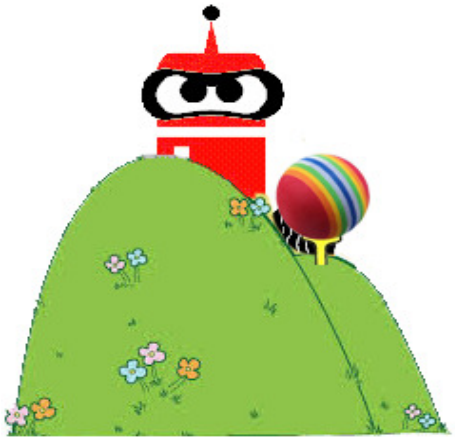
2016 KIPR Open

Autonomous Robot Tournament
Game Specification
Version 1.1



BotGolf

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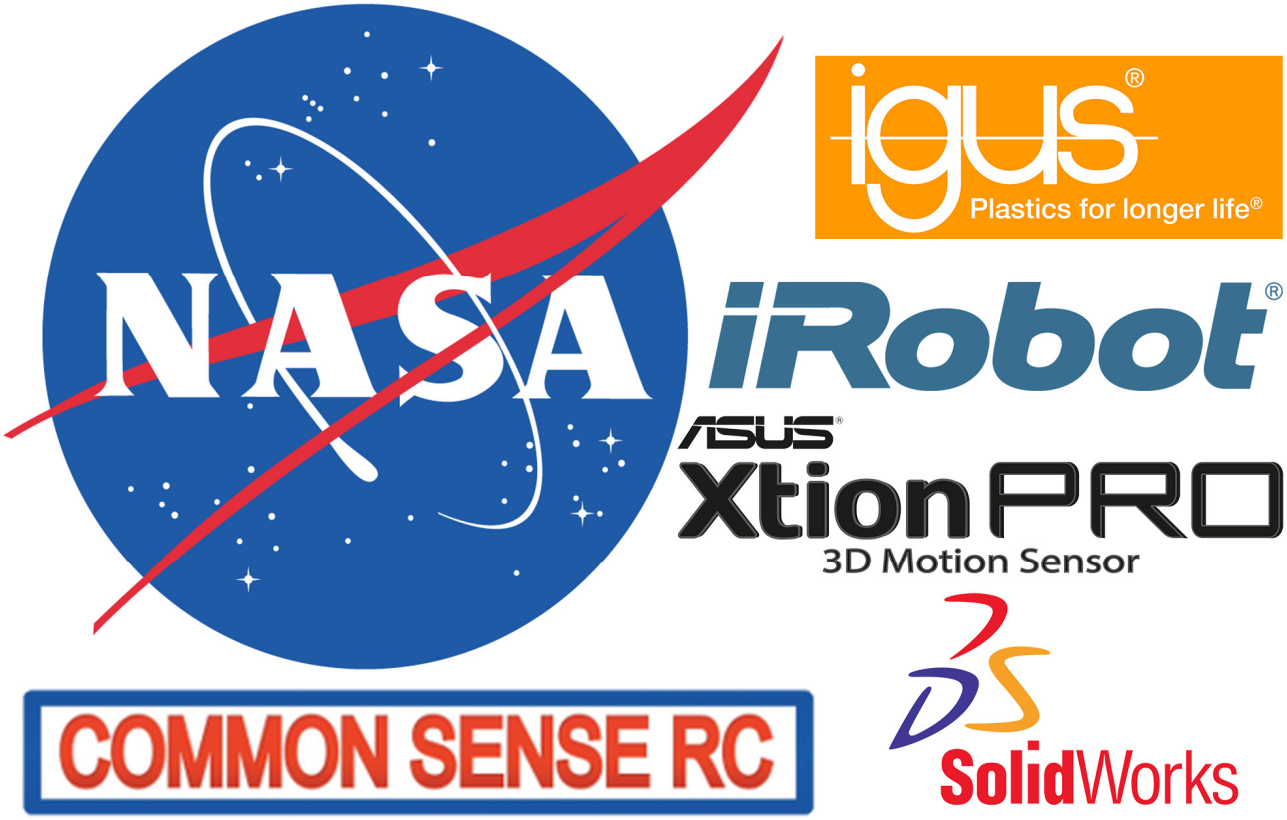
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Update History

Version 1.0: November 10, 2015
Version 1.1: January 9, 2016 - initial release (edited to coincide with Botball game release)

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International KIPR Open Tournament

KIPR produces the International KIPR Open Autonomous Robot Tournament each year at the Global Conference on Educational Robotics. The 2016 Global Conference on Educational Robotics (GCER) will be held July 6, 2016 - July 10, 2016 (pre-conference on July 5) at the World Golf Village Renaissance St. Augustine Resort located in St. Augustine, Florida. For more information on GCER, please see http://www.kipr.org/GCER.

KIPR Open Game

The KIPR Open Game is an autonomous robotics challenge designed and distributed each year by the KISS Institute for Practical Robotics (KIPR) to encourage ongoing robotics education beyond the high school level. This document presents the official game rules for the 2016 KIPR Open Game, subject to modification and adjustment in response to errata, oversights, or participant queries. The KIPR Open Game rules may be used free of charge for educational purposes. They are regularly used in conjunction with collegiate coursework and in educational robotics events around the world. For the latest information on the KIPR Open Game and the International KIPR Open Tournament, including updates to this rules document via posted notifications and FAQs, go to http://www.kipr.org/kipr-open.

For information on KIPR's Botball Educational Robotics Program for students in elementary school, middle school, and high school visit http://www.kipr.org.

This Year's Game: BotGolf

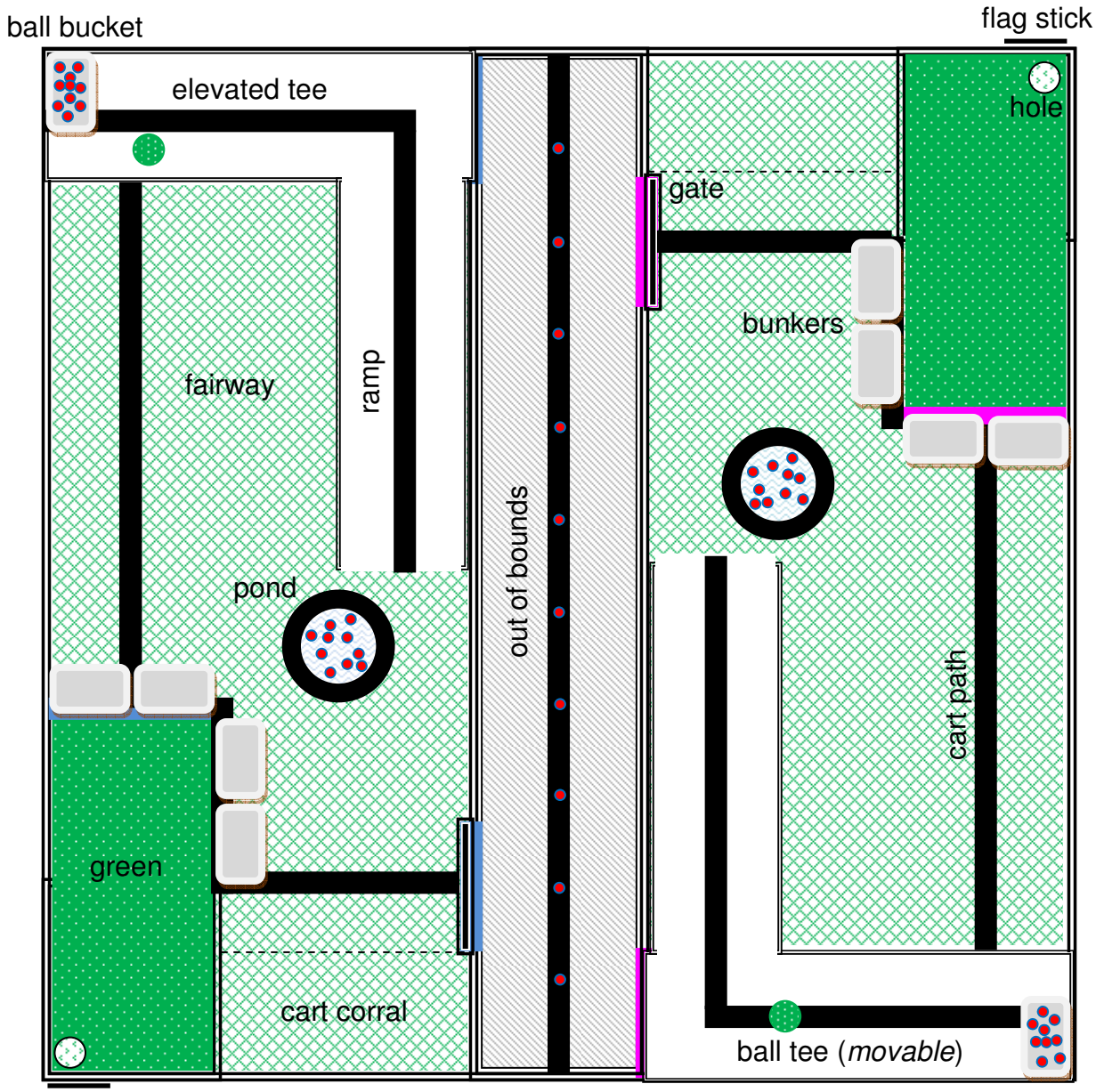
The objective for this year's game challenge reflects the world famous golf facilities in and around St. Augustine, Florida and golfing challenges such as TopGolf. The objective is twofold:

1. tee off golf balls from an elevated tee to land as many as you can on the "green" or in the "holes" on the surface below.
2. collect any loose golf balls from the surface and return them to a bin under the tee (from which they can be teed off again, or left in place to score points).

Team Identification

For each round, a team will be identified as the Pink team or the Teal team, depending on which side they set up on. Pink tape lines identify the Pink side and Teal tape lines identify the Teal side. Scoring is in bins placed on the surface in front of the elevated tee, on the indoor/outdoor carpet in the corner (the "green"), or in the storage bin under the elevated tee. While a team can take balls out of the storage bin under the elevated tee, only a robot on the surface and not on the elevated tee can place balls in the bin.

The Game Board



storage bin directly under ball bucket

The **out of bounds** area is the surface of the game board down the center plus the surface under the elevated tees and ramps. It includes the colored tape in the PVC gaps. The **elevated tees** are the platforms at each end of the game board. The **cart corrals** are marked off areas beside each green with PVC on 3 sides. The **Golf balls** are indoor practice sponge foam balls. A **ball tee** is a moveable patch of grass that can only be placed on the elevated tee. A **divot** is a ball tee knocked off the elevated tee. The **greens** are the "grass" surfaces in the corner boxes opposite each tee, each with a 4" **hole** cut in it. The **bunkers** are bins guarding the greens. The **ponds** are frisbee rings containing golf balls. The **fairways** are the exposed surfaces of the remainder of the game board. The fairways do not include the ramps, overhead tees, greens, or ponds (marked by vertical projection of the pond perimeter) , but any fairway surface under a bunker is in a fairway. Each side has a **storage bin** fastened in the outer corner under their elevated tee plus a **ball bucket** on their elevated tee fastened in the corner above their storage bin. There may be a **flag stick** (a backboard) behind each hole.

Scoring

Scoring: Overview

1. Teams score points by having a driver robot "tee off" light weight foam practice golf balls from an elevated tee to try to land them in a scoring area on their side. A ball bucket on their elevated tee holds their supply of balls to be teed off . Balls teed off score on the green and in the bunkers.
2. Teams may also have robots operating autonomously to retrieve balls from around the course to score points on their green or in their bunkers, or to bring them to their storage bin. Teams can (optionally) remove balls from their storage bin to their ball bucket for teeing off.
3. Judges score the game after the end of the match, so a team's score is determined by balls on their green, in their bunkers, or in their storage bin.

Scoring: Areas

- The fairways
- The greens (extra points for in the hole)
- The bunkers surrounding the greens
- The storage bins

Scoring: Game Objects

50 –practice golf balls

Specifications for game objects will be on the KIPR Open web site at http://www.kipr.org/kipr-open.

The balls used at the tournament will be indoor practice sponge foam balls which come in a bag of 50 available from
http://www.amazon.com/gp/product/B00IMYMAU4?p sc=1&redirect=true&ref =oh aui search detailpage

Scoring: Item Layout

Before the start of the round the judges will reset each fairway (the bunkers and ponds, putting 10 balls in each pond). A ball touching the fairway is in the fairway unless also touching the green. At game start, each team will have 10 balls in their ball bucket to tee off. The remaining 10 balls will be evenly spaced in a line down the out of bounds area between the two fairways. Any balls placed in the storage bin can be removed by the team to their ball bucket to tee up and try again (in penalty situations all balls in the storage bin must be removed to the ball bucket to be teed off). Rules regarding game play and scoring are below.

The judges will conduct a briefing with the teams in advance of the tournament to clarify (and possibly adjust) game rules or board setup ; e.g., a change in how to manage the ball bucket, penalties, or driver robot adjustments during game play.

Scoring: Rules

The official scoring rules for the 2016 KO Game are made up of this 2016 KO Game Review document **and** any updated scoring rules posted via the KO web site as responses to FAQs or other issues raised prior to the start of the tournament. If rule adjustments so warrant, an updated version of this document may be posted to provide changes and adjustments, notated on the update history page above and by a revised version number. Rule changes may occur as late as the team briefing held with the judges at the tournament venue prior to the tournament.

The objective for the game is to get as many balls as possible onto the fairway or the green, or into the bunkers or storage bin.

Each team is permitted to have one robot designated as its driver robot for hitting golf balls. Limited team interaction with this robot is permitted as detailed below. All other robots fielded must operate autonomously , responding to the starting light and ceasing all powered movement by game end (excepting the slight wiggle of an enabled servo holding position). Additionally, manipulation of the driver robot, ball tee, or balls during game time cannot be used to manipulate other independent structures the team may have on the field.

The starting box for this year's game consists of two rectangular volumes, each with a (virtual) height of 15":

1. The rectangular volume designated as the cart corral.
    a. Robots starting from this area must be ones designed to operate autonomously.
2. The rectangular volume above the surface of the elevated tee (inside the PVC perimeter of the elevated tee) designated as the upper star box.
    a. The ball bucket is anchored in the corner of this volume.
    b. Both the driver robot and robots that operate autonomously are permitted in this volume.
    c. Teams may use either the supplied 4" diameter circular ball tee, or use their own, so long as dimensions don't exceed a 4" square, 3/4" thick (approximate) with a carpet sample glued on top. The supplied tee is the 4" hole cut out of the green where the carpet is mounted on 1/2" plywood.
    d. When the driver robot has ceased all movement, the team can reset the ball tee flat anywhere touching the black line on the elevated tee and position a ball from the ball bucket on it. Any other balls within the volume must be returned to the ball bucket unless doing so would require touching a robot operating autonomously (remember that positioning a ball or ball tee cannot be used to manipulate a robot operating autonomously); i.e., only one ball at a time can be in play on the elevated tee. The driver robot must have ceased all movement by game end.
    e. Once the tee is set and a ball placed on it, the team may reposition their driver robot but not otherwise manipulate the robot (e.g., cock an arm). After positioning the driver robot, the team may signal it to perform by a single button press.
    f. Balls off the table are fair game and once retrieved must be placed in a ball bucket.
    g. In the event of a divot, only table judges are allowed to recover the team's ball tee and return it to them.

The only scoring objects are golf balls:

1. A ball must touch the fairway or the green to score on it.
2. A ball must project into the interior of the bunker or storage bin to score in it.
    a. A bunker does not have to be upright for balls to score in it.
    b. Each bunker has a piece of terry cloth covering the bottom of its interior to lessen bounce.
3. For the cup, a ball must be either in the cup (project into its interior) or on the green and intersecting the vertical projection of the cup.
4. Judges are not concerned with how balls ended up in scoring position since scoring is based on where balls are located at the end of the match.

Penalty situations:

1. Only robots operating autonomously can put a ball in the storage bin.
    a. If the driver robot or team member action puts a ball in the storage bin, all balls in the storage bin will be removed and placed in the ball bucket. This rule does not apply for a ball hit into the storage bin by the other side's driver robot.
2. If the driver robot reaches below the elevated tee, the storage bin will be emptied into the pond by the table judges.

Scoring: Points

Hole: 5 points per ball

The ball must break the volume of the hole or be on the green breaking the vertical projection of the hole.

Bunker: **3 points per ball**

The ball must intersect the interior of the bunker.

On the green not scoring in the hole: 2 points per ball

The ball must be touching the surface of the green.

Storage Bin: 2 points per ball

The ball must intersect the interior of the storage bin.

Fairway: 1 point per ball

The ball must be touching the fairway surface. If touching the green, it scores 2 points.

A penalty may be assessed as specified in the tournament logistics below for teams taking excess time for setup.

Scoring: Points Grid

	In the hole	On the green	In a bunker	In the storage bin	On the fairway
Ball	5	2	3	2	1

Scoring: Tie Breaking

In the event of a tie, the following tie breakers will be applied to determine the winning team (inorder):

1. Team with the most balls in the hole
2. Team with the most ball on the green
3. Team with the the ball closest to the hole
4. Team with the most balls in bunkers
5. Team with the most balls in the storage bin
6. Team with the most balls on the fairway
7. Team with the fewest balls in the pond
8. Team with a robot power switch closest to the center of the board

Game Board Construction

Game Board

The game board is the same structure used for the 2016 Botball game, although with different game elements and objectives. The game surface uses the same materials as last year's game. In addition to the materials for the Botball board you will need

- 2 pieces of 1/2" plywood, each 15" x 30"
- 2 pieces of indoor/outdoor carpet to glue to the surface of the plywood (the tournament table will use Home Depot Vantage Ivy Green, product part T27-2700, SKU 925845)
- 12 bins, Glad Deep Dish 64 Oz. available in 3 packs from most grocery stores (lids not used for the game)
- 2 flat black frisbee rings (9-5/8" diameter - the tournament will use the KIPR versions)

It will be necessary to use a hole saw or saber saw to cut a 4" circular hole in the plywood/carpet. The tournament supplied ball tee will be the salvage from cutting the hole. You may optionally use a square 4" carpet sample (free at Home Depot) glued to a 4" square piece of 1/2" plywood as your ball tee.

Game Board Layout

The KIPR open board is modeled off of the 2016 Botball board with the following changes:

- A green (with hole) is installed in each of the Botball starting boxes.
- The hole is as pictured, inset 2" from each edge in the corner.
- A ball bucket (same bin as used for bunkers) is attached in the outside corner of each elevated platform
- A storage bin (same bin as used for bunkers) is attached in the outside corner on the table surface directly underneath the ball bucket.

Frisbee rings (ponds) and the remaining 8 bins (bunkers) are placed on the game board in marked locations. The fifty practice golf balls are distributed 20 in the two ball buckets, 20 in the two ponds (random arrangement), and 10 on marked spots on the black line down the center of the board in the out of bounds area (with a minor restraint to secure position).

Robot Construction Rules

The following rules apply to all robots to be entered in the KIPR Open Robot Game:

1. A team's entry (all materials placed on the game-board) must mass less than 10kg (22 pounds).
2. A team's entry (all materials placed on the game-board) must fit within their (virtual) Start Boxes without restraint (other than pressing against interior edge of any game board PVC bordering a Start Box). Each team has two start boxes on their side as specified (each with a 15" virtual height) and can use either or both, but for starting can only use the two lights provided.
3. The team's entry may not contain or release pressurized materials at greater than 7 bar (100 psi).
4. The team's entry may not release any liquids during the game, or before, during, or after the game while the team is at the game table.
5. The team's entry may not release any gases while at the game table that are considered hazardous by the judges, or are at a temperature below 0^{o}C (32^{o}F) or above 50^{o}C (122^{o}F).
6. Robots may not contain features (manipulators, protrusions or materials) that are designed to, or are deemed by the judges likely to, cause damage or destruction to the game board, or to game pieces, or to a reasonably constructed opponent robot; in particular, things like needles serving to penetrate game objects or otherwise, or the use of a sticky substance to pick up game objects are prohibited.
7. A team's entry may not contain features (manipulators, protrusions or materials) that are designed to, or are deemed by the judges likely to, cause jamming or entanglement of a reasonably constructed opponent robot. Blocking and containing of opponent robots is allowed; strategies likely to entangle or damage opponents or the board or game pieces are not allowed.
8. Robots cannot use external power or control from outside of the game board area. During the game, teams may not take any action which breaks the vertical projection of the game table with the exception of the allowed actions associated with the driver robot and storage bin.
9. Other than the driver robot, robots must operate autonomously and only limited interaction during a game is permitted for the driver robot.
10. While the driver robot is static (not moving), the team can reset the ball tee flat on the surface of the upper start box and place a ball on it. The driver robot can be repositioned, but not manipulated otherwise. During this activity, the ball tee, ball, or driver robot cannot be used to push clear any object in the upper start box.
11. Once the driver robot's position has been reset, the team is permitted a single button push on the driver robot's controller to reactivate it, which must have a sufficient delay to allow the team to pull clear of the upper start box before the robot resumes action.
12. Only one ball is permitted on the elevated tee outside of the ball bucket unless removing any extra balls would interfere with an independent structure other than the driver robot.
13. If the driver robot causes a divot (described above), the table judges will retrieve the ball tee and return it to the team. Only the judges are allowed to perform this kind of action and will be held faultless for any issues that result.
14. Each team is limited to a maximum of five independent structures on the game board at a time.
15. Each robot must have a name suitable for broadcast over a PA system.
16. Team entries may NOT contain parts that may reasonably be confused with game pieces or table elements (entries may not contain mirrors, lights, colored objects, or tape designed to confuse an opponent).
17. A team's entry may be made out of any materials or parts (including Botball and non-Botball kits) as long as the entry conforms to the construction rules above.

18. No projectiles can be used other than game pieces and once collected may be launched by the team's robots with no restrictions.
19. Electrical tape (either black or white) may be used (or required to be used by judges) to cover metal pieces that are deemed to otherwise be a safety risk to robots or humans.
20. For any robot whose safety is in question, judges will decide whether or not the robot is allowed to compete. All judging decisions are final.

KIPR Open Tournament Rules

Team Membership

- At least one team member must be beyond High School in their educational careers.
- College students, professional engineers, hobbyists, poets, and anyone else fulfilling the criteria above are all encouraged to participate.

Game Length

Game duration is 180 seconds.

Seeding/Performance Rounds

1. S/P Rounds take place before the double elimination rounds
2. S/P rounds consist of best two out of three, unopposed rounds
3. Teams choose which side to play unopposed, Teal or Pink.
4. Scoring = (your points) - (their points)
5. Scores of less than 0 will be counted as 0
6. Passing on a round gives a score of -1 for that round
7. Seed Score = average of best two rounds

Double Elimination Tournament

1. A team is out of the tournament when it has lost two games
2. Initial matches are decided by seeding round score
3. Matches, including which team plays on which side, are arranged using KIPR tournament software
4. Judges' decisions are final

Double Elimination

1. If a team's entry fails to break the border of a Start Box sometime during the 180 seconds of game play or knock a ball off of the ball tee to the surface below, that round will be forfeit.
2. Robots must stop all motors and other actuators at the end of the round. Failure to do so will result in loss of round (unless the other team never broke the border of a Start Box and failed to knock a ball off the ball tee to the surface below).
3. If neither team's entry manages to break the border of a Start Box during game play, the round will be replayed once. If it happens again during the replay, the round will be decided by coin toss.

4. Robots which operate autonomously are expected to respond to the starting light. A robot which operates exclusively on a timer triggered by a hand operated switch is not allowed and is grounds for a forfeit of the round. The driver robot is not subject to this rule, but must be ready for activation when the starting light comes on and cannot be powered off or on during the match.

Tournament Logistics

1. Side assignment is determined by the scoring software. During seeding teams can play the side of their choice. A team can set up in either or both of the two start boxes on their side.
2. Teams will give a friendly nod, wish of good luck, and visually inspect each other's robots **before calibration**. Inspection is limited to a maximum of one (1) minute unless a specific challenge is made. Teams must notify table judges **before the end of "Hands Off"** if they believe the table is not set up properly. 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!**
    a. Judges will be the final arbiter.
        i. Judges can dismiss what they believe to be spurious challenges
    b. Teams found in violation will (unless the judge decides there have been extenuating circumstances) forfeit that round or at the judge's discretion, be allowed to remove offending elements before the round begins.
3. If the judges determine a robot violates the construction rules, whether or not a challenge has been made, that robot will not be allowed to run until it has been modified to meet the rules.
4. Construction rules apply only to what is brought to the game table.
5. Teams cannot use wireless links to program their robots within 10 yards of the game board and cannot use wireless links to send information or commands to a robot during a game.
6. During setup teams may adjust starting lights:
    a. Starting lights may not be in physical contact with any robot
    b. Starting lights may not be aimed to disrupt an opponent or blind anyone (judge's decision)
7. During setup teams perform any necessary calibrations needed by their robots.
8. Setup time should be two minutes or less.
9. **For each minute or fraction thereof in excess of 2 minutes the team's score will be reduced by 20%.**
10. When both teams are ready, or judges decide adequate time has been allowed for calibration, teams activate their robots and then -- Hands off!
11. After hands off, no part of a team's robot(s) may leave its Start Box until the starting lights turn on.
    a. If this happens, the judges will call a fault on the team.
    b. If a team receives a 2nd fault in a round, they forfeit the round.
12. After hands off, the team cannot access the activation button on their driver robot until the lights come on.
13. After hands off, judges will activate the game table controller to turn on the starting lights signalling game start.
14. After hands off, teams may not broadcast ANY physical or electromagnetic signals to robots.
15. When the starting lights turn on the robots other than the driver robot must autonomously start, whether or not they leave their start boxes.
16. Lights will remain on for 5 seconds, turn off for 170 seconds and flash the last 5 seconds.
17. Once the starting lights turn on, the round counts unless a judge rules outside interference.
18. Robots must cut power to their motors and turn off or stop issuing motion commands to servos by the end of the round or risk forfeiting the round.
19. Scoring is based on the location of pieces at the end of the round, not how the pieces got there.

20. There are no instant replays, and attempts to use videos to question a decision will be ignored.
    a. If a team is unhappy with a judge's decision, they should challenge it then and there.
    b. Challenges to scoring after the teams have left the table, will not be considered.
21. 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.

Overall Winner Calculations

A team's overall score is calculated as the sum of their Seeding and Double Elimination scores. The overall score is between 0 and 2.

Seeding Scoring Formula

$$\text{SeedScore} = \frac{3}{4}\left(\frac{\text{n} - \text{SeedRank} + 1}{\text{n}}\right) + \frac{1}{4}\left(\frac{\text{TeamAverageSeedScore}}{\text{MaxTournamentSeedScore}}\right)$$

Double Elimination Scoring Formula

$$\text{DoubleEliminationScore} = \left(\frac{\text{n} - \text{DERank} + 1}{\text{n}}\right)$$

Note: For all formulas n = Number of Teams at Tournament

Advice for Tournament Participants

Test your robots from start to end:

a. Go through the entire starting sequence
b. Test your robot on both sides of the game table
c. Make sure you can calibrate to the starting lights
d. Make sure the robots stop when they are supposed to: verify with a stop watch!
e. Does the starting sequence work with very different lighting conditions? (tournament tables may or may not have lights above them)
f. Test the shielding of your sensors!

Clarifications and adjustments to the game or game rules will be made via the KIPR Open web site http://www.kipr.org/kipr-open and may appear in the form of notifications or answers to FAQs.

The KIPR Open Robotics Game discussion board and FAQ are accessed via http://www.kipr.org/kipr-open.

Check http://www.kipr.org/kipr-open regularly for rules updates that may or may not appear with an FAQ answer or as updates to this document.

Good Luck!