

# RoboCup 2005 Official Rules for the Coach Competition

Revision 0.3

The RoboCup 2005 Simulation League Organizing Committee

January 10, 2005

# 1. Introduction

This document contains official rules of the coach competition at RoboCup 2005. While we will try to cover all cases, if unexpected events do occur, the organizing committee will seek input from the participants and then makes a decision. However, once the committee has made a decision, that decision is final and will not be open to further discussion. More information about this competition can be found at:

<http://www.science.uva.nl/~jellekok/robocup/rc05/>

## 2. Simulation Environment

- Machines: Teams can only use Linux operating system. The Linux distribution will be announced close to the competition.
- Simulator: The latest rcssserver official release will be used. Official copies of the configuration files will be provided.

## 3. Tournament Structure

In this section an overall structure of the coach competition is described. Before going to the following sections, the definition of some words is presented.

- Play Pattern: The term play pattern is used to describe a *simple behavior* that a team performs which is *predictable* and *exploitable* for the coaches. For example, suppose that the goalkeeper goes out of the penalty box when the ball passes mid-field line approaching his goal line. In this document we use the term pattern as a contraction of play pattern.
- Base Strategy: The general strategy of the test team, regardless of the pattern in it.
- Pattern Difficulty: Play patterns will be grouped to three levels of difficulty based on the complexity to detect.

### 3.1. Overall Competition Structure

1. The organizers will create a set of simple strategies to be used as the base strategies of the patterns. Then the patterns will be added to these base strategies, and some sample matches will be played.
2. Participants will be provided with the .rcg log-file of each pattern. It means that only one pattern is activated in a log-file.
3. The no-pattern .rcg log-file of the base strategy will be provided for the coaches. The coaches should be looking for the qualitative difference between the pattern log file and the corresponding no-pattern log file to recognize the pattern correctly.
4. Patterns and base strategies will be defined by Clang rules. So, coaches can definitely describe all of the simple behaviors or patterns by Clang. But, these rules will not be available to coaches.
5. Coaches will coach the standard coachable team in a full 6000 cycle match in front of the fixed-opponent. The strategy of the fixed-opponent is composed of a set of patterns (more than one in each game) given in step 2.
6. The coaches should detect the play patterns of the fixed-opponent in each game and report them. Therefore, coaches have to detect activated patterns in a 6000 cycle match and report them during the game. Note that the strategy of the opponent is not necessarily the same as the base strategy used to create corresponding .rcg log-files of patterns.
7. In each match a combination of easy, medium and hard-to-detect play patterns will be used. The total number of activated patterns will be set to a fixed number. But the number of patterns from each level may not be equal.
8. To avoid random reporting, we will only accept the first N reports from the coach where N is the number of activated patterns in the game.
9. A penalty will be assigned to each wrongly reported pattern.
10. Coaches can send Clang rules to the standard coachable team to facilitate the detection process.

## 3.2. Organizational Points

- a. Before the competitions the organizing committee will solicit suggestions for simple behaviors (play patterns). These suggestions will be filtered and a representative sample of a few of each type of patterns will be defined six weeks before the event (June 1, 2005). The patterns used in the competitions will include those, and also several others that are similar to them.
- b. Participants must submit their coach binary 24 hours before starting of each round.
- c. After receiving all the binaries from the participants, the organizers will decide on the patterns used and a set of log-files will be provided for the coaches. The set of patterns used in a round might be different from those used in the other rounds.
- d. The organizers will select 15 – 20 patterns of each level of difficulty (easy, medium, and hard) to use during a round. Therefore the coaches will be provided with 45 – 60 log files to detect play patterns. The log files do not necessarily contain a full 6000-cycle test game.
- e. The name of a log-file denotes the name of the pattern activated in it and the name of the base strategy used to create that game. i.e. The name of the log-file in which `somepattern` is activated is `somepattern-somestrategy.rcg`. It also means that `somestrategy` has been used as a base strategy to create this log-file.
- f. We will use several base strategies to create log-files of patterns. As we go to higher rounds, more complicated (realistic) strategies will be used.
- g. We will consider an average of 5 minutes for processing time of a log-file. Therefore, in case of using 60 log-files, coaches are given a total  $5 * 60$  minutes to analyze all the log-files. The restriction will be enforced just on the total processing time not the mentioned 5 minutes.
- h. To report a detected play pattern, either a new command will be added to the simulator, or a coach should send a free-form message in the following form:  
(pattern-detected <CLangStr>  
Where `CLangStr` is the same as `somepattern` as stated above. (The exact procedure will be announced later)
- i. In each game 5 or 6 patterns will be activated (The number will be given to the coach as an argument). Coaches must report less than or equal the number of activated patterns. More reports will be ignored.
- j. The cycle number of receiving the above message in the simulator's `.rcf` log-file will be assumed as the detection time of that pattern.
- k. The *whole* process will be done automatically. Participants must provide an automatic offline analyzer and online coach program(s). i.e. participants have to provide automatic program(s) to perform these tasks: Analyze the log-files of the patterns, detect the activated patterns of the opponent in the match and report activated patterns during the match. Participants can separate offline analysis from online detection by submitting two separate binaries. Coaches can create some files to record specifications of play patterns during analysis process and use them in the next steps.
- l. You can either modify your code or submit new code between rounds.
- m. Your coach binary will be executed by a different user in your user group. Your coach binary and other related files have to be given at least group read and executable permissions.
- n. If your coach doesn't work, we will not fix it. For more information on Agent Failures take a look at section 4.1.
- o. The official standard coachable team will be released one month before the competitions (June 13, 2005).

## 3.3. Ranking Coach Performance

To calculate the performance of a given coach the following formulas will be used:

$$\text{score} = \alpha \times \text{Correct report reward} - \text{Incorrect report penalty}$$

$$\text{Correct report reward} = 3000 \times N_c + \sum_{i=1}^{N_c} (6000 - tc_i)$$

$$\text{Incorrect report penalty} = 3000 \times N_i + \sum_{j=1}^{N_i} (6000 - tj_j)$$

Where:

$$\alpha = \frac{\text{Total number of flaws} - \text{Number of activated flaws}}{\text{Number of activated flaws}}$$

$N_c$  = Number of correct reports

$tc_i$  = Time of the  $i^{\text{th}}$  correct report

$N_i$  = Number of incorrect reports

$ti_j$  = Time of the  $j^{\text{th}}$  incorrect report

Note the following points about the formula:

- i. A given coach will be rewarded if he reports an activated pattern correctly. The sooner he detects the pattern, the more score he will get.
- ii. Penalty will be imposed to any incorrect report.
- iii. The Mathematical Expectation of the formula is equal to zero. This means that random reporting won't be worthwhile.
- iv. The incorrect report penalty depends on the time of incorrect detection. This is just to ensure that the Mathematical Expectation of the formula is equal to zero. At any given time, if a coach wants to report a random pattern, the probability of getting reward is equal to the probability of loosing score due to incorrect report.
- v. The constant value 3000 is multiplied to both  $N_c$  and  $N_i$  to make difference between a coach who doesn't say anything during games and the other ones. If a coach doesn't say anything at all, he will receive a score of zero and if another coach detects just one pattern correctly, he will get at least 3001 points (when he reports detected pattern in the cycle 5999!)

The drawback to this formula is that a given coach may get higher rank than the other one just for one cycle earlier report! We would like to consider two coaches that report within a few cycles as identical. Technically speaking reporting a pattern only 10 cycles or so earlier causes no preference. There needs to be some minimum difference in the total score for one coach to be considered better than the other. We use another formula to calculate  $\text{score}'$  which is the score that a given coach would have received, if he reported all of its correct patterns 25 cycles (identity-period) earlier and all of its incorrect patterns 25 cycles (identity-period) later.

$$\text{score}' = \alpha \times \text{Correct report reward}' - \text{Incorrect report penalty}'$$

$$\text{Correct report reward}' = 3000 \times N_c + \sum_{i=1}^{N_c} (6000 - (tc_i - \text{identity period}))$$

$$\text{Incorrect report penalty}' = 3000 \times N_i + \sum_{j=1}^{N_i} (6000 - (ti_j + \text{identity period}))$$

The identity-period is the number of cycles by which the difference in the reporting time yields a tie (which is by default 25 cycles). It can be concluded that for a given coach  $\text{score}'$  is always higher than  $\text{score}$  ( $\text{score}' > \text{score}$ ).

The following relations will be used to rank two coaches A and B.

1. Coach A will be ranked higher if and only if
  - $\text{score}(A) > \text{score}(B)$  and  $\text{score}(A) > \text{score}'(B)$
2. Coach A and Coach B will be considered as tie if and only if
  - $\text{score}(A) = \text{score}(B)$  or
  - $\text{score}(A) > \text{score}(B)$  but  $\text{score}(A) \leq \text{score}'(B)$

Note that if Coaches A and B are tied and Coaches B and C are tied, it is NOT necessarily the case that Coaches A and C are tied.

To make the ranking procedure clear, suppose that in some round, 20 patterns have been introduced to the coaches C1, C2 and C3, and 5 out of them have been activated in the match. We define  $U$  as the set of patterns and  $A$  as the set of activated patterns as follows:

$$U = \{ \text{pattern}_1, \text{pattern}_2, \dots, \text{pattern}_{20} \}$$

$$A = \{ \text{pattern}_1, \text{pattern}_2, \text{pattern}_3, \text{pattern}_5, \text{pattern}_7 \}$$

It can be concluded that:

$$\alpha = \frac{20-5}{5} = 3$$

Assume C1, C2 and C3 report the patterns as follows (each pair denotes the name of the pattern and the reporting time, respectively):

$$\text{C1 reported flaws} = \{(pattern_2, 500), (pattern_9, 4305), (pattern_5, 5999)\}$$

$$\text{C2 reported flaws} = \{(pattern_1, 480), (pattern_6, 4320), (pattern_2, 5990)\}$$

$$\text{C3 reported flaws} = \{(pattern_3, 480), (pattern_7, 5990)\}$$

Therefore, C1 and C2 report two correct patterns and one incorrect; and C3 detects 2 patterns correctly. C1 will get the following scores.

$$\text{Correct report reward} = 3000 \times 2 + ((6000 - 500) + (6000 - 5999)) = 11501$$

$$\text{Incorrect report penalty} = 3000 \times 1 + (6000 - 4305) = 4695$$

The final score would be equal to:

$$\text{score}(C1) = 3 \times 11501 - 4695 = 29808$$

And

$$\text{Correct report reward}' = 3000 \times 2 + ((6000 - (500 - 25)) + (6000 - (5999 - 25))) = 11551$$

$$\text{Incorrect report penalty}' = 3000 \times 1 + (6000 - (4305 + 25)) = 4670$$

$$\text{score}'(C1) = 3 \times 11551 - 4670 = 29983$$

Going through this way, we can calculate scores of C2 and C3. The final results are:

$$\text{score}(C2) = 3 \times 11530 - 4680 = 29910 \quad \text{and} \quad \text{score}'(C2) = 3 \times 11580 - 4655 = 30085$$

$$\text{score}(C3) = 3 \times 11530 - 0 = 34590 \quad \text{and} \quad \text{score}'(C3) = 3 \times 11580 - 0 = 34740$$

By using the mentioned ranking procedure, C3 will rank first because:

$$\text{score}(C3) > \text{score}(C2) > \text{score}(C1) \quad \text{and} \quad \text{score}'(C3) > \text{score}'(C2) > \text{score}'(C1)$$

C2 and C1 will be considered as tie since:

$$\text{score}(C2) > \text{score}(C1) \quad \text{but} \quad \text{score}(C2) \leq \text{score}'(C1)$$

Note that, the maximum and minimum scores in this scenario are:

$$\text{MAX}(\text{score}) = 3 \times 44995 - 0 = 134985$$

$$\text{MAX}(\text{score}') = 3 \times 45120 - 0 = 135360$$

$$\text{MIN}(\text{score}) = 0 - 44995 = -44995$$

$$\text{MIN}(\text{score}') = 0 - 44870 = -44870$$

### 3.4. Tournament Procedure

The tournament procedure will be as follows:

- a. The competition will consist of three rounds.
- b. All the teams in each round will be placed in only one group.

- c. If time allows, multiple games with different activated patterns will be used in each round. If multiple games were used the sum of individual scores in each game will represent the final score of a given coach.
- d. In the first round the first 8 top teams proceed to the second round. In the second round the first 4 teams proceed to the final round. The rank of the coaches in the final round determines the final ranking.
- e. If teams are tied and it is the case that some team(s) in the tie will advance to the next round and some team(s) will not, the tiebreaking procedure described in section 3.5 will be applied.

### 3.5. Tiebreakers

Tiebreakers between  $n \geq 2$  teams will apply in the following priorities:

1. An extra match will be used to rank the tied teams. The higher-ranked team(s) will proceed to the next round. If still there is a tie, the tied teams will continue this procedure.
2. Step 1 will be repeated for at most 3 times.
3. Random selection (e.g. coin toss)

## 4. Failures

### 4.1. Coach Failure

In case of coach failure due to any programmatic problems related to the agent itself, you will have only 2 minutes to fix the problem. If the problem still exists, in very exceptional situations, the organizing committee will decide what to do; otherwise, you will miss the competition.

### 4.2. Server Failure

In case of any failure in simulator the human referee will decide on continuation of the game by consulting the organizing committee. If the committee decides on stopping the game, the match will be restarted from the beginning.

## 5. Remote Participation

General Remark: *Remote participation is only possible in extreme cases.*

We will not have the resources to search for problems in remote participants' startup procedure, so, in their own interest, remote participants are asked to make sure that a 3<sup>rd</sup> party (i.e. we) can start up their code easily and smoothly on a platform that might be different from their development platform. We unfortunately are not able to guarantee the remote participation of a coach if we do not succeed in getting the code quickly and smoothly to run.

## 6. After Competition

The coaches' binaries will be published automatically after the competition. To help us with publishing your team, install everything necessary to start your team below `/home/[teamdir]/RC2005/`. In case a team fails to provide a working executable, we will publish the complete home directory of that team. Also, it will cause disqualification in RoboCup 2006 competitions.