Search Algorithms in Java language (Unblock Me/ Nº Grupo)

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Abstract—**In this document we describe a simple game, formulate it as a search problem, solve it with different algorithms, then we analyse the results and how we can benefit from them.**

Keywords—Artificial Intelligence, Search, A* Algorithm, Uniform Cost Algorithm, Greedy Algorithm, Depth First Algorithm and Breadth First Algorithm

I. INTRODUCTION

In this project we will implement an application capable of resolving instances of the game "Unblock Me", without any external interaction, using search algorithms of Artificial Intelligence, namely A* Algorithm, Uniform Cost Algorithm, Greedy Algorithm, Depth First Algorithm and Breadth First Algorithm.

II. PROBLEM DESCRIPTION

The game is played on a 6x6 board, with one special piece (typically 1x2), and several other that can vary in size and orientation, but always 1xY (pieces that move vertically) or Xx1 (pieces that move horizontally). The objective of the game is to move the special piece to the right side of the board, moving the other pieces out of the way to make room for it. The challenge lays in the fact that the small size of the board does not allow the pieces to move much without being obstructed by others, sometimes several pieces need to be moved before making room for a certain one to move just one position.

Released in 2009, the game is the most popular release of the Thai company Kiragames [2]. Although hard to find evidence, the game resembles an early 20th century game called Klotski, which was included in Windows3.1's Windows Entertainment Pack [3].
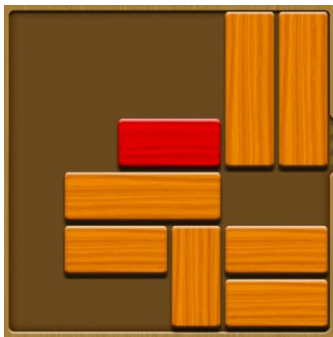
III. FORMULATION OF THE PROBLEM

State Representation: A board can be represented with a 6x6 matrix whose positions range from (0, 0) on the topmost left to (5, 5) on the bottommost right. Every piece can be represented with letters ranging from "A" to "Z" where every piece that occupies multiple positions is represented with the same letter. Two or more pieces cannot occupy the same position and blank space is represented with a dot (".").

Initial State: A board will always start with a key piece facing a target side and there might be pieces obstructing its movement but, by moving the surrounding pieces, it's always possible to achieve a target state. In the earlier levels played, the key piece is always located on the third row.

Target State: The game ends when a key piece reaches a target side. In the earlier levels played, this target side is always the rightmost of the board and can be achieved if the key piece reaches the matrix position (2, 5) (third row, sixth column). As with most puzzles of this nature, the goal should be to finish a level within the least amount of moves possible.

Operators:

P – Letter of the current piece

xPos – Position of the current piece within the horizontal axis.

yPos – Position of the current piece within the vertical axis.

Name:	Pre-conditions:	Effects:	Costs:
MoveUp	yPos > 0; (xPos, yPos-1) = "."	(xPos, yPos-1) = P; (xPos, yPos) = "."	1
MoveDown	yPos < 5; (xPos, yPos+1) = "."	(xPos, yPos+1) = P; (xPos, yPos) = "."	1
MoveLeft	xPos > 0; (xPos-1, yPos) = "."	(xPos-1, yPos) = P; (xPos, yPos) = "."	1
MoveRight	yPos < 5; (xPos+1, yPos) = "."	(xPos+1, yPos) = P; (xPos, yPos) = "."	1

IV. RELATED WORK

During our research there were several projects that we found which will likely assist us throughout the course of the development of the project. The first example details the development of a solver of the Unblock Me game [4]. It uses a Breadth First algorithm and it is implemented in C++ [5]. The second project is also an implementation of this game, but with a couple differences. It is developed using the Python language and the algorithm implemented is the A* [6].

V. Conclusions and Development Prespectives

To summarize, we believe that this initial formulation of the project, allied to the aid of the logic used behind the related projects that were found, will immensely help us in the development of the project, as it has given us the ability to build a solid idea on how we can structure this game and all its different intricacies.

References

[1] Source of the image used to view the gamestate example

[2] Kiragames website

[3] Klotski on the Microft Store

[4] https://www.thanassis.space/unblock.html

[5] https://github.com/ttsiodras/UnblockMeSolver

[6] https://github.com/atheed/UnblockMe-Solver