

# TU Graz Robotics Challenge 2017

[www.robotics-challenge.ist.tugraz.at](http://www.robotics-challenge.ist.tugraz.at)



Kick-Off 14.03.2017

# Overview

- Introduction
- Robotics Challenge Task
- Dates, Overview
- Rules
- Questions, Discussion

...

# *“World champions: TU Graz teams secure victory at RoboCup”*

*“Two TU Graz teams achieve success at the RoboCup 2016: Team **TEDUSAR** becomes world champion in Autonomous Exploration in the Rescue Robot league; Team **GRIPS** wins third place in the Logistics league and is Rookie of the Year”*



[TU Graz News+Stories 08.07.2016]


# Introduction

- student teams – applying knowledge in practical projects
- robotics as an interdisciplinary field
- successful TU Graz **RoboCup** teams  
=> for the most part on Master's Degree level
- <https://www.youtube.com/watch?v=co5nahvOqhw>
- <https://www.youtube.com/watch?v=od1oEeHI8k8>
- **RoboCupJunior** on pre-university level



# Introduction


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- robotics as an interdisciplinary field
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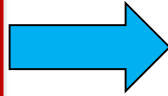
Pre-University:  
**RoboCupJunior**  
FLL, ...

Bachelor Studies:  
**TU Graz Robotics**  
**Challenge**

Master Studies:  
**RoboCup Rescue**  
**RoboCup Logistics**  
...



## Bachelor Studies: TU Graz Robotics Challenge



## Projects

Research group “Autonomous Intelligent Systems”

- Dependability for Robots (model based testing, diagnosis)
- Logistics with Robots (smart factory)
- Rescue Robots
- Industrial Applications (smart shuttle, 24/7 operation)
- Educational Robotics

## RoboCup Student Teams

Rescue  
Logistics



...



# Robotics Challenge 2017 - Task

The task of the TU Graz Robotics Challenge is to build and program a rescue robot which autonomously explores a maze and searches for simulated victims.

- open to students of all **Bachelor's Degree Programmes** of TU Graz
- a team comprises **2 – 5 students**
- required robotics platform: **LEGO Mindstorms NXT 2.0** (will be provided by TU Graz)
- maximum number of 5 teams for 2017
- student teams can **apply by sending a letter of motivation** (1 page, Arial 12pt) to [mkandlho@ist.tugraz.at](mailto:mkandlho@ist.tugraz.at)
  - subject: [robotics challenge]
  - deadline: 04.04.2017

The winning team will be awarded € 300  
sponsored by

 **incubed IT**  
Software | Robotics

# Important Dates

- **14.03.2017**: Kick-Off and information event (15.00h – 17.00h), [Seminar Room IST](#)
- **04.04.2017**: Deadline application of student teams
- **06.04.2017**: Notification accepted student teams
- **07.04.2017 / 28.04. / 05.05. / 19.05. / 02.06.**: Open lab days (13.30h – 17.00h; preparation for competition), [Robotics Lab](#)
- **13.06.2017**: **Competition** (09.00h – 16.00h), [Foyer Inffeldgasse 13](#)



# Overview

- The robot will get points for each victim found.
- The robot should avoid areas with black floor.
- If the robot is stuck in the maze it can be restarted at the last visited checkpoint.
- If the robot can find its way back to the beginning after exploring the whole maze it will receive extra points.
- The robot will also earn a reliability bonus (based on the number of required restarts)
- There are also some obstacles where the robot can earn additional points.

Example:

<https://www.youtube.com/watch?v=Pin9Ztx-ES4&t=176s>



# Overview of Rules (check website for current rules/changes)

<http://robotics-challenge.ist.tugraz.at/index.php/rules/>



**TU GRAZ  
ROBOTICS CHALLENGE  
2017**



**Design your own Rescue Robot  
Participate in a competition  
Discover Robotics**

Open to students of all  
Bachelor's Degree Programmes of TU Graz

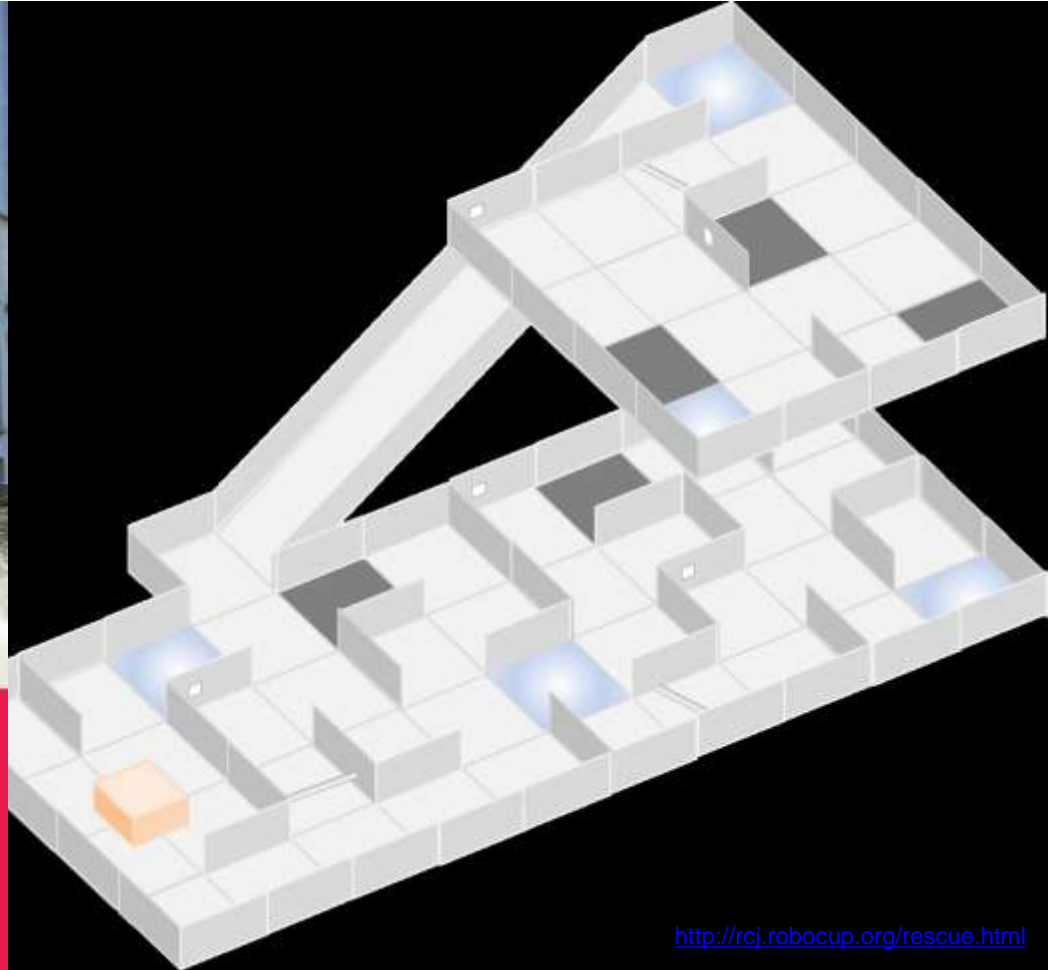


[www.robotics-challenge.ist.tugraz.at](http://www.robotics-challenge.ist.tugraz.at)

**Competition:**  
13.06.2017 (10:00h – 16:00h)  
Foyer Infobüro 13

**Kick-Off and Information Event:**  
14.05.2017 (10:00h – 17:00h)  
Seminar-Raum 307 Infobüro 1008

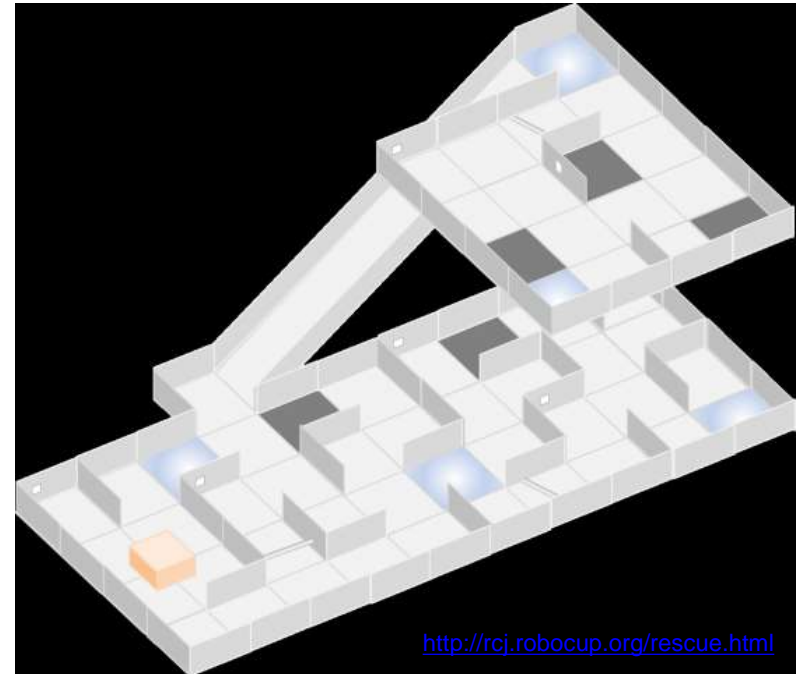
**Open Lab Days:**  
starting 01.04.2017  
(every second Friday afternoon)  
Robotik-Lab Infobüro 1307



<http://rcj.robocup.org/rescue.html>

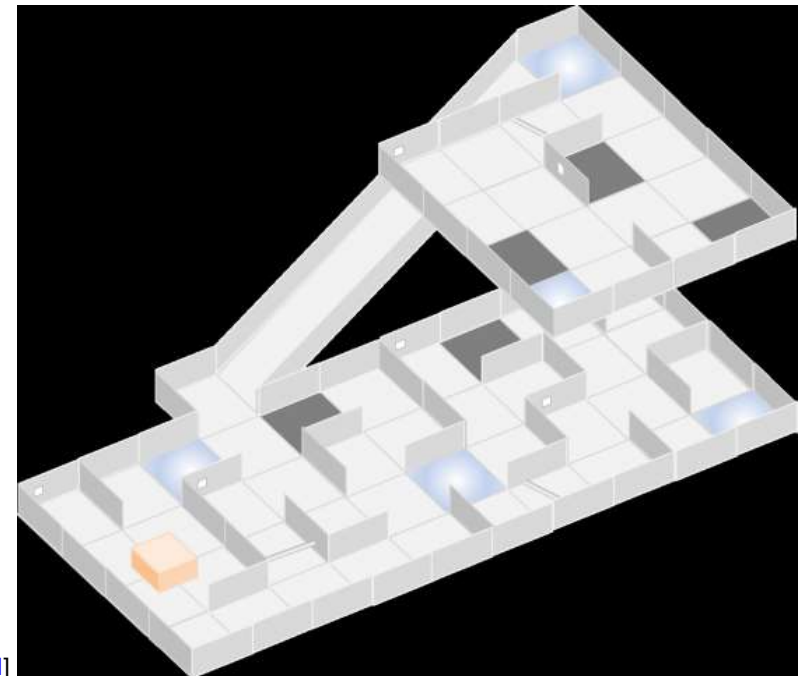
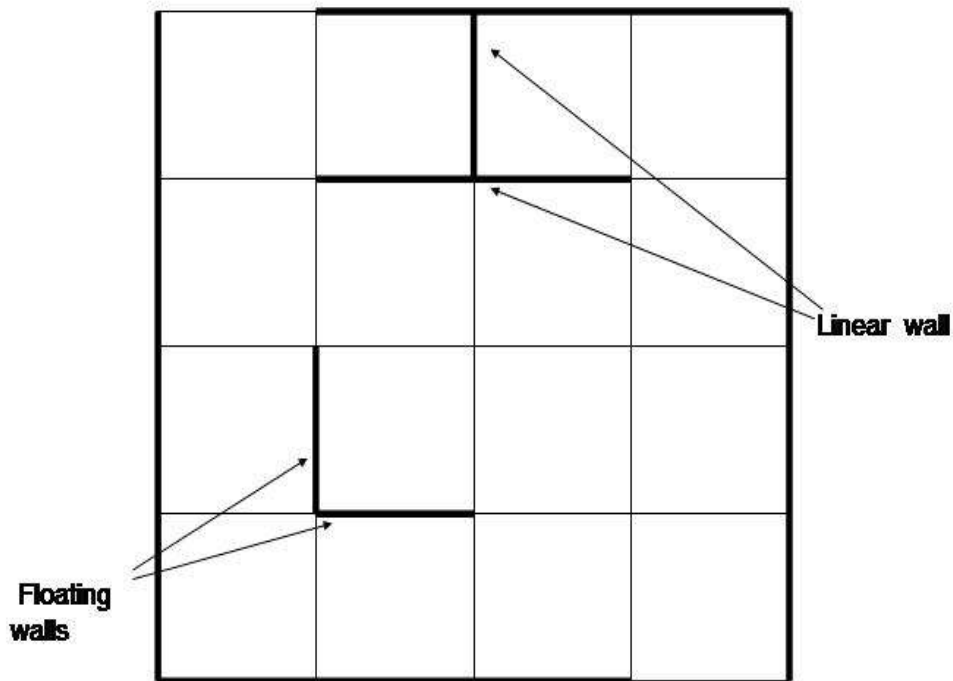
# Arena

- 1.1.1 The maze may consist of multiple distinct areas.
- 1.1.4 Doorways are at least 30 cm wide.
- 1.1.5 Ramps will be at least 30 cm wide.
- 1.2.2 Through the arena, there may exist **black tiles** that represent “no go” spaces (placed randomly; may not be completely fixed).
- 1.2.3 There may also exist **silver tiles** that represent checkpoints
- 1.2.4 A tile is defined as a 30x30 cm space



# Path

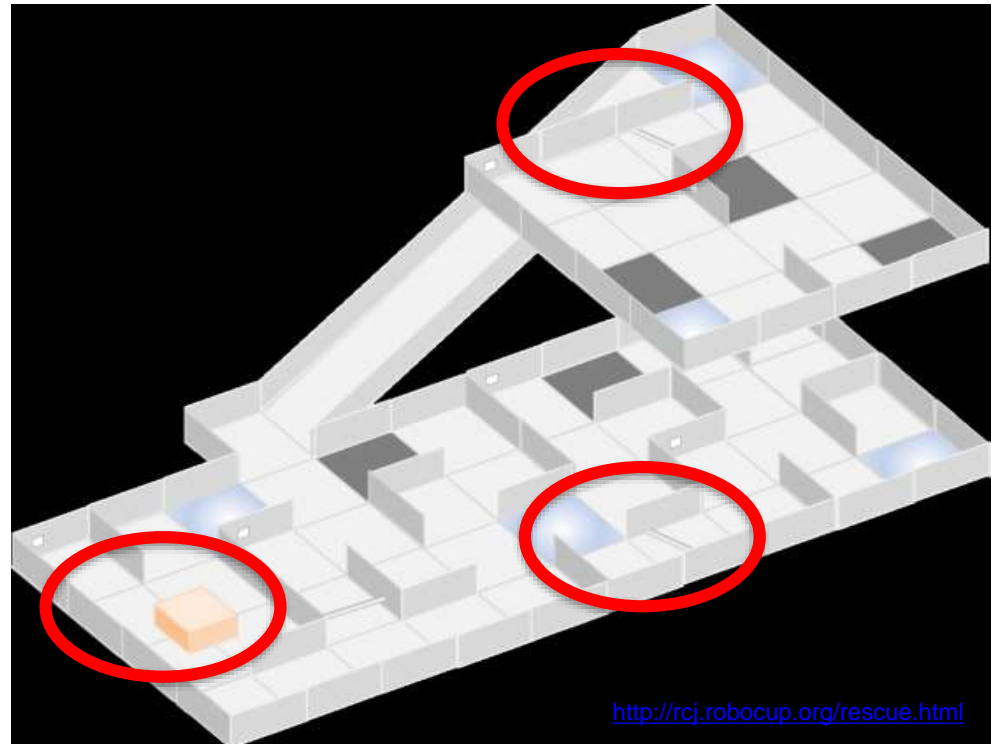
- 1.3.1 Walls may or may not lead to the entrance/exit.
- 1.3.2 Paths will be approximately 30 cm wide but may open into foyers wider than the path.
- 1.3.3 One of the outermost tiles is the starting tile, where a robot should start and exit the run.
- 1.3.4 The starting tile is always a checkpoint.



[\[http://rcj.robocup.org/rescue.html\]](http://rcj.robocup.org/rescue.html)

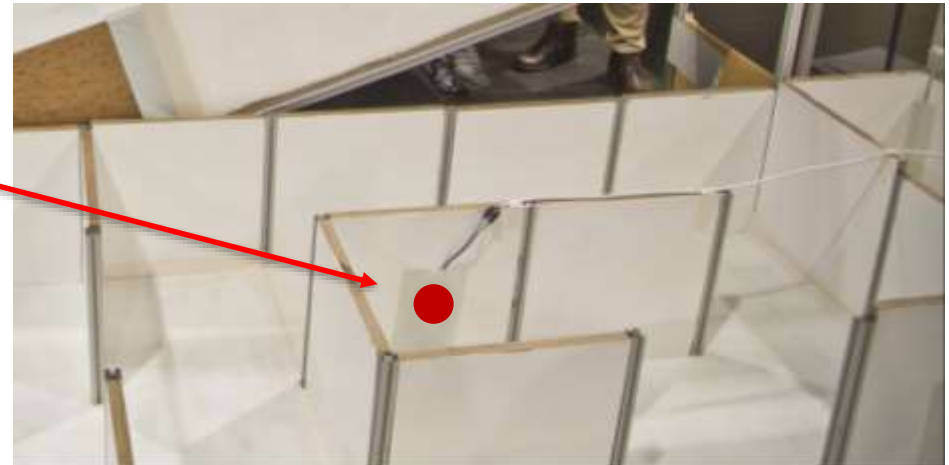
# Debris, Speed Bumps, Obstacles

- 1.4.1 **Speed bumps** are fixed to the floor, and have a maximum height of 2cm.
- 1.4.2 **Debris** will not be fixed on the floor, and have a maximum height of 1cm.
- 1.4.4 **Obstacles** may consist of any large, heavy items and its shape can be anything from rectangular, pyramidal, spherical to cylindrical.
- 1.4.7 Obstacles that are moved or knocked over will remain where they are moved to/fall and will not be reset during the run.



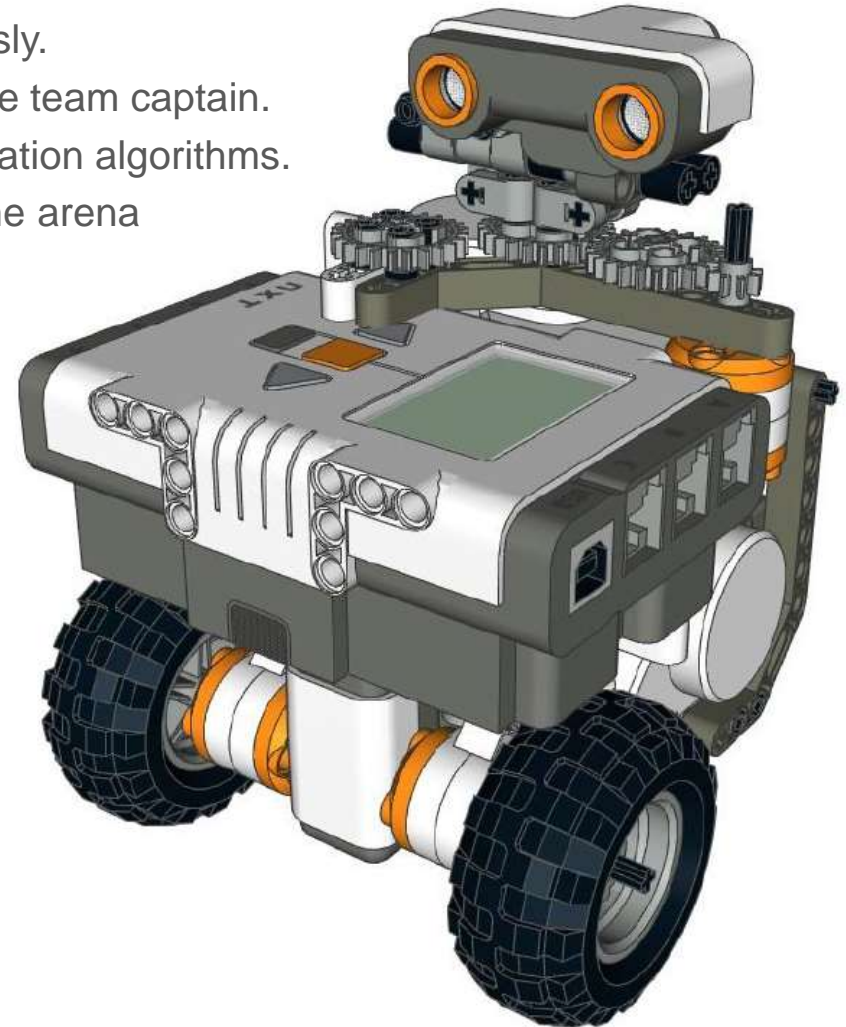
# Victims

- 1.5.1 Victims are **heated and color marked (red)** sources located near the floor
- 1.5.2 Each victim has a surface area greater than 16 cm<sup>2</sup>.
- 1.5.3 Temperature ~ 28° - 40° C.
- 1.5.4 There will be a minimum of five (5) **active** victims in any round.
  - 1.5.4.1 A victim is defined as **active** if it is
    - a) **heated** and
    - b) **marked with red color**
- 1.5.5 Not active victims have to be ignored



# Robot Control

- 2.1.1 Robots must be controlled autonomously.
- 2.1.2 Robots must be started manually by the team captain.
- 2.1.3 Robots may utilize various maze navigation algorithms.
- 2.1.4 A robot must not damage any part of the arena
- 2.1.5 Robots should include a stop/pause
- 2.2.1 Max. height 30 cm.



# Robot Construction

- 2.2.3 The use of the **LEGO Mindstorms NXT 2.0** robotics kit is mandatory.
  - each team gets a standard LEGO Mindstorms NXT 2.0 set
  - 3 standard LEGO motors, 4 sensors:
    - 1x ultrasonic sensor, 1x thermal IR sensor, 1x color sensor, 1x light sensor.
    - The development of own sensors is permitted
- 2.2.4 The use of any sensor- or motor-multiplexers is prohibited.
- 2.2.5. The use of further standard LEGO building material (in addition to which is included in the standard set) is permitted.
- 2.2.6 Any programming language (e.g. NXC, RobotC, ...) for the Mindstorms NXT 2.0





# Team

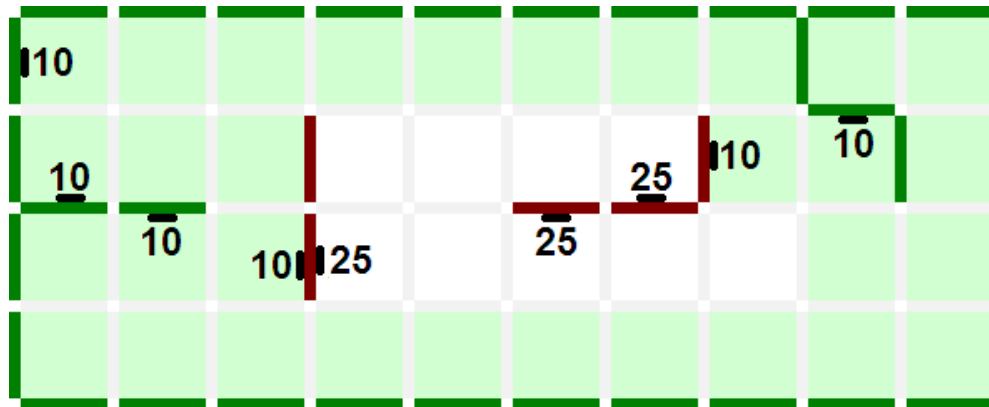
- 2.3.1 Each team must have only **one robot**.
- 2.3.2 Each team must have a **minimum of 2 members and a maximum of 5 members**.
- 2.3.3 The competition is open to students of **all Bachelor's Degree Programmes** of Graz University of Technology
- 2.3.5 Every team member can be registered in only one team.
- 2.3.6 A maximum number of **5 teams** is allowed for the 2017 competition.
  
- Each team has to apply for one of those available slots by sending a **letter of motivation** (1 page, Arial 12pt) to [mkandlho@ist.tugraz.at](mailto:mkandlho@ist.tugraz.at) with the subject: [robotics challenge] (deadline: 04.04.2017). The selection of teams will be based on this letter of motivation.
  
- During **open lab days** (starting 7.4.2017, every second Friday afternoon) teams can use the infrastructure of the robotics-lab and prepare for the competition.
  
- Teams should designate one of its own team members as **captain**

# Play

- 3.3.1 A run begins at the scheduled
- 3.3.2 Each run lasts a maximum of **8 minutes**.
- 3.3.3 Calibration is defined as the taking of sensor readings and modifying a robot's program to accommodate such sensor readings.
  - Once the clock has started, a team may calibrate their robot at as many locations as desired on the arena, but the clock will continue to count down. A robot is not permitted to move using its own power while calibrating.
- 3.3.4 Calibration time is not for pre-mapping the arena and/or victims' location
- 3.3.5 Before a scoring run begins, a dice will be rolled to determine the location of the black and silver tiles.
- 3.3.6 Once the robot is started, a referee will place the black and silver tiles
- 3.3.7 Once a scoring run has begun, no more calibration is permitted (this includes changing of code/code selection).
- 3.3.8 On the day of the competition each team will have **3 scoring runs (best two runs will be scored)**.
- 3.4.3 Teams are not allowed to give a robot any advance information about the field.
  - > The robot is supposed to recognize the field by itself.
- 3.4.4 A "visited tile" means that more **than half of the robot is inside** the tile when looking down from above.

# Scoring <sup>1/2</sup>

- 3.5.1 Successful victim identification: Robots are rewarded points for each successful victim identification (heat + color) in the arena:
  - 10 points per "victim" located at a tile adjacent to a linear wall
  - 25 points per "victim" at other walls.



[<http://rcj.robocup.org/rescue.html>]

- 3.5.2 To **identify a victim**, a robot must
  - stop within 15 cm of the victim while
  - playing a clearly audible, distinct tone for at least **five** (5) seconds.
  - When a robot completes this, it counts as one successful victim identification.

# Scoring 2/2

- 3.5.3 Reliability Bonus =  
[the number of 'successful victim identification' x 10] minus [the number of 'Lack of Progress' x 10].
- 3.5.4 Successful Speed Bump Crossing (5 pts.).
- 3.5.5 Successful Up Ramp Negotiation (horizontal plate – horizontal plate; 20 pts.).
- 3.5.6 Successful Down Ramp Negotiation (horizontal plate – horizontal plate; 10 pts.).
- 3.5.7 Successful Checkpoint Negotiation (each visited checkpoint; 10 pts.).
- 3.5.8 Successful Exit Bonus. A successful exit bonus (10 pts. per victim):
  - is awarded when a robot successfully finishes a round on the start tile.
- 3.5.9 Ties at the end. Ties in scoring will be resolved on the basis of the time each robot took to complete the run.
- 3.5.10 No duplicate rewards (for example, crossing a tile with speed bumps multiple times)

# Lack of Progress

- ❖ The team captain declares a Lack of Progress.
  - ❖ A robot fails to retreat from 'visited' black tile.
    - ❖ For a successful retreat it needs to back up without turning inside the black tile (it has to move straight backwards inside of a black tile).
  - ❖ A robot or a team member damages the arena.
  - ❖ A team member touches the arena or their robot without permission from a referee.
- 
- 3.6.2 If a Lack of Progress occurs, the robot must be returned to the last visited checkpoint.

# End of Play

- 3.7.1 The team captain may declare an "end of round" if the team wants to stop the round early.
- 3.7.2 The round ends when:
  - The time expires (8 minutes).
  - The team captain calls end of round.
  - The robot returns to the start tile and gets the exit bonus.

# Team Responsibilities

- 4.1 Teams have to document their work.
- 4.2 All teams are obliged to share the results of their work (source code, construction plans, documentation, ...) with TU Graz.
- 4.3 All equipment (robots, sensors, further provided material) has to be returned to TU Graz after the competition in complete order and perfect condition.

# Questions, Discussions



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Competition  
13.08.2017 (09:00h – 16:30h)  
TU Graz Inffeldgasse 13

Kick-Off and Information Event  
14.08.2017 (18:00h – 17:00h)  
Seminar-Room 502 Inffeldgasse 100/01

Open Lab Days  
starting 07.04.2017  
every second Friday afternoon  
Robotics Lab Inffeldgasse 13/V

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<http://robotics-challenge.ist.tugraz.at/>

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## CONTACT

Martin Kandlhofer

Email: [mkandlho@ist.tugraz.at](mailto:mkandlho@ist.tugraz.at)

Institute for Software Technology, Graz University of  
Technology

Inffeldgasse 13/V, 8010 Graz, Austria