Botball 2004 Teacher's Workshop Game Review

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Sonic America's Drive In

Botball 2004 Tournament

- Project Documentation
- Robot Tournament
  - Robot Construction Rules
  - Game Board Construction
  - Contest Game
  - Scoring Rules
  - Tournament Day

Documentation Site

Document your Botball robots

1. Team strategy
2. Mechanical design
3. Software code
4. Game strategy
5. Testing procedures
6. Robot names
7. Team assignments
8. Schedule
9. Weekly status reports
10. Lessons learned and advice to future teams
11. Supplemental Website (bonus)

Documentation Details

- Team strategy

  – Team organization, decision making process, methods for choosing team member assignments, **method for conflict resolution**

- Team assignments

  – Who is doing what and how they communicate what they are doing to the rest of the team

Documentation Details (2)

- Game strategy
  - What your robots are going to do
  - How you extracted constraints and requirements from the game rules in deciding on your design

- Mechanical design
  - Description, drawings, photos that explain what you want for your robot(s); in the beginning this is requirements and at the end it is specifications

- Software code
  - Commented code listings, flow charts or text description

Documentation Details (3)

- Testing
  - Testing procedures
  - Conditions you tested for and conditions you tested under
  - When you tested, what you tested, and why you decided to test what you did

- Robot names
  - List of names your robots have had during development, the last of which must be ones we can announce to a G-rated audience

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Documentation Details (4)

- Schedule
  - Something established during the first week and updated regularly as the project evolves

- Status reports
  - At least weekly update of what your team has accomplished, referring to your schedule, and what the plan is for the next week

- Lessons learned and advice to future teams
  - Things you wish you had known when you started and advice for next year (or next week)

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Documentation Details (5)

- Supplemental Website (bonus)
  - Cool things that don't fit other categories such as multi-media, poetry, wishful thinking
  - Up to an additional 10% of documentation site score at judges' discretion

Documentation Site Rules

- Teams will document their projects using the KIPR documentation site tools which can be found on teams home base pages

- The documentation sites will be periodically archived and scored by KIPR

- **Content & design must be performed exclusively by students**

Documentation Judging

- All elements judged on scale:
    - 0 pts: for missing
    - 1 pt: poor - something is there
    - 2 pts: good - adequately documents that item
    - 3 pts: excellent - superior documentation
- Friday noon Central Time week 2; blogs archived and scored: (20% of doc score)
- Friday noon Central Time week 4; blogs archived and scored: (20% of doc score)
- Both week 2 and week 4 judging covers the first 9 elements of the documentation specifications

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Documentation Judging (cont)

- Thursday noon Central Time before tournament; blogs archived and scored (60% of doc score)

- At selected tournaments, judging will take place at the tournament. Up to two members of a team will talk the judges through their blog. Judges will ask questions about the material presented. Scoring will be 2/3 blog content and 1/3 ease and familiarity with the blog material

Documentation

- Documentation is a living thing
- We expect there will be changes in strategy and design over the weeks -- that's ok -- as long as you document the reason for changes
- You should make a new entry, not edit your old entries (editing of entries is for correcting spelling, removal of unauthorized postings, etc)
- Scoring is not on the quality of the code or the design, but on the quality of the documentation of the code and the design

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Suggestions for Documentation Site

- Include graphics
  - Scan in your own artwork
  - Digital photos are great
- If you use other people's ideas, art, etc, acknowledge the source in your site
- MPEG or Quicktime movies are fine for supplemental site, not documentation site

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The Blog Counts!

- Top three reasons for doing the blog:
  - 3: It is a good learning experience for all involved
  - 2: It gives your team and school an edge for next year (you have archived experience)
  - 1: The score on your blog contributes to your overall team tournament score!

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Robot Construction Rules

- Robots may be made out of any or all of the kit parts except: the plastic box, bags and wrapping or packing material; the charger; download cables and interface electronics

- 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!

- No more than one piece of LEGO may be glued to any of the sensors. The servos & black gear motors can have up to 7 pieces attached: one to each side and one to the effector plate. The speed servos can have two additional pieces, 1 on the potentiometer base and one on the potentiometer knob (for a total of 9). Sensors that come from KIPR with one LEGO piece attached may have one additional piece glued on, if desired

Robot Construction Rules (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, with the exception of drawn or printed official logos for paying sponsors of your team**

- You may add 36 inches of thread or line or cable (max diameter 1mm), for use ONLY as tensile elements in winches and pulleys

- Up to 5 standard office rubber bands of maximum size #19 may be used (#19 is 3.5" x 1/16" x 1/32"); rubber bands may not be glued or melted

- 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 (3)

- All robots must start themselves when the game light goes on. Robots must stop themselves within 90 seconds after game start

- Robots must be completely within starting box at game start

- Each robot kit contains two computers/power sources

- If two robots are made from a single kit, they represent a single tournament entry

- Two robots from a single kit must together fit within the size constraints

- Two processors may exist on a single robot

- It is not necessary to use all the parts in a kit

Robot Construction Rules (4)

- No electrical modifications may be made to either processor, any sensors or any motors

- No wire extensions may be used except those provided in the kits (foil may **not** be used as wire!)

- 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

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Robot Construction Rules (5)

- You may trim the connector potting material as needed to ease insertion or mounting of sensors

- You may file or sand the mounting holes on the HB box to ease mounting of Lego parts to the box

- You may use wire ties to neaten up the wiring on your robot (cannot have any structural role)

- **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.**

- Servo horns may be trimmed to facilitate mounting to a Lego piece

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Robot Construction Rules (6)

- 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.
 - Items intentionally ejected from a robot count (judges judge intention)

Robot Construction Rules (7)

- Lego parts cannot be physically modified except for:
  - Pneumatic tubing and rubber bands can be cut to desired length
  - 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
- Each robot must have a name approved by an adult team leader (G rated) before the tournament
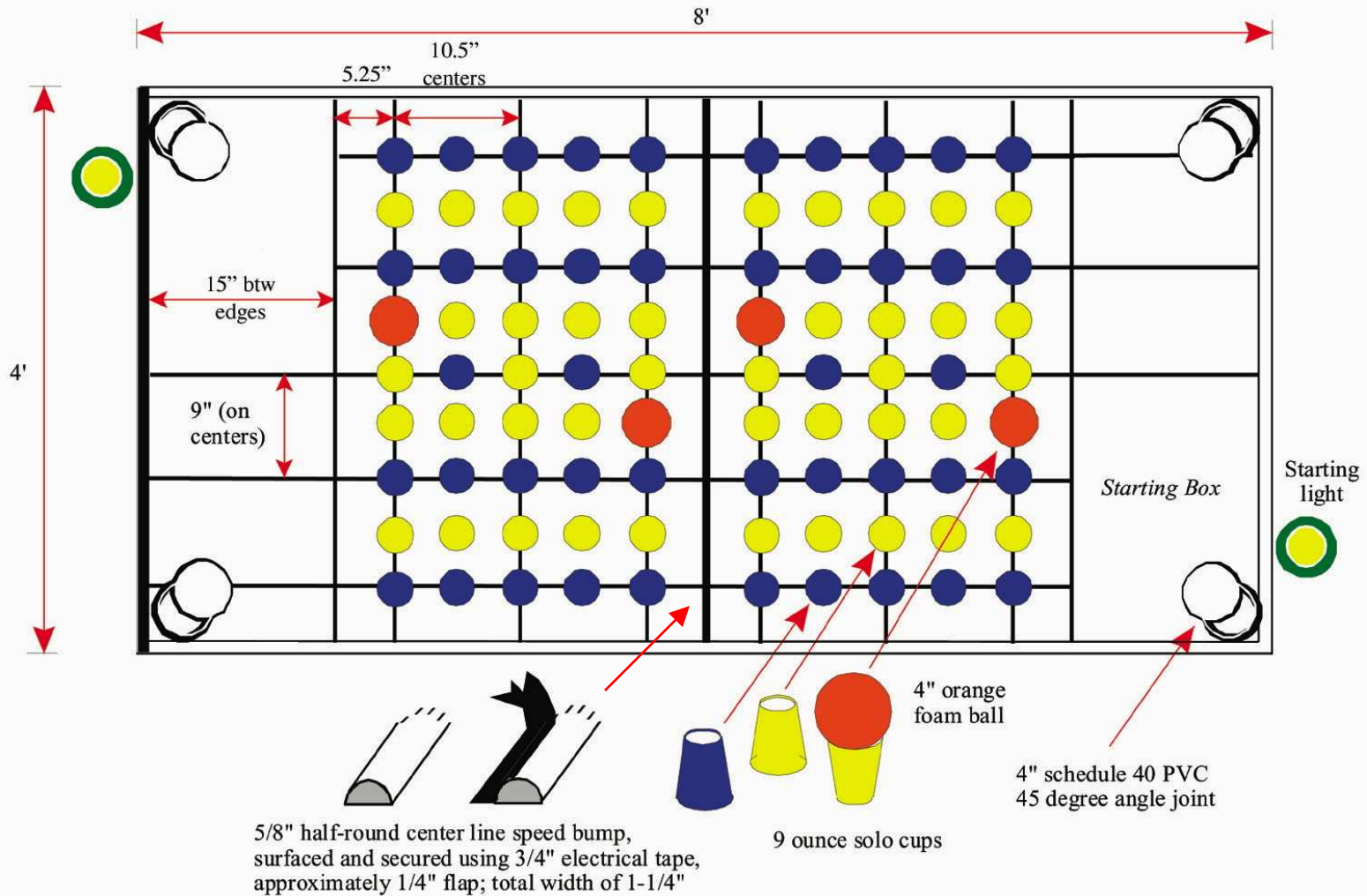
Botball

The Botball Table
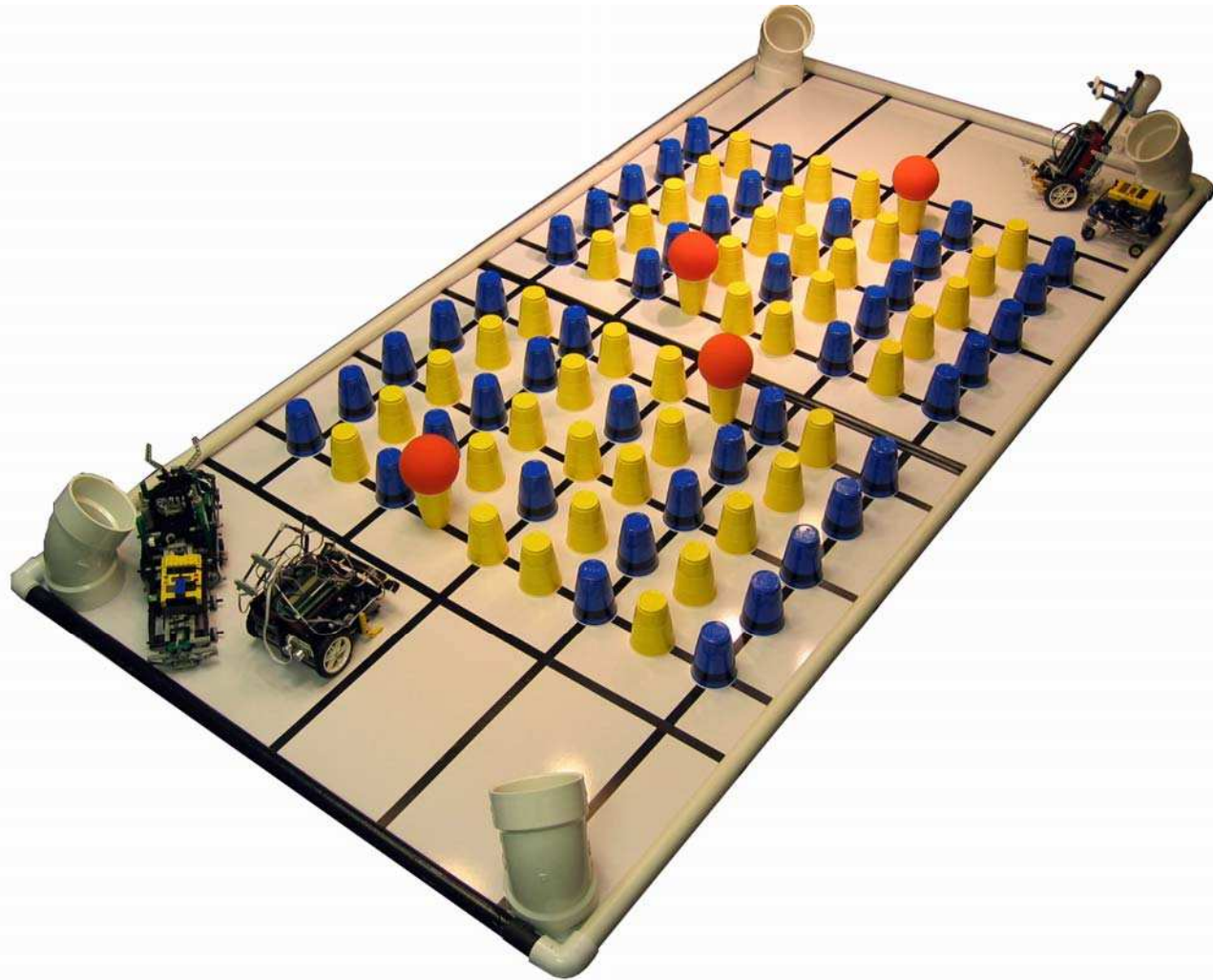
Game Overview

- The game has 3 major objectives
  - Capture yellow cups
  - Get rid of blue cups
  - Get orange balls in your corner baskets

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Game Board Layout

8'

10.5"
5.25"   centers

15" btw
edges

4'

9" (on
centers)

Starting Box

Starting
light

5/8" half-round center line speed bump,
surfaced and secured using 3/4" electrical tape,
approximately 1/4" flap; total width of 1-1/4"

9 ounce solo cups

4" orange
foam ball

4" schedule 40 PVC
45 degree angle joint

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Arena Construction: Parts

- 1" PVC pipe (approx 1 5/32" OD)
    - 2 – 45"   A (1 black 1 white)
    - 2 – 93 "   B (white)
- 4 90 degree PVC 1" corners
- 4 45 degree PVC 4" angle joints
- 1 45" length of wooden 5/8" half round

- 46 yellow Solo cups, 9 oz
- 44 blue Solo cups, 9 oz
- 4 4" orange foam ball
- 1 4' x8'   tile board
- 120' (2 rolls) of 3/4" black electrical tape for table lines, for striping blue cups, and for covering/attaching the half-round as a center "speed bump"
- 2 60W incandescent lamps

Arena Construction: Tools

- **Straight edge**
- **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)

Arena Construction: Boundaries

- The 4' PVC pieces at each end will be painted (rather than covered in duct tape)

- Lines are constructed using 3/4" electrical tape
  - The extra tape where one line crosses another will not be removed

- The "speed bump" at the center of the arena is made of 5/8" wooden half round, attached by using a 3/4" electrical tape strip that extends 1/2" onto the table and 3/4" along the side of the half round. The bump is finished off by running a 3rd piece of tape down its center to cover up the gap from the attachment strips.

Game Board Setup

- The outside dimensions of the PVC frame around the main field are 4' x 8'
- The starting box is the leftmost box on your end of the game board defined by the inner edge of the tape and PVC
  - 15" x 22-3/8" base
  - Contains one of the corner baskets
  - Has a (virtual) height of 12"
- Corner basket orientation is on the 45° degree line from the corner
  - the basket contacts the two rails that make the corner
- To identify the ends of the game board, one has a length of black PVC pipe, the other white

Game Board Setup (2)

- Cups are equi-spaced in a 4.5" x 5.25" grid
- With the exception of the center row, each row of cups has the same color.
  - The outer row of cups is blue
  - The color of row alternates until the center row
  - The center row has alternating colors (3 yellow, 2 blue).
- All cups are face down except for the 2 on each side that are inverted to hold a 4" orange ball
- Blue cups have a black band of tape just above the "grip" to facilitate identification using sensors

- Every other row and column in the grid is marked with a line
  - Grid lines extend across the board, except for within the starting boxes
- All measurements on official boards will be as specified within +/- 1/4 inch. All cups will be placed within +/-1" accuracy. Deal with it.

Game Rules & Scoring

- Each team scores points by:
  - Having more yellow cups than blue on their side
  - Stacking yellow cups
  - Placing the foam balls in the team's baskets
- A team that never breaks the boundary of the starting box CANNOT win over a team that does - regardless of score (growing taller than 12 inches does not count as breaking the boundary of the starting box)
- A team whose robot does not turn off motors and power down servos at the end of the round, CANNOT win over a team that shuts off, except for the case above

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Scoring

- Each yellow cup on a team's side at the end of the game counts 1 point

- Each yellow cup in a stack counts an extra point (regardless of the color of the other cups in the stack)

- A foam ball counts for 10 pts for the side where the basket is located if any part of the ball breaks the face of the basket

- Each blue cup removes a point for that side (but score does not go lower than 0)

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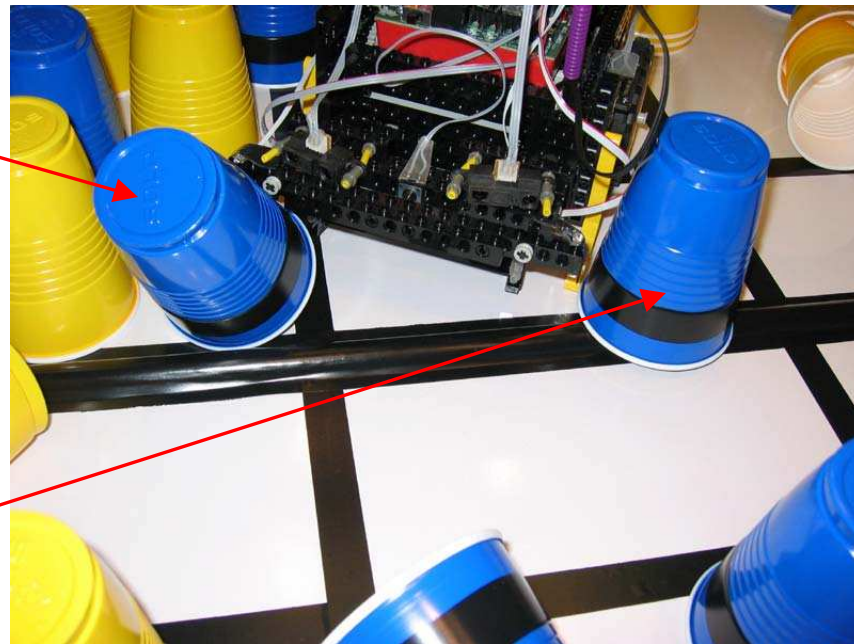
Scoring:
What Counts and What Doesn't

- A cup counts if it touches the table surface (including black tape, but not including the center speed bump); it belongs to the side it's touching

- A cup not touching the table surface counts only if its rim is wholly within the vertical projection of the white side or the black side (the speed bump is not part of either side); it belongs to the side its rim is over

- A stack consists of 2 or more cups (any color) where the closed end of one cup breaks the plane of the mouth of the other

- To be considered a stack, the bottom cup can tilt no more than 45° from vertical (up or down orientation does not matter)

- For cups in a stack, the position of the lowest cup of the stack determines the side to which the other cups in the stack belong

  – If the bottom cup belongs to neither side, no cup in the stack counts

- A yellow cup in a stack scores an extra point (even if the other cups in the stack are blue)

  – Blue cups in a stack do not count extra plus or minus.

Scoring: Odd Cases

- This rim of this cup is touching the table surface.

  It counts on the side it touches even though it leans into the other side.

- No part of this cup is touching the surface and its rim is not completely within the vertical projection of either side. It does not count on either side. (The surface does not include the PVC or speed bump)

Calculating Score

- At the end of the round, for each side:
  - Remove non-scoring cups
  - Add 10 specially marked cups for each foam ball scored
  - Add 1 specially marked cup for each yellow cup in a stack
  - Gather all yellow and specially marked cups into a **scoring stack**
  - Gather all blue cups in a stack
  - Remove cups from the scoring stack equal to the size of the blue stack
- Compare the remaining scoring stacks
  - The winner has the taller stack
  - If stacks are the same or both empty, see tie breaking

Scoring Example

Tie Breaking

- Tie breaking (in order) for a score > 0: the winner is
  1. The team with the most specially marked cups
  2. The team with the fewest blue cups
  3. The team with the most yellow cups
  4. The team who has a robot with a power switch closest to the speed bump

- Tie breaking for 0 - 0 games: the winner is
  1. The team with smaller number of blue-scoring stack cups
  2. The team with the most specially marked cups
  3. The team who has a robot with a power switch closest to the speed bump

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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 side
- In seeding, the score for a side is the height of the scoring stack minus the height of the blue stack (this score could be negative)
- Scoring = (black score) - (white score)
- Seeding scores of less than 0 will be counted as 0
- Passing on a round gives a score of -1 for that round
- Seed Score = average of best two rounds
- Perfect seed score is 176 points:
  - 92 pts for 46 Yellow cups all stacked on your side
  - + 44 pts for 44 Blue cups on opposing side
  - + 40 pts for 4 orange balls in goals on your side

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

Tournament Logistics

- No part of any adult 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 1 minute before the match

- Up to 2 students from a team bring the robot to the tournament table and set it up

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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)

- Prior to the start of each round, each team calibrates its starting sensor for lighting conditions by 1st turning on their starting light (located behind the starting box), then off for final calibration

- When both teams are ready or judges decide adequate time has been allowed for calibration, each team positions/activates its robots and then -- Hands off!

- Robots are signaled that the round has begun by the starting lights turning on

- After Hands off, no part of a team's robot(s) may leave the starting box until the round begins
  - 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, turn back on for 25 seconds, and then flash for the last 5 seconds

- Once the starting lights have lit, the round counts unless a judge rules outside interference.

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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 servos** by the end of the round or the that team will lose the round in all situations except against a team that does not break the boundary of the starting box

- Scoring takes place when items come to rest

- 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, or that team members are guilty of interference 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.**

Regional Awards

- Certificates will be given for a variety of robot and team features
- Awards will be given for:
  - Top finishers in tournament
  - Top finishers in seeding rounds
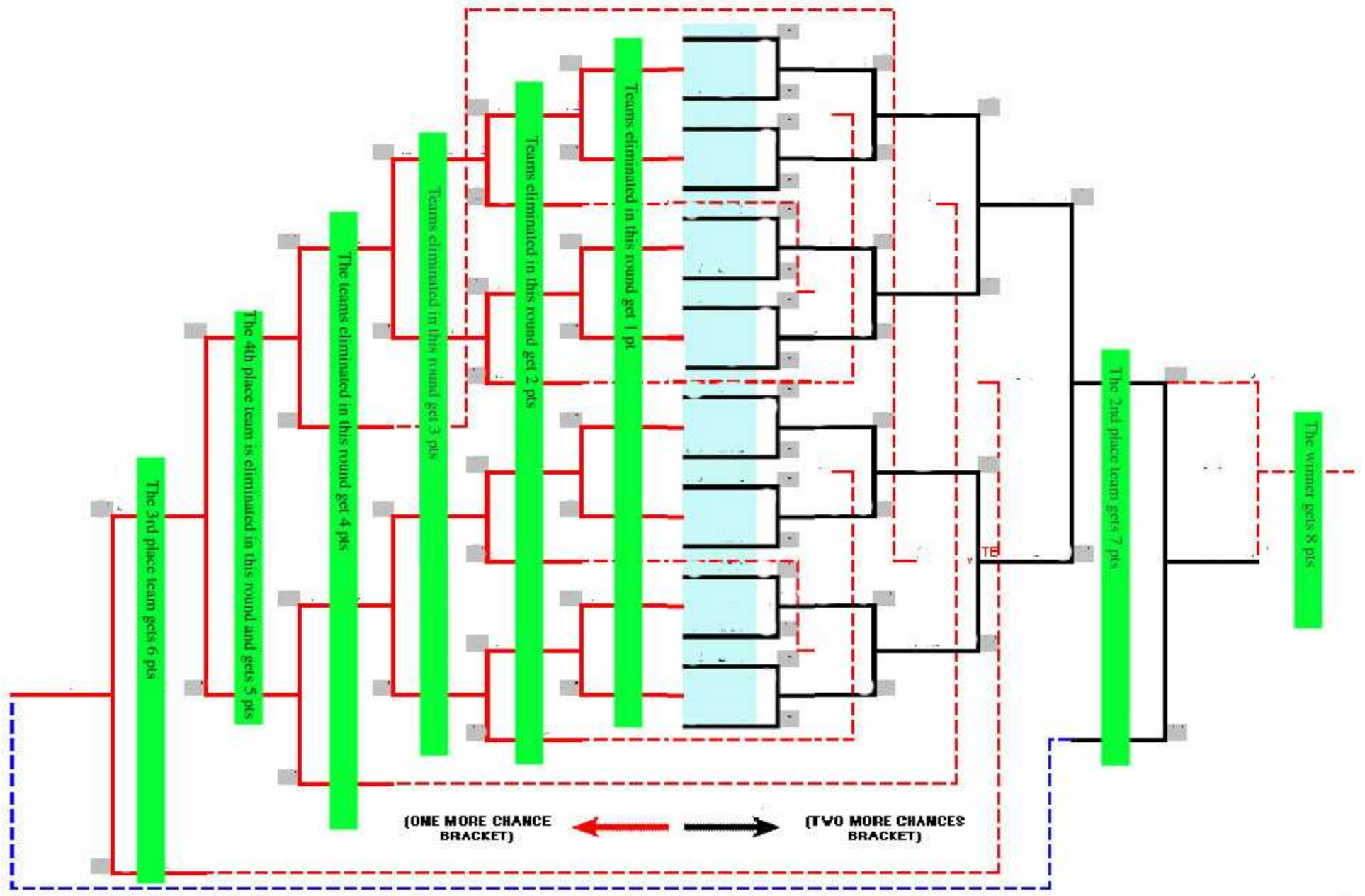- Trophies will be given for overall regional winners

Regional Winner

- Regional Trophy winners will be selected by summing their points in each of the three contests (N= # of teams):

  - Documentation Report:

    $LOG_2(N)*doc\_site\_score/100$

  - Seeding rounds:

    $LOG_2 (N/rank)+LOG_{10}(3*(seed\_score+2))$

  - Double elimination:

    winner gets: $2*Ceiling(LOG_2N)$

    (see next slide)

For 8<N<=16: Max score = $2LOG_2 16 = 8$

Teams eliminated in this round get 1 pt

Teams eliminated in this round get 2 pts

Teams eliminated in this round get 3 pts

The teams eliminated in this round get 4 pts

The 4th place team is eliminated in this round and gets 5 pts

The 3rd place team gets 6 pts

The 2nd place team gets 7 pts

The winner gets 8 pts

(ONE MORE CHANCE BRACKET)

(TWO MORE CHANCES BRACKET)

Regional Scoring Example

- Winning the double elimination does not guarantee winning the tournament

- In a 16 team regional, a team that receives 80% on their documentation site (4*0.8=3.2 pts) and wins the seeding with a score of 59 gets (4+2.26=6.26 pts) and then finishes 7th or 8th in the double elimination (3 pts) would have 12.46 pts

- A team that receives 25% on their documentation site (4*0.25=1 pts) and finishes 9th in the seeding with a score of 15 (.83+1.71=2.54 pts) and wins the double elimination (8 pts) would have a total of 11.54 pts

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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)

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Things to do on Monday

- Gather the team and...
  - Show the game video
  - Make copies of rules and slides available to all team members (e.g., place PDFs on shared disk)
  - Start brainstorming
  - Start entering documentation

Things to do first week...

- Decide on team strategy (how team will make decisions and resolve conflicts)
- Create project schedule
- Create project team roles
- Start documentation
- Have team buy-in on a game strategy
- Perform team programming project (e.g., each person writes a function that displays their name on the HB display)

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

- Test your robots from start to end:
  - Shield the light sensor you are using for starting
  - Go through the entire starting sequence
  - Make sure you can calibrate your light sensor to the starting light
  - Make sure the robots stop when they are supposed to: verify with a stop watch!

- **Does your starting sequence work with very bright overhead lights?** (tournament tables will have 8 FEIT ecobulb 60 Watt replacement (800 lumen, 13 watt) compact fluorescent light bulbs in 9" reflectors lights hung about five feet above the tables)

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Test

- **Test**
  - **The shielding of your light sensor(s)!**
  - **How your robot works after repeated test runs**
  - **Under different battery charge conditions**
  - **Under different lighting conditions**
    - **Your classroom lighting may be very different from the tournament lighting**
  - **Against opponents (real or imaginary)**

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
and your team website
regularly

Good Luck!

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