

# Robots' Intellect 2024

## Sumo

### 1. The task

As in the traditional Japanese martial arts, the robots try to push the competitor off the ring.

### 2. General rules

1. It is strictly forbidden for the robot to injure any participants or viewers.
2. It is forbidden for the robot to damage the course, obstacles or any other items of the organizer's inventory, unless it is explicitly a part of competition.
3. The robot must be fully autonomous. During the match, human input isn't allowed, unless it's specifically allowed by competition.
4. It is forbidden to intentionally cause any harm to other participants or robots.
5. The robot must be registered until the organizer's specified date. One robot can participate in only one competition.
6. The robot must pass qualification before participation. Robots that are late for qualification must get competition coordinator's permission to pass qualification after official qualification time.
7. During qualification, each robot will be assigned a unique number, which must be put on the robot, in a clearly visible location.
8. The competition coordinator has the final say on all questions and problems during the competition.
9. The organizers keep the right to alter/edit the rules, accordingly informing the participants about it.
10. Any violation of the rules listed above will result in disqualification or criminal liability.

### 3. Requirements for the robot

#### 3.1. General Robot Specifications

1. The robot must fit within a square tube of the appropriate dimensions for the given class.
2. The total mass of a robot at the start of a match must be under the designated weight for the given class.

Category	Length	Width	Height	Weight
Mini Sumo	0.10 m	0.10 m	Unlimited	0.5 kg
LEGO® Sumo	0.15 m	0.15 m	Unlimited	1.0 kg

3. The robot may expand in size after the match begins, but must not physically separate into pieces and must remain a single centralized robot. The robot's feet must not expand during the match. Robots that are violating these restrictions shall lose the match. Screws, nuts, and other robot parts with a total mass of less than 5 g can fall off the robot's body and will not cause the loss of a match.

4. All robots must be autonomous. Any control mechanisms can be employed, as long as all components are contained within the robot and the mechanism does not interact with an external control system (human, machine, or otherwise).
5. The robot gets a number for registration purposes. Display this number on your robot to allow spectators and officials to identify your robot.

### **3.2. Requirements for LEGO® Sumo robots**

1. Robot parts must be manufactured and distributed by LEGO®.
2. Robot parts can also be LEGO® licensed parts from third party manufacturers.

### **3.3. Additional Restrictions**

1. Jamming devices, such as IR LEDs intended to saturate the opponent's IR sensors, are not allowed.
2. Parts that could break or damage the ring are not allowed. Do not use parts that are intended to damage the opponent's robot or its operator. Normal pushes and bangs are not considered as an intent to damage.
3. Devices that can store liquid, powder, gas or other substances for throwing at the opponent are not allowed.
4. Any flaming devices are not allowed.
5. Devices that throw things at your opponent are not allowed.
6. Sticky substances to improve traction are not allowed. Tires and other components of the robot in contact with the ring must not be able to pick up and hold a standard A4 paper (80g/m<sup>2</sup>) for more than two seconds.
7. Devices to increase down force, such as vacuum pumps and magnets, are not allowed.
8. All edges, including but not limited to the front scoop, must not be sharp enough to scratch or damage the ring, other robots, or players. In general, edges with a radius of greater than 0.1 mm, as would be obtained with an unsharpened 0.2 mm thick metal strip, should be ok. Judges or competition officials may require edges that they deem too sharp to be covered with a piece of tape.

## **4. Team**

1. The team can't consist of more than 5 people.
2. The number of robots presented by a team is unlimited.

## **5. Sumo ring (Dohyo)**

1. The Dohyo interior is defined as the playing surface surrounded by and including the borderline. Anywhere outside this area is called the Dohyo exterior.
2. The ring shall be circular in shape and of the appropriate dimensions for the given size class.
3. The borderline is marked as a white circular ring of a width appropriate for the given class on the outer edge of the playing surface. The ring area extends to the outside edge of this circular line.
4. For all given Dohyo dimensions, a tolerance of 5% applies

Class	Diameter	Border width	Material	Minimum exterior space
Mini/LEGO® Sumo	0.77 m	0.025 m	Steel	0.5 m

- There should be a space appropriate for the given class outside the outer edge of the ring. This space can be of any color, and can be of any material or shape, as long as the basic concepts of these rules are not violated. This area, with the ring in the middle, is to be called the "ring area". Any markings or parts of the ring platform outside the minimum dimensions will also be considered in the ring area.

## 6. Competition progress

### 6.1. General rules

- One match will be fought for a total of 3 minutes, starting and ending upon the judge's command.
- An extended match, if called for by the judge, shall last for a maximum of 3 minutes.
- The match stops and resumes when a judge announces so.
- The match ends when the judge announces so. The two teams retrieve the robots from the ring area.

### 6.2. The start

- Upon the judge's instructions, the two teams approach the ring to place their robots on the ring.
- A cross in the middle divides the sumo ring into 4 quadrants. Robots always have to be placed in 2 opposing quadrants. The robots have to be placed at the border within the assigned quadrant.
- The robot has to cover the white border at least partially.
- The judge will remove the cross after positioning of the robots. After placing, the robots may not be moved anymore.
- Below is an example of robot placement (Figure 1).

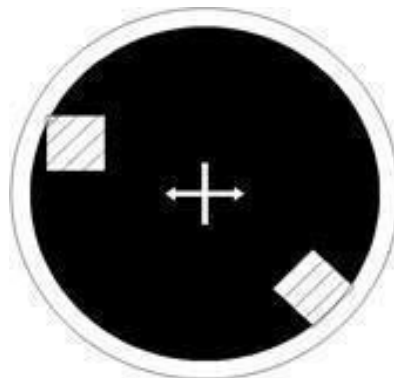


Figure 1 Robot placement example

- In the Mini sumo class, the judge starts every round by sending a start signal with an IR transmitter. As soon as the robots receive the signal, the round will start immediately, without any delay. The technical specifications for the IR receiver are provided in the appendix. Contestants must implement their own hardware module.

7. In all other classes, the judge announces the start of the round. The teams start their robots, and after a five-second pause the robots may start operating. During these five seconds, players must clear out of the ring area.

### **6.3. Points**

1. One Yuhkoh point is given when a team legally forces the body of the opposing robot to touch the space outside the ring, which includes the side of the ring itself.
2. One Yuhkoh point is given when the opposing robot has touched the space outside the ring on its own.
3. Point is given when either of the above takes place at the same time that the end of the match is announced.
4. When a wheeled robot has fallen over on the ring or in similar conditions, Yuhkoh will not be counted and the match continues.

### **6.4. Deciding the winner**

1. Participants will be divided into groups. In each group, there will be one on one matches.
2. Each robot will have as many matches as there are participants in the group.
3. When all matches end, results are counted, and the robots with the most eliminations will advance to the next round.
4. If there are those who are not in the next round but have the same number of points as those in the same group, everything is explained by a duel.
5. The second round takes place in tournament format.
6. Robots fight in duels, after winning the duel they travel to a higher level.
7. The losers continue to fight in the losers table.
8. The final fight takes place between the winner of the winners table and the winner of the losers table.
9. The winner of this match is the winner of this tournament, but the robot from the loser brackets has to win two times in the row in order to win the whole tournament. Other robot needs to win only once.

### **6.5. Comments**

1. When judges' decision is called for to decide the winner, the following points will be taken into considerations: technical merits in movement and operation of a robot; penalty points during the match; players' behavior during the match.
2. The match is stopped and a rematch starts when the robots are entangled or orbiting each other with no perceivable progress for 5 seconds. If it is unclear whether progress is being made or not, the judge can extend the time limit for observable progress for up to 30 seconds.
3. The match is also stopped and rematched, if both robots move, without making progress, or stop (at the exact same time) and stay stopped for 5 seconds without touching each other. However, if one robot stops its movement first, after 5 seconds it will be declared as not having the will to fight. In this case, the opponent shall receive a Yuhkoh, even if the opponent also stops. If both robots are moving, and it isn't clear if progress is being made or not, the judge can extend the time limit up to 30 seconds.

4. If both robots touch the outside of the ring at about the same time, and it cannot be determined which touched first, a rematch is called.

## **6.6. Violations and penalties**

1. A player who utters insulting words to the opponent or to the judges or puts voice devices in a robot to utter insulting words or writes insulting words on the body of a robot, or performs any insulting action, is in violation of these rules.
2. Minor violation shall be deemed to have occurred if the participant: enters into the ring during the match, except when the player does so to take the robot out of the ring upon the judge's announcement of Yuhkoh or stopping the match. To enter into the ring means: a part of the player's body is in the ring; a player puts any mechanical kits into the ring to support their body.
3. Demand to stop the match without appropriate reasons.
4. Take more than 30 seconds before resuming the match, unless the judge announces a time extension.
5. Start operating the robot within five seconds after the chief judge announces the start of the match.
6. Players who violate these rules by performing the deeds described in sections 2 and 6.6.1 shall lose the match. The judge shall give two Yuhkoh points to the opponent.
7. Each occasion of the violations described in section 6.6 shall be accumulated. Two of these violations shall give one Yuhkoh point to the opponent. Occasions of the violations will be accumulated throughout one match.

## **6.7. Injuries and accidents during the match**

1. A player can request to stop the game when they are injured or their robot had an accident and the game cannot continue.
2. When the game cannot continue due to a player's injury or robot's accident, the player who is the cause of such injury or accident loses the match. When it is not clear which team is the cause, the player who cannot continue the game, or who requests to stop the game, shall be declared as the loser.
3. Whether the game should continue in case of injury or accident shall be decided by the judges. The decision process shall take no longer than five minutes.
4. The winner decided based on section 11.2 shall gain two Yuhkoh points. The loser who already gained one Yuhkoh point is recorded as such. When the situation under section 11.2 takes place during an extended match, the winner shall gain one Yuhkoh point.

## **7. Appendix**

### **7.1. Remote start switch**

Every round in the Mini Sumo class is started by the referee sending a start signal with an IR transmitter. As soon as the robot receives the signal, the round will start. (This method makes the matches fairer since it eliminates false starts and is also time-saving since fewer restarts are needed). The contestant can choose to either implement all the hardware and software by themselves, or he/she can simply use a prebuilt module (recommended).

## 7.2. Prebuilt module

The prebuilt module takes care of all communication and is very easy to implement. The robot only needs to wait for the start pin on the module to go high, and then it should start. The module accepts supply voltage (VCC) 3.3-5V. The VCC GND Start has a standard 2.54mm pitch.

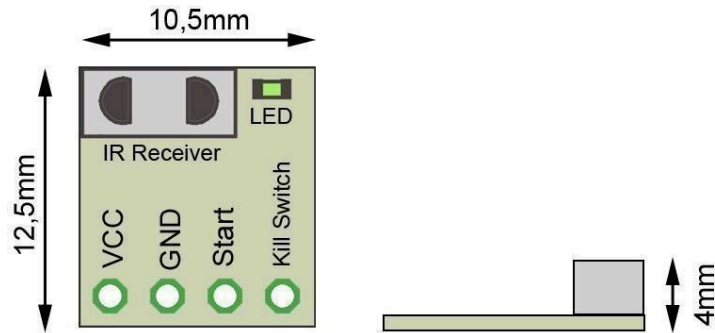


Figure 2 Prebuilt start module

More information about prepared modules: <http://www.startmodule.com>

For answers to the most common questions regarding the start systems: <http://www.startmodule.com/faq/>

## 7.3. Modes of operation

The figure below illustrates the modes of operation of the module. To be less sensitive to noise and disturbances, the module will save its current state into a non-volatile memory and if it is resets it will return to the last known state. This means that each match will end with the referee sending the stop command.

Note: If the LED on the module is on before the referee has sent the start command, it means that the module is in the “Started” state. Then the stop command has to be sent, and the robot needs to restart for the module to go back to the “Power ON” state.

To be able to run multiple matches next to each other, each Dohyo will have its own unique identifier. The prebuilt module can be re-programmed to listen for a new identifier. This is done by the referee by sending a special programming command which updates this identifier. Robots which use sensors that are based on IR technology with a 38 KHz transmitter modulation are encouraged to start their sensors after the start signal is received. This is to minimize the risk of disturbance.

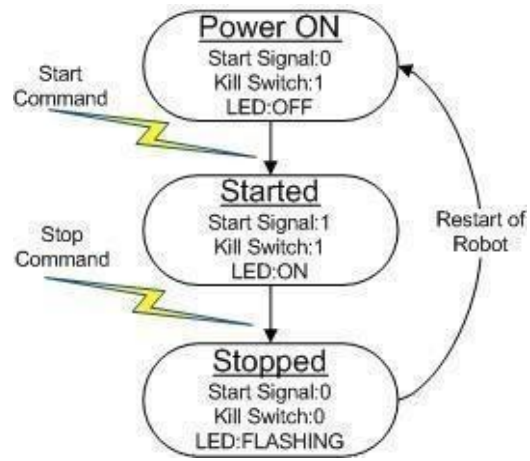


Figure 3 Modes of operation