

# 1 Robot Challenge: Guidelines

SG DS, 2. Semester

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Please also note that clarifications or additions to the guidelines or missions/tasks may be made throughout the semester through questions & answers (FAQ). You will find updates on spaces.

Disclaimer: some of the guidelines were inspired from World Robot Olympiad Switzerland (<https://wro.swiss/>).

## 1.1 Zumi Robot

You will borrow the Zumi Robot for the course of one semester in a team. Once you communicate your team to me (via Teams chat message), you will receive:

- 1 fully assembled Zumi robot
  - 1 USB-C cable
  - 1 screwdriver (including packaging)
  - 1 manual
  - 1 box consisting of 3 sub-boxes, including padding for Zumi
- Upon receiving the material, confirm via Teams chat that you have received all these components.

## 1.2 Definition of Teams

- Each team consists of 2 to 4 team members.
- Each team member may only be part of one team.
- Grading is independent of the team size and semester level.

## 1.3 Learning Objectives of Missions

- General programming knowledge and fundamental concepts of robotics (environment perception, control, navigation).
- General technical skills (understanding the robot's sensors).
- Developing optimal strategies to solve specific tasks.
- Computational thinking (thinking like a computer scientist, e.g., problem-solving, debugging, collaboration, etc.).
- Teamwork, communication, problem-solving, creativity.

## 1.4 Levels of Complexity of Missions

The playing fields and missions are designed so that difficulty and complexity increase. The increasing complexity is reflected in elements such as:

- The route on the playing field (e.g., line following).
- The technical complexity of the missions (e.g., which sensors used).
- Random placement of game objects (e.g., one or multiple random scenarios).
- Variety of game objects (e.g., number of differently colored and/or shaped objects).
- Required accuracy in solving tasks (e.g., a large target area vs. a small point).
- Overall complexity in the combination of the above elements.

## 1.5 Responsibilities

- A team must behave fairly and respectfully toward other teams, coaches, referees, and competition organizers.
- The programming and design of the missions of the robot may only be carried out by the participants themselves.
- Solutions must be unique and the team's own work. Identical or overly similar solutions to others, or those clearly not developed by the team, are not allowed.
- Violations may result in:
  - A team may be disqualified from one or more competition rounds.
  - A team may receive up to 50% fewer points in one or more competition rounds.
  - A team may not qualify for the next round of the competition (e.g., in a format with final rounds).
- A team may not perform any actions or movements to interfere with or assist the robot after the random placement of game objects has taken place.
- The robot must complete missions/tasks autonomously and independently. Any wireless connection, remote control, or wired control system is not allowed while the robot is executing the mission.
- A team may not perform any actions or movements to interfere with or assist the robot after the random placement of game objects.
- Any software or API for programming the robot is allowed, and teams may prepare the code before the competition day.
- The teams may add additional sensors to the robot, but the robot must be reversible at the end of the semester.

## 1.6 Game Table and Equipment

- The robot completes a mission on a playing field. Each playing field consists of a game table (a flat surface with boundaries) and a printed mat placed on the table.
- It is not allowed to damage game objects or the playing field mat. If a game object is damaged, any possible points for that object will not be counted (unless otherwise defined in the task description). If the robot intentionally damages objects, the team may be disqualified from the scoring run. This also applies to objects that do not contribute to the score.
- The robot's start area is exclusively the white area within a colored border. The robot must be fully within the start area (white area) at the start.
- When designing tasks and programming, keep in mind that some variability must always be expected, e.g.:
  - Minor imperfections on the playing field mats
  - Differences in color intensity between playing fields and tables
  - Variations in lighting conditions throughout the competition day and/or between tables
  - Shadows cast by the referee on the playing field
  - The referee moving around the table for assessment
  - Texture of the playing field mat or uneven surfaces underneath it
  - Waves or creases in the playing field mat, with location and extent varying
  - The game table not being perfectly leveled

## 1.7 Possible Elements of a Competition

- **Main tasks:** The known tasks from the exercises that include individual sub-tasks. The main tasks can be used alone or in combination with one or more other elements.

- **Surprise tasks/rules:** A surprise task and surprise rule are two slightly different concepts, though they are often referred to under the same name.
  - A **surprise task** is an additional sub-task that teams can complete while solving the main task (e.g., an extra object that needs to be processed). In many cases, the additional object must be recognized on the playing field but integrating it into the solution is optional.
  - A **surprise rule** is a small modification to the existing mission that teams must adapt to (e.g., changing the color of objects). This forces teams to program their robot flexibly.
  - In both cases, these types of changes are mentioned in the weekly exercises.
  - Additional points are awarded for completing these surprises.
- **Extra task:** An extra task is an additional challenge similar to a surprise task, but teams are informed about it before the competition so they can prepare. This introduces an interesting new challenge for teams after they have already spent time working on the main task.

## 1.8 Format and Flow of the Competition

The competition consists of the following elements:

- **Test phase:** Each competition begins with a test phase to allow teams to adjust to local conditions (e.g., lighting conditions at the venue).
  - Teams work in designated team areas and may modify their robot's programming only during test phases. To conduct test runs, teams must line up with their robots in hand. Sensor calibration must be done during test phases, not right before a competition round.
- **Competition rounds.** The competition rounds consist the main tasks (given by the weekly exercises), the surprise tasks/rules and the extra tasks.
- The teams are responsible that the robot's battery is charged. It is allowed to charge the battery during the competition. If the battery is not charged for a competition round, the team loses their points for that round.
- The order of the teams participating in a competition round is announced in advance.

## 1.9 Scoring Run

- During a competition round three scoring runs can be conducted.
- The best score out of three scoring runs counts as final points.
- Each scoring run lasts 2 minutes. The time starts when the referee gives the start signal.
- The robot must be placed in the start area so that it is fully within the start area when viewed from above.
- If there are uncertainties during the scoring run, the referee makes the final decision. If no clear rule interpretation is possible, the decision should favor the team.
- A scoring run ends when...
  - the scoring run time has expired.
  - a team member touches the robot.
  - the robot has completely left the game table.
  - the robot or the team has violated rules or regulations.
  - a team member calls "STOP" and the robot is no longer moving. If the robot is still in motion, the scoring run ends only when the robot stops on its own or is stopped by the team or the referee.

- Once the scoring run is over, the time is stopped, and the referee evaluates the attempt based on the situation on the playing field at that moment. Time is recorded in full seconds only. Points are awarded based on the random placement at the start of the run.
- The points are recorded on a score sheet (paper or digital), and the team must confirm the score. Once the score is confirmed, no further appeals from the team are allowed.
- If a team touches or modifies the game objects on the playing field during the scoring run, the team will be disqualified from that scoring round.
- A team's disqualification in a scoring round results in the lowest possible score (usually 0 points) and the maximum time.
- If a team completes a scoring run without solving any sub-task of the main tasks that earns positive points, the time for that competition round is set to the maximum time.
- Some of the points are earned based on the ranking within a competition round. If competing teams have the same score, the ranking is determined by the better time. The following ranking criteria apply:
  - Points from the best run of the main tasks (including any solved surprise task) and extra tasks
  - Time from the best run of the main tasks
  - Points from the second-best run of the main tasks (including any solved surprise task)
  - Time from the second-best run of the main tasks
  - Points from the third-best run of the main tasks (including any solved surprise task)
  - Time from the third-best run of the main tasks
  - After this, teams will be ranked equally.