2023 Botball
Game Review

KISS INSTITUTE FOR PRACTICAL ROBOTICS

Botball®

Version 1.2 (1/5/2023)

Contents

Revision History

Version 1.0 – Initial Draft

Version 1.1 – Final KIPR edits, updating images and definitions

Version 1.2 – Added additional t-shirt guidelines and minor clarifications

Contributors

Game Design Chair, Wesley Myers

Numerous KIPR staff members and KIPR Community Members

Director's Note

Botball Community,

We are super excited for our Botball tournaments occurring in 2023! I am grateful to our dedicated staff and team of volunteers who contributed an incredible number of hours putting together this year's game. We started planning this before GCER in the summer of 2022 and have put in months of effort to get to this point. I hope that this year's game theme is motivating and challenging and that you are as excited as we are here at KIPR about this year's game! Good luck!

Respectfully,

Steve Goodgame

KIPR Executive Director

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This Year's Game

In this year's game, Botgal has taken on a new role as a Cybersecurity Engineer! She is working in a modern Data Center and must take on the challenge of keeping the Data Center operational while defending against cyber threats. She applies her experience to be able to protect the network, mitigate infected systems, and analyze threats. With her background, she is able to quickly maneuver between the Watch Floor where she oversees daily operations, to locations such as the Analysis and Cybersecurity Labs to really dive into the issues at hand. She must leverage her experience to keep the Data Center fully operational.

The Watch Floor is where Botgal's team of site engineers are constantly watching for any issues with the Data Center. The External Network (internet) connection to the data center enters through the Watch Floor. Hackers are working to disrupt Internet services by deploying some malicious programs (malware). She must install the Firewall to secure the network connection. Even better, she can leverage Wireshark to analyze the incoming data packets to further identify potential malware. She will have to respond quickly to get tools from the Cybersecurity Lab to the Network Connection to prevent future attacks.

Within the Data Center, packets are constantly on the move. Botgal and her team must analyze all packets to identify malware and take them to the Cybersecurity Lab. She needs to collect as many packets as possible in the Cybersecurity and Analysis Lab; however, mixing the malicious and benign packets makes her analysis more difficult.

One of Botgal's primary tasks is keeping the servers patched and operational. The servers reside in five racks in the Server Room. She must apply the correct Patch to the appropriate server. In addition, she's discovered some hard drives in the Server Racks that have been infected and must be swapped. She must go to the Backup Room to retrieve clean backup hard drives to install in the servers. Lastly, to effectively monitor the network traffic and behavior of her systems, she must retrieve the Logs from the servers and bring them to the Analysis Lab where she analyzes the logs to find anomalous system activity that may indicate there's a hacker operating on her network.

One of the worries that keep Cybersecurity Engineers awake at night is a "zero day" attack. In the case of a potential zero day, Botgal will need to notify the Computer Incident Response Team to ensure that other Cybersecurity Engineers are warned about the threat. In addition, she must get the malware over to the Cybersecurity Lab for further analysis to determine if the anomalous activity is in fact a zero day. Botgal must use the Reverse Engineering tool to determine if she has, in fact, discovered a zero day.

While Botgal hopes that the Data Center will not be attacked by hackers, she has taken proactive steps to prepare, mitigate, and act upon dynamic and complex cyber threats. She is ready to defend the network!

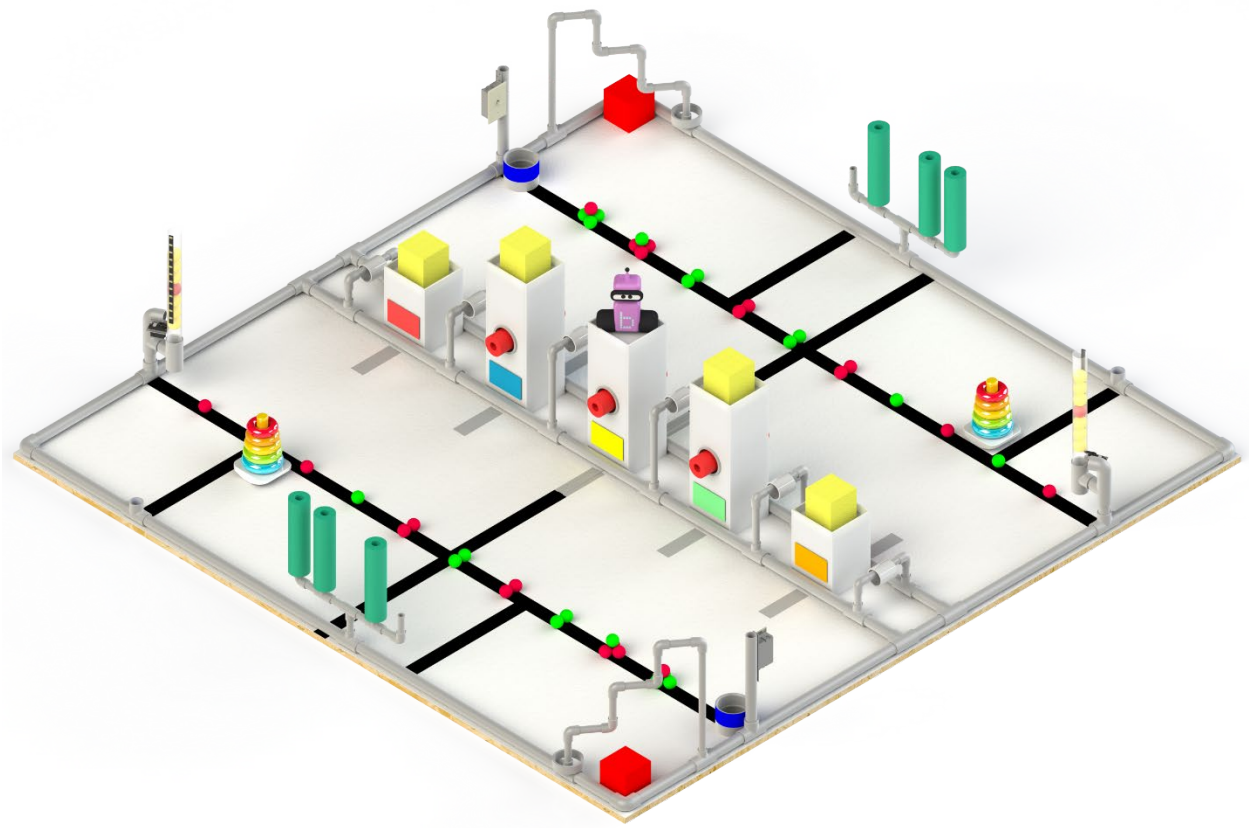

Figure 1 - Game Overview

Game Board Areas

Official game board specifications are on the Team Home Base. All tournament boards and game pieces will fulfill the following specifications within +/- 0.25" or up to 1% of the specification.

The game board is composed of four 4' x 4', reusable modules whose surfaces are pebble grain white fiberglass reinforced plastic panel (FRP). A fully assembled game board will be ~8' x 8'. A panel channel or black or white duct tape is used to close exposed seams where modules abut.

The game board is separated into defined areas for each team. For double elimination rounds, a team is assigned to play on side A or side B by the KIPR scoring software.

- *Data Center*
- *Network Connection – Ping pong ball dropper (external) and black tape lines (internal)*
- *Watch Floor – Large Start Box*
- *Analysis Lab*
- *Backup Storage Room – Small Start Box*
- *Backup Storage Racks – Posts on PVC edge of Backup Storage Room*
- *Cybersecurity Lab*
- *Reverse Engineering Tool– moveable PVC structure in corner*
- *Alarm – Light Switch at end of black tape*
- *Wireshark – 3" coupler under Alarm*
- *Server Room – space between two sides*
- *Server Racks – plastic structures in Server Room*
- *Encryption Keys – PVC structures with slidable coupler in Server Room adjacent to Server Racks*

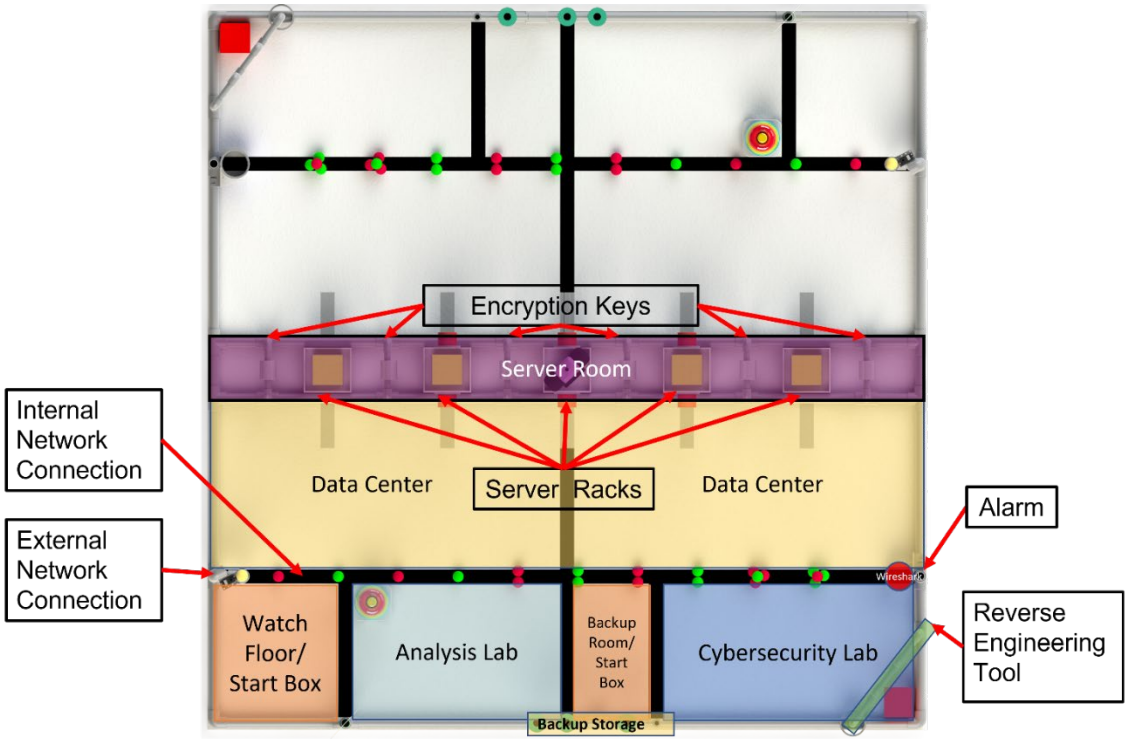

Figure 2 - Game Areas

Data Center – A team's *Data Center* is the surface of the game table as delineated by the **inside edges** of the surrounding PVC and tape and is between the *Server Room* in the center of the table and the black tape line that runs across the full length of the board.

External Network Connection – The PVC structure, including the mounted servo and clear tube, that holds the *Packet*s (ping pong balls)

Internal Network Connection – Any black tape line on the surface of the game table.

Watch Floor (Large Start Box) – The boundary of the *Watch Floor* area is defined by the **inside edges** of the tape lines and inside edge of the PVC. This also serves as one of the team's *Starting Boxes.*

Analysis Lab – The *Analysis Lab* sits adjacent to the right of the *Watch Floor*. The boundary of the *Analysis Lab* area is defined by the **inside edges** of the tape lines and inside edge of the PVC.

Backup Storage Room (Small Start Box) – The *Backup Storage Room* sits adjacent to the right of the *Analysis Lab*. The boundary of the *Backup Storage Room* area is defined by the **inside edges** of the tape lines and inside edge of the PVC. For scoring purposes, it also encompasses the *Backup Storage Racks*.

Backup Storage Racks – The four upright PVC pipes that sit behind the *Backup Storage Room*.

Cybersecurity Lab – The *Cybersecurity Lab* sits adjacent to the right of the *Backup Storage Room*. The boundary of the *Cybersecurity Lab* area is defined by the **inside edges** of the tape lines and inside edge of the PVC.

Reverse Engineering Tool – The PVC structure that traverses over the corner of the *Cybersecurity Lab* that forms a corner of the game table.

Alarm – The light switch at the end of the black tape on the corner of the *Cybersecurity Lab.*

Wireshark – The inside volume of the 3" coupler that sits centered on the tape line underneath the *Alarm*.

Server Room – The boundary of the *Server Room* area is defined by the **inside edges** of the PVC. It is the area that sits between the two halves of the game table.

Server Racks – The five corrugated plastic structures that sit in the *Server Room*. The three middle structures also have a 3" PVC pipe that runs through them where *Corrupted Drives* start and *Backup Drives* can be scored. The red, yellow, and orange cards are static on the outer left, middle, and outer right *Server Racks*. The blue and green cards will be randomly placed at the start of the round on the left and right tall *Server Racks*.

Encryption Keys – The six varied height PVC structures with a 1 ½" coupler on them adjacent to each *Server Rack*. The coupler will start out centered on the pipe.

Game Piece

Scoring Pieces

- 1 – *Botgal*
- 2 – *Firewall* (4" red cube)
- 2 – *Patch Holder* (Rock-a-Stack)
- 2 – *Malicious Packet* (red ping pong ball)
- 3 – *Corrupted Drives* (red pool noodles)
- 4 – *Logs* (4" yellow cubes)
- 6 – *Backup Drives* (green pool noodles)
- 12 – *Benign Packets* (orange ping pong balls)
- 20 – *Corrupt Files* (red poms)
- 20 – *Test Files* (green poms)

Starting Positions

- *Botgal* – Will be placed on top of the center *Server Rack* approximately angled towards the *Reverse Engineering Tool* closest to the audience.
- *Firewall* – Will be placed coincident to the corner of the *Cybersecurity Lab* underneath the *Reverse Engineering Tool.*
- *Patch Holder* – May be placed anywhere in the *Analysis Lab* by the team. It must be placed upright with only the white base touching the surface. It will start by default coincident to the tape only corner of the *Analysis Lab* closest to the *Watch Floor*.
- *Malicious Packet* – Will start in the middle of the other 6 ping pong balls in the clear tube of the *External Network Connection.*
- *Corrupted Drives* – Will start centered in the three holes of the center three *Server Racks.*
- *Logs* – Start roughly centered on top of each of the *Server Racks*.
- *Backup Drives* – May be placed on any of the 4 *Backup Storage Racks* by the team. By default they start on the three closest to the *Watch Floor*.
- *Benign Packets* – Will be placed 3 above and 3 below the *Malicious Packet* in the clear tube of the *External Network Connection.*
- *Corrupt Files and Files* – Will be placed along the ~8' long *Internal Network Connection:*
    - The first four poms are placed 8" apart starting from the end of the line closest to the *Watch Floor*, alternating *Corrupt Files* and *Test Files,* and starting with a *Corrupt File*.
    - The next four groups consist of two identical poms also placed 8" apart in the same pattern.
    - The last two groups of poms are placed 8" apart and are a group of one *Corrupt File* **on top of** three *Test Files* for the first group and one *File* **on top of** three *Corrupt Test Files* for the second group.

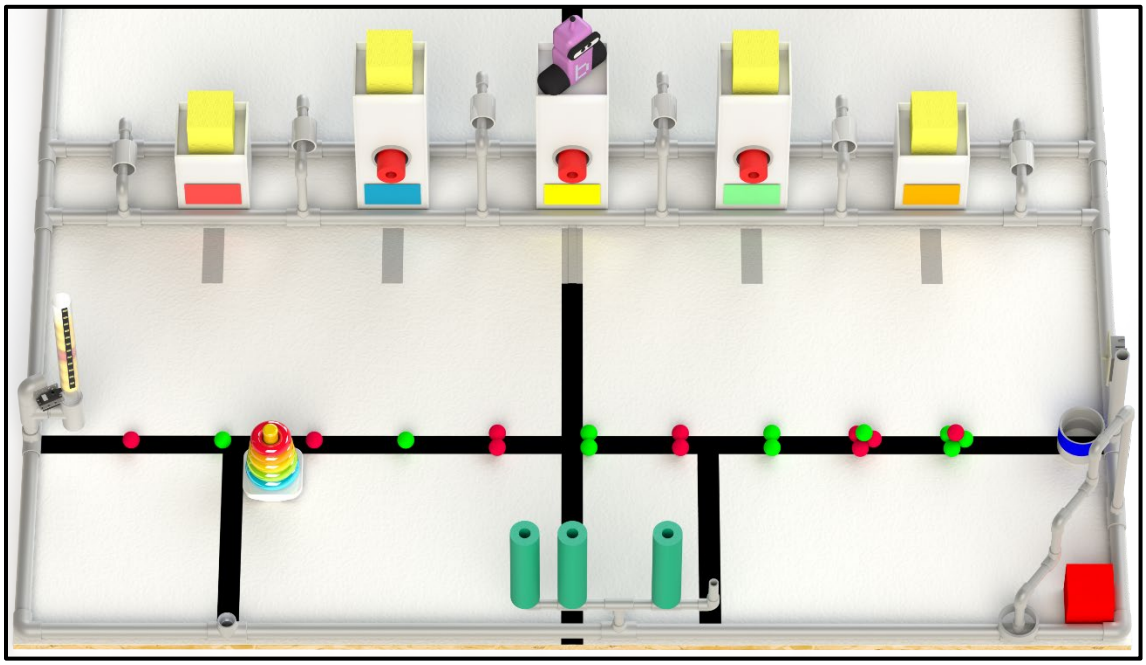

Figure 3 - Game Board Angled View

Score Sheet

Areas	Itemized Points	Multipliers	Totals
1. Data Center			
Unsorted Poms	#_____ X 5 = _____	Alarm X 2 + Stack Height X _____	
Sorted Poms/Cubes	#_____ X 25 = _____		
Rings/Empty Ring Stand	#_____ X 100 = _____		
Pool Noodles/Botgal	#_____ X 200 = _____		
	Subtotal = _____		
2. Watch Floor			
Unsorted Poms	#_____ X 10 = _____	Botgal X 2 + Stack Height X _____	
Sorted Poms	#_____ X 50 = _____		
Rings/Empty Stand/Yellow Cubes	#_____ X 100 = _____		
Pool Noodles	#_____ X 200 = _____		
Red Cubes	#_____ X 400 = _____		
	Subtotal = _____		
3. Analysis Lab			
Unsorted Poms	#_____ X 10 = _____	Botgal X 2 + Stack Height X _____	
Sorted Poms	#_____ X 50 = _____		
Rings/ Empty Stand	#_____ X 100 = _____		
Pool Noodles/ Red Cubes	#_____ X 200 = _____		
Yellow Cubes	#_____ X 400 = _____		
	Subtotal = _____		
4. Backup Storage Room			
Unsorted Poms	#_____ X 10 = _____	Botgal X 2 + Stack Height X _____	
Sorted Poms	#_____ X 50 = _____		
Rings	#_____ X 100 = _____		
Pool Noodles/Cubes/Empty Stand	#_____ X 200 = _____		
Mounted Red Noodles	#_____ X 500 = _____		
	Subtotal = _____		
5. Cybersecurity Lab			
Unsorted Poms	#_____ X 10 = _____	Botgal X 2 + Stack Height X _____	
Sorted Poms	#_____ X 50 = _____		
Rings/ Empty Stand/ Red Cubes	#_____ X 100 = _____		
Yellow Cubes/ Pool Noodles	#_____ X 200 = _____		
Alarm Flipped	#_____ X 250 = _____		
	Subtotal = _____		
6. Reverse Engineering Tool		Encryption Keys X _____	
Reverse Eng. Tool Level	#_____ X 350 = _____		
7. Wireshark		Analysis Lab X 3 or All Other Zones X 2	
Ping Pong Balls	#_____ X 100 = _____		
Only Red Ping Pong Ball	#_____ X 1000 = _____		
Botgal Same Zone as Red PP Ball	#_____ X 500 = _____		
	Subtotal = _____		
8. External Network Connection		Alarm X 2	
PP Balls w/ Firewall in Place	#_____ X 150 = _____		
9. Server Room		Matching Rings X _____	
Rings on Base Tape	#_____ X 150 = _____		
Rings on Short Rack	#_____ X 300 = _____		
Rings on Tall Rack	#_____ X 500 = _____		
Green Pool Noodles in Rack	#_____ X 500 = _____		
	Subtotal = _____		
10. Max File Accumulation		Sorted X 10	
Poms	#_____ X 30 = _____		
		Side A Total	

Scoring Rules

1. **Black Tape Rule:** Any game piece touching any Black Tape line do not score, with the exception of *Corrupted Drives* and *Backup Drives* (red and green pool noodles),pieces scoring in the *Wireshark (3" coupler)*, or the *Firewall* (red cube).
2. **General Scoring Rule:** A game piece must touch the surface of the scoring area to score, with the exception of game pieces in the volume of the *Wireshark*, mounted on the *Storage Racks*, or in the *Server Racks*.
3. **Volume Rule:** To score in the *Wireshark* or the tops of the *Server Racks* some part of a game piece must break the volume of the scoring area.
4. **Drive Scoring Rule:** *Backup Drives* may only score in the cylindrical cut out of a *Server Rack* if any part of the black lines on them breaks the volume of the cylindrical cutout of the *Server Rack*. *Corrupted Drives* may only score on the *Storage Rack* if the PVC breaks the volume of the *Corrupted Drive* and can stay on the *Storage Rack* unsupported (i.e. no robot, external structure, game piece, etc).
5. **Network Connection Rule:** For the *Packets* (ping pong balls) to score in the *External Network Connection*, the *Firewall* must be the only thing between the *External and Internal Network Connections*.
6. **Wireshark Rule:** In order for the *Wireshark* to score in an area it must be touching black tape and that area. It will score in the area with the highest multiplier for the *Wireshark*.
7. **Sort Rule:** An area will only count as sorted if all the *Files* (red and green poms) in it are of the same color and there is more than one pom in the area.
8. **Stacking Rule:** *Logs* (yellow cubes) in a stack score if the bottommost item in the stack is touching a scoring surface on the team's side. Each level must touch the topmost surface of the cube below it. In order for something to be considered a stack, there must be more than one *Log* in the stack.

   > **Note:** Judges must be able to visibly determine the stack *height* and *integrity* (all items in stack touching other items in the stack) **without moving any items** otherwise all cubes in the stack score as "flat in the scoring zone of the base item of the stack".

9. **Highest Scoring Rule:** A game piece can only score in one scoring area and will be scored as if it is in the highest scoring area, as determined by base score without multipliers. A game piece may not multiply two areas or multiply one area and score in another.
10. **Robot Rule:** For the purposes of scoring, a robot is defined minimally as a KIPR Robot Controller with at least two motors or a Create connected to it. A robot with 2 controllers counts as a single robot.
11. **Final Scoring Rule:** The score is determined by final object location, not by how it got there. Judges will wait until any scoring objects still in motion have come to rest before scoring a game.
12. **Create Rule:** A non-Create robot can proceed from its side to the other side as part of game strategy in DE.
13. **DE/ DS igus© Chain Rule:** If the igus© chain of a team is across the vertical projection of the opponent's side, then it may not touch an opponent's robot or else the team will be disqualified. This is regardless if the action is intentional or accidental.

14. **DE/ DS Non-Robot Structure Rule:** If a *non-robot structure* enters the vertical projection of their opponent's *side*, then the team will be disqualified for that round. See **Robot Rule** for definition of a robot. For example, if the non-structure covers the playing field, blocks any vertical space of the field to deny their opponent access, etc.
15. **DE/ DS Interference Rules:**
    a. **If a robot or portion of a robot *intentionally* crosses to their opponent's side** (not mutual scoring areas) **and pulls out or snags wires on their opponents robot, or uses effectors that could damage the robot or the controller, then that team will be Disqualified and lose the match.**
    b. If a *robot* is intentionally touching the surface of their opponent's *side* or their scoring areas (not mutual scoring areas) at the end of the game, then the opponent will receive a bonus to their score of 25% of the offending team's score.

Tie Breakers & Special Scoring Conditions

If one team never breaks any border of the *Starting Box*, including the 14" ceiling of the large start box or the 21" ceiling of the small start box, then they lose the round. If both teams break the boundary of their *Starting Box* and one team's robot does not shut down their motors or does not stop commanding their servos to move at the end, then they lose the round. In the case of a tie score, a team wins if none of the above conditions apply and they are the:

1. Team with the most *Backup Drives* scoring in the *Server Racks*
2. Team with the most *Corrupted Drives* scoring on the *Storage Racks*
3. Team with the most points scored by the *Network Connection*
4. Team with the tallest *Log* stack
5. Team with the most points scored in the *Wireshark*
6. Team with the highest *Reverse Engineering Tool* level
7. Team with the *Alarm* flipped on
8. Team with *Botgal* anywhere on their side
9. Team with the most points in the *Data Center*
10. Team with the robot (defined by the KIPR Robot Controller power switch) closest to *Botgal*

Game Play

Fair Play and Spirit of Botball

Botball is about the development of **student** skills. Once a team enters the pits with their robots, we require that the **robots not leave the pits** for any purpose until the conclusion of the tournament or suspension of play for the day. Adults are not allowed into the pits, except to help teams carry in equipment as they are arriving in the morning. All adults accompanying a team should understand that responsible Botball mentorship **does not include** working on the robot entries or programming the robot entries for the students but **does** allow for appropriate mentor guidance of the team. **Teams hosting a tournament at their school must check their robots into the pit area at least one-hour prior to the start of the seeding rounds.**

Spirit of Botball: This is a 100% student-driven experience.

Students know this, and adults know better!

Mentors, parents, adults, or other non-students who wish to actively participate in the construction, programming, testing, or documentation of a robot are invited to participate in other activities such as the KIPR Aerial

Filming of Robots

Botball competitions are public events and as such, filming of robots while they are on official game tables in either practice or competition mode is allowed by any member of the public in attendance including parents and other team members.

The use of team members to shield, block, or hinder the public from filming the robots is not allowed and against the Spirit of Botball. Team members are encouraged to observe from the "Pit" side of the competition barriers and not from the public audience side.

For parents, coaches, and other team stakeholders, likewise they should not shield, block, or hinder the public from filming the robots and it is against the Spirit of Botball.

Team T-Shirts

Botball teams are encouraged to design and wear their own Botball competition t-shirts. Graphics must be family and school appropriate and not explicit or suggestive of inappropriate content. If teams are wanting to wear their shirts to the table, it is recommended that the shirts contain mostly neutral colors so as not to potentially confuse any cameras on robots at the table.

Practice

Teams are permitted to send up to 3 team members to the practice tables. Teams will have 3-5 minutes at the table to practice before being asked to wrap up. Teams should reset the table before departing.

Teams are permitted to bring a laptop, tablet, or other programming device to the table to conduct code changes unless otherwise not permitted by KIPR at the tournament. Teams are allowed to bring a mouse to the table to interface with the KIPR Robot Controller. Teams are asked to stay at their practice table and to not go to other tables to observe other team's robots during their practice round.

On-Deck

Entry to the On-Deck

Only the current year's kit materials that total up to a single kit are allowed in the on-deck area. The intent is that teams do not bring up multiple sets of robots to the game table to choose which ones they will play. In the event that a robot is swapped while in the on-deck for another robot, then that team will be disqualified for that round. If this is observed by the on-deck manager, then he or she will inform the Head Judge who will then enforce the disqualification for the round.

Inspections

Tournaments may have a robot inspection prior to teams entering the on-deck area. This is dependent on KIPR staff or volunteers who are available to execute the process. Inspectors will have a parts list on hand and may reference it as documentation if they determine there is a violation.

The objective is to verify that teams have no illegal parts present on their robot. If a team is found to have an illegal part, then a couple of scenarios can play out. If a team has a timeout card available, then they may take a timeout in order to take their robot back to their pit to remove the illegal part. If a team does not have a timeout card, then the robot with illegal parts will be disqualified for that round. Please see the Timeout Card section for further information.

In the Spirit of Botball, teams that notice part violations or construction violations on other teams' robots should inform the team or the head judge prior to any competition rounds. Encouraging other teams to challenge part violations prior to or during competition rounds is not in the Spirit of Botball.

Setup – Before Hands-Off

Up to two students from a team may bring the team's robot(s) to the tournament table and perform the setup. If at any point during or after setup, a team is observed with a laptop near the game table and appears to be reprogramming their robot, then the team may be disqualified by the Head Judge. Teams will place their robot(s) within their *Starting Box(s)* as desired. Teams may position either or both of the starting lights on their side as they wish, provided:

- Starting lights must be attached to the outside edge of the game table alongside the *Starting Box(s)*.
- Starting lights must either be aimed at the team's light sensors or at the floor and cannot be aimed so as to disrupt an opponent (judges' ruling).
- Starting lights may **not** break the vertical projection of the board inside its PVC boundary. This is for safety as robots do occasionally break the bulbs if they make contact.
- There are two starting lights for each team, so each KIPR Robot Controller can have its own starting light. Both lights will turn on and off at the same time and cannot be controlled individually.
- Teams cannot touch starting lights or any part of the table after Hands-Off.

Teams will greet each other and:

1. Visually inspect each other's robots before calibration. Inspection is limited to a maximum of 1 minute unless a specific part violation challenge (refer to parts challenges under Challenges section) is made. Teams are encouraged to utilize the parts lists provided on the Team Home Base for each of their robots to ensure they won't have a robot's construction challenged. The parts list is also useful as documentation.

2. 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, each team positions/activates its robots and then – **Hands-Off**!

If judges determine a team is taking too long to calibrate, then they will issue a 30-second warning. At the end of the 30 seconds, a team that is not ready for "Hands-Off" will be assigned a fault, and the setup

clock will be reset. If a team receives a 2nd fault in a round, then they forfeit the round. The maximum setup time, which may be extended at judges' discretion, is 90 seconds.

If it is observed by any judge that a team pulled a robot off of the table and swapped the robot out that was not in the on-deck area, then that team will be disqualified by the Head Judge.

Before the Game Begins – After Hands-Off

Once "Hands-Off" has been declared, the team members will position themselves so as not to block the view of the table by the audience. No part of a team's robot(s) may leave the *Starting Box(s)* until the round has begun. Movement is okay so long as the *Starting Box(s)* boundary isn't violated. If a moving violation happens, then the judges will call a fault on the team. Team members may not move the starting lights at any time after hands-off. A judge may move the light to avoid potential damage to a light. If a team receives a 2nd fault in a round, then they forfeit the round. Team members may not signal to their robots after "Hands-Off" to start their robots. If a team member at the table is wearing a shirt with large solid colors that are similar to game pieces on the table, they will be asked to crouch during the round if the robots are using cameras.

Timeout Card

Each team will be given a single red Timeout Card that is labeled with their team name and number when they register on-site. Only the team whose name appears on the card may use it. The card can only be used at an on-deck robot inspection if it is being used at the tournament or while that team is at the table before "Hands-Off". While a team is at the table, any time **before** "Hands-Off", a team may turn in their timeout card and get a 3-minute timeout. The team may spend that time in the pits or at the table, but not to practice at the table. However, the team may practice the starting light sequence. Only a single timeout per team is allowed for the entire tournament. Teams are advised to save their timeout card for the Double Elimination rounds, as Seeding rounds are best 2 out of 3.

If your region has on-deck robot inspections and your robot is deemed to have an illegal part **during seeding rounds**, then you may use your time out card to take your robot to the pit to remove the part. If your region has on-deck robot inspections and your robot is deemed to have an illegal part **during double elimination rounds**, then your robot will be disqualified. It is highly recommended that teams carefully and meticulously review the parts on their robot prior to entering the inspection area.

After the Game Begins – Lights On

Once the starting lights have turned on, the round counts unless a judge rules otherwise. At the start of the game, the starting lights turn on and robots are then allowed to leave the *Starting Box*.

The round lasts two minutes (120 seconds). The lighting sequence is:

- 0 seconds: lights turn on; robots can leave starting boxes
- 15 seconds: lights turn off
- 60 seconds: servo moves to release ping pong balls
- 115 seconds: Lights turn back on and blink for five seconds
- 120 seconds: lights turn off; game over; robots must turn off motors and freeze/power down servos

End of Game

Robots must **stop driving their motors, including those on the Create, and stop servo motion** by the end of the round or that team will lose the round in all situations except against a team that does not break the boundary of the *Starting Box* (in Seeding, this condition will give a score of 0). Incidental motion from a servo holding a position under load is OK.

Scoring is based on the location of pieces at the end, not how the pieces got there. Scoring takes place when the round has ended and items have come to rest.

If all motion has stopped before 120 seconds, the judges may ask the teams if their robots are done and if so, then they may end the round at that time. Both teams must agree in order for this to end the round.

Final Scoring and Rulings

If your team does not agree with the score as calculated, then they must immediately notify the table judge(s) **before** leaving the table and **before** any items have been moved on the table. If they do not agree with the table judge's ruling, then they may ask to speak with the Head Judge. The Head Judge will spend no more than 5 minutes on the decision. Teams will be required to initial the score sheet before leaving the table, signifying acceptance of the ruling. If they do not agree with the ruling, then the Head Judge is permitted to sign for the team to progress the event forward.

There are no instant replays. No external videos will be used in consideration of scoring. If a team is unhappy with a judge's decision, then they should politely challenge it then and there. **Challenges to scoring after the teams have signed the score sheet may not be considered.**

The head judge reserves the right to make rulings on specific rules or wording in the game review that will be in effect for the remainder of the tournament.

Spirit of Botball: Mentors, spectators, and team members should respect teams' and judges' final decisions.

Challenges

Challenges may only come from judges and only the four (two per team) members at the table. If either team wants to challenge the validity of the robots they are facing, then they have to bring it to the table judges' attention during the inspection period and the Head Judge will come over. Teams should bring the list of parts to the table to aid in the inspection. Challenges must be specific. Teams are encouraged to have a parts lists for each robot they bring to the table as a means for minimizing the likelihood of a robot's construction being challenged. There is a parts lists on the Team Home Base, which can be used to specify which kit parts are allowed to be used for the robots at the table.

The Head Judge is the final arbiter of a challenge and can dismiss what they believe to be spurious or irrelevant challenges. Teams determined by the judges to be in safety or performance-changing violation will be given 60 seconds by the judges to make a correction, remove offending pieces, or take the robot off the table; otherwise, the robot must be removed for the round or the team can forfeit. A robot that is determined before the beginning of a round to be in a safety or performance-changing violation of the construction rules will not be allowed to play while in that state. A robot ruled to be unsafe for humans will

not be allowed to run until modified.

If a team wants to execute a challenge, then they must wager their round. If the team that makes the challenge is correct, then they win the round and the other team is disqualified for that round. However, if the team that makes the challenge is incorrect then they will be disqualified for that round and the other team will win the round. In the case that both teams wish to make a challenge, the one to approach the judge with the challenge first will be the determining challenge.

If a team notices that another team has a challengeable issue during seeding, another double elimination round, or any other time and is not facing that team, in the Spirit of Botball and fair play, they should inform the head judge so that the head judge may consult with the team.

Acknowledgements

The KIPR Robot Controller is a powerful device, but the use of threading can cause unpredictable results, such as the robot not stopping when utilizing the *shutdown in* function. Teams are encouraged to limit their use of threading and to make sure they take precautionary steps to stop their robot within the time limit of the game. If the robot fails to stop moving after the time limit, then it will result in a score of 0 for a Seeding round or a disqualification for a Double Elimination round.

Seeding Rounds

Seeding rounds take place before Double Elimination. There will be three Seeding rounds. The order in which teams appear in each round is set by tournament software and is the same for each round. In Seeding, a team plays the game unopposed, and the score for both sides counts, where your Seeding Round score is (*the score for your side*) + (*the score for the other side*). Note that Seeding scores are the **sum** of the entire board and **teams are encouraged to cross sides and use the whole board for scoring during Seeding**. Unlike the Double Elimination rounds, a Create chassis is permitted to cross to the other side.

Seed scores of less than 0 will be counted as 0. A team's Seed Score is the average of their best two Seeding rounds. The tableside used by a team for a Seeding round (the side from which the robots will start) is determined when teams arrive at the table and at the judges' discretion for their turn in a Seeding round.

A coach or team member must bring any concerns about the posted seeding round scores to the attention of the Head Judge before the bracketing for the double elimination rounds. Bracketing occurs within ~5 minutes of the completion of the last seeding round. Only math errors or incorrect placement of scores will be accounted for.

Double Seeding Rounds

Double Seeding will only be played at the Global Conference on Educational Robotics. Double Seeding consists of head to head Seeding rounds where teams get as many points as they can while still playing against another team on the table. No scores will be dropped in Double Seeding.

It is against the "Spirit of Botball" for teams to form coalitions and partnerships with other teams with the goal of collaborating to benefit one team's score.

Double Elimination (DE) Rounds

A team is out of the Double Elimination tournament when it has lost two games. Initial matches are decided by KIPR tournament software using Seeding round scores. As the tournament progresses, the order of matches and table sides for the competing teams are determined using KIPR tournament software. The two teams for a match play each other and the highest score at the end of the game wins, subject to tie breakers and special scoring conditions. The size of Double Elimination scores does not affect ranking, only wins and losses.

During a Double Elimination match, a team's Create chassis may not ever be entirely on the other team's side. During match play, the table judge, through observation, may decide that a robot is guilty of interference, and then disqualify the team for that round.

Alliance Matches

Logistics

At selected tournaments, if a team is eliminated from the Double Elimination tournament before the Finals of Double Elimination play, then that team may sign up to play in Alliance Matches. Alliance Matches will pair up two teams to play the game collaboratively with the goal of scoring the most points. Each team will bring one robot to the table to run simultaneously. The teams will place their robots in any of the *Starting Boxes* (i.e. both on the same side or split between the two sides).

Scoring

Alliance rounds will follow all of the same scoring rules as a regular Seeding round. The total Alliance score is (*Your side's score*) + (*Ally side's score*). The Alliance team with the highest combined score from a single run will win the Alliance Tournament. Alliance matches will be conducted until tournament officials suspend play (usually when the final Double Elimination rounds are near complete).

Tiered Rounds

Logistics

At selected tournaments, if there are enough teams, then there might be a chance of breaking out the Double Elimination rounds into multiple tiers. The objective is to play against your peers.

Virtual Tournaments

Virtual Tournaments will require the team to have a competition game board that meets requirements, access to the internet and two cameras (one static to show the game board and one mobile for robot inspection and judges scoring questions) to participate. Some exceptions to rules related to game board setup may be accommodated by the head judge.

Construction Rules

The official construction rules for the 2022 Botball Game consist of the latest revision of this 2022 Botball Game Review document and any updated game rules posted on the Team Home Base (including those posted in answers to FAQs or otherwise). Posts on the 2022 Team Home Base in the Game Rules Question area will be used to update the document and provide notice of any rule changes or adjustments.

Kit Rules

1. Sensors from the 2017, 2018, 2019 and 2020-22 kit may be used as long as they don't exceed the type or number in the 2023 kit.
2. Only the metal chassis (steel) will be allowed in robot construction.
3. Robots may be constructed out of any or all of this year's kit parts except: the boxes, bags, wrapping or packing material, the chargers, download cables, wrenches, screwdriver and color stickers. Materials supplied at the workshop for creating your game board (e.g., Botguy, poms, etc.) are not part of the kit and cannot be used on your entry. The included camera and Create are the only USB devices that may be plugged into a robot during the game. **Consult the official parts lists for allowable kit parts!**
4. Small removable mounting dots/strips such as those produced by Glue Dots, UGlu and/or Scotch Brand Restickable Dots/Strips, blue tack (acquired at team's expense) may be used for construction purposes. They may not be exposed for sticking things otherwise in any manner. In particular, this means you may **not** use your mounting dots/strips to contact the game board, game elements, or the other team's entry. **Note that neither hot melt glue nor any other adhesives, other than removable mounting dots/strips, are allowed in robot construction.**
    a. Mounting dots/strips are available at stores such as Home Depot, and online from vendors such as Amazon.
3. Judges may require excessive adhesive to be removed. Teams should always try to come up with a mechanical means for construction and only resort to using adhesive methods as a last resort.
4. Supplied servo accessories such as grommets, screws, washers, etc. may only be used to mount pieces to the servo horn.
5. Servos and motors may be mounted to structural pieces using the supplied machine screws.
6. Teams may trim the connector potting material as needed to ease insertion or mounting of sensors. Damaged pieces will be replaced at team's expense.
7. Plastic servo horns may be trimmed as desired. Damaged pieces will be replaced at team's expense.
8. Teams are allowed to add the following pieces to their entry:
    a. Up to 100cm of thread, string or fishing line (maximum diameter 1mm, **non-metallic only**) may be used as desired except for offensive measures such as entanglement and entrapment.
    b. Paper (maximum 20#) so long as all the pieces can be taken from the **same single** standard US letter-sized (8.5" X 11") or A4-sized (210mm x 297mm) sheet. See rule 9.
    c. Standard 3/16" thick foam board as long as all the pieces can be taken from the **same single** standard US letter-sized or **#1**, A4 footprint. See rule 9.
    d. Up to 10 standard office rubber bands of maximum size #19 may be used (#19 is 3.5" x 1/16" x 1/32").
    e. Up to 10 Paper Clips, smooth, metal (between 1" and 1 ½" in length). Paper clips can be bent

in any fashion but cannot be cut, broken or plugged into any wire or robot controller

f. Coins, up to 250 grams (~100 U.S. pennies) to be used as a counterweight only. Please be prepared to prove that it is within the legal weight limit if necessary. Coins may be rolled in wrappers (up to two rolls) to make it easier to weigh.

9. If the team's entry uses paper and/or foam core board, then the team **MUST** bring a template showing how the material you are using was cut out of **ONE** 8.5" X 11" (or A4) paper sheet and one 8.5" X 11" (or A4) 3/16" foam core sheet. The paper/foam core board may only be held in place through the use of other kit parts (including removable mounting dots/strips detailed above if used as allowed for other kit parts). **Paper and foam core board may only be black or white; only grayscale may be used for printing including official logos for sponsors of your team, or QR codes.**
10. Rubber bands may not be glued or melted. Rubber bands may be cut, but only a total of ten whole rubber bands or five cut rubber bands may be used on a team's entry. For any combination having both whole and cut rubber bands, the limit is 5.
11. **The light sensors in the kit usually do not require a light guide unless there is a lot of direct sunlight in the room.** Soda straws, paper, electrical tape and/or foil may be used as light guides for sensors (light guides may be shielded by using tape, but not in a fashion that is for structural purposes or for manipulation). Light guide materials are in addition to the allowable parts.
12. Teams are not allowed to shield robot sensors externally to their official entry (i.e., teams are not allowed to stand between their robots and the audience to keep the robots from sensing the audience). Teams should orient and calibrate the sensors on their robot appropriately so that this is not an issue. Teams using cameras may request that anyone whose attire includes significant color markings closely matching game object colors stand well back from the table.
13. Team are limited to ten (10) 4" white zip ties (included in the kit), and they may be used for any purpose. You may replace damaged ties with ones of equivalent size (black or white).
14. Lego parts cannot be physically modified. This includes threading axle holes with screws.
15. Metal parts may not be cut or broken to a smaller size. Only **straps and plates** as listed in the kit may be bent if desired.
    - Warning: At tournaments KIPR will not provide replacements for metal parts that have been altered or damaged. Replacements may be purchased from the online Botball Store.
16. Optional Create parts are the top plate, dust bin, and brush bar box. If any optional pieces are removed, they may NOT be reused anywhere else on the entry. The Create may not be assembled/disassembled otherwise.
17. Teams are limited to the number and size screws as follows: 20 -#8-32 quarter inch, 45 -#8-32 half inch, and 35 -#8-32 three-quarter inch screws. All #8-32 screws are black. There are 10 silver M3 x 14mm screws and six silver M3 nuts. There is also #8-32 threaded rod: 10 - 1", 2 - 2", 2 - 3", and 1 - 6" long.

Robot Logistics

1. Each robot if named can only have a name (G-rated) approved by an adult team leader before the tournament.
2. Multiple processors (such as two KIPR robot controllers) may exist on a single robot.
    a. You may use any combination up to two of the KIPR wallaby and/or wombat
3. It is not necessary to use all the parts in a kit.
4. The *Large Starting Box* is 14" tall. The *Small Starting Box* is 21" tall. A starting box is defined by the **interior edge** of the PVC and the **interior edge** of the black tape around the perimeter of the starting box. Robots may not touch any game piece at the start of the game.
5. All elements of a team's entry must be within the volume of the *Starting Box* at game start.
6. After game start, robots are allowed to expand in size.
7. **While not always necessary,** starting light sensors may be shielded as demonstrated in the workshop slides and in the construction rules and neither sensor nor shielding may extend outside the *Starting Box*.
8. All independent structures not under computer control should be clearly marked with the team's number. Maximum label size is 1" diameter (Avery #5410), or you may use permanent marker directly on the structure. Teams may only run robots with their team number on them.
9. Robot teams can have a maximum of 4 independent structures on the game table at a time
    a. A team's entry, including any supplied game pieces, must fit in the *Starting Box* **without any external restraint** at game start (the *Starting Box* floor and border PVC is not an external restraint).
    b. Each structure must be large enough so that it does not, in the judge's opinion, constitute a jamming or entanglement hazard.
    c. Examples of structures include: robots, barricades, detachable baskets, etc.
    d. A team's entry can contain as many robots up to the structures limit as can be constructed from the parts in a single kit.
    e. Items intentionally ejected from a robot count as structures (judges judge intention); there are special rules regarding projectiles, discussed later.
    f. The igus© chain **must** be permanently affixed to a robot (defined as a KIPR Robot Controller with a minimum of two attached motors) by at least one end of the chain. Using the igus© chain in a gear-driven system for motion of a robot component counts as being affixed to the robot. The igus© chain may **not** be used as a projectile (even tethered) or as an independent structure. If the Head Judge deems the use of the igus© chain to be in violation of this rule, the offending team will be disqualified for the round.
10. No electrical modifications may be made to any KIPR robot controller, the Create, any sensors or any motors, except for substitution of batteries with one approved by KIPR.
11. No wire extensions may be used except those provided in the kit.
12. Offensive entanglement strategies that involve an independent structure are not in line with the Spirit of Botball and may be subject to disqualification as determined by the Head Judge.

Safety

1. Human & Robot Safety:
    a. No untethered robot-launched projectiles, other than game pieces, are allowed.
    b. No tethered projectiles containing metal pieces are allowed.
    c. No metal pieces or wires are to be used in effectors that move or rotate at high speed.
    d. No metal protrusions are to be used that are likely to cause electrical or safety risks for other robots (including arms and projectiles).
    e. Judges will determine how safe a robot is. Teams may alert judges to a potential safety or entanglement hazard, but judges will interpret whether or not a robot is safe, needs to be modified, or is not allowed to run.
2. Electrical tape, either black or white, may be used to cover metal pieces that are deemed to otherwise be a safety risk to robots or humans. Judges might require this to be done at the game table. Note that tape is not allowed to be used for structural purposes.
3. If the Head Judge decides that a robot is not considered safe, then the robot will not be allowed to run until it has been modified or it will be removed from the table.

External Communication

1. No external communications (e.g., IR, Bluetooth, wireless, or semaphores) may be used during tournament play with the exception of robot to robot.
2. The USB cables & chargers may not be used during game table tournament play with the exception of the create cable.
3. Communication between robots for your team's entry is allowed
4. Your robot controller may have WiFi turned on or off at the tournament, however we strongly advise teams with Wallabies to use USB communication at all times as teams can remotely access your Wallaby and gain your password.
5. Any teams found in violation of any communication hacking or tampering with another team's robots or equipment is in violation of the "Spirit of Botball" and may be disqualified from the rest of the tournament.

Teams found in violation of any communication rule may be disqualified from the tournament at the discretion of the Head Judge.

Overall Winner Calculations

A team's overall score is calculated as the sum of their Seeding, Double Elimination, and Documentation scores. The overall score is between 0 and 4.

Documentation Scoring Formula

$$DocScore = \frac{3}{10}(Period1Doc\%) + \frac{3}{10}(Period2Doc\%) + \frac{1}{10}(Period3Doc\%) + \frac{3}{10}(OnsiteDoc\%)$$

Seeding Scoring Formula

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

Double Seeding Scoring Formula

$$DoubleSeedScore = \frac{2}{3}\left(\frac{n - DoubleSeedRank + 1}{n}\right) + \frac{1}{3}\left(\frac{TeamAverageDoubleSeedScore}{MaxTournamentDoubleSeedScore}\right)$$

Double Elimination Bracket Scoring Formula

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

Note: For all formulas n = Number of Teams at Tournament or in bracket
Note #2: Weighting of brackets and number of brackets will be released at GCER