World Robot Olympiad 2017

Regular Category

Junior

Game Description, Rules and Scoring

Sustainabots [Robots for sustainability]

Carbon Neutrality

Version: Final Version January 15th

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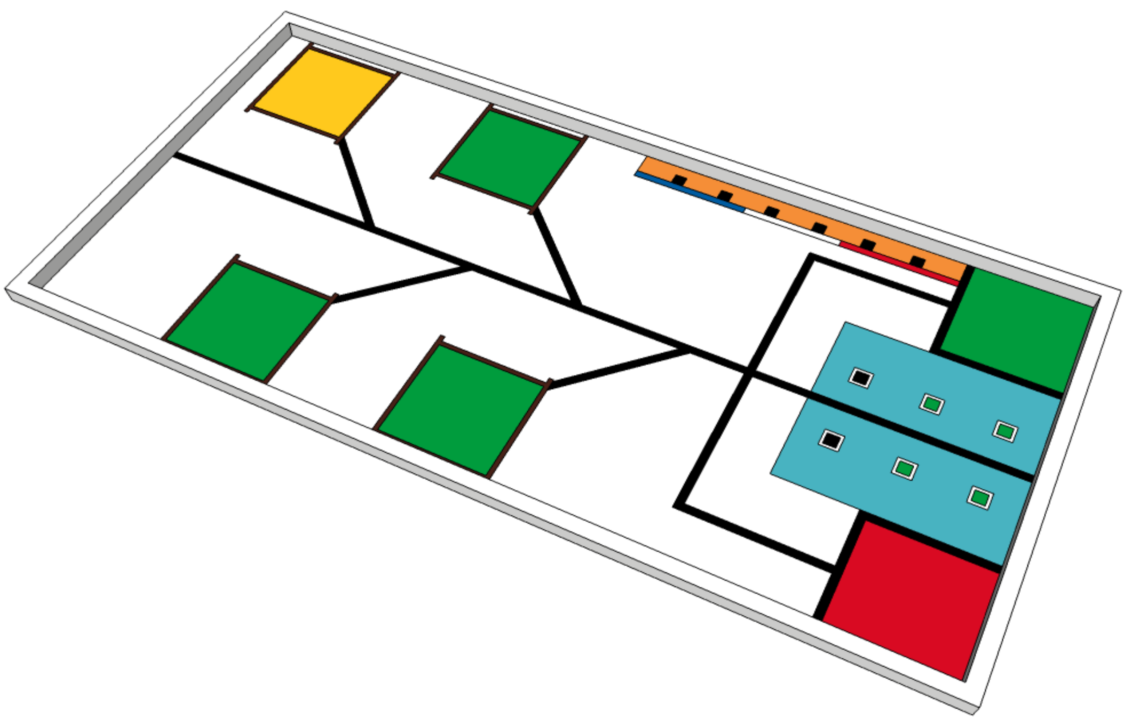
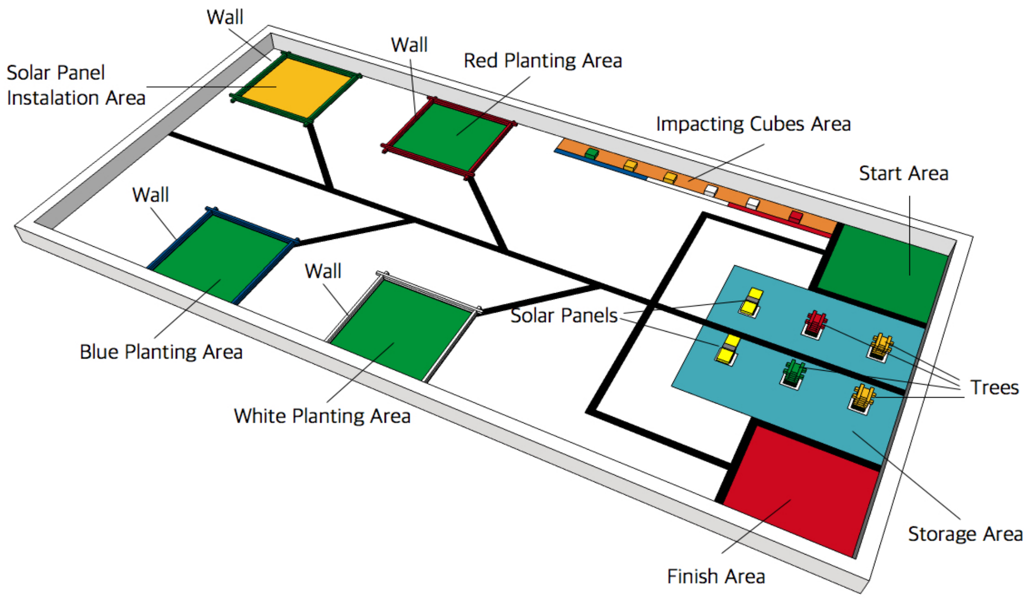
Introduction

Greenhouse gasses, such as carbon dioxide, emitted by human activities like transportation, industrial processes and energy production affect the temperature of our planet. The Challenge is to make a robot that can help one company reach carbon neutrality. To accomplish this, the robot must install renewable energy sources, like solar panels, and plant trees to counterbalance the emissions from the industrial processes of the company.

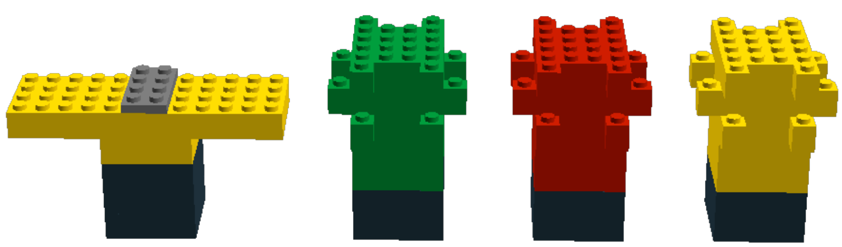


1. Game Description

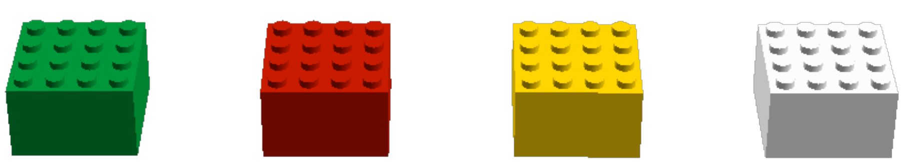
The mission of the robot is to bring the carbon footprint of one company to zero. The carbon footprint of a company is the amount of carbon dioxide emitted by the industrial processes of the company. The robot must install solar panels and plant the right kind of trees in the different planting areas to counterbalance the emissions of the company.



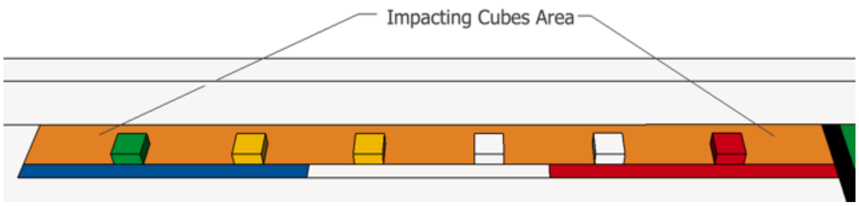
In the Storage Area there are 2 solar panels and 4 trees. There are three different kinds of trees: green, red and yellow.



The Impacting Cubes Area contains the industrial processes of the company. Located in the area are 6 Process Cubes that represent the industrial processes of the company. There are four kinds of Process Cubes:



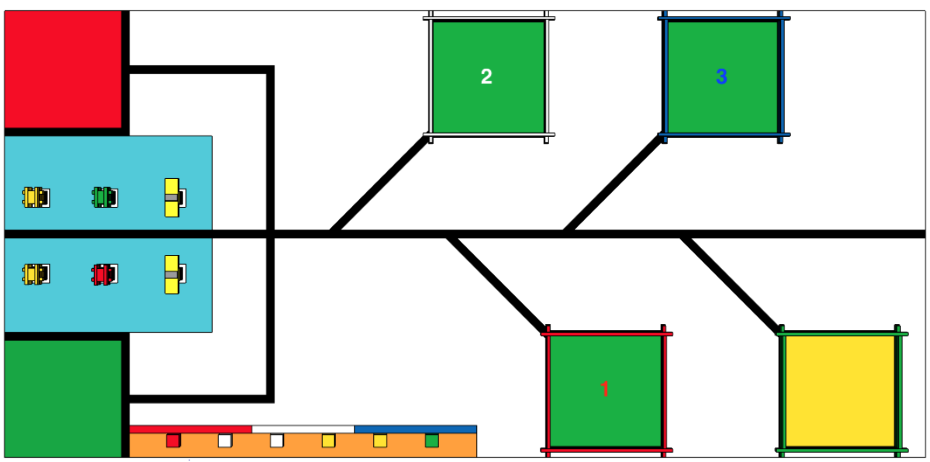
A white cube represents a process with no emission and a colored cube (red, green, or yellow) represents an industrial process that emits carbon dioxide. The 6 Process Cubes are positioned on the 6 black squares of the Impacting Cubes Area (see figure below).



There are blue, white, and red lines separating the orange area of the Impacting Cubes Area from the white area of the mat. These colored lines divide the Process Cubes into three groups of two cubes. In the figure above, the green and yellow cubes closest to the blue line are in Group Blue, the yellow and white cubes closest to the white line are in Group White, and the white and red cubes closest to the red line are in Group Red.

The robot will start from within the Start Area (the green square next to the Storage Area). One mission of the robot is to install the two solar panels in the Solar Panel Installation Area (the yellow square).

The second mission of the robot is to bring the 4 trees from the Storage Area to the three green Planting Areas. Each green planting area is surrounded by a different colored wall…red, white, and blue. The positions of the red, white and blue Planting Areas are shown with the numbers 1, 2 and 3 in the figure below:



The color of the trees to be planted in each Planting Area is determined by the colors of the Process Cubes and their position in the Impacting Process Cube Area. The emission from one colored Process Cube needs to be counterbalanced by planting one tree of the corresponding color in a planting area:

- If the process cube is in Group Blue, the tree must be planted in the blue Planting Area;
- If the process cube is in Group White, the tree must be planted in the white Planting Area;
- If the process cube is in Group Red, the tree must be planted in the red Planting Area.

For its third mission, the robot must bring the colored Process Cubes to the Finish Area and stop completely within the Finish Area.

The following figures illustrate three ways of earning points. Figure 1 shows the initial placement of trees, solar panels and process cubes. Figure 2 shows the final placement to earn points in all three ways.

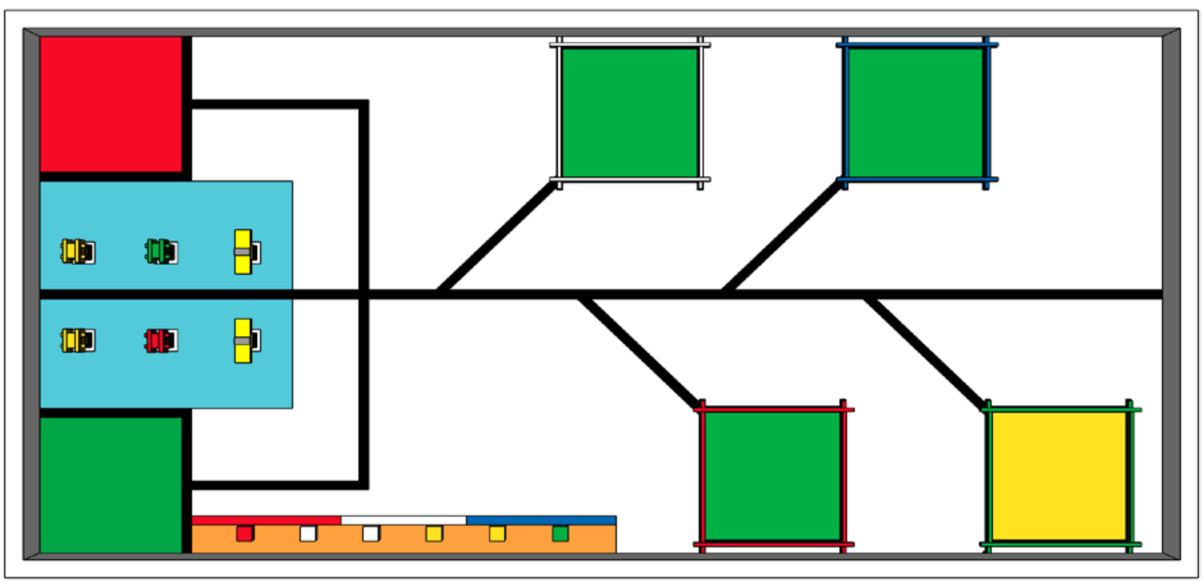


Figure 1

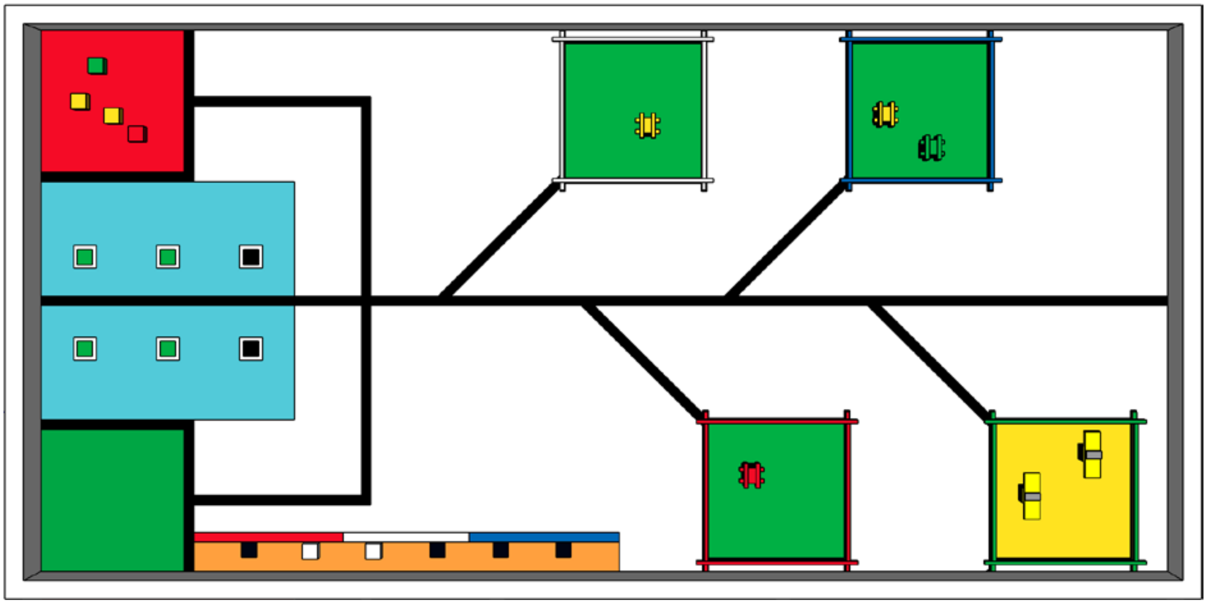
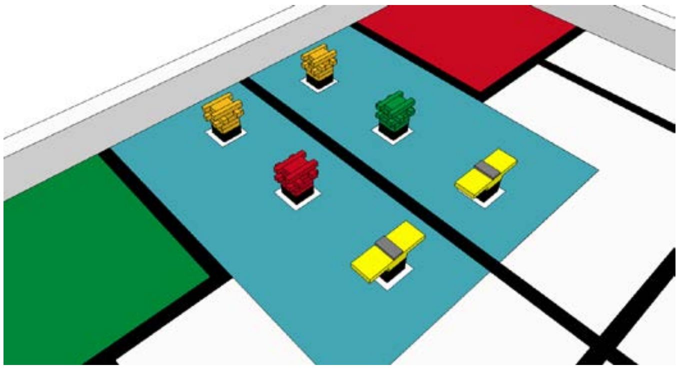


Figure 2

The time allowed for the challenge is 2 minutes.

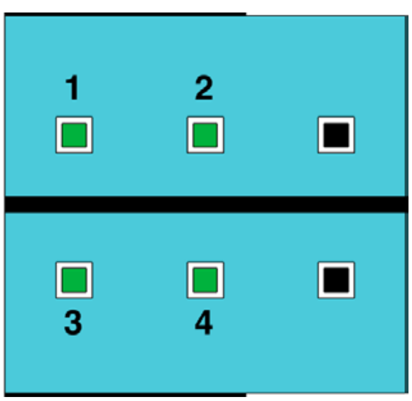
2. Game Rules

1. Each attempt starts with 4 trees and 2 solar panels in the Storage Area. Solar panels are placed on the 2 black squares in a position with the longer upper panel area parallel to the shorter side of the table. The trees are placed on the 4 green squares in a position with the lowest branches parallel to the shorter side of the table.



2. Before each round, the colors and positions of the 4 trees in the Storage Area are determined randomly. The random selection and placement should be done as follows:

- Place 3 green trees, 3 red trees and 3 yellow trees in a non-transparent box;
- Mix the trees up by stirring gently with one hand;
- Pick 4 trees from the box, one by one, and place them on the green squares in the Storage Area in the order shown in the figure below:



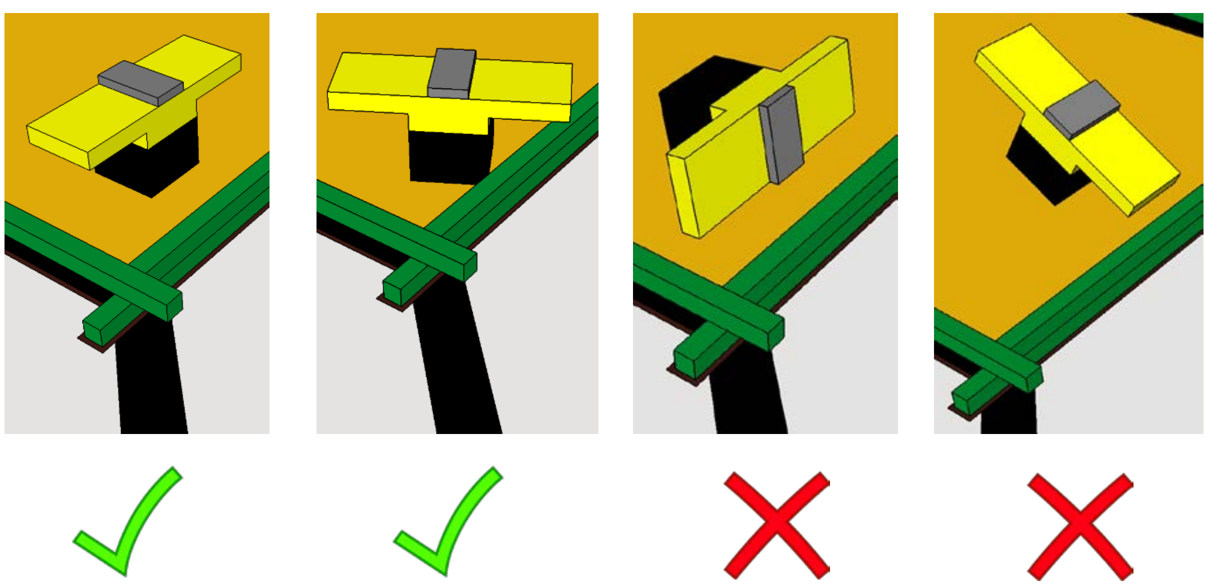
The chosen colors and placements of the 4 trees are kept constant throughout a round.

3. Before each round, the colors and positions of the 6 Process Cubes in the Impacting Cubes Area are determined as follows:

- Place 2 white cubes and 4 colored cubes (the same number and colors as the randomly drawn trees) in a non-transparent box;
- Mix the cubes up by stirring gently with one hand;
- Pick 6 cubes from the box, one by one, and place them on the black squares in the Impacting Cubes Area in the order shown in the figure below:

The chosen colors and placements of the 6 cubes are kept constant throughout a round.

4. Each solar panel must be moved from the Storage Area to the Solar Panel Installation Area. A solar panel is correctly placed if it is undamaged(*) and placed in an upright position, with the base touching the mat and completely within the orange Solar Panel Installation Area. See the figure below for examples of proper and improper placement.

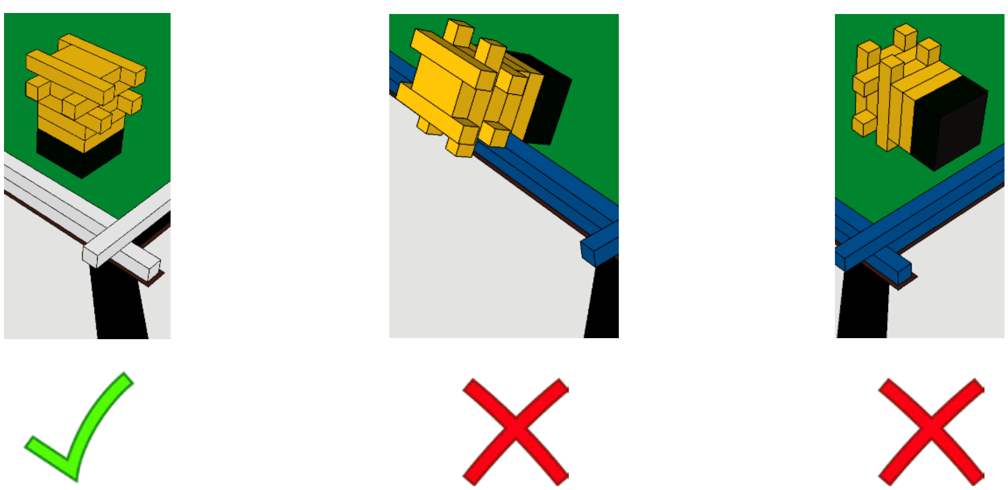


(*) Definition of damaged for this document: A game object is damaged if at least one brick is completely detached from the position it was attached in the initial buildup.

5. Each tree from the Storage Area must be moved to one of the three Planting Areas. The color of the trees to be planted in each Planting Area depends on the colors of the Process Cubes and their position in the Impacting Cubes Area. The emission from one colored Process Cube needs to be counterbalanced by planting one tree in the same color planting area as the color group:

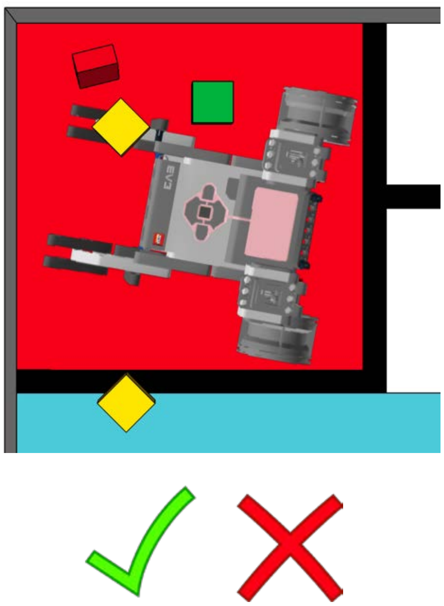
   - If the Process Cube is in Group Blue, the tree must be planted in the blue Planting Area;
   - If the Process Cube is in Group White, the tree must be planted in the white Planting Area;
   - If the Process Cube is in Group Red the tree must be planted in the red Planting Area.

   A tree is correctly planted if it is undamaged and placed in an upright position, with the base totally within the green Planting Area touching the mat, as shown in the following figure:

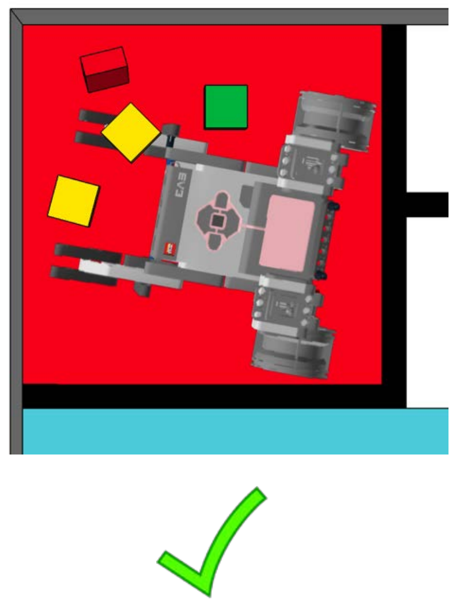


6. If more trees than necessary are planted in an area, no points will be awarded for the extra trees.

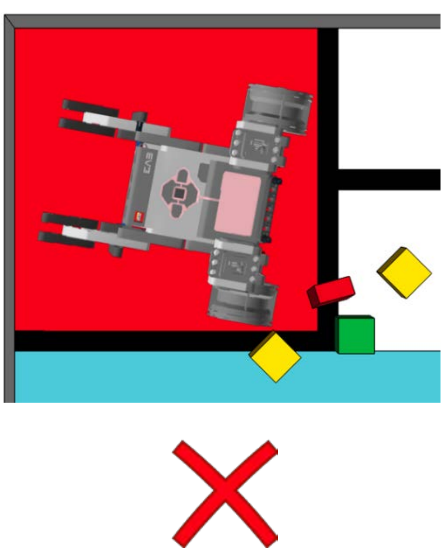
7. The four colored Process Cubes must be moved to the Finish Area. A colored process cube is correctly placed in the Finish Area if it is undamaged and the **projection of the process cube** is placed completely inside the red square of the Finish Area without touching the surrounding black lines. See the following photos for clarification:



Only 3 cubes are inside the red square.
One yellow one is outside. 75 points.

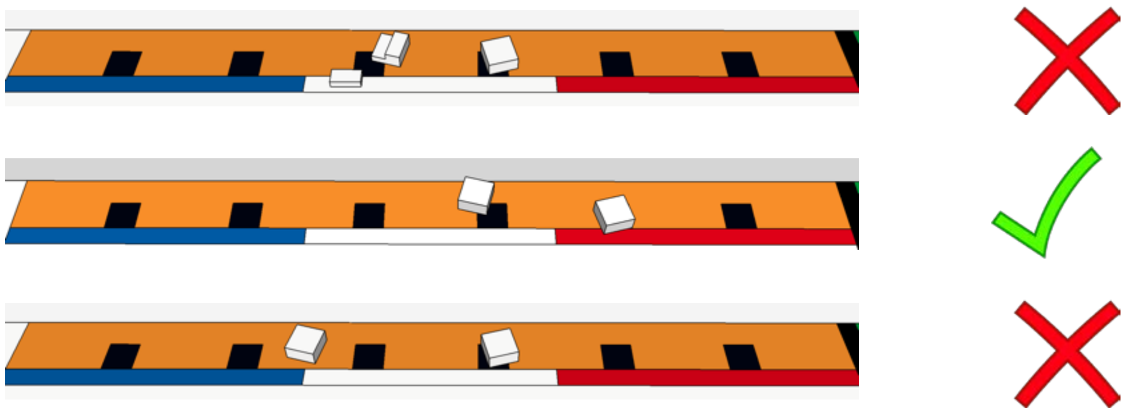


All 4 cubes inside the red square.
100 points.



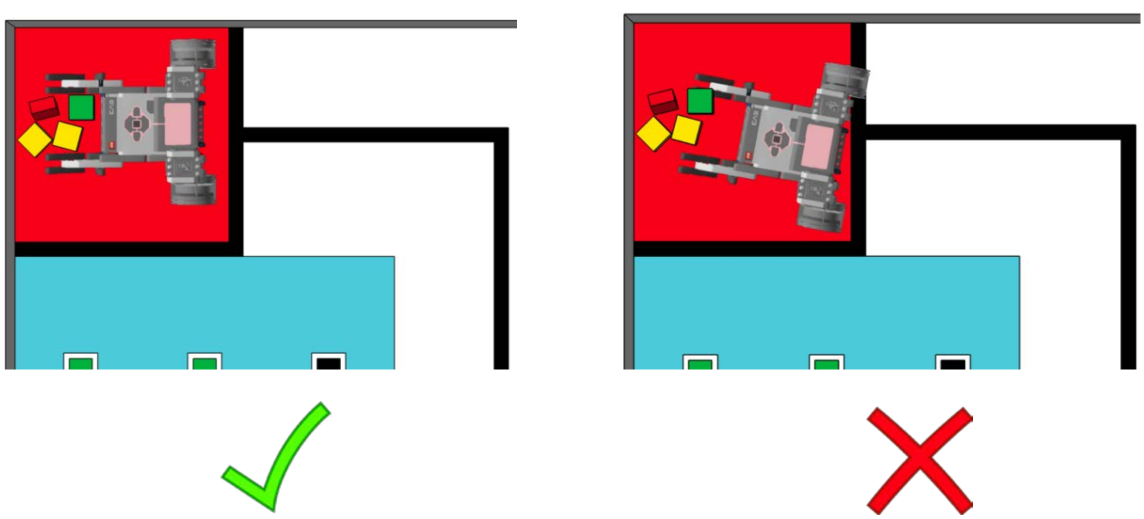
No cube is inside, 0 points.

8. The two white Process Cubes must remain at their initial locations. That is, some part of a white cube must touch the black square where it was initially placed, only one white cube can be touching a black square, and the cubes are undamaged.



9. The colored LEGO walls surrounding each planting area must not be damaged or moved from their initial placement (all parts must touch the mat in the brown area surrounding the planting area). A penalty will be given for each damaged /moved wall if this does not result in a negative score.

10. The Challenge is completed when the robot stops and the projection of the robot is completely within the Finish Area (cables are allowed to be outside of the finish area).



3. Scoring

a. Score will be determined when the Challenge is completed or when time expires.

b. Maximum score = 430 points.

c. Penalties are only subtracted if it results in a non-negative score.

d. If teams have the same score, ranking is decided by the fastest time recorded.

Scoring Table:

Tasks	**Points Each**	**Total**
Tree correctly planted in the right planting area.	50	200
Tree correctly planted in the wrong planting area.	10	40
Correctly installed solar panel.	50	100
Colored impacting cube in the Finish Area.	25	100
White impact process cube remains in initial location (only gets these points if at least one colored impacting cube is in the Finish Area).	5	10
Robot finishes completely in the Finish Area (only gets these points if other points are assigned).		20
Wall damaged or moved outside its placement.	-5	-20
Maximum Score		**430**

4. Table Specifications

a. The internal sizes of a game table are 2362 mm x 1143 mm.

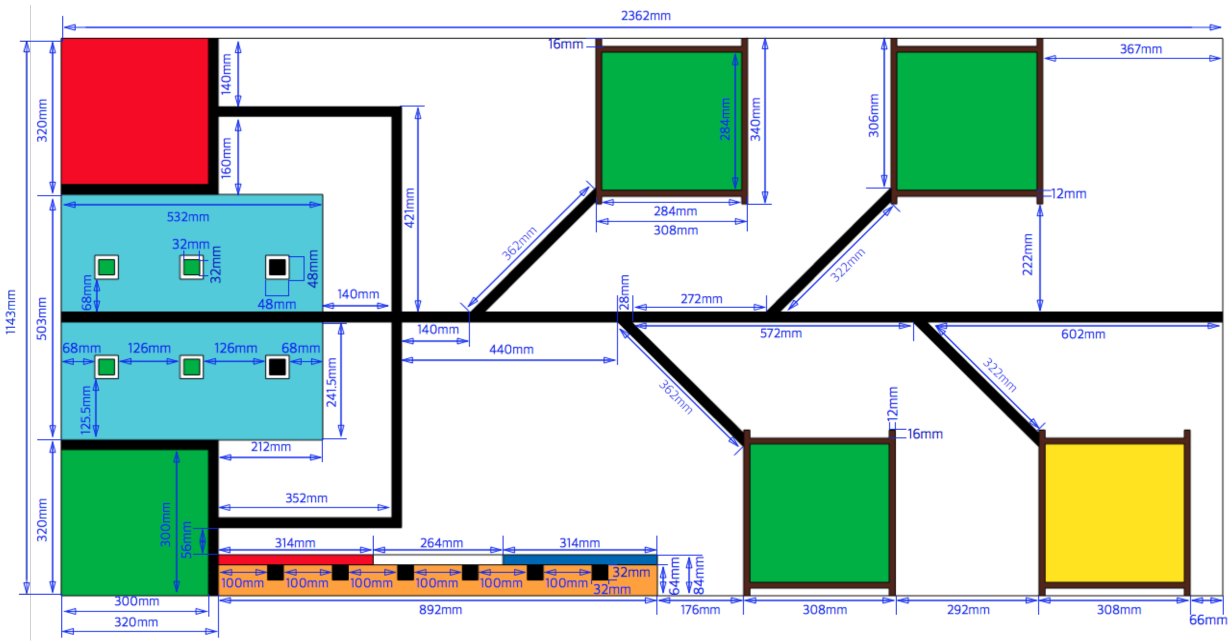
b. The external sizes of the table are 2438 mm x 1219 mm.

c. The primary color of a table surface is white.

d. Height of the borders: 70 ± 20 mm

5. Game Mat Specifications

1. All white lines are 20 ± 1 mm.
2. All dimensions may vary within ± 5 mm.
3. If the table is larger than the game mat, the bottom edge and the left edge of the game mat should align with two walls on the table.



Color Specification

Color Name	Lego Color ID	Pantone	CMYK				RGB			RGB Sample
			C	M	Y	K	R	G	B	
Bright Red	21	032C	0	100	100	0	237	28	36	
Bright Blue	23	293C	100	47	0	0	0	117	191	
Bright Yellow	24	116C	0	19	100	0	255	205	3	
Bright Green	37	355C	88	0	100	0	0	172	70	

Reddish Brown	192	499C	32	80	95	50	105	46	20	
Bright Orange	106	151C	0	44	87	0	255	130	0	
Light Royal Blue	212	292C	62	2	15	2	105	179	231	

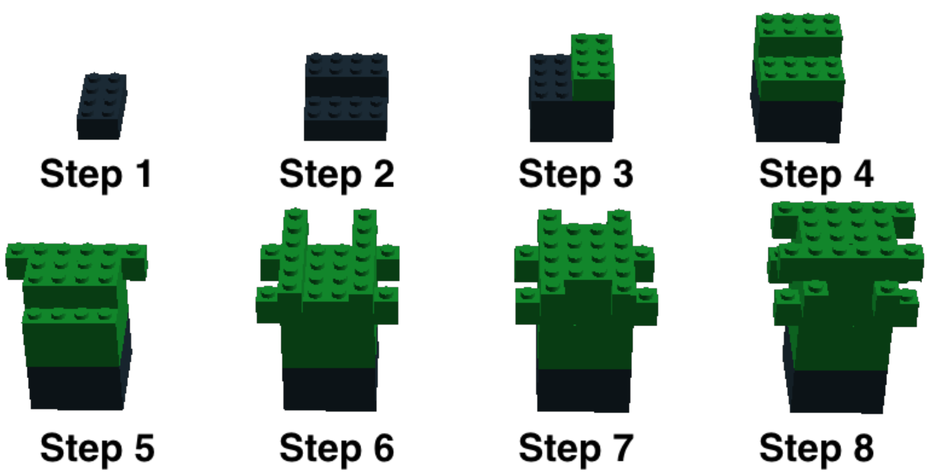
6. Game Object Specifications

There are 9 trees:

1) 3 red trees with 4 black 2x4 LEGO bricks, 7 red 2x4 LEGO bricks, and 6 red 1x6 LEGO bricks.

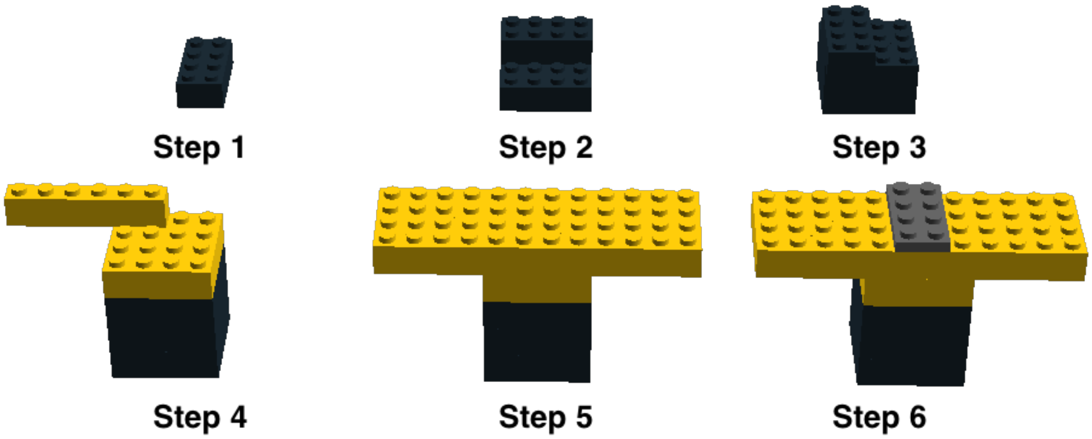
2) 3 green trees with 4 black 2x4 LEGO bricks, 7 green 2x4 LEGO bricks, and 6 green 1x6 LEGO bricks.

3) 3 yellow trees with 4 black 2x4 LEGO bricks, 7 yellow 2x4 LEGO bricks, and 6 yellow 1x6 LEGO bricks.



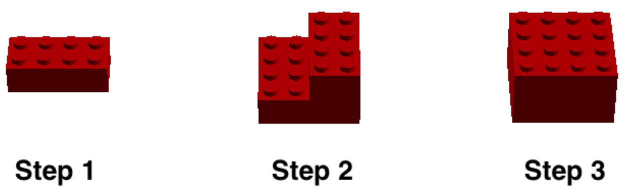
There are 2 solar panels:

1) Each solar panel has 6 black 2x4 LEGO bricks, 2 yellow 2x4 LEGO bricks, 8 yellow 1x6 LEGO bricks, and 2 grey 2x2 LEGO bricks.



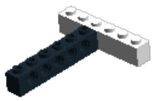
There are 3 red, 3 yellow, 3 green and 2 white process cubes (4 of each color 2x4 LEGO bricks):

1) 2 cubes with 4 white 2x4 LEGO bricks.
2) 3 cubes with 4 yellow 2x4 LEGO bricks.
3) 3 cubes with 4 green 2x4 LEGO bricks.
4) 3 cubes with 4 red 2x4 LEGO bricks.

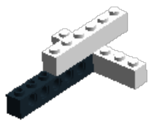


There are 4 walls:

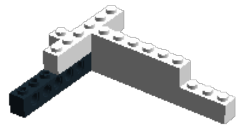
1) 1 red wall with 40 red 1x6 LEGO bricks and 12 black 1x6 LEGO bricks on the small bottom part.
2) 1 white wall with 40 white 1x6 LEGO bricks and 12 black 1x6 LEGO bricks on the small bottom part.
3) 1 blue wall with 40 blue 1x6 LEGO bricks and 12 black 1x6 LEGO bricks on the small bottom part.
4) 1 green wall with 40 green 1x6 LEGO bricks and 12 black 1x6 LEGO bricks on the small bottom part.



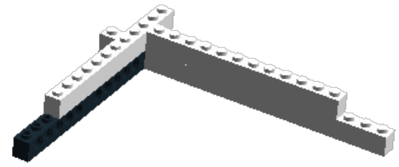
Step 1



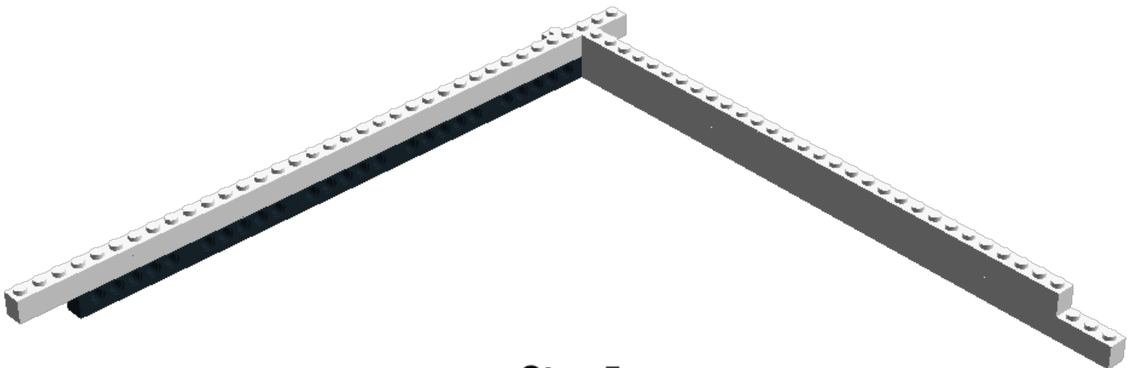
Step 2



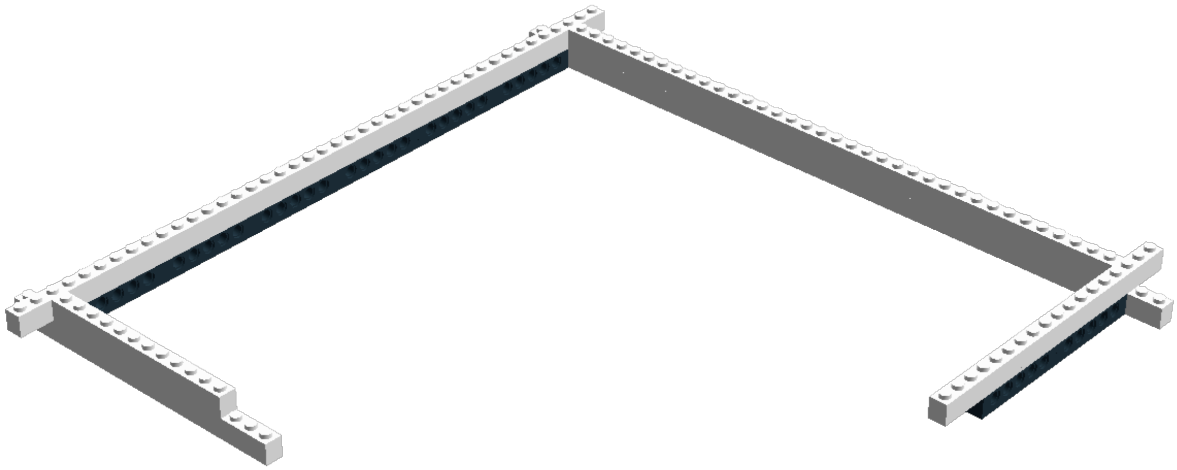
Step 3



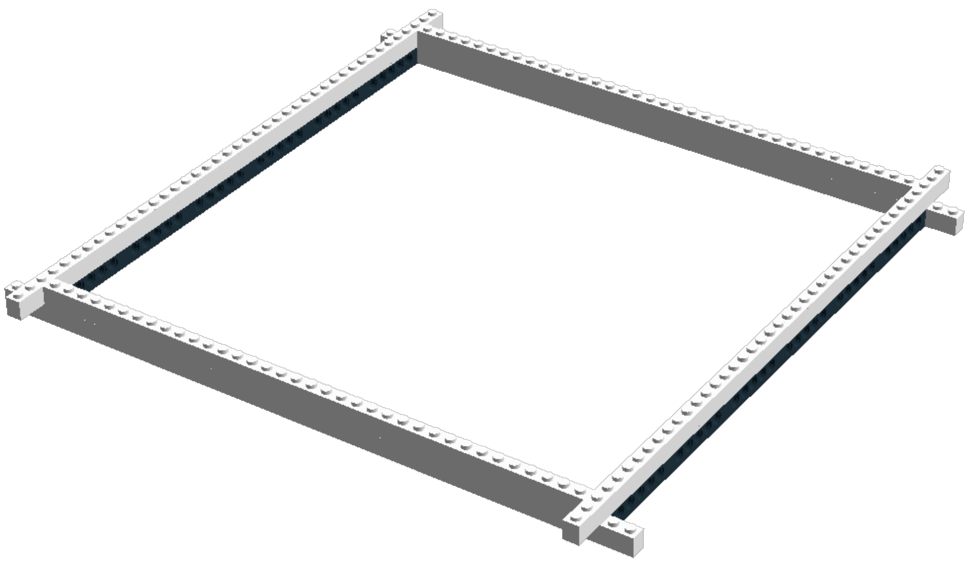
Step 4



Step 5



Step 6



Step 7