UNIVERSAL ROBOTICS CHALLENGE 2024

Real Robotics Regular Division

Rulebook

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Overview

<u>Transporting Packages</u>

The modern world is full of robots. From robots which help harvest crops on farms to ones which move heavy objects on construction sites, they can be a lifesaver when there aren't enough people to do the job! In this competition, your goal is to make a robot that can pick up block packages from specific locations on a construction site. These packages are different shapes and sizes, and the more you move to the Delivery Area, the higher your score!

1. The Competition

○ <u>Competition Guidelines</u>

◇ The Mission

The robot will carry block packages from different points around the field and stack them in the Delivery Area. You will get points based on how many packages you can deliver within the time limit.
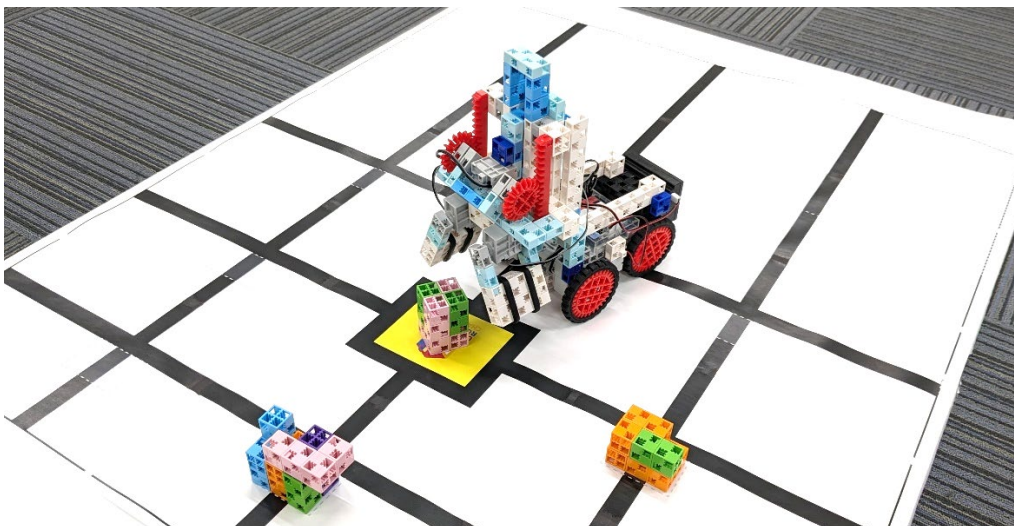

Fig 1. A robot delivering packages
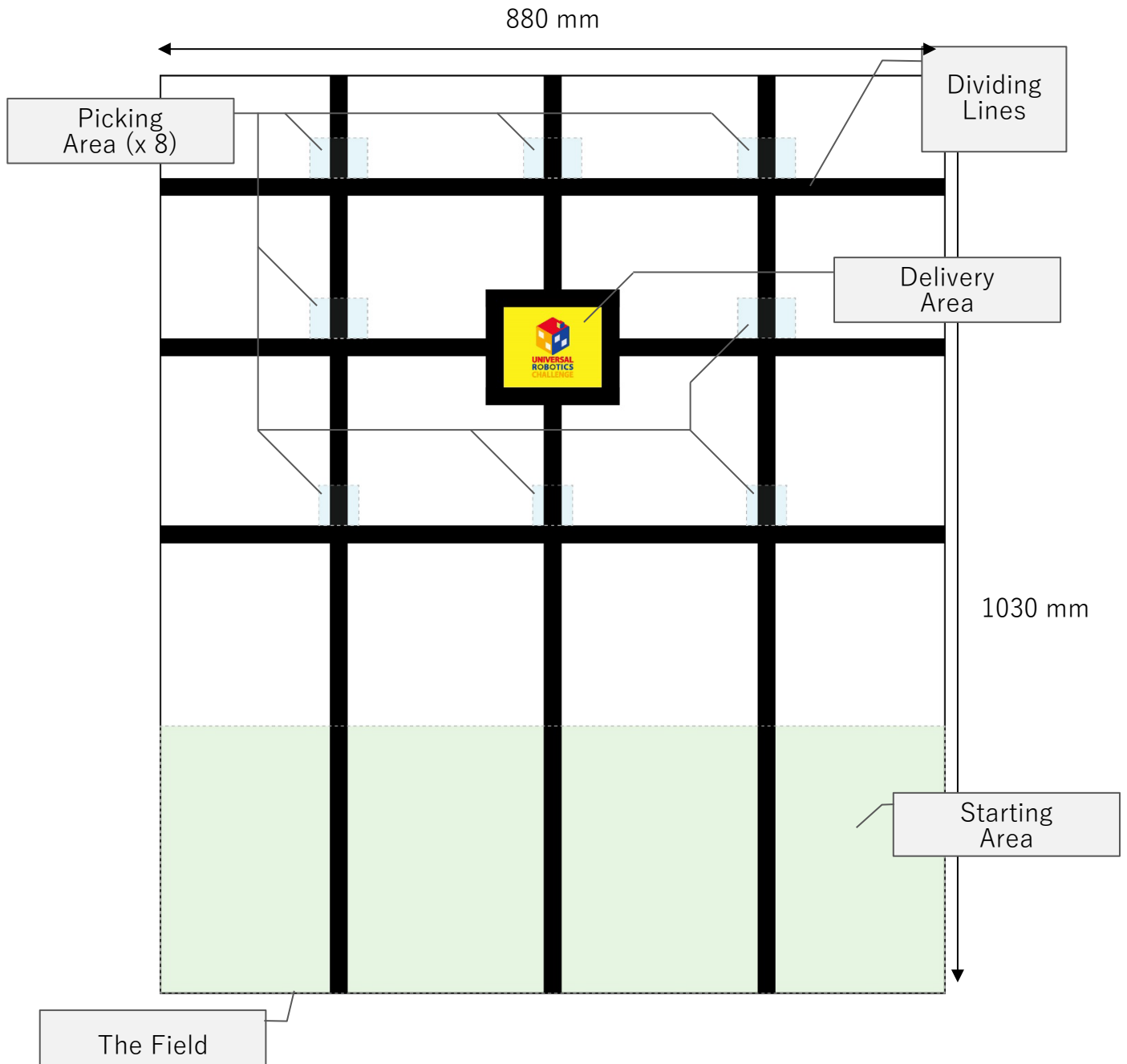
2. The Field

○ Layout and Placement

880 mm

Picking Area (x 8)

Dividing Lines

Delivery Area

1030 mm

Starting Area

The Field

Fig 2. Competition Field

◇ The Starting Area

Start by setting down your robot inside of this light green rectangle. The Starting Area includes the black Dividing Lines shown inside of the red box in Figure 3.
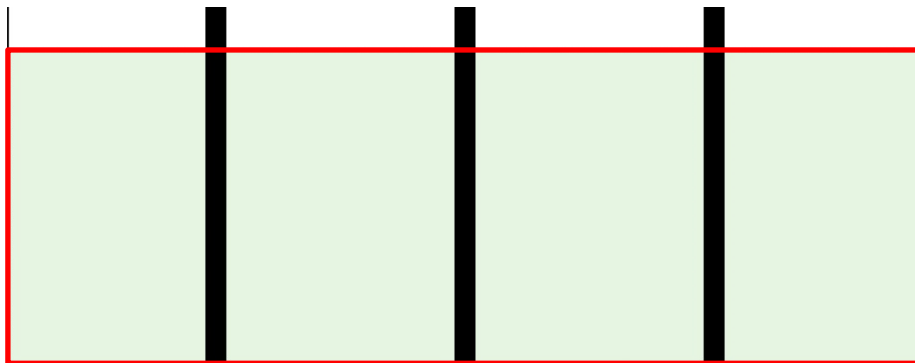

Fig 3. The Starting Area

◇ The Delivery Area
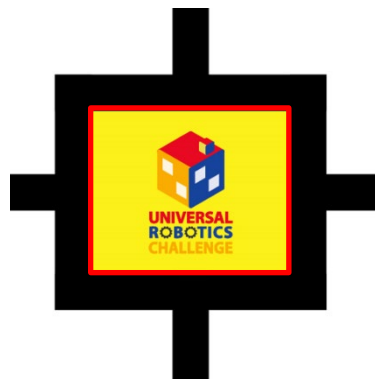
The Delivery Area is a yellow square on the field.

Fig 4. The Delivery Area

◇ **Packages A-F**

Packages are made of multiple Artec Block cubes. Your robot's job is to transport them from different points around the field. There are six types of packages, and the shape and color of each package is shown in Figure 6. Follow the instructions in Appendix 1 to build these packages.

Fig 5. Packages and Blocks
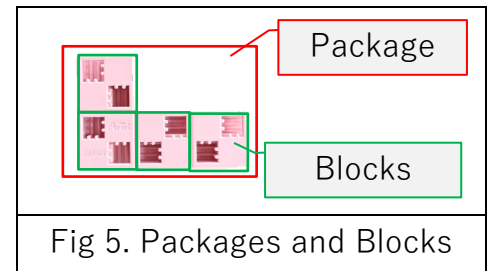
Package A	Package B	Package C
Yellow-Green	Orange	Light Aqua
2 blocks	3 blocks	4 blocks

Package D	Package E	Package F
Aqua	Light Pink	Light Purple
4 blocks	4 blocks	5 blocks

Fig 6. Packages

The packages you make for your preliminary video submission can be any single color you wish, but each package must be a different color. For example, you could make Package A pink, Package B gray, Package C red, and so forth.

★ Packages in the World Finals will be the colors shown in Figure 6.

◇ **Picking Areas**

Place your packages in the light blue Picking Areas before the round starts. There are eight of these on the field. Picking Areas include the black Dividing Lines shown inside of the red boxes in Figure 7.
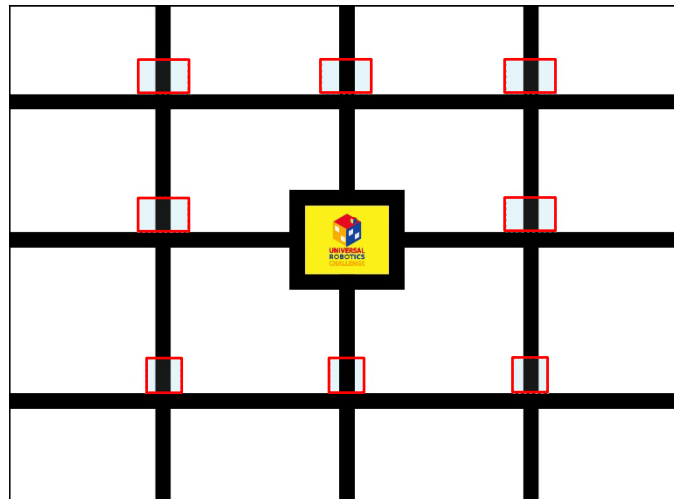

Fig 7. Picking Areas

◇ **Dividing Lines**

These lines are used as guides on the competition field.

◇ **The Field**

Set your packages and robot on the field.

○ Placement Rules (Preliminaries)

★ Placement in the World Finals will be determined by the judges. Fields made of official competition material will be sent to participants who advance to the World Finals.

1) You can make your field for the preliminaries by printing out the field PDF on 15 sheets of A4 paper.

2) Use any quality of paper to print out the field.

3) Do not place any other robots, walls, or objects which change the height of the field on the field. Changes in height caused by overlapping tape or paper are acceptable.

4) The floor beneath the competition field should be perfectly level with no angles that cause changes in height.

5) You can also lay the field on plywood, styrene, or other material to keep it level.

6) There are multiple ways to deal with white margins caused by printing the course:

・ Proceed with the round leaving the margins intact.

・ Use markers of similar colors to fill in the margins on the Dividing Lines, Starting, Picking, and Delivery Areas and cover the remaining margins with extra paper.

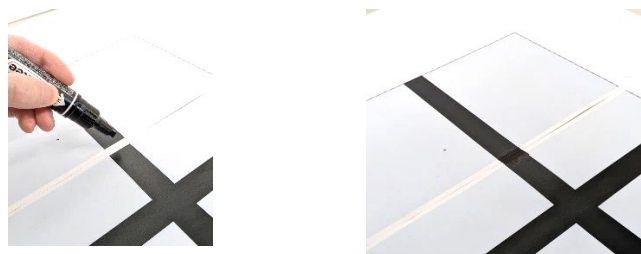★ There will be no white margins on the fields in the World Finals.

Fig 8. Filling in Margins

3. The Rules

○ Before the Round

1) Placing Packages

Place one package in each Picking Area. The time limit to do this is **one minute**.

The rules for placing packages are as follows:

・ Packages you place on the field shouldn't touch anything besides the Picking Area.

・ You can place packages on top of one another.

・ Parts of a package which aren't touching the ground are allowed to stick out of the Picking Area.

・ Packages you place can be a maximum of three blocks higher than the field.

・ Packages must be touching the field completely and not leaning.

・ You don't have to place every package. Set your leftover packages away from the field. These packages shouldn't be used, including for retries.

・ You aren't allowed to touch pieces after placing them or resetting them for a retry.

The below show examples of correct and incorrect placements.

Placing Packages
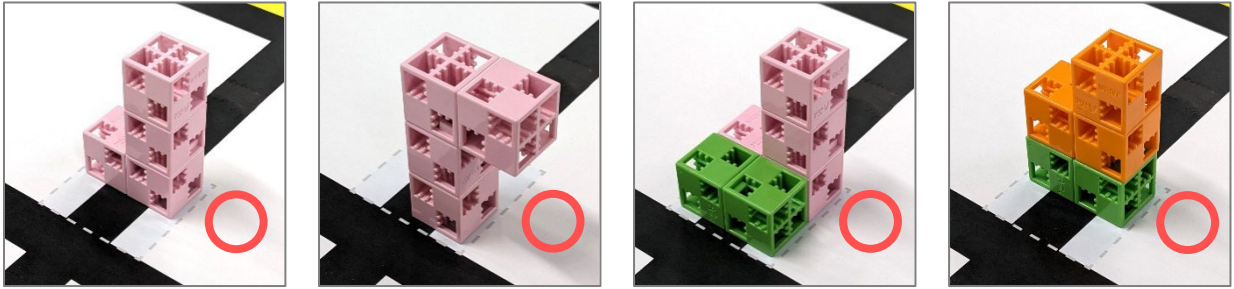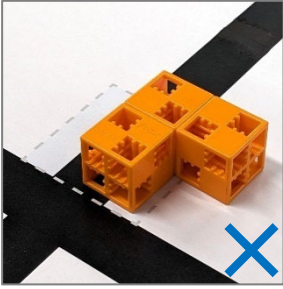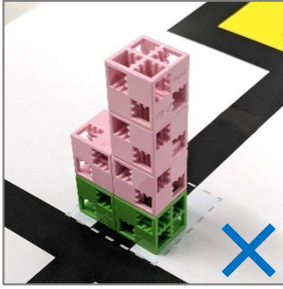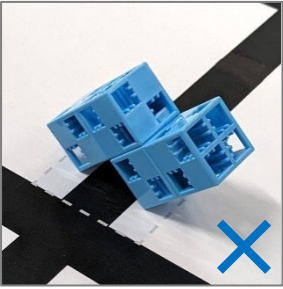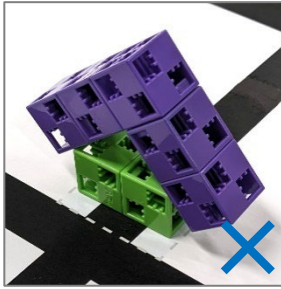
Correct

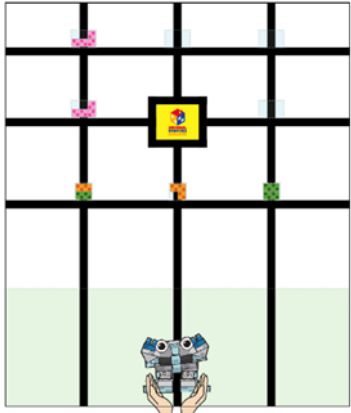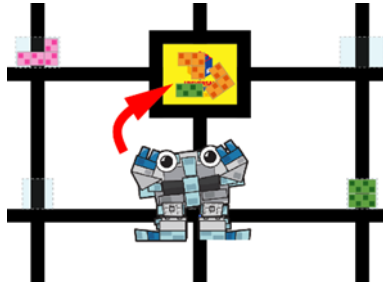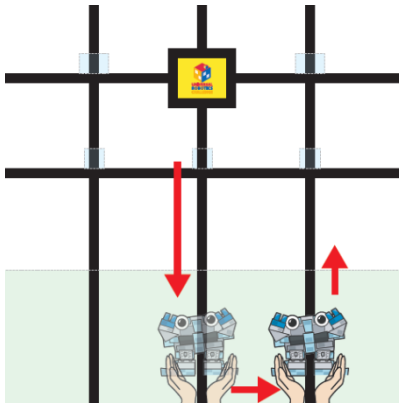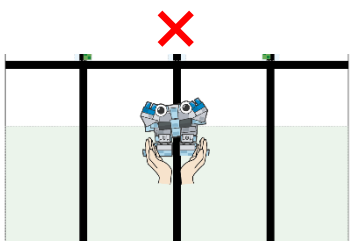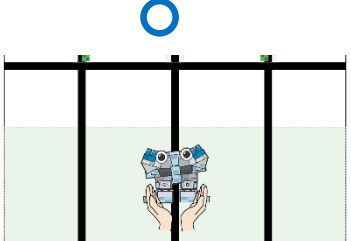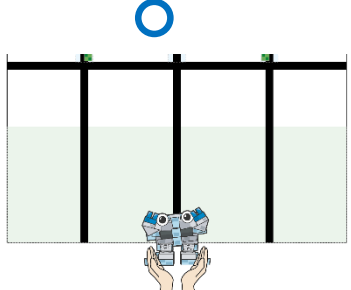| Incorrect	Incorrect
Bottom of package is sticking out of the Picking Area.	Packages stacked 4+ blocks high on the field.

Incorrect
Packages are leaning.

Fig 9. Package Placement

2) Placing the Robot

One participant sets the robot at any point inside of the Starting Area. The robot must be completely inside of the Starting Area. This includes the parts of the robot not touching the ground. The time limit to do this is **one minute**. The same participant can place the robot and packages.
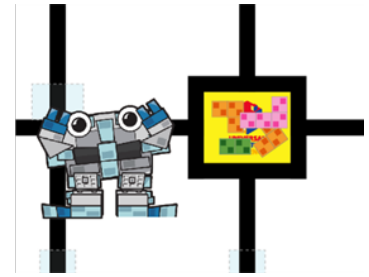
○ The Round

1)

Starting the Round

Turn your robot on.

You're allowed to control your robot using buttons or touch it to adjust its position as long as it stays in the Starting Area.

Leaving the Starting Area

Your robot must move by itself to pick up and stack packages in the Delivery Area until it returns to the Starting Area.

Returning to the Starting Area

Once it's completely inside of the Starting Area, you're free to control your robot again and adjust its position before it leaves.

It can straddle the boundary between the Starting Area and the field at this time. as shown below.

The robot doesn't have to leave the Starting Area again. Feel free to end the round after one trip.

Ending the Round

The round is over once the participant declares
that the round is over or **180 seconds** have passed.
You won't be allowed to touch your robot or
packages until the judge finishes scoring.

2) Participants aren't allowed to touch the robot if any part of it is outside of the Starting Area. This includes parts not touching the ground. Touching the robot will count as a retry and will result in a **40-point** deduction each time this happens.

3) The robot is allowed to handle any packages in the Delivery Area.

4) The robot can handle any packages it has already moved.

5) The round will end in the event of any of the following:

・ The participant declares the round over. The time of the declaration will be the time for the round.

・ **180 seconds** have passed.

・ The judges determine that there has been a serious rule violation.

○ Retries

1) If a robot malfunctions and stops moving after it leaves or the packages are placed in unexpected ways, participants can declare a retry and move their robot back to the Starting Area.

2) Each retry will result in a **40-point** deduction.

3) The timer for the round will keep running during a retry.

4) Participants must notify the judges when the retry is over.

5) The robot must be completely inside of the Starting Area before the retry is over.

6) Participants are allowed to do the following during a retry:

・ Handle their robot.

・ Move the robot back to the Starting Area.

・ Touch the packages and move them to Picking Areas of their choosing.

★ This is limited to packages which have already been placed on the field.

7) There is no limit to the number of retries allowed.

○ Ending the Round

1) The round is over once the participants declare it's over or **180 seconds** have passed.

2) Judges may handle the robot and packages to determine the final score.

3) Once the round is over, the judge will calculate your final score to determine rankings.

4) If scoring becomes impossible due to an error on the part of the committee, teams may retry the round after a consultation with the committee.

4. Scoring

1) Preliminary scores will be calculated by judges based on submitted videos.

2) At the World Finals, the highest score out of two rounds will be your final score.

3) Scores will be calculated at the end of each round.

4) A package **is valid and receives points if it satisfies the following conditions:**

> ① **The package only makes contacts with the Delivery Area on the field.**
>
> (Parts of a package which aren't touching the ground are allowed to stick out
>
> of the Delivery Area.)

② **The package is placed on top of another valid package.**

5) A package **is invalid under the following conditions:**

> ① **The package makes contact with any other area than the Delivery Area.**
>
> ② **The package is touching the robot.**

6) Valid packages are scored according to the following criteria:

- ・ Each valid package receives **10 points per block** in the package.
- ・ The total for all packages is calculated to get the score.

7) Points will be deducted based on your number of retries to get your final score.

| 6 blocks total = **60 points** | 4 blocks total = **40 points** |
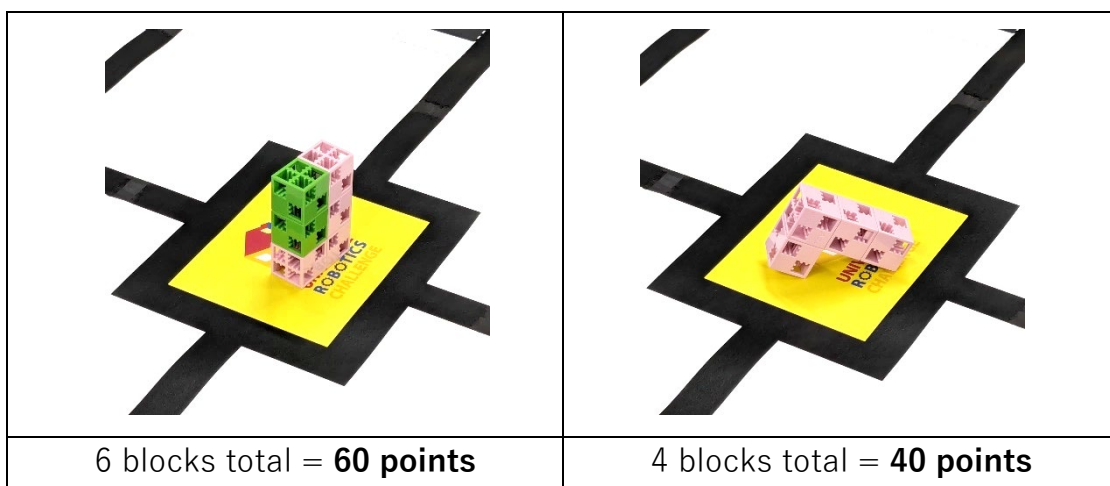
Fig 10. Scoring Packages

You can find more specific examples of stacked packages in **Appendix 2. Scoring Examples**.

○ Ranking

Ranks in the competition are determined as follows:

1) The highest-scoring team.

2) In the event of multiple teams with the same score, ranks are determined as follows:

    1. The number of packages.

    2. The smallest number of retries.

    3. The shortest round time.

5. Preliminary Video Rules

1) In order to ensure the robot meets the size requirements of the competition, participants must include a clip or images in their video of them measuring the length, width, and height of the robot using a tape measure or ruler. The camera must be still for at least three seconds for each dimension.

2) In order to measure the time for the round, include a stopwatch or clock with a second hand in the video.

3) After the round is over, take a video or image of the Delivery Area that clearly shows the packages. Include this at the end of the video.

4) You do not need to include the placement of the robot or packages. The video of the round can start with these already placed on the field.

5) There should be no cuts between the start and the end of the round. You should not move the camera as it films (see Fig. 11).

Video or photo of the robot's length, width, and height	Start ⟶ End Round Round Footage	Video or image of the Delivery Area
You can cut or move the camera	**You can't cut or move the camera**	**You can cut or move the camera**
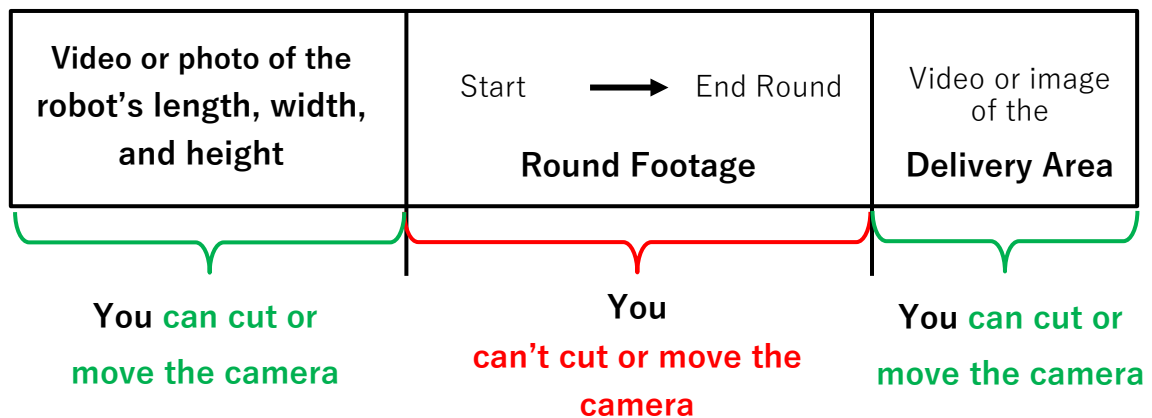
Fig 11. Video Content

6. Competition Robots

1) Only one robot is allowed per team per round.

2) See Appendix 3 and Appendix 4 for the ArtecRobo parts and Artec Blocks competitors can use to build their robots.

3) Robots may use only one Studuino, Studuino:bit Core Unit, or micro:bit to control their robot. This limit doesn't apply to purposes such as the build of the robot or weight adjustments. There are no restrictions on the number of other parts.

4) Any parts from 2) can't be modified.

5) Participants are not allowed to reinforce their robots using zip ties, rubber bands, or adhesives. You are, however, allowed to bundle cables together.

6) Robots must not exceed **25 cm in width**, **30 cm in length**, and **25 cm in height** at the start of the round.

7) There are no weight restrictions on robots.

8) While robots are allowed to transform at the start of the round, they must stay in one piece.

9) Robots should move completely on their own once the round has started. They must not be remote controlled.

10) Robots must not use any power sources aside from those recommended in Appendix 3.

7. Disqualification

Preliminary submissions will be disqualified in the event:

1) It has been determined that the video was fast-forwarded, fabricated, clipped, or otherwise edited

2) The robot does not meet the specifications in section 6.

3) Participants move or touch the packages outside of a retry.

Appendix 1. Building Packages

・ Package A

1	2

・ Package B

1	2
3	4

・ Package C

1		2	
3		4	
5		6	

- Package D

1	2
	x 2
3	4

- Package E

1	2
3	4

- Package F

1	2

3	4
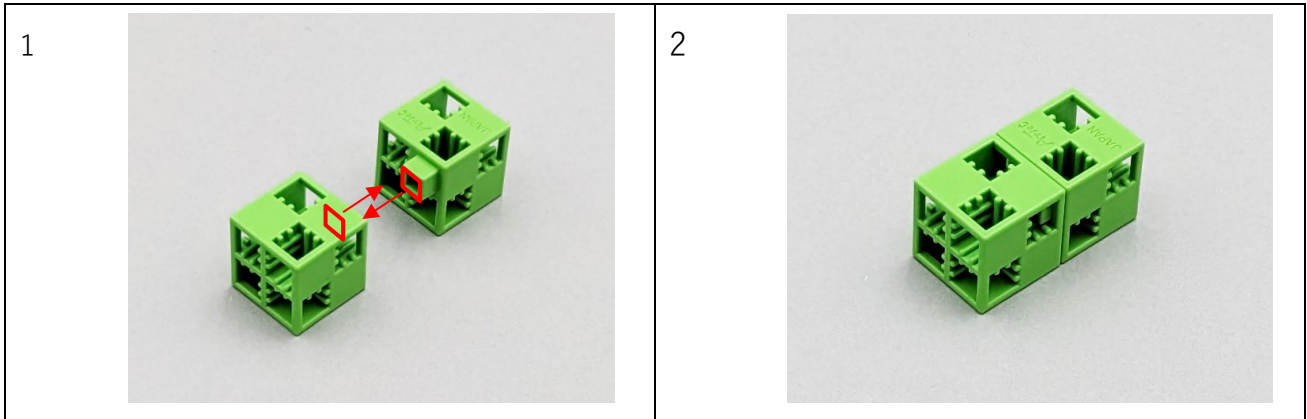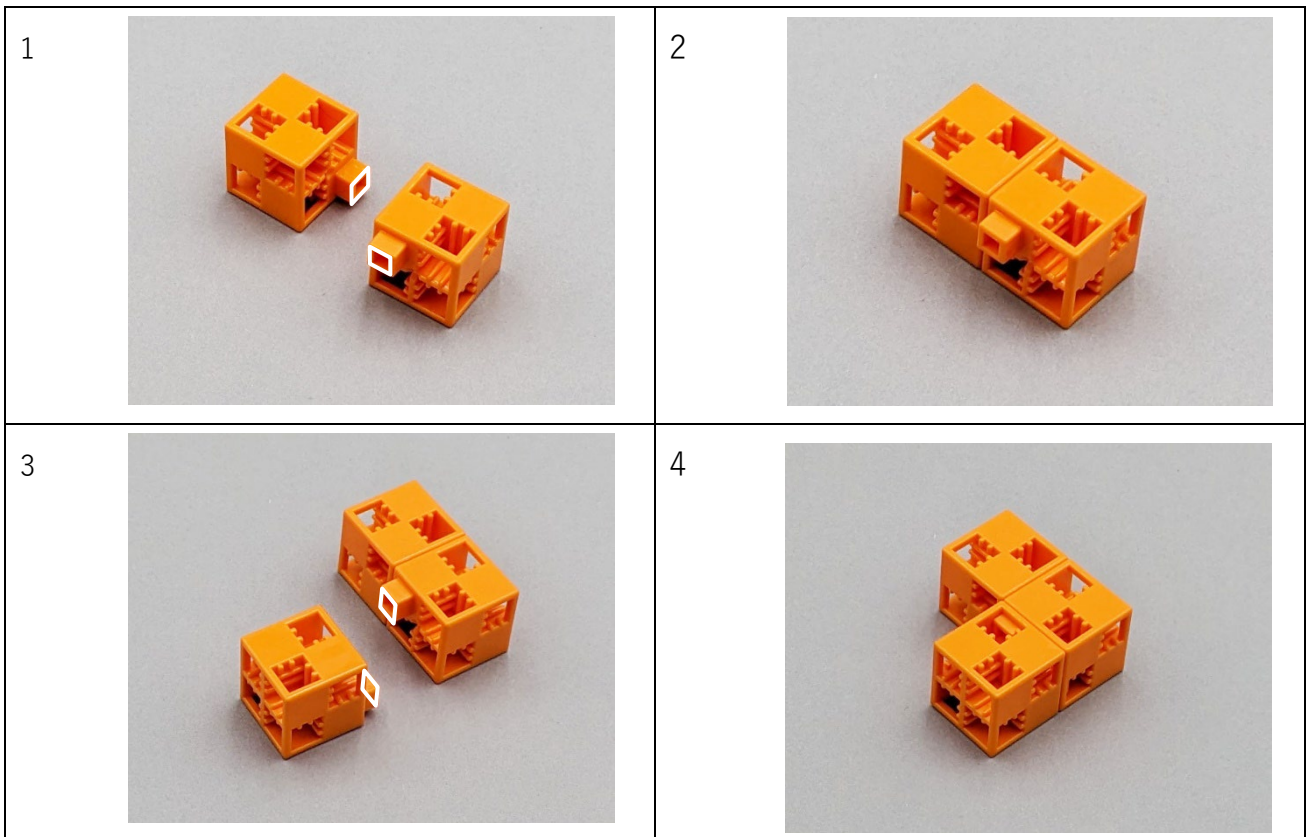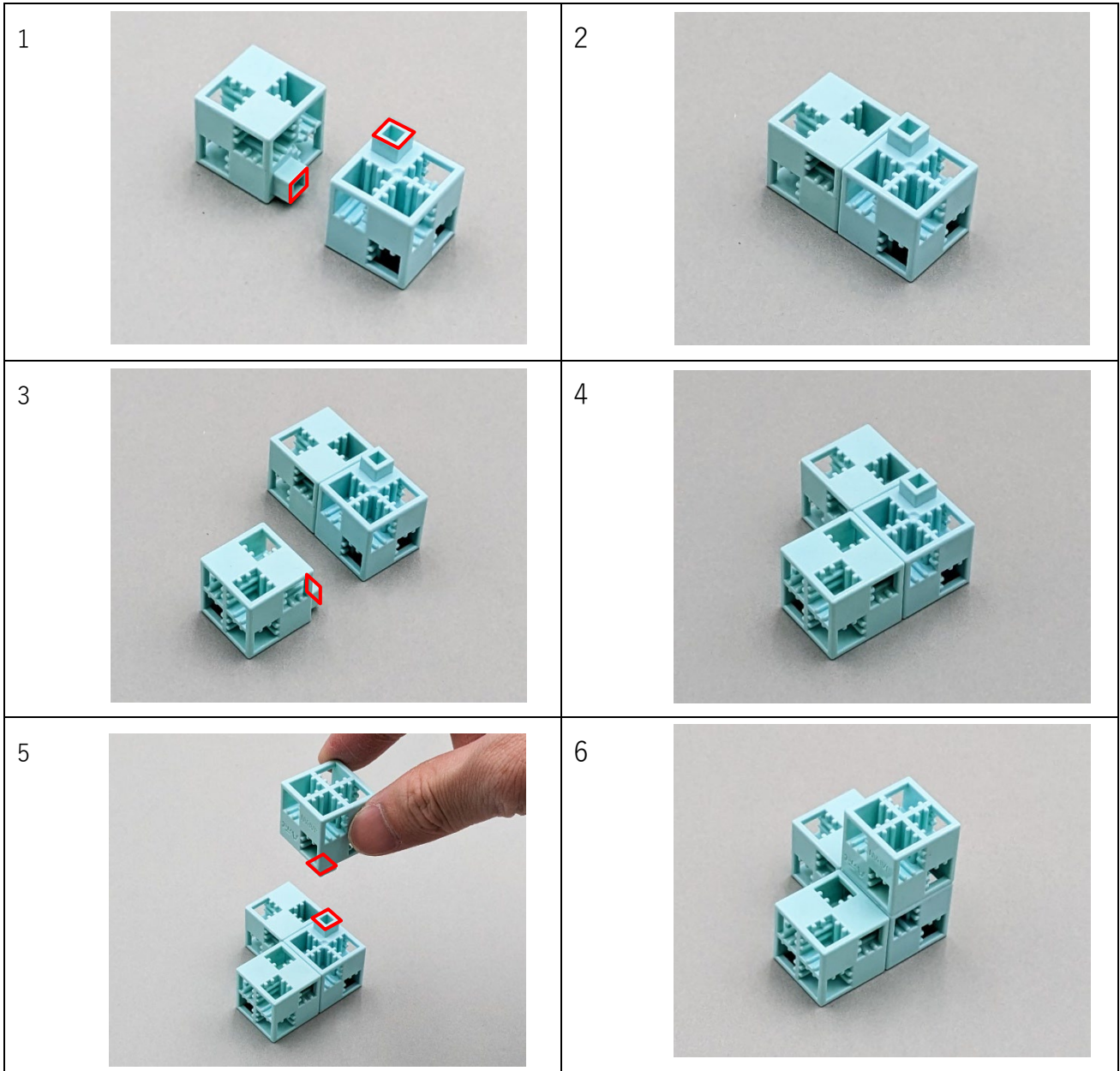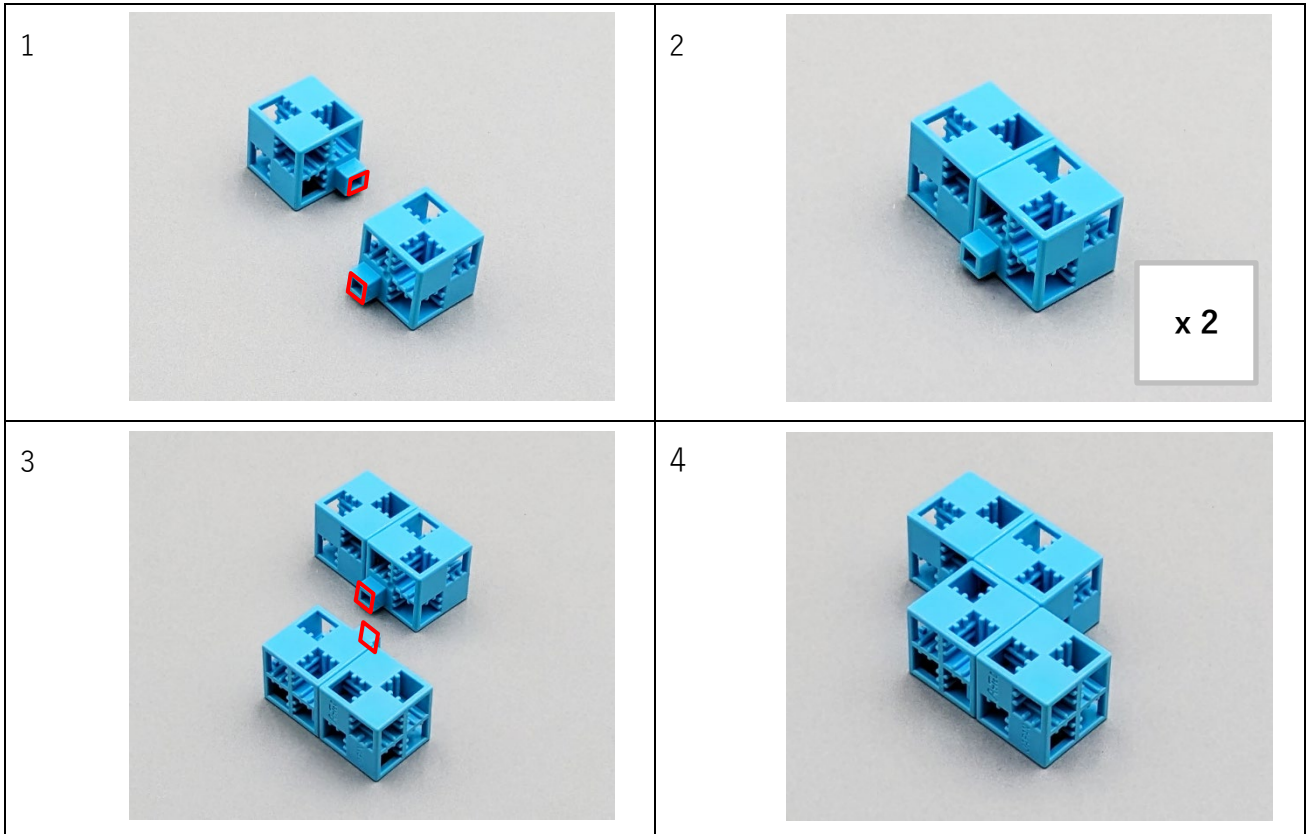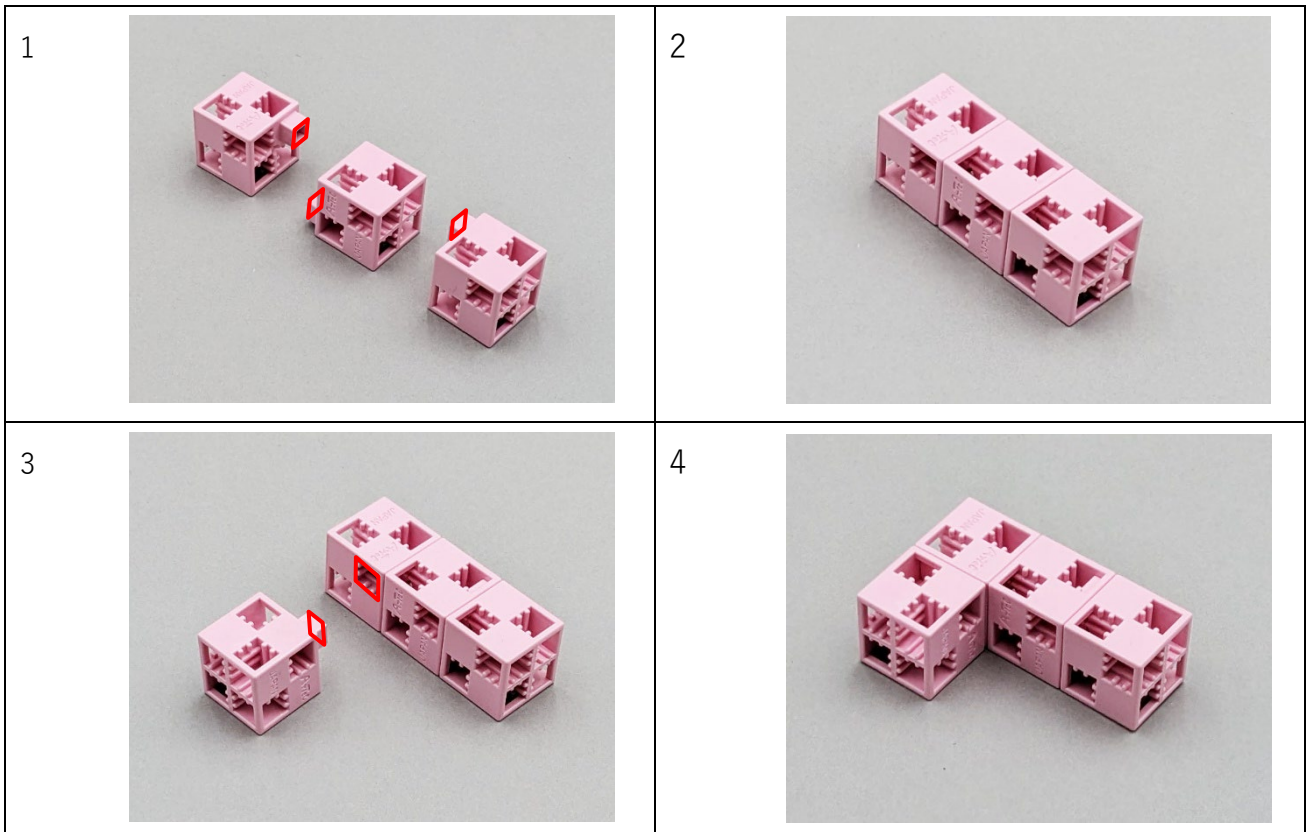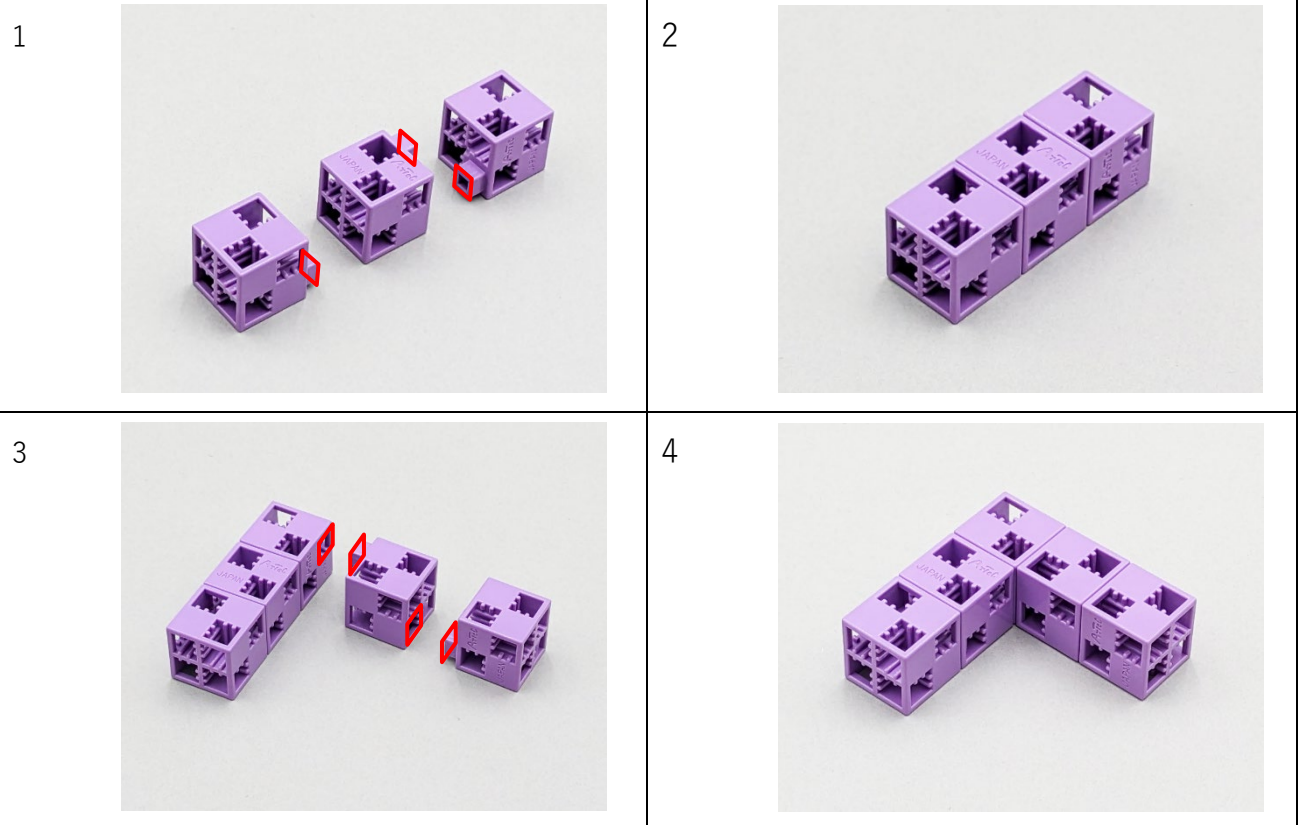
Appendix 2. Scoring Examples
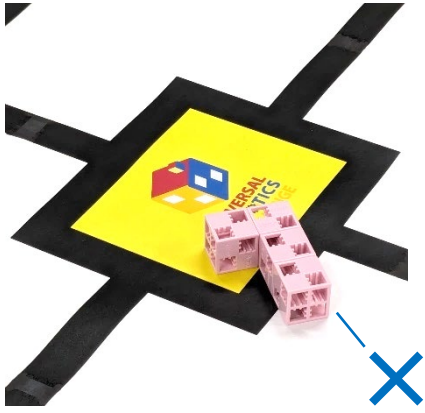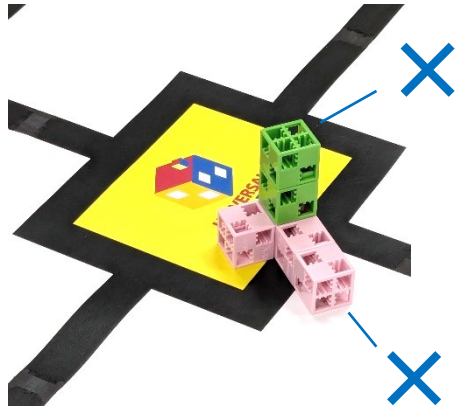
The following section shows example scores.

20 points	20 points
Score is the same regardless of how the package faces.	
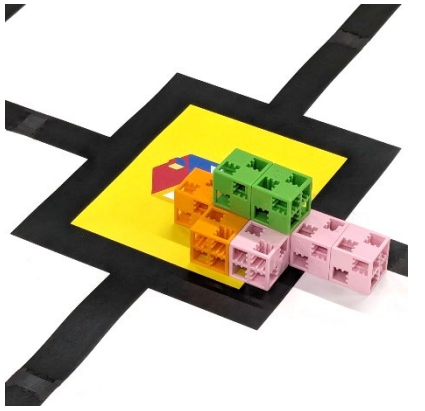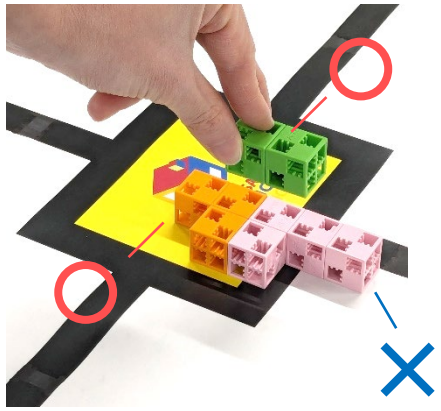
40 points	40 points
The top of the packages can stick out of the area.	They can also lean.
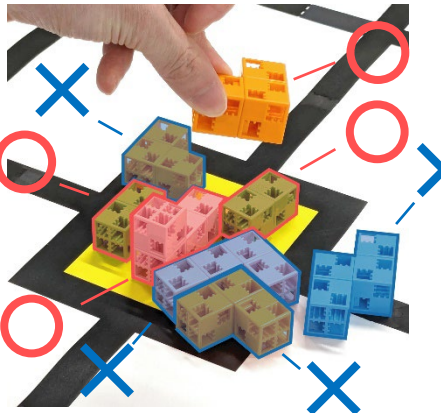
6 blocks total = **60 points**
The green package is placed on top of another valid package.

Example) Package is touching area outside of the Delivery Area.

0 blocks = **0 points**	0 blocks total = **0 points**
The package is invalid.	This makes the green package invalid, too.

Example) Package is straddling multiple other packages.

5 blocks total = **50 points**
Green package is valid because it's on top of another valid package.

11 blocks total = **110 points**

Example) Robot is touching the package.
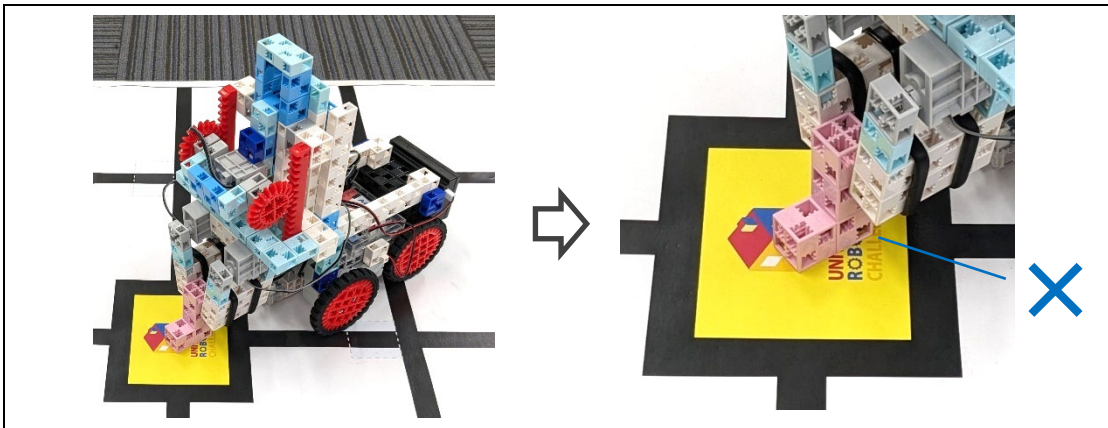
0 blocks = **0 points**

No points are given to packages if the robot is still touching them.
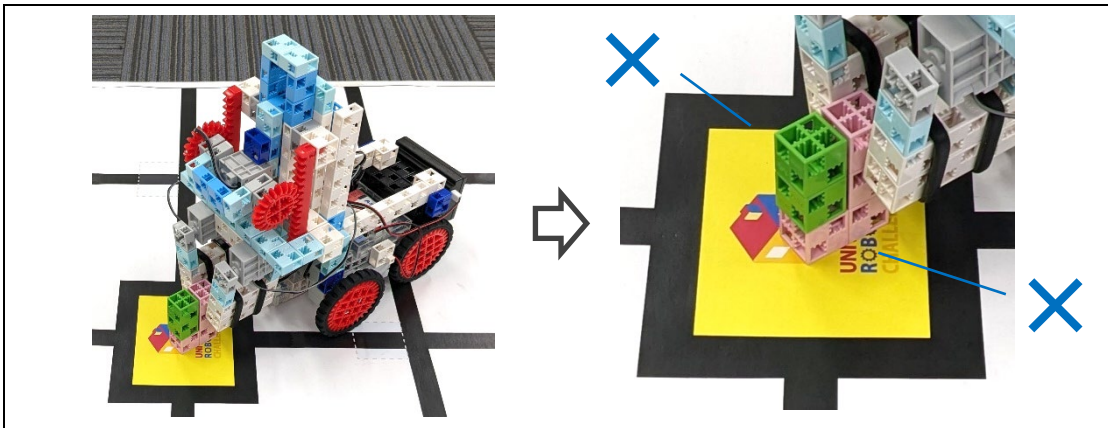
0 blocks = **0 points**
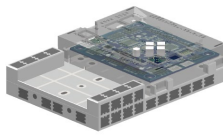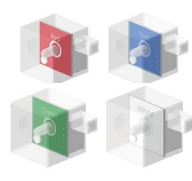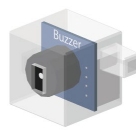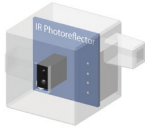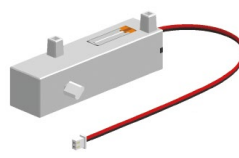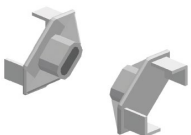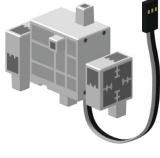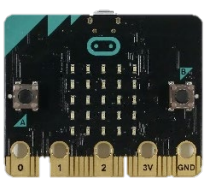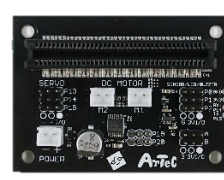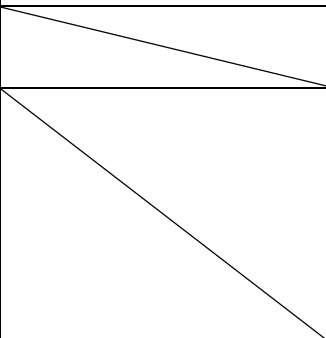
This makes the green package invalid, too.
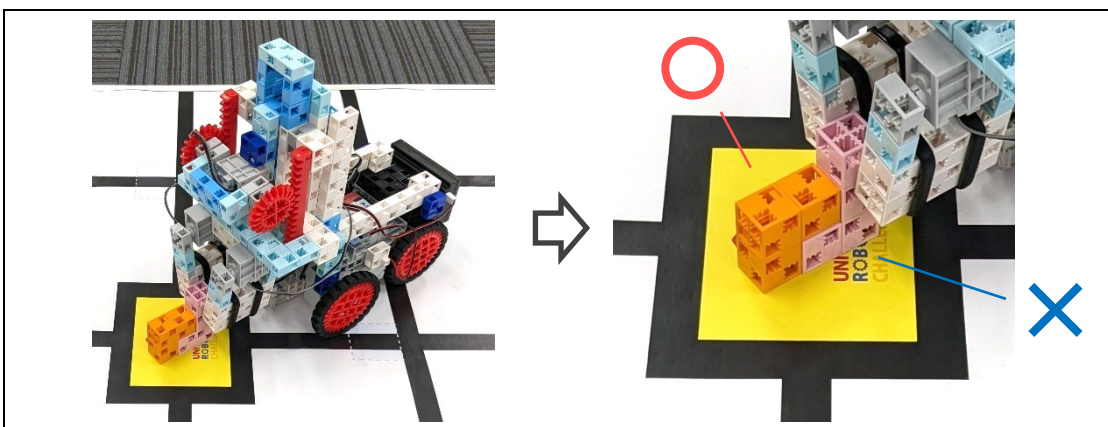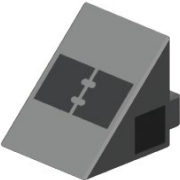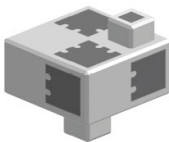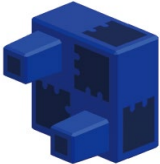

3 blocks = **3 points**
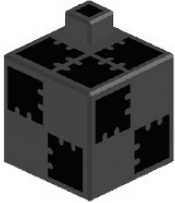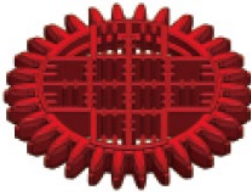
The orange package makes contact with the Delivery Area on the field.

Appendix 3. ArtecRobo Parts

Studuino	Studuino Battery Box	LED (red, blue, green, white)	Buzzer
★ The Studuino may have a face plate sticker attached			
Touch Sensor	IR Photoreflector	Accelerometer	DC Motor
DC Motor Parts	Servomotor	Sensor Connecting Cable (any type)	Extension Cable for Servomotors
Studuino:bit Core Unit	Studuino:bit Battery Box	Robot Expansion Unit	ArtecRobo 2.0 Power Bank
Power Bank Cable	micro:bit	micro:bit Expansion Board	

Appendix 4. Artec Blocks

★ Blocks can be of any color.

Basic Cube	Triangle	Half A	Half B
Half C	Half D	Axle	Wheel
Beam	Disk	Gear (L)	Gear (S)
Gear Rack	O-ring	Tire	