UI-AI 2005 Coach Description : a statistical approach to pattern recognition in robotic soccer

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Abstract. In year 2005 the coach competition is experiencing a large change in the competition structure. The new UI-AI coach team started right after the official rule release by creating a framework for detecting certain strategies and actions named as *patterns* in robocup soccer simulation coach competitions. The term *play pattern* is used to describe a simple behavior that a team performs which is predictable and exploitable for the coaches. We first defined a framework needed to detect such patterns, and therefore presented some learning structures which are performed by the team online and offline. Most of the parts are in their early phases of development, but the whole structure is currently implemented and is working fairly.

1   Introduction

UI-AI Coach project started for the first time in year 2003, the project's main goal was based on deterministic decision making and opponent modelling systems. By the changes applied to this year's coach competition the coach should now be capable of detecting pattern which are in robocup soccer simulation log files. Its necessary for the coaches to understand and detect some play patterns and report them while avoiding miss-detections.

2   Coach Architecture and Learning structure

To detect a pattern, a precise declaration of a pattern is needed. We have simplified the definition of patterns to :
" *Movements by players and opponents in the field by some conditions and restrictions* "

Therefore to detect a certain action we should be able to detect the movements and satisfy the constrains (conditions and restrictions). We first divide the field into small squares. The square edges' length is selected in a way, so that they can contain one player (and the ball maybe) at most. A movement is defined for a player or ball as a change in its coordinates (a number of squares in length and height) in less than a fixed amount of time (say 60 cycles). So we can define a movement by 5 numbers:

X,Y,X_Thr,Y_Thr,Object_Number

X : The Number of squares the movement has in X scale
Y : The Number of squares the movement has in Y scale
X_Thr : The Number of squares which the movement can have less/more than the X specified
Y_Thr : The Number of squares which the movement can have less/more than the Y specified
Object_Number : The object performing the movement which can either be a player or the ball
The coach starts tracking the movements in soccer by creating several soccer fields for each player and the ball. The coach then marks the squares each player passes by and the relative x and y the player transfers during each move. If the move's X and Y considering the error threshold mentioned above (X_THR and Y_THR) is the same as one of the moves that should be detected, then the coach assumes the data as one testcase for the learning phase. It is important to understand that the coach only assumes this data as just one test case, not a detected pattern. The detection is described in offline learning.
There are several other things to accept one data as a test case, which are the conditions for that movement. Assume the Pattern is something like this :
"*the goalie does not respond to kicks straight to the goal*"
The conditions such as not responding and ... are implemented using a simple learning automata which the rules are completely handcoded. This way a data is only accepted as a test case, iff the movement is correct and the output of the automata is also *true*.

3   Offline Learning

The coach detects a certain action if it is repeated for several times during a certain log. So if a fixed number of testcases for a certain movement is found and the conditions predefined for the movement is detected by the learning automata, then the movement data is selected as a detected pattern.

4   Online Learning

After each offline learning phase the team saves a number of tables needed to detect the actions in the logfiles and uses them as a memory for detecting the

actions happening in a online game. The techniques used for defining the boundaries between different patterns are currently simplified.

5   Online Learning Error

The error may increase if the patterns are very similar to each other or the movements are very close or chaotic in the field since we are using a table which is fixed in time. It is impossible to detect patterns which are defined as same things at different times. The error is currently estimated using the X,Y threshold mentioned in defining movements.

6   Conclusion and Future Work

The work done on UI-AI Coach Project is mainly based on movement detection and learning automata. The model therefore lacks opponent modelling to a great extent. In our current implementation the model is simplified in many aspects due to the lack of time to the coach competition we had. Our future work contains on self organized learning automata used for condition detection, memory table creation using reinforcement learning and a new and more concise definition for a movement in soccer.

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