based on the location of pieces at the end of the round, not how the pieces got there.
- Judges may at any time, while a robot is on the table, decide that a robot is in violation of construction rules, and then disqualify that robot for that round. Judges will not accept challenges to robots from the peanut gallery. Challenges must come from the judges or the teams at the table.



Tournament Logistics (6)

- We don't care what LEGO, HBs etc there are in the pit. Construction rules apply only to what is brought to the Game Table.
- There are no instant replays, we do not want to see videos of questionable decisions. If a team is unhappy with a judge's decision, they should challenge it then and there. Challenges to scoring after the teams have left the table, will not be considered.
- Teams cannot touch, borrow equipment, modify robots or computers, or beam commands to another team's stuff (including their pit table) without the permission and presence of a member of that team
- The security of a team's equipment is the responsibility of that team -- **don't leave valuables unattended.**

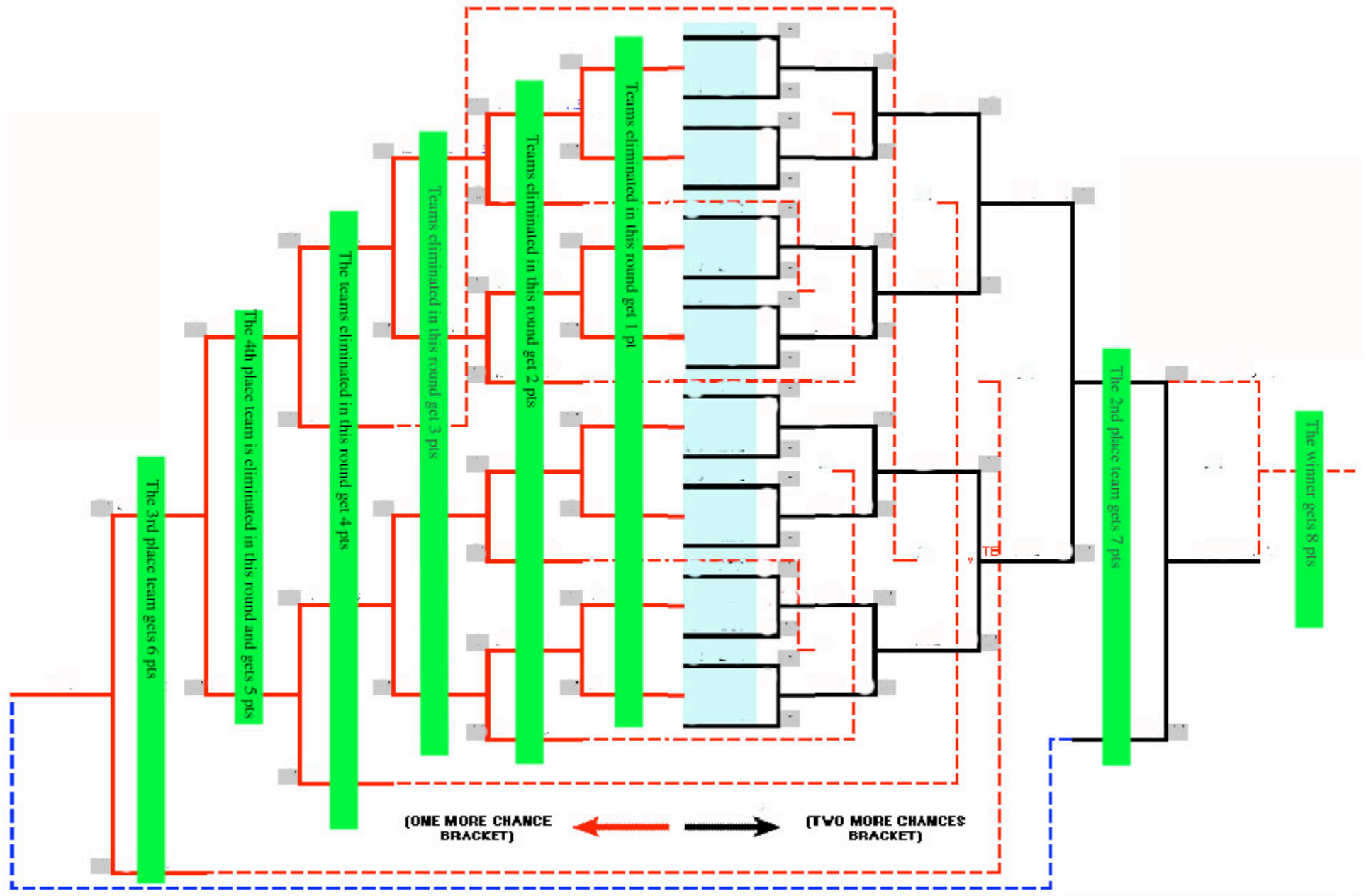


Winner

- Trophy winners will be selected by summing their points in each of the two contests (N= # of teams):
 - Seeding rounds:
 $\text{LOG}_2 (N/\text{rank}) + \text{LOG}_{10}(3 * (\text{seed_score} + 2))$
 - Double elimination:
winner gets: $2 * \text{Ceiling}(\text{LOG}_2 N)$
(see next slide)



For $8 < N \leq 16$: Max score = $2\text{LOG}_2 16 = 8$



Regional Scoring Example

- Winning the double elimination does not guarantee winning the tournament
- In a 16 team contest, a team that wins the seeding with a score of 59 gets ($4+2.66=6.66$ pts) and then finishes 7th or 8th in the double elimination (3pts) would have 9.66pts
- A team that finishes 9th in the seeding with a score of 15 ($.83+1.71=2.54$ pts) and wins the double elimination (8pts) would have a total of 10.54pts



Mentoring

- Students design the robot
- Students build the robot
- Students program the robot
- Mentors provide encouragement
- Mentors answer questions
- Mentors give examples
- Mentors give advice (not too explicit)



Things to do Before You Come to the Tournament...

- Test your robots from start to end:
 - Go through the entire starting sequence
 - Make sure you can calibrate to the starting light
 - Make sure the robots stop when they are supposed to: verify with a stop watch!
- **Does the starting sequence work with very bright overhead lights** (tournament tables will have bright lights hung about five feet above the tables) - **Test the shielding of your sensors!**



Some Useful Links

- Handy Board Home Page
<http://www.handyboard.com/>
- NASA Robotics Education Project Website
<http://robotics.nasa.gov/>
- MLCAD Website
<http://www.lm-software.com/mlcad/>
- Good Books:
 - *Mobile Robots: Inspiration to Implementation*. Jones, et. al.
 - *Definitive Guide to LEGO Mindstorms*. Baum
 - *Robotic Explorations*. Fred Martin



Check
www.botball.org
regularly
Good Luck!

