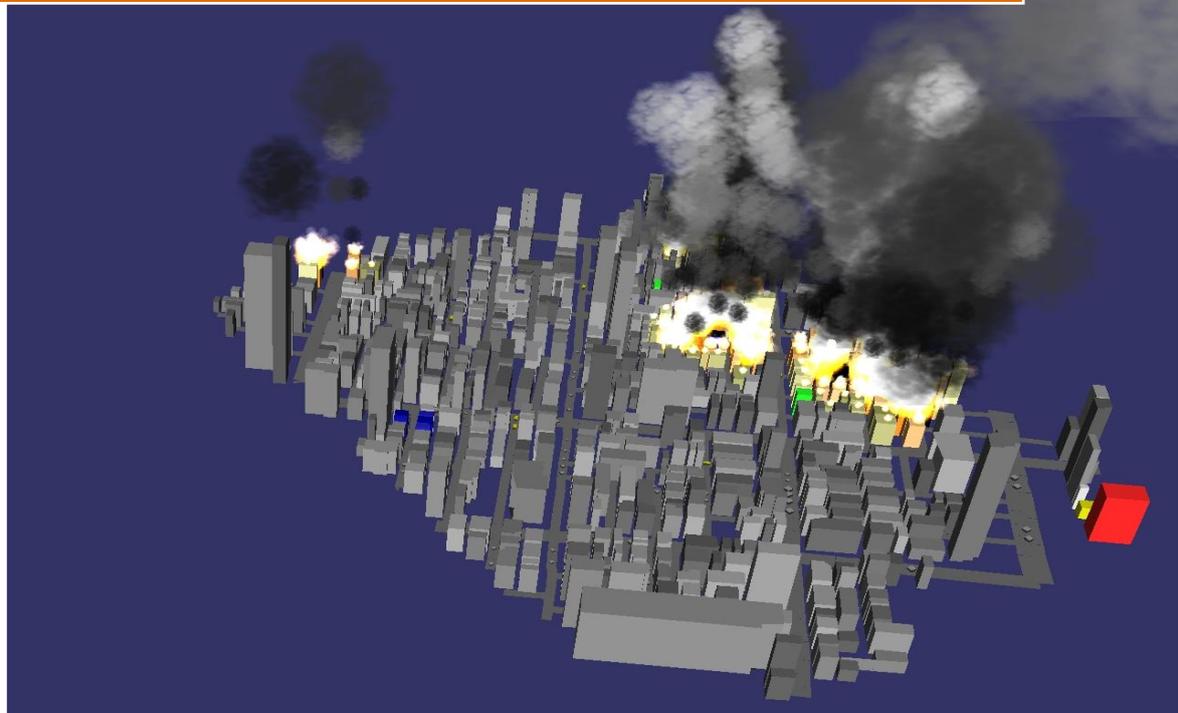# RoboCup 2015

RoboCup Rescue Simulation League Agent Competition

Rules and Setup

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Abstract

This document describes the rules and the ranking formula for the 2015 RoboCup Rescue Agent Simulation League Competitions.

1. Introduction

Disaster rescue is one of the most serious social issues that involve very large numbers of heterogeneous actors in the hostile environment. The RoboCup Rescue project aims to promote research and development in this socially significant domain at various levels involving (i) multi-agent team coordination, (ii) information infrastructures, (iii) personal digital assistants, (iv) a standard simulator, (v) decision support systems, and (vi) evaluation benchmarks for search and rescue strategies that are all integrated into a comprehensive system.

The purpose of the RoboCup Rescue Agent Simulation League is twofold. First, it aims to develop simulators that form a simulation infrastructure able to represent realistic disaster scenarios. Second, it aims to develop intelligent agents that are given the capabilities of the main actors (i.e. Police, Fire Brigades and Ambulance) usually involved in a disaster response scenario.

The RoboCup Rescue Simulation Agent League consists of three competitions:

- RoboCup Rescue Simulation Agent Competition (see Section 2)

- Infrastructure Competition (see Section 3)

- Presentation Competition (see Section 4)

2. RoboCup Rescue Simulation Agent Competition

The RoboCup Rescue Simulation Agent Competition is divided in three rounds, i.e., preliminary round, semi-final round and final round. Each round is sub-divided into two stages and they have the same weight in the final team' score. The stages description follows.

- **FIRST STAGE**

  In the first stage, the competition involves evaluating competing agent coordination algorithms on different scenarios of the RoboCup Rescue Agent simulation platform. Specifically, it involves evaluating coordination algorithms enabling teams of Ambulances, Police Forces, and Fire Brigades to rescue as many civilians as possible and to extinguish fires in cities where an earthquake has just happened. Teams have to individually achieve a score on chosen maps which represent different situations (e.g., civilians and fires, major fire in one corner of a city, blocked roads to refuges, damaged platoon agents, fire maps, civilian maps where only fires need to be extinguished or civilians need be saved respectively) and this will determine how they compare with other teams.

- **SECOND STAGE**

  In the second stage, the competition consists of demonstrating efficient algorithms for coordinating large teams of agents solving one or more of the pre-defined challenge tasks in the Multi-agent Coordination Benchmark (RMAS) platform. The goal of the challenge is to provide scenarios relevant to large-scale urban search and rescue and disaster mitigation. These will include performance metrics to assess technologies in the areas of distributed and centralized multi-agent task allocation, team formation, and path planning. The challenge comes with an open source policy designed to encourage collaboration and the dissemination of ideas and algorithms.

The teams need to implement a code to compete on the Agent RoboCup Rescue platform and another code to compete on the Multi-agent Coordination Benchmark platform. The competition will be carried out in rounds. At each round, an Agent and a Multi-agent simulation will be executed with the score being the summary of both simulations results. The teams with the highest scores in all the maps are then selected to move up the various rounds of the tournament, which is composed of one preliminary round, one semi-final round and one final round.

Currently, the RoboCup Rescue simulation platform consists of a Kernel simulator connecting various specialized simulators:

- **Traffic simulator** – It enforces rules of traffic (e.g. one-way and multi-lane roads), simulates traffic jams and the movements of agents along roads (given agents' speed and direction).

- **Fire Simulator** – It simulates the propagation of fire according to the properties of buildings, wind direction and water content.

- **Civilian Simulator** – It simulates the behavior of civilians, such as movement along roads.

- **Collapse Simulator** – It simulates the generation of new blockades (i.e. aftershock blockages) during the simulation.

On top of this simulator, it was developed a Multi-agent Coordination Benchmark platform whose main purpose is to evaluate more specific tasks in the domain of disaster rescue. The Multi-agent simulation challenge envisions the distributed and centralized assignment of agents to targets. These targets could be either fires to extinguish or buried civilians to rescue. The challenge in this task is to distribute agents among the targets in order to minimize the overall damage, i.e., either reducing the number of burning buildings or increasing the number of rescued civilians.

2.1. Scenarios
A scenario is composed of (i) a map, (ii) a set of initial rescue agent/civilian positions, and (iii) a set of configuration options for each of the simulator components. The Technical Committee will produce a set of scenarios for the competition. All teams will run on the same set of scenarios.

2.2. Maps
The maps will be provided by the Technical Committee.

The number of buildings and roads will be limited to 10.000 of each.

A validation tool will be used to check the full connectivity of roads and building entrances in the map. However, teams do not have the right to complain in the case in which roads or building entrances are not fully connected if evidenced that this results from a validation tool error.

Map Scale: Simulation parameters will be adjusted according to the maps scale, the intended difficult level for the scenario and to match the real world.

2.3. Ranking
The 2015competitionis composed of two stages and both will be evaluated according to the following ranking formula. The stages are composed of several sessions (S), and at each session the participating teams receive an identification ranging from t1 to tn, where n represents the number of teams participating on that session. Each session will have a set of maps (M), and each map will also receive an identification ranging from m1 to mp, where p represents the number of maps in that session. Then,

the teams (T = {t1,…,tn}) will be evaluated at each session for each map (M = {m1,…,mp}). $Score_{ji}^s$ is the score obtained by the team i (i ∈ T) in the map j (j ∈ M) in session s (s ∈ S).

For each session and map, it is calculated

$$SelectiveMin_j^s = Max(Score_j^s) - \left(Max(Score_j^s) - Average(Score_j^s)\right) * 2$$

Then, it is defined a Maximum Score (MaxScore), which is calculated as

$$MaxScore_j^s = n * StepDiffCoef$$

where, n is the number of teams on session s, and StepDiffCoef is coefficient indicating the step between points among teams (we will use StepDiffCoef = 2 in RoboCup Rescue 2015 competition).

The maximum value represented by each step is calculated as

$$MaxStepScore_{j\ step\ \in\{1..MaxScore_j^s\}}^s = \frac{(Max(Score_j^s) - SelectiveMin_j^s)}{MaxScore_j^s * (MaxScore_j^s - step)}$$

Each team i (i ∈ T) point is assigned to the step value, whose step MaxStepScore value is lower than the team' score, but the next MaxStepScore step value is greater than the team' score.

$$TeamPoints_{ij}^s = step \therefore MaxStepScore_{j\ step}^s < Score_{ij}^s < MaxStepScore_{j\ step+1}^s$$

The Team Points are then aggregated as described in the formula below.

$$FinalTeamPointsSession_i^s = \sum_{j=m_1}^{m_p} TeamPoints_{ij}^s$$

The Team Final scores calculated for a session at each stage is then used to generate a ranking for that session in which the team with the highest mean points between the stages is ranked as first, the second highest as second, and so on.

2.4. Rules

a. **Remote Participation**: Remote participation is not allowed in any circumstance. At least one team member must be locally present at the venue.

b. **Rounds**: The competition is structured into 3rounds composed of two stages according to the following order: one preliminary round, one semifinal, and one final round. The preliminary round will be run in two consecutive days (first and second days of competition), while the semifinal and final rounds are executed in one day each (third and fourth day of competition).

c. **Sessions:** Each round consists of several sessions. A session is the set of simulation runs for all teams in a specific scenario. A member of the Technical or Organizing Committee will be responsible for chairing each session. This session chair is responsible for starting the session, collecting scores and logs, and handling any issues that arise during the session. The teams do not have the right to object to the scenarios provided by the Technical Committee.

d. **Code submission:** All teams should submit working ***source codes***(***no binaries*** will be accepted) and adequate ***compile scripts*** at the start of each round. The number of submissions as well as their time and requirements will be explained further in a brief presentation during the competition setup time at the venue. The Technical Committee has the authority to do

adjustments in the time of submissions during the competition. Furthermore, the Technical Committee has the authority to review all submitted teams' source code.

e. **Scenarios**: The scenarios will be provided by the Technical Committee. Teams shall NOT know the disaster situation (map, random seeds, simulator configuration, parameter values) of the session before it starts. All the conditions for a particular disaster situation shall be identical for all the teams.

f. **Agents**: Teams shall implement all kinds of agents and must connect the correct number of agents as specified for the current session.

g. **Shared memory**: Agents **must not** use any form of shared memory, including static memory accessible to all agents, direct function calls between agents, or writing files for use by other agents during the scenario simulation; however, agents are allowed to write files during the *Pre-Computation phase* as described in item h. The Technical Committee may require each agent to run in a different virtual/physical machine if teams are suspected of violating this rule.

h. **Phases**: There will be two phases of execution for each scenario simulation requiring two executions of the team's code. The two phases are: (i) *Pre-Computation phase* (item i) and (ii) *Simulation phase* (item j).

i. **Pre-Computation phase**: The Pre-Computation allows an agent of each type to load and use map-specific and scenario-specific data in order to pre-process them and store it into a file. In this phase, the connected agents are permitted to write into files. However, only one agent of each type can connect to the server and executes such Pre-Computation algorithms. This phase is limited in 2minutes and after the time is elapsed, the server will be terminated. Pre-Computation is allowed under the following conditions:

  I.   The data must be generated by a computer program with no human interaction.
  II.   Information for all known maps must be generated by a single computer program.
  III. The computer program used for computing data for known maps should work properly if it is given a new map.
  IV.   An agent should choose the data file to be used itself.
  V.   Agents should be able to work if no Pre-Computation data is present for a map.
  VI.   The source of the Pre-Computation program shall be open after the competition.

j. **Simulation phase:** The Simulation phase corresponds to the actual team's simulation in the competition scenario (the one valid for collecting the score). The team must connect all its agents to the kernel in order to perform the actual scenario simulation in 3 minutes. The scenario simulation will begin no later than 3 minutes after the first agent begins its handshake with the kernel. All file permissions, except read permission for previously written files, will be removed.

k. **Valid map**: The Technical or Organization is entitled to define whether a map results is valid or invalid in a session. The decision is based on the results of the map, and it may be decided that a map is invalid when all the teams score very close in the map.

l. **Valid games:** Teams will not be entitled to rerun their agent team in most circumstances. It is expected that teams write their agents so that they work correctly with the given simulators. In extreme circumstances teams may have the right of a single rerun. Circumstances that may result in a rerun are:
  I.   A power failure.
  II. Accidental or deliberate termination of a kernel, simulator or agent process.
  III. Java Virtual Machine crash
In the case of rerunning, the latest score is used as the official score of the team on that map.

Examples of events that will not result in a rerun are:
- IV. A simulator crash.
- V. Agents failing to fully connect before the simulation starts.
- VI. Agents crashing or failing to act during the run.
- VII. Observing apparently incorrect behavior by a simulator or the viewer.

Teams that wish to request a rerun must do so in writing. The request must include the team name, the scenario name, a description of the problem and the reasons why the team feels a rerun is appropriate. The request must also state whether the request is for a rerun of just that team or for a full session rerun. Only one Java Virtual Machine crash rerun request is accepted in each session.

m. **Simulation bugs:** It is the responsibility of each team to ensure that its code works correctly with the provided simulators. Although the Technical Committee makes every attempt to provide a reliable simulation environment, the Technical Committee accepts no responsibility for any kind of software failure at competition time. Simulator bugs are not sufficient grounds to request a rerun.

n. **Committee decisions**: If a problem arises during a session then teams may ask for the session chair to resolve the problem. The session chair may make a decision on the spot, or may refer it to the committee. Decisions are final, but if a team strongly disagrees then they may submit a written appeal to the committee. In order to allow the competition to continue, appeals will not be heard during a round, but will be discussed by the committee at the end of each day. The Technical Committee will make final decision at any condition.

o. **Comments from teams:** Only the team leader of participating teams can comment and make suggestions to the Technical Committee about the running of the competition. If these comments or suggestions are deemed derogatory or abusive then the matter will be referred to the RoboCup Trustees and may result in penalties for the team concerned. Penalties may include points reduction or, in the worst case, disqualification. Expect team leaders, other team members are not entitled to comment or make suggestions to the Technical Committee.

p. **Exploits**: A team that knowingly uses bugs in the simulation package to gain an advantage will be disqualified from the competition. Disqualifications will be made only after consultation with the RoboCup Trustees.

q. **Dispute Resolution:** If there is an ambiguity in the rule and any unexpected situation happens, a temporary committee composed of technical, organization and executive committee members and the local chair have the power to take a decision regarding the issue. The temporary committee's decision has the same effect as a rule.

r. **Open source policy:**

- Source code files must be guaranteed open-source access immediately after the end of the competition to guarantee fair play and to encourage community activity after competition.

- Log files and related parameter files will be open.

2.5. Hardware& Software

2.5.1 Cluster Configuration

In the competition venue, there will be several clusters with 4 computers each. One PC per cluster will be reserved for the simulator components; the remaining three will be available to run the agent teams.

2.5.2 Each PC Specification

CPU: Core i7 processor 3.0GHz or higher
RAM: 8.0 GB or higher

2.5.3 Operating System

Linux Ubuntu 12.04 LTS (64bit) or higher with Oracle Java 1.7 run-time or higher

2.5.4 Simulation Packages

The simulation packages used in the 2015 RoboCup Rescue Simulation League competition will be available at http://www.sourceforge.net/projects/roborescue and https://github.com/RMASBench/RMASBench.

To download the latest version of Rescue Agent Simulation Server run the following git command:
git clone git://git.code.sf.net/p/roborescue/roborescue roborescue-roborescue

2.6. Parameters

The parameters and their possible values are the same as those in the 2014 Rules, which are listed in Section 8 of the document RoboCup 2014 – RoboCup Rescue Simulation League Agent Competition (http://roborescue.sourceforge.net/2014/rules2014.pdf).

3. Infrastructure Competition

The Infrastructure competition involves the presentation of already existent tools and simulators of disaster management problems in general. The intent is the evaluation of possible enhancements and expansions of the basic RoboCup Rescue Agent simulator based on the new ideas and concepts proposed in these tools and simulators. The evaluation will be done in a panel and a winner chosen accordingly to a set of factors related to the technical aspects of the tool or simulator and the presentation. The best tool will be selected for further integration with the simulation platform.

3.1. Ranking

The score of each team participating in the Infrastructure Competition is given by the sum of the punctuation given by each other team to a set of evaluative factors related to the innovative aspect of the proposal and the presentation quality and clarity. The team with the highest sum of scores provided by the other teams is the winner of the competition.

Each member of Technical committee who is not a member of a team may participate in the scoring.

Each team should participate and evaluate the infrastructure presentation. Absence of every presentation incurs in a penalty of as much as 50% of the score of each session at each round.

3.2. Duty of Release

In addition to the submission of a Team Description Paper (TDP), teams participating in the Infrastructure competition **must release their source code as an open-source project before the competition**. Even though a team is accepted to participate in the competition, if it does not release the source code, a complete manual, prepare an easy installation and running script files (for example, install.sh and run.sh) before the beginning of the RoboCup 2015 (before July 10th 2015), it will be disqualified and it will not be allowed to participate in the competition, and thus it will not be evaluated and considered for winning the prize.

4. Presentation Competition

The Presentation Competition involves a one section presentation of teams' strategy regarding the agents' structure and programming in general. Each team must participate and present a document of its work. The Presentation session will be defined exactly one month before the competition start in an amendment.

4.1. Evaluation

The teams' presentation will be evaluated according to a set of criteria. Follows the criteria used to evaluate the team's presentation.

- Quality of the Research for RoboCup Rescue

    o **Relevance (5 points)**
    Evaluate how much relevant or important is the team's approach to the goals of the RoboCup Rescue Agent Competition. 0 means it is not relevant and 5 means it is very relevant.

    o **Originality / Significance (5 points)**
    Evaluate how much original is the proposed team's approach to RoboCup Rescue. 0 means it is not original or significant and 5 means it is very original and significant.

- Quality of the Presentation

    o **Slides (Content and Structure) (10 points)**
    Evaluate the quality and completeness of the presentation material with respect to the team's strategy, the readability and structuring. 0 means that the presentation slides are of poor quality with respect to the content and structure and 10 means that it is very informative and complete.

    o **Talk (Audience attention) (5 points)**
    Evaluate how much clear and easy to follow was the presentation and explanation, and whether the presenter had a positive attitude or not, with respect to the presentation and the raised questions. 0 means it is a not clear presentation and bad attitude of the presenter and 5 means it is a clear presentation and good attitude of the presenter.

4.2. Ranking

The score is given by the sum of the punctuation given by each other team to a set of evaluative factors related to the innovative aspect of the proposal and the presentation quality and clarity. Each team receives a score related to the sum of scores provided by the other teams. Each member of Technical Committee who is not member of a team may participate in the scoring.

4.3. Rules

a. The presentation file should be released before the presentation day in PowerPoint or PDF formats.

b. Refusing to participate in this competition leads to disqualify the team from the *RoboCup Rescue Simulation Agent Competition*.

c. The Presentation Competition result does not influence in the RoboCup Rescue Simulation Agent Competition scoring. However, a too bad presentation will cause the disqualification of the team from the RoboCup Rescue Simulation Agent Competition.

d. A too bad presentation means that the team has obtained an overall <u>average</u> Evaluation score of lower than or equal to 10 points, or a Slide criteria <u>average</u> score lower than or equal to 5 points.

e. Each team participating to the *RoboCup Rescue Simulation Agent Competition* must participate and evaluate the presentation of other teams. Absence in every presentation incurs in a penalty of up to 50% of the score of each session of all rounds in the *RoboCup Rescue Simulation Agent Competition*.

5. Acknowledgments

6. References

[1] Cameron Skinner (2010).RoboCup Rescue Simulation League Agent Competition 2010 Rules and Setup.

[2] Farshid et al. (2014). RoboCup Rescue Simulation League Agent Competition 2014 Rules and Setup.