



Rules Based Algorithm for AI game JADDWAL

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Abstract. The video game landscape is populated by games that rely on AI to make the player have a challenging and enjoyable experience, especially as games keep getting better and better in terms of performance and technology, soon it will be hard to ignore it as just a game and perceive it as a technological accomplishment, In this paper, we implemented a Rules-Based Algorithm to create an AI for a relatively simple game, We further analyze how the AI works and functions and if it would be the best suited for a simple video board game.

Keywords: Game AI; Rules Based Algorithm; Schedule.

1. Introduction

Rules based algorithm or Learning classifier system is a method that creates a set of patterns and actions based on a set of rules that it has to follow, this is quite common in behavior modeling, data mining and game strategy. This method allows a system to work with complex patterns in an easier way through breaking it down to smaller, simple parts. A common method that Rules based algorithm follows is that of an {IF :THEN} expression that creates an input-output response from the system. This is a critical and important part of how the algorithm works.

The Classifier system in play also allows multiple condition variables to be present that controls how the algorithm would work, by setting up parameters that would be carried out by the IF THEN expressions. Unlike other algorithms, rules based algorithms start out with nothing and is built up as the algorithm gets developed, this makes it very flexible to use as an algorithm for Data mining, game strategy and behavior modelling that other algorithms cannot follow

JADDWAL is a board video game played by two players, in which both players use a "schedule" to accumulate points. Schedule pieces are placed on the board alternately, as much as possible to influence the AI "person" to get the most points. An attractive schedule reward for the AI "person" is key in the game.

AI in video games is a technology that keeps getting better and better and in the future it might be hard to distinguish real player behaviors from AI behaviour in game, with the rapid development of the climate of video game AI we would like to take a step back to see how it works in a simple video game board game JADDWAL.

The Rules based algorithm that we implement in this game is meant to work well in situations where game strategy is needed, so we used that algorithm in our game. The goal of this paper is to establish if it is possible to use a rules based algorithm on a video board game and if it would work well in said game. Also how the algorithm works in the game and analyze its time complexity.

2. Methods

2.1. JADDWAL Game Illustration

AI will scan the area that he can step and then AI will eat the node that is on time(0) and has the highest score.

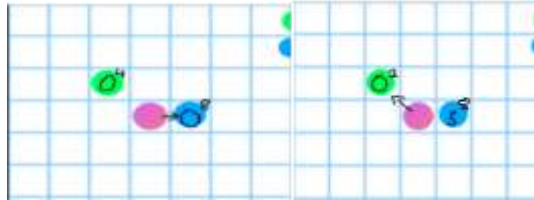


Figure 1 JADDWAL Game first step

In the motion area there is three option: a). If there is no scheduler then motion origin, b). If there is 1 scheduler then eat (even though it's still full) and c). If more than 1 scheduler then eat with the largest value.

If there's no node that is on time(0) and has the highest score, AI will eat the node that is closest to completion (closest to 0), AI will prioritize the node that has the highest value if all nodes are on the same schedule.

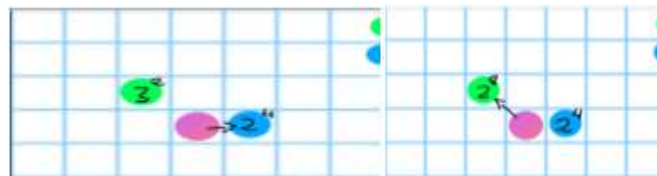


Figure 2 Eat the node that is closest to completion

If there are no node that is closest to completion, if the schedule and the value are the same, the AI will eat what you find at the beginning of the quest.

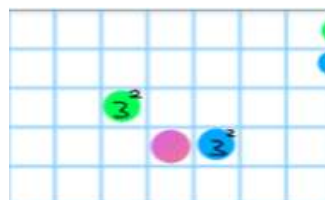


Figure 3 Eat at the beginning of the quest

If there are no nodes in the AI Area, then AI will step towards the node that is closest to completion (closest to 0), AI prioritizes the node that has the highest value if all nodes are on the same schedule

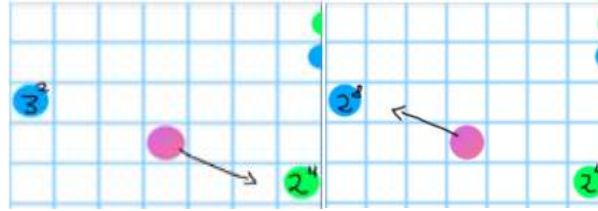


Figure 4 Step towards the node that is closest to completion

If there are no node that is closest to completion, if the value, schedule and distance are the same, the AI will move to the one it met at the beginning of the search.

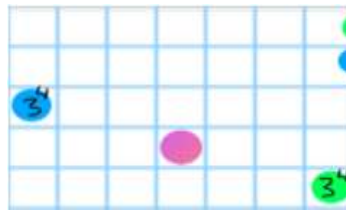


Figure 5 Move to the one it met at the beginning of the search

2.2. JADDWAL Game Analysis

Rules-Based algorithm or Rules-Based classifier is an algorithm based on multiple If..Else rules which is used as a guide for AI systems. Classifier using Capture Area and Scheduler's score.

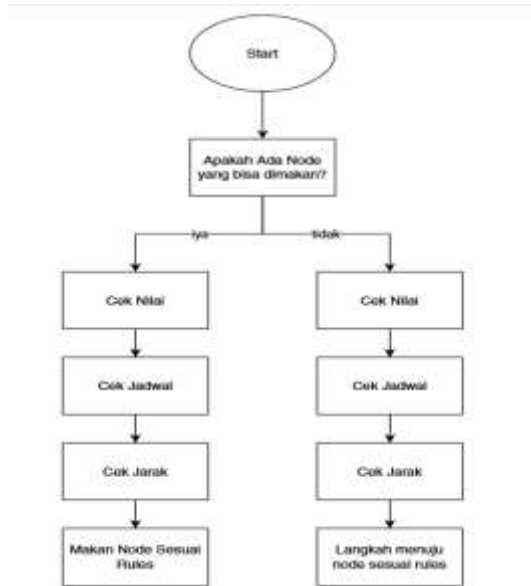


Figure 6 General-to-specific method

Here, we use the general-to-specific method wherein the system starts without rules and specifications, and when the AI starts running, it will add a lot of specifications until it can come to the right decision.

3. Results and Discussion

3.1. Algorithm of the program

The program starts with checking whether any scheduler on board. If there is any then run Person Move to Random Cell process. If there's no scheduler, then run Find Highest Score Scheduler within Capture Area process and then return the schMax. After that process completed, set sch as schMax. The program will then check is scheduler with zero cooldown is exist. If exist, then run Find Highest Score Scheduler within capture area that has zero cooldown process and return schZeroMax value. The program will continue by setting schZeroMax as sch. Lastly the program will check again if sch value is null or no. If sch is null then run person piece move to sch cells. And the program will finish.

3.2. Time Complexity

The AI program has a best-case of constant time complexity. The Best-case occurred when there is no scheduler piece on the board. The AI "person" will execute the "move to random cell" algorithm when this happens. As shown on 4.1.1, the algorithm only consists of three steps so the time complexity is $O(3)$, hence $O(1)$.

Worst-case happens when in every valid movement cells of the AI contains zero-countdown scheduler. The algorithm on 4.1.2 iterates through all the cells and runs all the processes. But since 4.1.3 loops through the scheduler that has a countdown of zero, this algorithm also repeats the same process all over. This makes the time complexity as $O(2n)$ with n as the number of valid movement cells. Based on the mechanic, n should always be 24. In conclusion, the AI "Person" has a linear time complexity. The main program doesn't consist of any loop. But one of the sub-algorithm, which is the "find highest score" algorithm, has to iterate through the valid cell movement. This has a number of 8 or 24 cells. The other two also have a loop in a linear manner. So, the AI "Person" has a $O(n)$ time complexity

4. Conclusions

It would seem that using a rules based algorithm works in a video game requiring an AI that responds to player input and we would say that its flexibility in its own design is what makes it so, the algorithm adapts to the game's core mechanics and performs well to the parameters set for it.

JADDWAL is still a simple video board game so for the future, a more complex game and AI requirement could be used to test it even further if rules based algorithm still hold up in more complex games

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