RoboCup@Home

Rules & Regulations on the organization of the competition

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About this document

These are the organization guidelines of the RoboCup@Home competition 2024. It contains the procedures surrounding the Robocup@Home competition. Both those leading up to the event and those in place during the competition. This document excludes the tests the robot are expected to perform and the scores associated with them. Those can be found in the RULEBOOK. This document has been written by the 2024 RoboCup@Home Technical Committee.

How to cite this document

If you refer to RoboCup@Home and this document in particular, please cite:

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Contents

Chapter 1

Introduction

1.1 Organization

@HOME is organized into three subcommittees. The current members of the committees are listed at https://athome.robocup.org/committees/.

1.1.1 Executive Committee — ec@robocupathome.org

The *executive committee* (EC) consists of members of the board of trustees, and representatives of each activity area, and supervises both the TC and OC. The committee is responsible for the long-term planning of the league and cast the final vote in all decisions within the competition, including those pertaining to any of the committees and any other affair that requires a qualified vote. Additionally, the EC must act when any of the committees fail, as it responds to the Trustee board and directs the league accordingly.

1.1.2 Technical Committee — tc@robocupathome.org

The *technical committee* (TC) is responsible for the rules of the league; its main focus is writing the rulebook and refereeing. The members of the EC are always members of the TC as well.

1.1.3 Organizing Committee — oc@robocupathome.org

The *organizing committee* (OC) is responsible for the organization of the competition, namely it creates the schedule and provides information about the scenarios. The *Local Organizing Committee* (LOC), on the other hand, is responsible for the set up and organization of the competition venue.

1.2 Infrastructure

RoboCup@Home Mailing List   The official @HOME mailing list can be found at robocup-athome@lists.robocup.org. You can subscribe to the mailing list at: http://lists.robocup.org/cgi-bin/mailman/listinfo/robocup-athome

RoboCup@Home Web Page   The official @HOME website that also hosts this rulebook can be found at https://athome.robocup.org/

RoboCup@Home Rulebook Repository   The official @HOME *Rulebook Repository* is where rules are publicly discussed before applying changes. The entire @HOME community is welcome and encouraged to actively participate in creating and discussing the rules. The *Rulebook Repository* is hosted at https://github.com/RoboCupAtHome/RuleBook/

RoboCup@Home Telegram Group   The official @HOME *Telegram Group* is a communication channel for the @HOME community where rules are discussed, announcements are made, and questions are answered. Beyond supporting the technical aspects of the competition, the group is a meeting point to stay in contact with the community, foster knowledge exchange, and strengthen relationships. The *Telegram Group* can be reached at https://t.me/RoboCupAtHome

RoboCup@Home Wiki   The official @HOME *Wiki* is meant to be a central place to collect information on all topics related to the @HOME league. The wiki was set up to simplify and unify the exchange of relevant information; this includes, but is not limited to, hardware, software, media, data, and more. The *Wiki* can be reached at https://github.com/RoboCupAtHome/AtHomeCommunityWiki/wiki

1.3 Leagues

@HOME is divided into three Leagues. One of these grants complete freedom to all competitors with respect to the robot used, while two of them are *Standard Platform Leagues* (SPLs), namely all competitors use the same robot. The official leagues and their names are:

- *Open Platform League* (OPL)
- *Domestic Standard Platform League* (DSPL)
- *Social Standard Platform League* (SSPL)

Each league focuses on a different aspect of service robotics by targeting specific abilities.

1.3.1 Domestic Standard Platform League (DSPL)

The main goal of the DSPL is to assist humans in a domestic environment, paying special attention to elderly people and people suffering from illness or disability. As a consequence, the DSPL focuses on *Ambient Intelligence*, *Computer Vision*, *Object Manipulation*, safe indoor *Navigation* and *Mapping*, and *Task Planning*. The robot used in the DSPL is the *Toyota HSR*, shown in Figure 1.1.

Figure 1.1: Toyota HSR

1.3.2 Social Standard Platform League (SSPL)

The SSPL takes robots away from a traditional passive servant role, as the robot is now the one who actively looks for interaction. From a party waiter in a domestic environment to a hostess in a museum or shopping mall, in SSPL we look for the next user who

Figure 1.2: Softbank / Aldebaran Pepper

may require the robot's services. Hence, this league focuses on *Human-Robot Interaction*, *Natural Language Processing*, *Person Detection* and *Person Recognition*, *Adaptive Behaviors*, and safe outdoor *Navigation* and *Mapping*. The robot to be used in the SSPL is the *Softbank Pepper*, shown in Figure 1.2.

1.3.3 Open Platform League (OPL)

The OPL has had the same modus operandi since the foundation of @Home. With no hardware constrains, OPL is the league for teams who want to test their own robot designs and configurations, as well as for old at-homers. In this league, robots are tested to their limits without having in mind any concrete design restriction, although the scope is similar to the DSPL.

1.4 Awards

The @Home league features the *awards* described below. Note that all awards need to be approved by the *RoboCup Federation* (RCF); based on a decision by the RCF, some of them may not be given.

1.4.1 Winner of the Competition

For each league, there will be 1st, 2nd, and 3rd place award trophies (or first and second place only if the number of teams in a league is eight or less).

1.4.2 Best Human-Robot Interface Award

To honor outstanding human-robot interfaces developed for interacting with robots in @Home, a special *Best Human-Robot Interface Award* may be given to one of the participating teams. Special attention is paid to making the interface open and available to the @Home community.

The @Home EC members nominate a set of candidates for the award and the TC elects the winner. A TC member whose team is among the nominees is not allowed to vote. There is no *Best Human-Robot Interface Award* in case the EC decides that there is no outstanding interface, and thus no nominees.

1.4.3 Best Poster Award

To foster scientific knowledge exchange and reward the teams' efforts to present their research contributions, all scientific posters of each league are evaluated and have the chance of receiving the *Best DSPL Poster Award*, the *Best OPL Poster Award*, or the *Best SSPL Poster Award*, respectively.

Candidate posters must present innovative and state-of-the-art research within a field with a direct application to @Home, and demonstrate successful and clear results in an easy-to-understand way. In addition to being attractive and well-rated in the *Poster Session* (see Section 3.3), the described research must have impact in the team's performance during the competition.

The @HOME EC members nominate a set of candidates for the award and the TC elects the winner. A TC member whose team is among the nominees is not allowed to vote.

1.4.4 Open Challenge Award

To encourage teams to present their research to the other teams in the competition off-hours, @HOME grants the *Best Open Challenge Award* to the best open demonstration presented during the competition. This award is granted only if a team has demonstrated innovative research that is related to the global objectives of @HOME; thus, the award is not necessarily granted.

The @HOME TC members, with a recommendation from the team leaders, nominate a set of candidates for the award; the EC decides if the award should be granted and elects the winner. A TC member is not allowed to nominate their own team without a recommendation from the team leaders.

1.4.5 Skill Certificates

The @HOME league features certificates for best demonstrated skills in *Navigation*, *Manipulation*, *Person Recognition*, and *Natural Language Processing*. A team is given the certificate if it scores at least 75% of the attainable points for that skill. This is counted over all tests and challenges, so, for example, if a robot scores manipulation points during the *Help-me-Carry* test to open the door, that will count for the *Manipulation* certificate. Note that the certificate will only be handed out if the team is *not* the overall winner of the competition.

1.4.6 Open-source software award

Since Nagoya 2017, RoboCup@Home awards the best contribution to the community by means of an open source software solution. To be eligible for the award, the software must be easy to read, have proper documentation, follow standard design patterns, be actively maintained, and meet the IEEE software engineering metrics of scalability, portability, maintainability, fault tolerance, and robustness. In addition, the open sourced software must be made available as a framework-independent standalone library so it can be reused with any software architecture.

Candidates must send their application to the TC at least one month before the competition by means of a short paper (maximum 4 pages), following the same format used for the *Team Description Paper* (TDP) (see Section 2.1.2), including a brief explanation of the approach, comparison with state-of-the-art techniques, statement of the used metrics and software design patterns, and the name of the teams and other collaborators that are also using the software being described.

The @HOME TC members nominate a set of candidates for the award and the EC elects the winner. An EC/TC member whose team is among the nominees is not allowed to vote.

Chapter 2

General Rules and Regulations

These are the general rules and regulations for the competition in the RoboCup@Home league. Every rule in this section can be considered to implicitly include the term *"unless stated otherwise"*. This means that additional or contrary rules, in particular with respect to the specification of tests, have a higher priority than those mentioned in the general rules and regulations.

2.1 Team Registration and Qualification

2.1.1 Registration and Qualification Process

Each year, there are three phases in the process towards participation in @Home:

1. *Preregistration*
2. *Qualification* announcement
3. Final *Registration* for qualified teams

The preregistration will be announced by a call for participation sent to the *RoboCup@Home mailing list*. Preregistration requires a *team description paper*, a *video* and a *website*. The expected contents of these are described below.

2.1.2 Team Description Paper

The *Team Description Paper* (TDP) is an 8-pages long scientific paper, which must include a description of your main research, including the scientific contribution, goals, scope, and results. The TDP has to be written in English and formatted using the template of the RoboCup International Symposium without any alterations. The paper should contain the following items:

- The focus of research and the contributions in the respective fields
- Innovative technology (if any)
- Re-usability of the system for other research groups
- Applicability of the robot in real-world scenarios
- Photo(s) of the robot(s) used

As an appendix on the 9th page (after the references), please include:

- Team name
- Contact information
- Website URL
- Names of the team members

- Photo(s) of the robot(s), unless included before
- Description of the hardware used
- A brief, compact list of *external devices* (see Section 2.4), if any
- A brief, compact list of any used 3rd party software packages (e.g. ROS' `object_recognition` should be listed, but `OpenCV` doesn't have to be because it is a rather standard library)
- [**Open Platform League only**] A brief description of the hardware used by the robot(s)

During the qualification process, the TDP will be scored according to its scientific value, novelty, and contributions.

2.1.3 Qualification Video

As a proof of running hardware, each team has to provide a *qualification video* that shows at least two of the following abilities (as a minimum requirement):

- Human-robot interaction
- Safe navigation (indoors, with obstacle avoidance)
- Object detection and manipulation
- People detection
- Speech recognition
- Speech synthesis (clear and loud)

Showing some of the following abilities is also recommended:

- Activity recognition
- Complex speech recognition
- Complex action planning
- Gesture recognition
- Failure recovery

The video should not exceed the average time for a test (max. 10 min), should be self-explanatory and designed for a general audience, and should show the robot solving complex tasks relevant for @HOME. In particular, to qualify for the competition, the video should show that the robot is able to successfully solve at least one test from the current or previous year's rule book. For robots moving slowly, we suggest to speed-up videos, but please indicate the speed factor being used when doing so (e.g. 2x); the same rule applies for slow motion scenes.

2.1.4 Team Website

The *team website* should be designed for a broader audience and include scientific material (scientific papers, datasets, and documented open source code). The requirements for the website are as follows:

1. **Language**: The team website has to be in English. Other languages may be also available, but English must be default language.
2. **Team**: A comprehensive list of all team members, including brief profiles.
3. **RoboCup**: Link to the league website and previous participations of the team at ROBOCUP (not necessarily only @HOME).

4. **Scientific approach**: Include a research statement, a description of the used approach, and information on scientific achievements.
5. **Publications**: Relevant *publications* from at least the last five years should be included. Downloadable publications are scored higher during the qualification process.
6. **Open source material**: Blueprints, datasets, repositories, or any other kinds of contributions to the league are scored highly during the qualification process.
7. **Multimedia**: Photos and videos of the robot(s) used should be included and easy to find.

2.1.5 Qualification

During the *qualification process*, a selection will be made by the OC. The following points are taken into account and evaluated in the decision process:

- The scientific value, novelty, and contributions of the TDP
- The number of abilities and the complexity of the tasks shown in the qualification video
- The contents of the team website, where relevant publications and open source resources are valued highly

In addition, the following evaluation criteria are considered:

- The performance in previous competitions
- Relevant scientific contributions and publications
- Any additional contributions to the @Home league

Important note for the Standard Platform Leagues: Only unmodified robots may compete in Standard Platform Leagues. Any *unathorized* modification made to the robot that are found in the qualification material will automatically disqualify the team in the qualification process.

2.1.6 Participation Confirmation

In order to have as many participating teams as possible, qualified teams *must* contact the OC to confirm (or cancel) the participation several months in advance. Confirming attendance implies that the team has sufficient resources to register for the competition and commits to attend the event. Qualified teams that do not confirm their participation may be disqualified.

2.2 Audience interaction

Part of making RoboCup@Home appealing is to show the audience what robots should do and what they are actually doing during tasks. In particular, providing information about what a robot is doing to the audience is important for the advancement of the league. To this end, robots in @Home are expected to run the RoboCup@Home VizBox[1], which is a web server to be run on a robot during a task. The page it serves can be displayed on a screen and is visible to the audience via a secondary computer in or around the *Arena*, which is connected to the web server via the wireless network. The *VizBox* can:

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[1] https://github.com/LoyVanBeek/vizbox

- display images of what a robot can see, such as camera images, or a visualization of the robot's world model, the robot's map, or anything else that clarifies what the robot is trying to do
- show an outline of the current tasks and the robot's current state in it
- display subtitles of the conversation between a robot and an operator

Additionally, the *VizBox* offers a way to input text commands to the robot so that automatic speech recognition can be bypassed, if necessary.

The documentation of the component is maintained in the *VizBox* repository. All teams should ideally run the same VizBox code, as the audience should be shown a consistent presentation; however, opening a pull request to share any changes is much appreciated so that all teams can benefit from them.

2.3 Robots

2.3.1 Number of Robots

1. **Registration:** The maximum *number of robots* per team is *two* (2).
2. **Regular Tests:** Only one robot is allowed per test. For different test runs, different robots can be used.
3. **Final:** In the *Final*, both robots can be used simultaneously.

2.3.2 Appearance and Safety

Robots should have a product-like appearance and be safe to operate. The following rules apply to all robots:

1. **Cover:** The robot's internal hardware (electronics and cables) should be covered so that safety is ensured. The use of (visible) duct tape is strictly prohibited.
2. **Loose cables:** Loose cables hanging out of the robot are not permitted.
3. **Safety:** The robot must not have sharp edges or elements that might harm people.
4. **Annoyance:** The robot must not be continuously making loud noises or use blinding lights.
5. **Marks:** The robot may not exhibit any kind of artificial marks or patterns.
6. **Driving:** To be safe, the robots should be careful when driving. Obstacle avoidance is mandatory.

The compliance with these rules will be verified during *Robot Inspection* (see 3.4).

2.3.3 Standard Platform Leagues

Standardized platforms allow teams to compete under equal conditions by eliminating all hardware-dependent variables from the tasks; therefore, *unauthorized* modifications and alterations to the robots are strictly forbidden. This includes, but is not limited to, attaching, connecting, plugging, gluing, and taping components into and onto the robot, as well as, modifying or altering the robot structure. Not complying with this rule leads to an immediate disqualification and penalization of the team (see Section 2.7.2). Robots are, however, allowed to "wear" clothes,

have stickers (such as a sticker exhibiting the logo of a sponsor), or be painted (provided that the robot provider has approved that).

All modifications to the robots will be examined during the *Robot Inspection* (see 3.4). Note that the EC and TC members may request re-inspection of an SPL robot at any time during the competition.

Authorized DSPL Modifications

In the *Domestic Standard Platform League* (DSPL), teams may use an external laptop, which is safely located in the official *Mounting Bracket* provided by Toyota and is connected to the *Toyota HSR* via an Ethernet cable. Any laptop fitting inside the *Mounting Bracket* is allowed to be used, regardless of its technical specification. Furthermore, teams are allowed to attach the following devices to either the *Toyota HSR* or the laptop in the *Mounting Bracket*:

- **Audio**: A USB audio output device, such as a USB speaker or a sound card dongle.
- **Wi-Fi adapter**: A USB-powered IEEE 802.11ac (or newer) compliant device.
- **Ethernet Switch**: A USB-powered IEEE 802.3ab (or newer) compliant device.

In all cases, a maximum of three such devices can be attached, such that they may not increase the robot's dimensions. For this purpose, using short cables and attaching the devices to the laptop in the *Mounting Bracket* is advised.

2.3.4 Robot Specifications for the Open Platform League

Robots competing in the RoboCup@Home Open Platform League must comply with security specifications in order to avoid causing any harm while operating.

Size and Weight

1. **Dimensions:** The dimensions of a robot should not exceed the limits of an average door (200 cm by 70 cm in most countries). The TC may allow the qualification and registration of larger robots, but, due to local restrictions, it cannot be guaranteed that the robots can actually enter the *Arena*. In doubt, please contact the *Local Organizing Committee* (LOC).
2. **Weight:** There are no specific weight restrictions; however, the weight of the robot and the pressure it exerts on the floor should not exceed local regulations for the construction of offices and/or buildings which are used for living in the country where the competitions is being held.
3. **Transportation:** Team members are responsible for quickly moving the robot out of the *Arena*. If the robot cannot move by itself (for any reason), the team members must be able to transport the robot away quickly and easily.

Appearance

OPL robots should have an appearance that resembles a safe and finished product rather than an early stage prototype. This, in particular, means that the robot's internal hardware (electronics and cables) should be completely covered so that safety is ensured. Please note that covering the robot's internal hardware with a t-shirt is not forbidden, but is not advised.

Emergency Stop Button

1. **Accessibility and visibility:** Every robot has to provide an easily accessible and visible *Emergency Stop* button.
2. **Color:** The *Emergency Stop* must be coloured red and be the only red button on the robot. The TC may ask the team to tape over or remove any other red buttons present on the robot.
3. **Robot behavior:** When the *Emergency Stop* button is pressed, the robot and all its parts must stop moving immediately.

Start Button

1. **Requirements:** As explained in Section 2.6.8, teams that aren't able to carry out the default start signal (opening the door) have to provide a *Start Button* that can be used to start tests. Teams need to announce this to the TC before every test that involves a start signal, including the *Robot Inspection*.
2. **Definition:** The *Start Button* can be any "one-button procedure" that can be easily executed by a referee (such as releasing the *Emergency Stop*, a green button, or a software button in a graphical user interface).

Note: All robot requirements will be tested during the *Robot Inspection* (see 3.4).

2.4 External devices

Everything that a team uses during a test and is not part of the robot is considered an *External Device*. All *External Devices* must be authorized by the *technical committee* (TC) during the *Robot Inspection* test (see Section 3.4). The TC specifies whether an *External Device* can be used freely or under referee supervision, and determines its impact on scoring.

Note that the use of wireless devices, such as hand microphones and headsets, is not allowed, with the exception of *External Computing* as specified below. Please also note that the competition organizers do not guarantee or take any responsibility regarding the availability or reliability of the network or the internet connection in the *Arena*. Teams can thus use *External Computing* resources at their own risk.

2.4.1 On-site External Computing

Computing resources that are not physically attached to the robot are considered *External Computing* resources. The use of up to five *External Computing* resources is allowed, but only in the *Arena Network* (see Rulebook) and with a prior approval of the TC. Teams must inform the TC about the use of any *External Computing* at least one month before the competition. Note, however, that robots must be able to operate safely even if *External Computing* is unavailable.

External Computing devices must be placed in the *External Computing Resource Area* (ECRA), which is announced by the TC during the *Setup Days*. A switch connected to the *Arena* wireless network will be available to teams in the ECRA. During a *Test Block*, at most two laptops and two people from different teams are allowed in the ECRA simultaneously, one member each of

the teams up next. No peripherals, such as screens, mice, keyboards, and so forth, are allowed to be used.

During a *Test Slot*, everyone must stay at least 1 m away from the ECRA. Interacting with anything in the ECRA after the referee has given the start signal for a test will result in the test being stopped with a score of zero.

If a laptop is used as *External Computing*, a team can only place it in the ECRA if their *Test Slot* is up next and must remove the device immediately after the test.

2.4.2 On-line external computing

Teams are allowed to use *External Computing* through the internet connection of the *Arena Network*; this includes cloud services or online APIs. These must be announced to and approved by the TC one month prior to the competition.

2.5 Organization of the Competition

2.5.1 Stage System

The competition features a *stage system*, namely it is organized in two stages, each consisting of a number of specific tasks, and ends with a *Final*.

1. **Robot Inspection:** For security, robots are inspected during the *Setup Days*. A robot must pass the *Robot Inspection* test (see Section 3.4) so that it is allowed to compete.
2. **Stage I:** The first days of the competition are called *Stage I*. All qualified teams that have passed the *Robot Inspection* can participate in *Stage I*.
3. **Stage II:** The best *50% of teams* after *Stage I* advance to *Stage II*. If the total number of teams is less than 12, up to 6 teams may advance to *Stage II*. In this stage, tasks require more complex abilities or combinations of abilities.
4. **Final:** The best *two teams* of each league, namely the ones with the highest score after *Stage II*, advance to the *Final*. The final round features only a single task integrating all tested abilities.

In case of having no considerable score deviation between a team advancing to the next stage and a team dropping out, the TC may announce additional teams advancing to the next stage.

2.5.2 Schedule

1. **Test Blocks:** For each test one Test Block is scheduled during which each (qualified) team gets at least two Test Slots assigned. With the Restaurant test being the exception where only one Test Slot is assigned.
2. **Test Slots:** During a Test Slot a team has the amount of time specified for the test to attempt to solve it.
3. **Participation is default:** Teams have to inform the OC in advance if they are skipping a Test Block. Without such indication, they may receive a penalty when not attending (see Section 2.7.1).

4. **GPSR Block:** During the GPSR slot teams are allowed to perform one Stage 1 test of their choice instead, to allow more attempts for newer or specialized teams. Note that participation in GPSR is mandatory to advance to Stage 2.
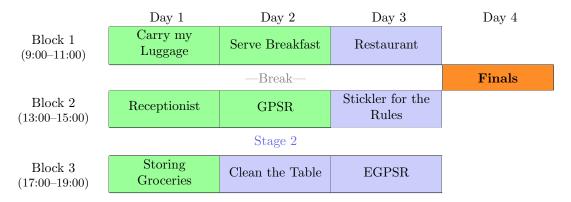
	Day 1	Day 2	Day 3	Day 4
Block 1 (9:00–11:00)	Carry my Luggage	Serve Breakfast	Restaurant	
	—Break—			**Finals**
Block 2 (13:00–15:00)	Receptionist	GPSR	Stickler for the Rules	
	Stage 2			
Block 3 (17:00–19:00)	Storing Groceries	Clean the Table	EGPSR	

Table 2.1: Example schedule. Each team has at least two Test Slots assigned in every Test Block.

Note that the actual allocation of blocks will be announced by the OC during the *Setup Days* (see Table 2.1).

2.5.3 Scoring System

Each task has a main objective and a set of bonus scores. To score in a test, a team must successfully accomplish the main objective of the task; bonuses are not awarded otherwise.

The scoring system has the following constrains:

1. ***Stage I:*** The maximum total score per task in *Stage I* is *1000 points.*
2. ***Stage II:*** The maximum total score per task in *Stage II* is *2000 points.*
3. ***Final:*** The final score is normalized.
4. **Minimum score:** The minimum total score per test in *Stage I* and *Stage II* is *0 points.* In principle, teams cannot receive negative points, except if they receive penalties. In particular, both penalties for not attending (see Section 2.7.1) and extraordinary penalties (see Section 2.7.2) can result in a total negative score.

2.6 Procedure during Tests

2.6.1 Safety First!

1. **Emergency Stop:** At any time when operating the robot inside and outside the scenario the owners have to stop the robot immediately if there is a possibility of dangerous behavior towards people and/or objects.
2. **Stopping on request:** If a referee, member of the Technical or Organizational committee, an Executive or Trustee of the federation stops the robot (by pressing the emergency button) there will be no discussion. Similarly if they tell the team to stop the robot, the robot must be stopped *immediately.*

3. **Penalties:** If the team does not comply, the team and its members will be excluded from the ongoing competition immediately by a decision of the RoboCup@Home *Technical Committee* (TC). Furthermore, the team and its members may be banned from future competitions for a period not less than a year by a decision of the RoboCup Federation Trustee Board.

2.6.2 Maximum number of team members

1. **Regular Tests:** During a regular test, the maximum number of team members allowed inside the *Arena* is *one* (1). Exceptions are tests that explicitly require volunteer assistance.
2. **Setup:** During the setup of a test, the number of team members inside the *Arena* is not limited.
3. ***Final*:** During the *Final*, the number of team members inside the *Arena* is not limited.

2.6.3 Fair play

Fair Play and cooperative behavior is expected from all teams during the entire competition, in particular:

- while evaluating other teams,
- while refereeing, and
- when having to interact with other teams' robots.

This also includes:

- not trying to cheat (e.g., pretending autonomous behavior where there is none),
- not trying to exploit the rules (e.g., not trying to solve the task but trying to score), and
- not trying to make other robots fail on purpose.
- not modifying robots in standard platforms.

Disregard of this rule can lead to penalties in the form of negative scores, disqualification for a test, or even for the entire competition.

2.6.4 Expected Robot's Behavior

Unless stated otherwise, it is expected that the robot always behave and react in the same way a polite and friendly human being would do. This applies also to how robots try solve the assigned task As rule of thumb, one may ask any non-scientist how she would solve the task.

Please consider that average users will not know the specific procedure to operate a robot. Hence, interaction should be as with any other human being.

2.6.5 Robot Autonomy and Remote Control

1. **No touching:** During a test, the participants are not allowed to make contact with the robot(s), unless it is in a "natural" way and required by the task.
2. **Natural interaction:** The only allowed means to interact with the robot(s) are gestures and speech.

3. **Natural commands:** Anything that resembles direct control is forbidden.
4. **Remote Control:** Remotely controlling the robot(s) is strictly prohibited. This also includes pressing buttons, or influencing sensors on purpose.
5. **Penalties:** Disregard of these rules will lead to disqualification for a test or for the entire competition.

2.6.6 Collisions

1. ***Touching*:** Gently *touching* objects is tolerated but unadvised. However, robots are not allowed to crash with something. The "safety first" rule (Section 2.6.1) overrides any other rule.
2. ***Major collisions*:** If a robot crushes into something during a test, the robot is immediately stopped. Additional penalties may apply.
3. ***Functional touching*:** Robots are allowed to apply pressure on objects, push away furniture and, in general, interact with the environment using structural parts other than their manipulators. This is known as *functional touching*. However, the robot must clearly announce the collision-like interaction and kindly request not being stopped.
   Remark: Referees can (and will) immediately stop a robot in case or suspicion of *dangerous* behavior.

2.6.7 Removal of robots

Robots not obeying the rules are stopped and removed from the *Arena*.

1. It is the decision of the referees and the TC member monitoring the test if and when to remove a robot.
2. When told to do so by the referees or the TC member monitoring the test, the team must immediately stop the robot, and remove it from the *Arena* without disturbing the ongoing test.
3. More than 1 team member is allowed to enter the *Arena* after the robot has been stopped to quickly remove the robot from the *Arena*

2.6.8 Start signal

The default *start signal* (unless stated otherwise) is *door opening*. Other start signals are allowed but must be authorized by the *Technical Committee* (TC) during the Robot Inspection (see Section 3.4).

1. **Door opening:** The robot is waiting behind the door, outside the *Arena* and accompanied by a team member. The test starts when a referee (not a team member) opens the door.
2. **Start button:** If the robot is not able to automatically start after the door is open, the team may start the robot using a start button.
   2.1. It must be a physical button on the robot (e.g., a dedicated one or releasing the eStop).
   2.2. It is allowed to use the robot's contact/pressure sensors (e.g., pushing the head or an arm joint).
   2.3. Using a start button needs to be announced to the referees before the test starts.

2.4. There may be penalties for using a start button in some tests
3. **Ad-hoc start signal:** Other means of triggering robot to action are allowed but must be approved by the *Technical Committee* (TC) during the Robot Inspection (see Section 3.4). These include:
   - QR Codes
   - Verbal instructions
   - Custom HRI interfaces (apps, software, etc.)

   Remark: There may be penalties for using Ad-hoc start signals in some tests. The use of mouses, keyboards, and devices attached to ECRA computers is strictly forbidden.

2.6.9 Entering and leaving the *Arena*

1. **Start position:** Unless stated otherwise, the robot starts outside of the *Arena*.
2. **Entering:** The robot must autonomously enter the *Arena*.

2.6.10 Gestures

Hand gestures may be used to control the robot in the following way:

1. **Definition:** The teams define the hand gestures by themselves.
2. **Approval:** Gestures need to be approved by the referees and TC member monitoring the test. Gestures should not involve more than the movement of both arms. This includes, e.g., expressions of sign language or pointing gestures.
3. **Instructing operators:** It is the responsibility of the team to instruct operators.

   3.1. The team may only instruct the operator when told to so by a referee.
   3.2. The team may only instruct the operator in the presence of a referee.
   3.3. The team may only instruct the robot for as long as allowed by the referee.
   3.4. When the robot has to instruct the operator, it is the robot that instructs the operator and *not* the team. The team is not allowed to additionally guide the operator, e.g., tell the operator to come closer, speak louder, or to repeat a command.
   3.5. The robot is allows to instruct the operator at any time.

4. **Receiving gestures:** Unless stated otherwise, it is not allowed to use a speech command to set the robot into a special mode for receiving gestures.

2.6.11 Referees

All tests are monitored by a referee, who is a member of the *Technical Committee* (TC). The referee may appoint an assistant to aid in keeping time and filling in scoresheets. The following rules apply:

1. **Selection:** Referees are chosen by EC/TC/OC.
2. **Referee instructions:** Right before each test, referee chooses one or more assistant to aid during the test. The assistants will be instructed by the referee.

2.6.12 Operators

Unless stated otherwise, robots are operated by the referee or by a person selected by the referee. If the robot fails to understand the default operator, the team may request the use of a custom operator. Penalty may apply when using a custom operator.

2.6.13 Time limits

1. **Stage I:** Unless stated otherwise, the time limit for each test in *Stage I* is *5 minutes*.
2. **Stage II:** Unless stated otherwise, the time limit for each test in *Stage II* is *10 minutes*.
3. **Inactivity:** Robots are not allowed to stand still or get stuck into endless loops. A robot not progressing in the task execution (and obviously not trying to), is consider as inactive. Robots must be removed after 30 seconds of inactivity.
4. **Requesting time:** A robot (not the team) can request referees to make exception from the 30-seconds inactivity time limit. In its request, the robot must clearly state for how long it will be performing a time-consuming process (e.g., 60 seconds). This time cannot exceed 3 minutes and cannot be used more than once per test.
5. **Setup time:** Unless stated otherwise, there is no setup time. Robots need to be ready to enter the *Arena* no later than one minute after the door has been closed to the former team.
6. **Time-up:** When the time is up, the team must immediately remove their robot(s) from the *Arena*. No more additional score will be giving.
7. **Show must go on:** On special cases, the referee may let the robot continue the test for demonstration purposes, but no additional points will be scored.

2.7 Special penalties and bonuses

2.7.1 Penalty for not attending

1. **Automatic schedule:** All teams are automatically scheduled for all tests.
2. **Announcement:** If a team cannot participate in a test (for any reason), the team leader has to announce this to the OC at least *60 minutes* before the test slot begins.
3. **Penalties:** A team that is not present at the start position when their scheduled test starts, the team is not allowed to participate in the test anymore. If the team has not announced that it is not going to participate, it gets a penalty of *250 points*.

2.7.2 Extraordinary penalties

1. **Penalty for cheating:** If a team member is found cheating or breaking Fair Play, the team will be automatically disqualified of the running test, and a penalty of *500 points* is handed out. The *Technical Committee* (TC) may also disqualify the team for the entire competition.
2. **Penalty for faking robots:** If a team starts a test, but it does not solve any of the partial tasks (and is obviously not trying to do so), a penalty of *250 points* is handed out. The decision is made by the referees and the monitoring TC member.

3. **Extra penalty for collision:** In case of major, (grossly) negligent collisions the *Technical Committee* (TC) may disqualify the team for a test (the team receives *0 points*), or for the entire competition.

4. **Not showing up as referee or jury member:** If a team does not provide a referee or jury member (being at the *Arena* on time), the team receives a penalty of *250 points*, and will be remembered for qualification decisions in future competitions.
Jury members missing a performance to evaluate are excluded from the jury, and the team is disqualified from the test (receives *0 points*).

5. **Modifying or altering standard platform robots:** If any unauthorized modification is found on a Standard Platform League robot, the responsible team will be immediately disqualified for the entire competition while also receiving a penalty of *500 points* in the overall score. This behavior will be remembered for qualification decisions in future competitions.

2.7.3 Bonus for outstanding performance

1. For every regular test in *Stage I* and *Stage II*, the @Home *Technical Committee* (TC) can decide to give an extra bonus for *outstanding performance* of up to 10% of the maximum test score.

2. This is to reward teams that do more than what is needed to solely score points in a test but show innovative and general approaches to enhance the scope of @Home.

3. If a team thinks that it deserves this bonus, it should announce (and briefly explain) this to the *Technical Committee* (TC) beforehand.

4. It is the decision of the *Technical Committee* (TC) if (and to which degree) the bonus score is granted.

2.7.4 Bonus for perceived social intelligence

1. For the test *Receptionist* in *Stage I* and, *Restaurant* in *Stage II* tests. Teams are evaluated on the robot's perceived social intelligence performance

2. This bonus, ranging from 0 to 50, depends on the robot's social performance which will be assessed by Referees using a specially designed scale in a survey.

3. The survey evaluates how the robot recognizes, adapts to, and predicts emotions, behaviors, and cognitions. Each component is assessed through several questions, scored on a scale from 1 to 5, where 1 represents "strongly disagree" and 5 represents "strongly agree." The questions used for evaluation include:

   - This robot notices human presence
   - This robot enjoys meeting people
   - This robot recognizes individual people
   - This robot notices when people do things
   - This robot adapts effectively to different things people do
   - This robot anticipates people's behavior
   - This robot tries to be helpful
   - This robot is trustworthy
   - This robot cares about others

- This robot tries to hurt people
- This robot knows if someone is part of a social group
- This robot thinks it is better than everyone else
- This robot adapts its behavior based upon what people around it know
- This robot is impolite
- This robot is socially competent

Detailed information can be found in this manual.

4. In each evaluation, the score for every question is summed up and then normalized as follows:

$$x' = N \cdot \frac{x - x_{\min}}{x_{\max} - x_{\min}}$$

Here, N is the normalizing factor (50), x is the sum of scores for each question in the current evaluation, $x_{\min}$ is set to 15 (since there are 15 questions), and $x_{\max}$ is set to 75 (as the maximum score for each question is 5).

5. The final score is calculated as the average of individual evaluator scores.

6. The referee has the authority to skip the social assessment test if they believe the robot's performance is not suitable for measurement.

7. After the test is completed, the evaluators will fill out the form, and the scores will be automatically recorded in this spreadsheet.

2.8 Open Challenge

On the first two competition days after the end of the regular test blocks, teams will have an opportunity to present an *Open Challenge* in which they demonstrate their novel research and approaches.

2.8.1 Procedure

1. **Participation:** Teams have to announce whether they want to perform an *Open Challenge* to the OC during the *Setup Days*.

2. **Time:** Each team gets a 10 minute time slot for the *Open Challenge*; of these, 8 minutes are for presenting and 2 minutes are for questions by the audience.

3. **Arena Changes:** The team can rearrange the arena when their time slot starts, but all changes need to be reverted as soon as their time slot ends.

4. **Focus:** While the demonstrations are intended to share research insights, we still want to see robots performing; in particular, the *Open Challenge* should not be turned into a pure academic lecture.

5. **Leagues:** Ideally, the open challenges of all @Home leagues will be scheduled consecutively so that everyone has an opportunity to see all demonstrations; however, in case more than 12 participants across the leagues register for the *Open Challenge*, each league will hold their *Open Challenge* concurrently.

6. **Award:** The *Open Challenge* does not contribute any points towards the official competition score, but participating teams are eligible to receive the *Best Open Challenge Award* (see 1.4.4).

Chapter 3

Setup and Preparation

Prior to the RoboCup@Home competition, all arriving teams will have an opportunity to set up their robots and prepare for the competition in a *Setup & Preparation* phase. This phase is scheduled to start on the first day of the competition, namely when the venue opens and the teams arrive. During the *Setup Days*, teams can assemble and test their robots. On the last setup day, a *Welcome Reception* will be held. To foster the knowledge exchange between teams a conference-like *Poster Session* takes place during the reception. Additionally, all teams have to get their robots inspected by members of the TC to be allowed to participate in the competition.

Regular tests are not conducted during the setup & preparation phase.   The competition starts with *Stage I* (see RULEBOOK).

Table 3.1: Stage System and Schedule per League (distribution of tests and stages over days may vary)

Setup & Preparation	Stage I	Stage II	Finals
	advance	*advance*	*advance*
	All teams that passed Inspection	Best 10 (< 6) or best 50% (≥ 12)	Best 2 teams

3.1 General Setup

Depending on the schedule, the *Setup & Preparation* phase lasts for one or two days.

1. **Start:** The *Setup & Preparation* starts when the venue opens for the first time.
2. **Intention:** During the *Setup & Preparation*, teams arrive, bring or receive their robots, and assemble and test them.
3. **Tables:** The local organization will set up and randomly assign team tables.
4. **Groups:** Depending on the number of teams, the *organizing committee* (OC) may form multiple groups of teams (usually two) for the first (and second stage). The OC will assign teams to groups and announce the assignment to the teams.
5. ***Arena***: The *Arena* is available to all teams during the *Setup & Preparation*. The OC may schedule special test or mapping slots in which *Arena* access is limited to one or more teams exclusively (all teams get slots). Note, however, that the *Arena* may not yet be complete and that the last work is conducted in the *Arena* during the *Setup Days*.

6. **Objects:** The delegation of EC, TC, OC and local organizers will buy the objects (see RULEBOOK). Note, however, that the objects may not be available at all times and not from the beginning of the *Setup & Preparation*.

3.2 Welcome Reception

Since Eindhoven 2013, RoboCup@Home holds an own *Welcome Reception* in addition to the official opening ceremony. During the *Welcome Reception*, a *Poster Session* is held in which teams present their research focus and latest results (see Section 3.3).

1. **Time:** The *Welcome Reception* is held in the evening of the last setup day.
2. **Place:** The *Welcome Reception* takes place in the @Home *Arena* and/or in the @HOME team area.
3. **Snacks & drinks:** During the *Welcome Reception*, snacks and beverages (beers, sodas, etc.) are served.
4. **Organization:** It is the responsibility of the OC and the local organizers to organize the *Welcome Reception* and *Poster Session*, including:

    4.1. organizing poster stands (one per team) or alternatives for presenting the posters,
    4.2. organizing snacks and drinks, and
    4.3. inviting officials, sponsors, the local organization, and the trustees of the RoboCup Federation to the event.

5. **Poster presentation:** During the *Welcome Reception*, the teams give a poster presentation on their research focus, recent results, and their scientific contribution. Both the poster and the teaser talk are evaluated by a jury (see Section 3.3).

3.3 Poster Teaser Session

Before the *Welcome Reception* and *Poster Session*, a *Poster Teaser Session* is held. In this teaser session, each team can give a short presentation of their research and the poster being presented at the poster session.

3.3.1 Poster teaser session

1. **Presentation:** Each team has a maximum of three minutes to give a short presentation of their poster.
2. **Time:** The *Poster Teaser Session* is to be held before the *Welcome Reception* and *Poster Session* (see Section 3.2).
3. **Place:** The *Poster Session* may be held in or around the *Arena*, but should not interfere with the *Robot Inspection* (see Section 3.4).
4. **Evaluation:** The teaser and poster presentations are evaluated by a jury consisting of members of the other teams. Each team has to provide one person (preferably the team-leader) to follow and evaluate the entire *Poster Teaser Session* and the *Poster Session*.
5. **Criteria:** For each of the following evaluation criteria, a maximum of 10 points is given per jury member:

5.1. Novelty and scientific contribution

5.2. Relevance for RoboCup@Home

5.3. Presentation (quality of poster, teaser talk, and discussion during the *Poster Session*)

6. **Score:** The points given by each jury member are scaled to obtain a maximum of 50 points. The total score for each team is the mean of the jury member scores. To neglect outliers, the N best and worst scores are left out:

$$score = \frac{\sum \text{team-leader-score}}{\text{number-of-teams} - (2N + 1)}, N = \begin{cases} 1, & \text{number-of-teams} \geq 10 \\ 2, & \text{number-of-teams} < 10 \end{cases}$$

7. **Sheet collection:** The evaluation sheets are collected by the OC at a later time (announced beforehand by the OC), allowing teams to continue knowledge exchange during the first days of the competition (*Stage I*).

8. **OC Instructions:**

   - Prepare and distribute evaluation sheets before the *Poster Teaser Session*.
   - Collect the evaluation sheets.
   - Organize and manage the poster teaser presentations and the *Poster Session*.

3.4 Robot Inspection

Safety is the most important issue when interacting with humans and operating in the same physical workspace. Because of this, all participating robots are inspected before participating in RoboCup@Home. Every team needs to get their robot(s) inspected and approved so that they can participate in the competition.

1. **Procedure:** The *Robot Inspection* is conducted like a regular test, namely it starts with opening of the arena door (see Section 2.6.8). One team after another (and one robot after another) has to enter the *Arena* through a designated entrance door, move to the *Inspection Point*, and leave the arena through the designated exit door. In between entering and leaving, the robot is inspected by the *technical committee* (TC).

2. **Checked aspects:** During the *Robot Inspection*, each robot is checked for compliance with the competition rules (see Section 2.3), in particular:

   - emergency button(s)
   - collision avoidance (a TC member steps in front of the robot)
   - voice of the robot (it must be loud and clear)
   - custom containers (bowl, tray, etc.)
   - external devices (including wireless network), if any
   - Alternative human-robot interfaces (see Rulebook).
   - *Standard Platform robots*
     - no modifications have been made
     - specification of the *Official Standard Laptop* (OSL) (if required)
   - *Open Platform robots*
     - robot speed and dimension
     - start button (if the team requires it)

    – robot speaker system (plug for RF transmission)

    – other safety issues (duct tape, hanging cables, sharp edges etc.)

3. **Re-inspection:** If the robot is not approved in the inspection, it is the responsibility of the team to get the approval at a later point. Robots are not allowed to participate in any test before passing the *Robot Inspection*.

4. **Time limit:** The robot inspection is interrupted after three minutes (per robot). When told so by the TC — in case of time interrupt or failure — the team has to move the robot out of the *Arena* through the designated exit door.

5. **Appearance Evaluation:** In addition to the inspection, the TC evaluates the appearance of the robots. Robots are expected to look nice (no duct tape, no cables hanging loose etc.). In case of objection, the TC may penalize the team with a penalty of maximum 50 points.

6. **Accompanying team member:** Each robot is accompanied by only one team member (the team leader is advised).

7. **OC instructions (at least two hours before the *Robot Inspection*):**

   - Announce the entry and exit doors.
   - Announce the location of the *Inspection Point* in the *Arena*.
   - Specify and announce where and when the poster teaser and the poster presentation session take place.

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