Milestone 1

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1 Introduction

This project is all about a fuzzy logic agent for the the game connect-four. The knowledge of the game, linguistic fuzzy logic for decision making and fuzzy logic as a game mechanic will be used to create a fuzzy logic agent. This agent will be tested by playing other AI that use other approaches like neural networks. The game has been solved for a 7 by 6 board, so this agent will learn to play on boards of different sizes.

2 Objectives

The objective is to create an fuzzy based connect-4 agent that will be at least as good in solving this problem as its counterparts (or humans), if not better. Hereby we can demonstrate whether or not the potential for fuzzy logic to be used in strategic thinking and decision making is justified.

3 Literature Review

3.1 A knowledge-based approach of connect-four

All of the possible strategies have been evaluated by a strategy program named VICTOR. This program has proven that connect-four can always be won by the first player on the standard 7 by 6 board. It was also used to prove that the second player can at least get a draw on a 7 by $2n$ or 6 by $2n$ board if the first player doesn't start in the middle column.

3.2 Linguistic fuzzy-logic game theory

The aspects of a game (strategies, preferences and rules of reasoning) are replaced by their fuzzy logic counterparts. The Boolean two-valued logic becomes

linguistic fuzzy logic, which preserves the vagueness that is present in real strategic situations. This makes the linguistic fuzzy logic "much more straightforwardly relevant to analyzing real-world situations of strategic interaction".

3.3 Fuzzy Tactics: A scripting game that leverages fuzzy logic as an engaging game mechanic

This paper is about a game that uses fuzzy logic as the main aspect. The player gives the troopers rules that they have to follow and tries to give them rules that can make them win the fight. It shows us how to incorporate fuzzy logic in game mechanics and what kind of input variables to use.

4 Approach

4.1 Data

The data contains expert knowledge from the the paper of Allis, L. V. (1988) and our own knowledge of the game. This knowledge will be used to create the membership functions and the rules for the fuzzy logic system. Furthermore, we can use the evaluations from other AI agents of past games as data and generate rules out of that with the methods described in the lectures. The infrastructure of that is nearly finished

4.2 Design

To do its strategic reasoning the fuzzy agent expands nodes of each situation of the game until a certain depth (3). At that depth the fuzzy agent uses a fuzzy system, which will probably exist out of multiple layers, taking in various measurements about the situation. This "leaf-node-fuzzy-system" is then used to give feedback to the parent node lying above about the strength of their situation. This is done in combination with all other sister nodes of the leaf node (or children of the parent node) which will be combined in another fuzzy system which takes in own gain and opponent gain as a input variable and gives feedback on its very own parent node again. This is done all the way to the number of nodes the agent has to consider, after which it can make it's decision

4.3 Implementation

Everything is made in Python and the toolbox made by us to be used for this specific challenge. The general aspects of a fuzzy logic system are made in this toolbox in such manner that they can be used for the implementation of the agent itself.

Furthermore, we implemented ourselves a conversion-toolbox that can convert Matlab fuzzy system designs (fis file) into python structure, so that we can both work with the visualizations of Matlab and the customizations of python