BAE Systems Mini-Bot Challenge #5
Alliance Antics the Recharge

Alliance Antics the Recharge is a tournament in which you join forces with another team to score more points than your opponent while bobbing and weaving around obstacles on the field. Each team will be randomly paired with Alliance partners through the tournament, accumulating ranking points toward a playoff.

This is a cooperative challenge based on scoring. Registered FRC teams or teams that intend to compete in the 2022 FRC season can register for the tournament, which will take place on December 4, 2021 beginning at 9:00 am Eastern Time. New England teams will have priority in registration. Teams from outside of the New England District may register and will be entered on a first come, first served basis.

Teams must register by Sunday, November 21, 2021 at 11:59 PM. FRC teams can enter more than one team in this tournament, however second teams will be admitted based on availability after first teams are confirmed. Participating teams must have broadband access to Internet, must have a high quality, Internet-connected camera that can see their entire field, and they must have an audio connection in addition to the camera so they can communicate with their Alliance partner during matches. This can be a smartphone, a tablet, or a camera connected to a computer.

Participating teams must be available for the entirety of the tournament. Teams must also come to a pre-flight meeting in advance of the tournament to ensure proper connection and local camera setup. If selected for playoffs, teams must be available for the playoff period. The duration of the tournament will depend on the number of participating teams. Matches will be simulcast on Twitch.

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Challenge rules

1. Teams
   a. Each participating team must have a student **driver** and a student **human player**.
   b. Teams can optionally use another student as a **second driver**.
   c. These roles can change during the tournament, and teams are encouraged to swap in other students during the day.

2. Robot
   d. Teams must use the "stock" Romi kit provided by NEFIRST, or purchased as a kit to match the kit of parts in the "stock" kit. This kit is available from Pololu. All parts in the kit, including motors, wheels, and roller balls, must be used. Kits from NEFIRST include a Raspberry Pi 3+. Teams may alternatively use a Raspberry Pi 4.
   e. Additional attachments or sensors may be used.
      i. The team is free to design attachments or use commercially available attachments.
      ii. Attachments must remain connected to the robot at all times.
      iii. Sensors must deliver data to the robot, either to the Romi or to the Raspberry Pi.
      iv. Sensors must be attached to the robot, and all sensor data must be processed by the Romi or by the Raspberry Pi.
      v. Sensors can pre-process data before handing it off to the Romi or the Raspberry Pi.
   f. There is no weight limit for the robot.
   g. There is no size limit for any attachments or sensors affixed to the robot, however at the start of each match, robots must fit within a 15-inch cube formed by black or blue lines around the Starting Circle and extending up 15 inches from the mat. Once the match begins, the robots can expand to any size. At the conclusion of the match, the robot must fit within the boundaries of Target Zone 2.
   h. Extensions that touch the mat are treated as roller balls (at the point of contact with the mat) from the perspective of penalties.
   i. Teams must use WPILib to program the robot.

3. Playing field
    a. (see the attachment *Alliance Antics mat for print.pdf* for full size)
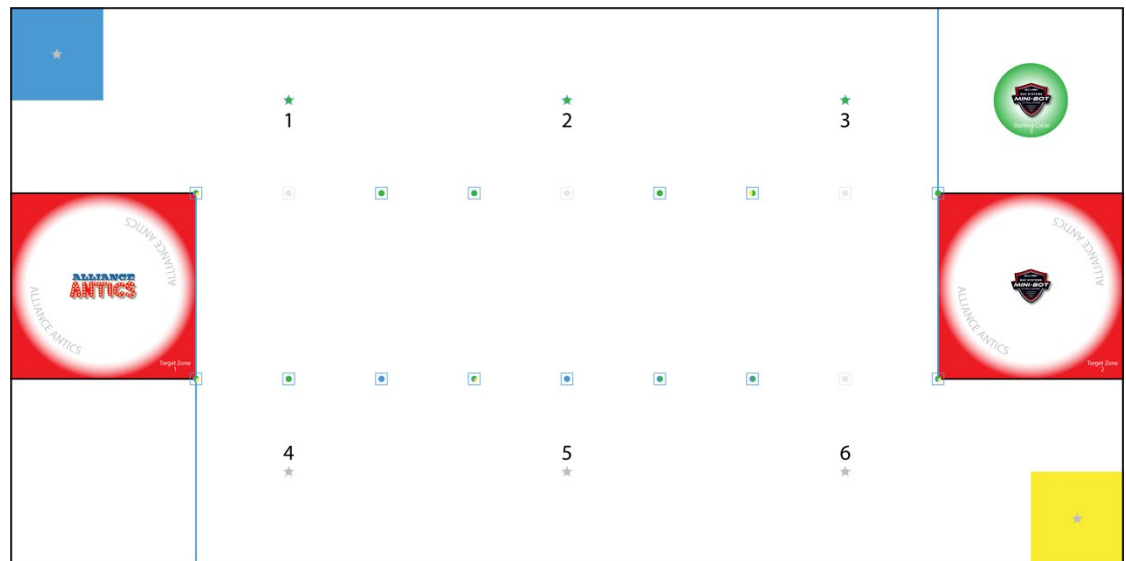
    b. Teams may use a Color Conundrum mat for this competition.
    c. Teams who do not already have a mat are encouraged to print out the supplied Field mat from PDF.
    d. Teams that want to purchase a mat can get one from Turnone Graphics for $65 including shipping.
    e. Teams can print as a single sheet on a wide-format printer or tile sheets together.
    f. Instructions for tiling in Adobe Reader and Acrobat are found here.
    g. When printed, the Playing Field should measure 45" x 90".
        i. All solid black lines are 0.125" thick.
        ii. All solid blue lines are 0.125" thick.
        iii. There is a black border around the entire field.
        iv. The field is laid out in 7.5" square regions.
        v. The field is 12 squares wide by 6 squares tall.

7.5" grid
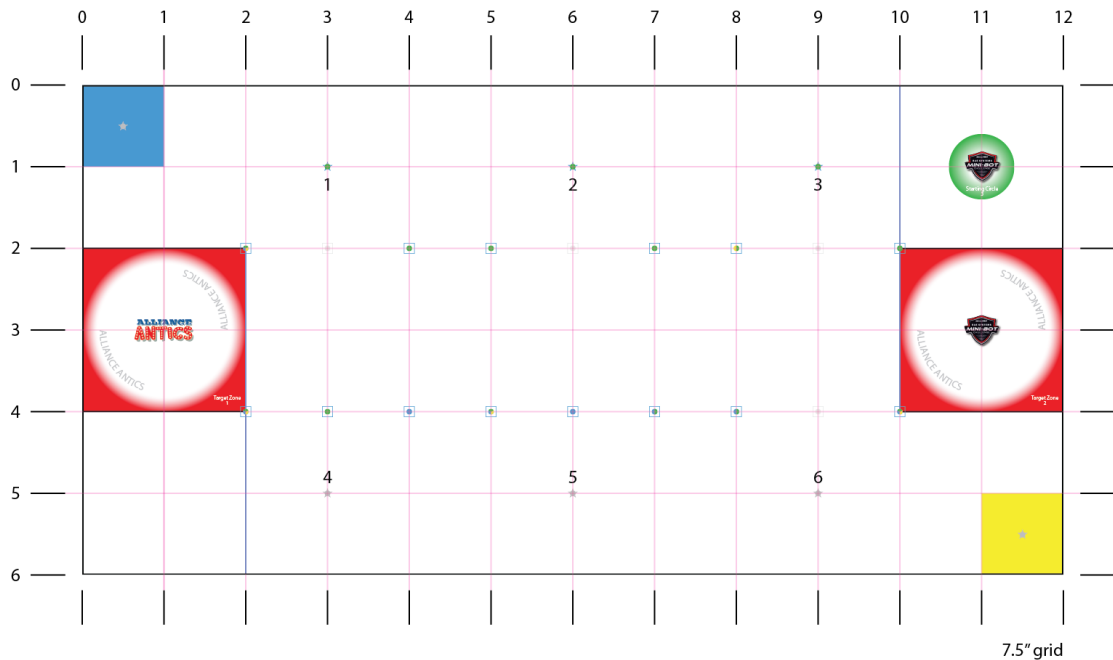
vi. There is one Starting Circle on the Alliance Antics field. Color Conundrum mats will have three Starting Circles on the field.
  1. The Starting Circles are labeled as Starting Circle 1, Starting Circle 2, or Starting Circle 3. The Color Conundrum mat contains all three Starting Circles. The Alliance Antics mat contains Starting Circle 3.
  2. Each Starting Circle has a diameter of 6 inches.
  3. *(Color Conundrum mat only)* With the blue corner of the mat in the upper left orientation, the center of Starting Circle 1 is located 7.5 inches from the left outer edge of the mat and 22.5 inches from the top outer edge of the mat.
  4. *(Color Conundrum mat only)* With the blue corner of the mat in the upper left orientation, the center of Starting Circle 2 is located 7.5 inches from the left outer edge of the mat and 37.5 inches from the top outer edge of the mat.
  5. With the blue corner of the mat in the upper left orientation, the center of Starting Circle 3 is located 82.5 inches from the left outer edge of the mat and 7.5 inches from the top outer edge of the mat.

vii. There are two Target Zones on the field.
  1. The Target Zones are labeled as Target Zone 1 and Target Zone 2.
  2. Target Zones are two squares tall by two squares wide.
  3. With the blue corner of the mat in the upper left orientation, the center of Target Zone 1 is located 7.5 inches from the left outer edge of the mat and 22.5 inches from the top outer edge of the mat.
  4. With the blue corner of the mat in the upper left orientation, the center of Target Zone 2 is located 82.5 inches from the left outer

edge of the mat and 22.5 inches from the top outer edge of the mat.

5. With the blue corner of the mat in the upper left orientation, each Target Zone has a solid black line bounding the top and bottom of the Target Zone.

6. With the blue corner of the mat in the upper left orientation, Target Zone 1 has a solid blue line bounding its right-hand edge.

7. With the blue corner of the mat in the upper left orientation, Target Zone 2 has a solid blue line bounding its left-hand edge.

viii. There are eighteen (18) 1" squares on the field.
1. The color of the perimeter of each square varies.
2. Each square has a .5" diameter circle at its center.
3. The color of each circle varies, and some circles consist of more than one color.

ix. There are eight (8) 1" stars on the field.
1. The color of the perimeter of each star varies.
2. Each star has a 0.5" diameter circle at its center.
3. The color of each circle varies.

x. Yellow, blue and red areas on the Field are treated as white for the purposes of penalties.

h. Scoring Zone and Endgame Zone
i. The blue square with a grey star in its center is the Scoring Zone.
ii. The yellow square with a grey star in its center is the Endgame Zone.
iii. Each team must make a Scoring Crib and an Endgame Crib, which will constrain golf balls during match play.
iv. Scoring Cribs can be 3D printed from the file *Alliance Antics Scoring Crib.stl* attached to this PDF or made using LEGOs or other materials such as cardboard. Cribs must meet the following specifications:
1. The Scoring Crib must measure 7.5" x 7.5" square.
2. Going clockwise around the square:
   a. The first side must be 1.85" (5 LEGO bricks) high.
   b. The second side must be 5.55" (15 LEGO bricks) high.
   c. The third side must start as 3.7" (10 LEGO bricks) high and step down to 1.85" (5 LEGO Bricks) halfway along its length The 3.7" high side must join to the second side of the Crib.
3. The remaining side is called the Crib Entrance.
   a. Starting on the left-hand edge, the Crib Entrance must be at least 1/8" high but no more than 1/4" high for 1/2 of its length, and 1.85" high for the remaining 1/2 of its length.
4. There must be a wall that divides the interior of the Scoring Crib into two sections. The wall runs from a point 1/2 from the left-hand edge of the Crib Entrance to the opposite wall. From the Crib Entrance end of the wall, it must be 1.85" high for half of its length and then 3.7" high for the remaining length.

5. There must be a 3.7" high wall that divides the portion of the Crib with high walls into two sections.
   a. This wall should run from the midpoint of the longer wall to the opposite wall, dividing this portion into two square portions.
6. This creates three Scoring Zones within the Scoring Crib.
   a. Scoring Zone 1 measures 7.5" x 3.75" and is bordered by a 1.85" high wall, a 5.55" high wall, a wall that is 3.7" high for half its length and 1.85" high for the remainder, and one 1/8" to 1/4" high wall.
   b. Scoring Zone 2 measures 3.75" x 3.75" and is bordered by a 1.85" high wall, a 3.7" high wall, a 3.7" high wall and a 3.7" high wall.
   c. Scoring Zone 3 measures 3.75" x 3.75" and is bordered by a 3.7" high wall, a 5.55" high wall, a 3.7" high wall and a 3.7" high wall.
7. The crib must be solidly built to withstand impact from the robot.
8. We recommend 3D-printing the supplied model to use during competition.

xi. Endgame Cribs can be 3D printed from the file *Alliance Antics Endgame Crib.stl* attached to this PDF, or made using LEGOs or other materials such as cardboard. Cribs must meet the following specifications:
   1. The Endgame Crib must measure 7.5" x 7.5 inches square.
   2. Three sides must be at least 5/8" high but no more than 1" high.
   3. One side must be at least 1/8" high but no more than 1/4" high.
   4. The crib must be solidly built to withstand impact from the robot.
   5. We recommend 3D-printing the supplied model to use during competition.

v. Teams must place a Scoring Crib over the Scoring Zone so that the Crib Entrance faces Starting Circle 3.

vi. Teams must place an Endgame Crib over the Endgame Zone so that the Crib Entrance faces Target Zone 1.

vii. Teams may choose to use double-sided tape or hook and loop fastener to secure the Scoring Cribs to the game mat.

i. Outer boundary wall
   i. Teams are encouraged but not required to build a wall around the mat to constrain the balls to the playing field.
   ii. The wall can be constructed out of any material.
   iii. The wall cannot exceed 4" in height.
   iv. The minimum inner dimensions of the wall are 45" x 90".
   v. The wall must not overlap the white area of the playing field.

4. Game
   a. Each match is 135 seconds long.

b. Each match is divided into four periods:
   i. A 20 second Autonomous period
   ii. A 10 second Pause
   iii. A 75 second Teleoperated period
   iv. A 30 second Endgame period
c. Each match will have four teams participating: two Red Alliance teams and two Blue Alliance teams.
d. There will be audio cues to the teams to signal the start of each match phase.
e. Alliance pairings and the match schedule will be generated no later than one hour before the start of the competition.
f. Each team will have 6 golf balls in their possession at the start of the match.
g. Prior to the start of the match and based on **Setup** below, each team will place three of their golf balls on the field.
h. At the start of the match, each robot's Romi circular frame must completely cover Starting Circle 3.
   i. No portion of the Starting Circle can be visible when viewed from above the robot at the start of the run.
i. At the start of the match, all parts of the robot and its attachments must fit within the boundaries formed by a cube defined by the three black lines and the blue line around Starting Circle 3 extending up 15" from the mat.
j. Robots may not topple any Obstacles during their match.
   i. Obstacles are defined as AA Batteries. There are 12 Obstacles on the field, as indicated in **Setup** below.
   ii. Each toppled Obstacle accrues one penalty.
   iii. All penalties will be assessed at the conclusion of the match.
   iv. At the end of the run, if Obstacles have been restored to a vertical orientation by the robot, there will be no penalty accrued for that obstacle. Obstacles do not need to be in their original positions.
   v. Human players may not touch or move Obstacles during the match.
k. Robots may not cross any black line during the match.
   i. Crossing a line is defined as the point of contact between the wheels or roller balls and the mat moving from one area to another area while traversing a line.
   ii. Wheels and roller balls are allowed to touch a line in the course of their movement, so long as they do not cross the line.
   iii. Components of the robot that normally do not touch the ground are allowed to cover black lines.
   iv. If a robot crosses a line from one area to another area and then crosses back to the first area as part of a turn, the run will accrue ONE penalty.
   v. The decision of the referees is final.
l. Prior to each match, the Master of Ceremonies will confirm that each Alliance is ready for the match.
m. Match time starts when the Master of Ceremonies counts down with the phrase: "Three, Two, One, Go!"

n. Match time is controlled centrally by the FTA. All teams must have access to the competition system during the match to see the official match time and to hear the audio cues during the matches.

o. Autonomous Period
   i. During the Autonomous Period, the robot must be controlled solely by robot code that is run in simulation mode on a computer.
   ii. All code must be started in simulation mode, and a connection established to the Romi MiniBot before commencing a run.
   iii. Code must be started from the computer connected to the MiniBot by activating the "Autonomous" mode on the driver station or simulation GUI, but no other human input is permitted.
   iv. Robots can use built-in internal sensors or attached additional sensors to control their robot. These sensors include but are not limited to wheel encoders, IMU or cameras.

p. Pause
   i. The match Pauses for 10 seconds after the conclusion of the Autonomous period. Drivers must pick up their controllers and switch their robots to their teleoperated mode during this time.
   ii. Autonomous scoring will be entered by the referee during the Pause.
   iii. The Human Players will place golf balls from their reserve into the Endgame Zone.
      i. The number of golf balls will be the same as the number of balls scored during the autonomous period. For instance, if the team scores two golf balls during the autonomous period, then the Human Player will place two of the reserve Golf Balls into the Endgame Zone. The remaining reserve golf ball will not be used for the remainder of the match.
   iv. Teleoperated period starts automatically following the 10 second pause.

q. Teleoperated and Endgame Periods
   i. During the Teleoperated and Endgame Periods, the following additional conditions apply:
      1. Robots must receive input from the Drivers' Station or the ROMI Simulator during the run to qualify as a Teleoperated run.
      2. The robot can use any amount of automation to assist the driver.
      3. Teams are free to design a Drivers' Station to suit the challenge.
      4. With the mat viewed from above and the Scoring Zone in the upper left orientation, the Driver and optional Manipulator must remain on the right-hand side of the mat.
   ii. Robots will attempt to score as many golf balls as possible during the Teleoperated period.
   iii. The Human Player may return scored golf balls to their starting positions during the Teleoperated Period. *Human Players, please note: the starting positions for each match will likely be different, so be sure to keep track.*

a. With the mat viewed from above and the Scoring Zone in the upper left orientation, the Human Player may move around the top, bottom and left-hand side of the mat.

r. Penalties

i. As noted above, each toppled battery at the conclusion of the match earns the team one penalty.

ii. One or two wheels crossing a black line will accrue a penalty.

iii. Human Players may not touch golf balls once they place them on the mat.

iv. Placing a golf ball on a star other than its correspondingly numbered starting positions will earn one penalty for every 5 seconds the ball remains on the star.

v. A robot that completely leaves the mat during the match will earn a red card. To completely leave the mat, all points of contact between the robot and the mat must be outside of the mat's perimeter. A team which earns a red card in a match will earn zero rank points and zero match points for the match, regardless of the outcome of the match. Their Alliance partner will earn the points from both Alliance teams. Teams who earn a red card will carry the red card with them for the remainder of the tournament.

vi. Touching the robot during a run will earn a penalty and a yellow card.

vii. Two yellow cards become a red card.

viii. The decision of the referee is final.

s. Setup

a. Place AA batteries over the 12 small circles with green color. Some circles have more than one color. For this game, only cover circles with green. Some of the circles will also have other colors, so be sure to cover any circle with green. These locations are indicated in pink on the image below.
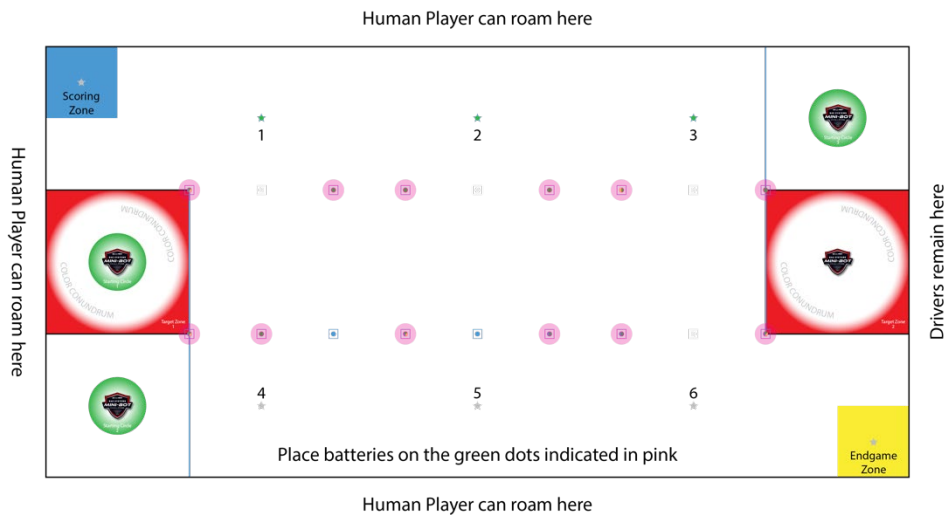
b. The match schedule will specify which teams are Red Alliance and which teams are Blue Alliance.

a. Red Alliance has an A team and a B team

b. Blue Alliance has an A team and a B team

c. Each Alliance will place six golf balls on the field according to the following procedure:

   a. Per *Alliance*, each of the six numbered golf ball locations must be covered by its corresponding numbered golf ball at the start of the match.
   b. Each *team* will place three numbered golf balls on their mat.
      i. The Match Schedule will specify a location for one golf ball for each team.
      ii. At the beginning of the On-Deck period, each Alliance will specify the location for two golf balls for their opposing Alliance, one for Team A and one for Team B.
      iii. Alliance members will complete placing their remaining balls, ensuring that between the two Alliance members, all ball positions are covered at the start of the match.
   c. Each *team* will hold three golf balls in reserve.

d. During the Autonomous Period, teams will attempt to score one or more balls by moving them into one of the three Scoring Zones. If both teams score at least one ball during the Autonomous period, the Alliance will earn one Rank Point.

e. At the conclusion of the Autonomous Period, if the robot is located inside of Target Zone 1, it counts as AutoParked. No part of the Romi Frame may extend beyond the boundaries of Target Zone 1; however, attachments may extend beyond the boundaries of Target Zone 1.

f. During the Pause, from the remaining golf balls, teams will place balls into the Endgame Zone equal to the number of balls scored during the Autonomous period. Each team has three balls in reserve. For each numbered ball scored, the Human Player will place one ball into the Endgame Zone.

g. During the Teleoperated Period, teams will attempt to score additional balls from their numbered positions. The Human Player may return balls that have been placed in the Scoring Zone to their numbered positions during the Teleoperated period. The Human Player may also return balls that have left the playing field to their numbered positions. Balls do not count as scored unless they come to rest in one of the Scoring Zones.

h. During the Endgame, the Human Player may not return any balls to their numbered position. This includes balls that have left the playing field.

i. During the Endgame, the Team may score any balls remaining on the field, including balls that were placed in the Endgame Zone during the Pause.

j. Endgame Zone balls score 2x points when placed into the Scoring Zone.

k. At the conclusion of the Endgame Period, if the robot is located completely inside of Target Zone 2, it counts as Parked. All attachments must fit within the Target Zone and no part of the robot or its attachments may extend beyond the boundaries of Target Zone 2.

      l.   If both teams are Parked at the conclusion of the Endgame period, the Alliance will earn one Rank Point.

  t. Example Match Flow

      a. Prior to the start of the On-Deck period, Red Alliance teams place numbered balls on their mats according to the locations shown on the match schedule. The schedule indicates the following positions:

          Team A: position 1

          Team B: position 4

      b. At the start of the On-Deck period, the Blue Alliance tells the Red Alliance to place numbered balls on the mat at the following locations:

          Team A: position 3

          Team B: position 2

      c. The Red Alliance then decides to place their remaining numbered balls on the field in the following locations:

          Team A: position 6

          Team B: position 5

      d. At the start of the match, Team A will have balls covering starting locations 1, 3, & 6 and Team B will have balls covering starting locations 2, 4, & 5.

      e. During the Autonomous period, Team A scores the balls from position 1 & 6, and Team B scores the ball from position 5. The Alliance earns one Rank Point.

      f. At the conclusion of the Autonomous period, teams may AutoPark in Target Zone 1.

      g. During the Pause, Team A Human Player places one ball from their reserve into the Endgame, and Team B Human Player places one ball from their reserve into the Endgame Zone. The remaining reserve balls are out of play for the rest of the match.

      h. During Teleoperated play, Human Players may return any scored ball from the scoring zone back to its corresponding numbered position for this match. Remember starting locations will change from match to match. In this example, Team A's Human Player may return correspondingly numbered balls to positions 1, 3 and 6. Team B's Human Player may return correspondingly numbered balls to positions 2, 4 and 5.

      i. During Endgame play, the Human Players may not return balls to the field.

      j. During the Endgame, robots may score any remaining balls on the field, including those in the Endgame Zone.

      k. Prior to the conclusion of the Endgame, robots may Park in Target Zone 2.

  u. Visual guidance

      i. Robots may use visual inputs to help them navigate the chosen course and identify Obstacles and golf balls.

- ii. Teams may add a fixed path to the Course, which the robot can track using the team's choice of line follower.
- iii. Teams may add other visual targets external to the field. These can be placed anywhere outside of the perimeter to aid navigation.
- iv. Aside from a fixed path, no visual aids can be added to the field. This includes barcodes or other visual guidance.
- v. Golf Balls
  - i. Please use the supplied Titleist golf balls where possible. If unavailable, please use a comparable golf ball for this challenge. Other analogs are not allowed.
  - ii. Golf balls must be clearly numbered using a Sharpie or similar marker.
  - iii. Golf balls must be sequentially numbered from 1 to 6. The numbers must be clearly visible to the referees.
  - iv. Coloring the golf balls is allowed, so long as the numbers are clearly visible to the referees.
  - v. Golf balls that move outside of the mat are out of play unless they are under the control of the robot while they move outside the mat.
    For example, if the robot has control of a ball and executes a turn so that the ball rolls outside of the mat and then back onto the mat, the ball remains in play. If the robot nudges the ball from its resting point and it rolls off of the mat, it is out of play.
  - vi. Human players can return golf balls to their correspondingly numbered spaces on the field. See **Setup** above.
    - a. Human players may not touch a robot while replacing golf balls onto the field.
    - b. The Human player can only retrieve golf balls from the Scoring Zones or that have rolled out of play during the Teleoperated period. They may not retrieve golf balls during Autonomous, Pause, or End Game.
    - c. The Human player cannot retrieve golf balls from the Scoring Zone while the robot is in contact with or overlapping the Scoring Zone.
    - d. Golf balls must come to rest in a Scoring Zone to count as scored.
5. Scoring
   - a. In order to score, a golf ball must be in contact with the base of the Scoring Zone. Balls will not score if they are supported by other balls.
   - b. During the Autonomous period, each ball scored in Scoring Zone 1 counts as 2 points.
   - c. During the Autonomous period, each ball scored in Scoring Zone 2 counts as 6 points.
   - d. During the Autonomous period, each ball scored in Scoring Zone 3 counts as 10 points.
   - e. During the Autonomous period, if each team on an Alliance scores at least one ball in any Scoring Zone, the team earns a Rank Point.

f. At the conclusion of the Autonomous period, each AutoParked robot earns 10 points.
g. During the Teleoperated period, each ball scored in Scoring Zone 1 counts as 1 point.
h. During the Teleoperated period, each ball scored in Scoring Zone 2 counts as 3 points.
i. During the Teleoperated period, each ball scored in Scoring Zone 3 counts as 5 points.
j. Please make sure the camera is setup such that the referees can see when a ball is scored. They cannot count a ball they never saw enter the scoring zone.
k. If a ball rolls out of the Scoring Zone, it does not count as scored. It must come to rest in the Scoring Zone before the Human Player can retrieve it. Scoring Zone 1 is designed with a lip to prevent slow-rolling balls from exiting. It also has several holes to reduce ball momentum inside the Crib.
l. During the Endgame, scored balls count the same as during Teleoperated, however balls scored from the Endgame Zone earn double points.
m. At the conclusion of the Endgame, a Parked robot earns 10 points.
n. At the conclusion of the Endgame, if both robots on an Alliance are Parked, the team earns a Rank Point.
o. At the conclusion of the Endgame, each penalty will award the opposing Alliance 1 point. These will be tallied and recorded by the referees.
p. The Alliance with the most points at the conclusion of a match earns two Rank Points. In the event of a tie, each Alliance will earn one Rank Point.
q. Teams will be ranked according to their accumulated Rank Points.
r. In the event of a ranking tie, priority will be given based on the following criteria:
    i. First priority: Total Autonomous Score (highest is best, as recorded for the team)
    ii. Second priority: Total Penalties (lowest is best, as recorded for the team)
    iii. Third Priority: Total Endgame Park, as recorded for the team

6. Playoffs
    a. There will be a playoff tournament.
    b. The top 8 ranked teams after the qualification rounds will select Alliance partners for the tournament.
    c. Each Alliance will have three teams.
    d. The selection process will mirror that used by FRC, with Alliance 1 selecting first, then down to 8, then 8 again, then up to 1, then 1 again, then back to 8.
    e. Once chosen, the Alliances will play a tournament bracket.
    f. Each team on an Alliance must play in at least one match at each level of the tournament.
    g. Alliances must win two matches to advance in the tournament.
7. Awards
    h. There will be awards for Alliance performance during the tournament.
    i. There will be a Judge's Award.
    j. There will be a Team Spirit Award.
    k. There will be an Innovative Solution award.
        i. Judges will review robot design including code and performance to evaluate this award.