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Application of Artificial Intelligence on Puzzle-8 Using Steepest Ascent Hill Climbing Algorithm

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Abstrack

The Steepest-Ascent Hill Climbing algorithm is part of the implementation of artificial intelligence. To solve the case problem in Puzzle 8, an algorithm is needed to obtain the final result. Problems that often occur in this algorithm include, 1. the state of all adjacent boxes is worse or equal to its own state, 2. the state of all adjacent cities is the same as its own state, 3. local optimum which is due to the inability to use all operators at once. The way the Ascent Hill Climbing algorithm works is to start with the initial state, perform the test, if it is a goal then stop, and if not, continue with the current state as the initial state. The final result of this research is that there are 5 incorrect positions, after the completion process there are 8 correct puzzle positions according to the final state. Thus the test is stopped because it has obtained the final state.

Keywords: *Heuristics, Steepest Algorithm- Ascent Hill Climbing, Puzzle-8, Searching.*

1. Introduction

Searching is a problem solving technique that develops a problem space systematically in a process. In the development of computer technology today is very sophisticated, this can be seen from the various inventions and applications created to help human work. Sources of information in real time are in the real world environment of everyday life that can be processed in real time by human cognitive intelligence. . The goal of artificial general intelligence operating with limited resources under time constraints in such an environment is to carefully choose which information to process and which to ignore. Even in the minority of cases where sufficient resources may be available, mindfulness can help make better use of them. All real-world tasks come with time constraints, and managing this is a key part of the role of intelligence. Most artificial intelligence researchers ignore this fact. Thus, the majority of existing artificial intelligence architectures are mistakenly based on assumptions (explicit or implicit) about unlimited or sufficient computing resources. Attention has not been recognized as a key cognitive process of artificial intelligence systems and in particular not artificial general intelligence systems.

AI (Artificial Intelligence) or Artificial Intelligence is a branch of computer science that studies how to make an intelligent machine, namely a machine that has the ability to learn and adapt to something. The purpose of Artificial Intelligence (AI) research is how make a machine can think as well as humans can think. AI is used to answer problems that are unpredictable and not algorithmic or procedural. Until now, researchers in the AI field still keep a lot of their homework due to the complexity of research in the field of Artificial Intelligence (AI) and the technology support factor to make it happen. Due to the wide coverage area, Artificial Intelligence (AI) is further divided into sub-sections where these sub-sections can stand alone and can also complement each other. AI makes machines think and act like humans and think and act rationally.

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a) Acting Humanly.
Acting humanly is a system that approaches by imitating human-like behavior which was introduced in 1950 with the workings of testing via teletype, namely if the examiner (integrator) cannot distinguish between humans and computers, the computer is said to have passed (become artificial intelligence).
b) Thinking Humanly.
That is a system that is carried out by means of introspection, namely the capture of human psychological thoughts on a computer, this is often tested with neurons to other neurons or brain cells with other brain cells, the way of learning is through experiments.
c) Thinking Rationaly.
This is a very difficult system, because there are often errors in principles and practice, this system is known as computational reasoning.
d) Actng Rationaly.
That is a system that takes action by creating an intelligent robotics that replaces human tasks [1].

The word heuristic comes from a Greek verb, namely heuriskein, which means "to seek" or "to find". The heuristic method is a method that uses a system approach in performing search optimization. In the search method, the word heuristic is defined as a function that calculates the estimated cost (estimate) from the starting point to the destination point (Suyanto, 2007: 22). Heuristics have information about the cost to achieve the goal state from the current state. With this information, the heuristic search can make considerations to develop or examine the nodes that lead to goal states. For example, searching for a route on a map, if we depart from city A to destination city B which is located north of city A, with a heuristic search, the search will be more focused towards the north (with cost information to the goal), so in general the heuristic search is more efficient. [2].

There are two slightly different types of Hill Climbing, namely Simple Hill Climbing and Steepest-ascent Hill Climbing (Hill Climbing with the sharpest/steepest slope). Simple Hill Climbing, in simple terms, directly selects a new state that has a better ("steep") path than the previous paths without taking into account other "steep" trails. While Steepest Ascent Hill Climbing, as the name implies, will evaluate all states that are under the current state and choose the state with the most “steep” path [3]. The steepest ascent hill climbing method is an algorithm method that is widely used for optimization problems. One application is to find the shortest route by maximizing or minimizing the value of the existing optimization function. The optimization function in question is the replacement of the user's point, thus affecting the shortest route sought. [4].

Heuristics is a technique that improves efficiency in the search process, but at the expense of completeness. To measure the performance of the search method, there are four criteria that can be used:

a) Completeness: does the method guarantee finding a solution if a solution exists;
b) Time complexity : how long it takes;
c) Space complexity : how much memory is required;
d) Optimality: does the method guarantee to find the best solution if there are several solutions [5].

To solve problems in an algorithm, a solution is needed by paying attention to how to see the shortest rule path in order to obtain the goal. The main purpose of this search is to provide instructions to make it easier to complete the calculation of the shortest path to save energy and time [6]. The optimal solution step to complete the puzzle, in this study, used the Steepest Ascent Hill Climbing method. The steps in calculating the SAHC (Steepest Ascent Hill Climbing) are: (1) counting the squares that occupy the correct place, (2) calculating the possible movements. (3) get the value of h(n) using manual calculations using the sum of squares that occupy the correct place, (4) compare the

heuristic values of the possible movements, (5) apply the search flow of the SAHC (Steepest Ascent Hill Climbing) algorithm with heuristic values h(n) which has been obtained [7].

2. Research Methodology

To obtain a good research methodology is needed systematically. The steps used in this research are as follows:

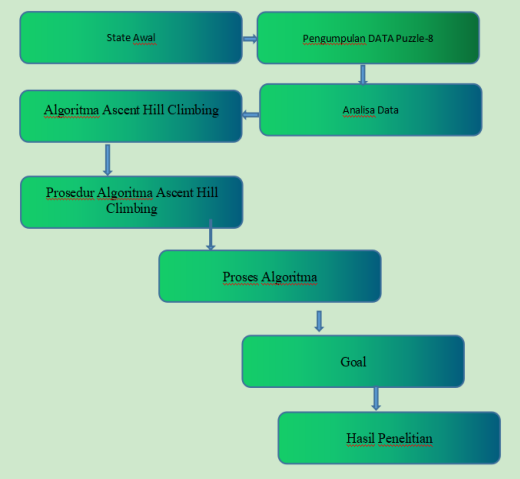

Figure 1. Research Methodology

Information:

a) Initial Steta.
The initial data will be processed using the Steepest-ascent Hill Climbing algorithm.
b) Data Collection Puzzle 8.
All 8 puzzle data are arranged according to the initial data.
c) Steepest-ascent Hill Climbing Algorithm.
Puzzle-8 completion process.
d) Data Analysis.
The data is analyzed according to the initial state.
e) Ascent Hill Climbing Algorithm Procedure.
In solving the case of the Steepest-ascent Hill Climbing algorithm, you must follow the procedure according to the rules that have been set.
f) Process Algorithm.
The algorithm process is carried out step by step starting with the initial state to the goal state.
g) Goal.
Goal state is the final result of the search method on the Steepest-ascent Hill Climbing algorithm.
h) Research Results.
The results of the study were in the form of a difficult 8 puzzle arrangement according to the sequence and initial data.

3. Results and Discussion

State space solution form
Example :
x = Row = [1. 2. 3]
y = Column = [1. 2. 3]

Thus, suppose the state space = all possible positions of the city in puzzle 8 We enter the puzzle position on lift 7 which is in the initial state with position 3.1
The rules that must be followed include:
The initial box position is empty(x,y)
x = Rows of boxes that are still empty
y = Column box that is still empty

1) The basic rule that must be done is to move the empty box to the top of the puzzle where if x>1 then (x-1,y)
2) The basic rule that must be done is to move the empty box down Puzzle if x<3 then (x+1,y)
3) The basic rule that must be done is to move the empty box to the right. Puzzle if x<3 then (x+1,y)
4) The basic rule that must be done is to move the empty box to the left. Puzzle if x>1 then (x,y-1)[8].

The simple Hill Climbing solution process has several steps that must be done, firstly, this algorithm will stop if it gets a value, secondly, using operators has an effect on finding a solution and thirdly, it is not allowed to see the previous step, even if it is one value. Based on the research conducted, the implementation of the Hill Climbing algorithm in the case of Puzzle 8 [9].To carry out the process of searching to produce a Goal value, then See the initial state to produce a goal value.

Puzzle data in order of

1	2	3
4	5	6
7	8	

Initial State/Raw Data

1	2	3
7		5
8	4	6

Figure 1. Initial Data

Shape Space State Puzzle-8

Figure 2. State Space

Steps in the search process Searching using the Ascent Hill Climbing Algorithm:
1) Iteration 1
   Check initial state = Goal
   Current state = Initial state
   The current state is subject to 3 operators at once then the result is

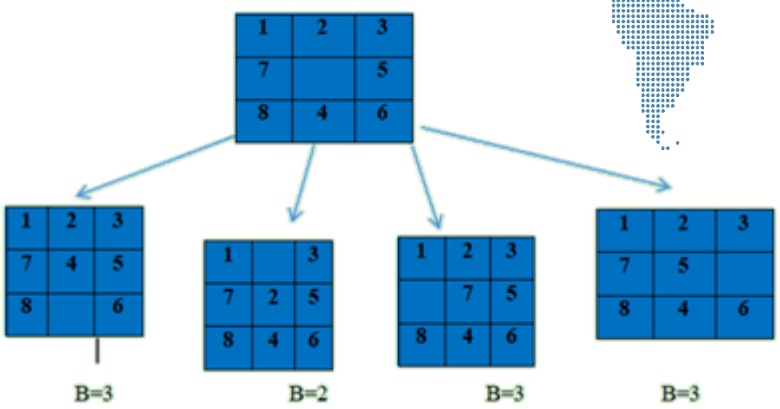

Figure 3. Iteration 1

2) Iteration 2

Check initial state = Goal

Current state = Initial state

The current state is subject to 3 operators at once. In the picture above there are 3 values that have the same truth value, then the next step is to try all the correct results so that the search process is fast which will be used for the next search process.After searching for the search results from three puzzles that have the same value, the search process that quickly produces the goal value.

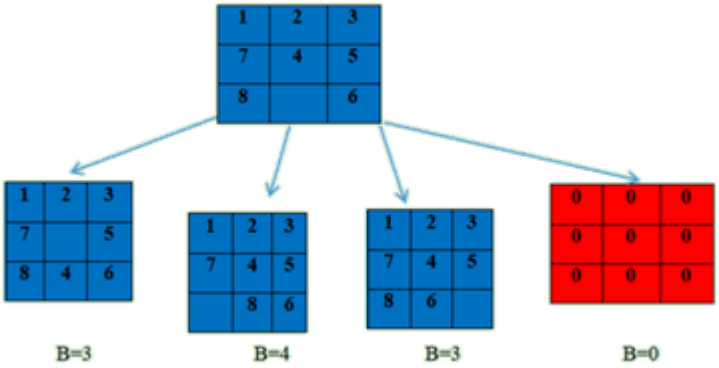

Figure 4. Iteration 2

3) Iteration 3

Check initial state = Goal

Current state = Initial state

The current state is subject to 4 operators at once then the result is

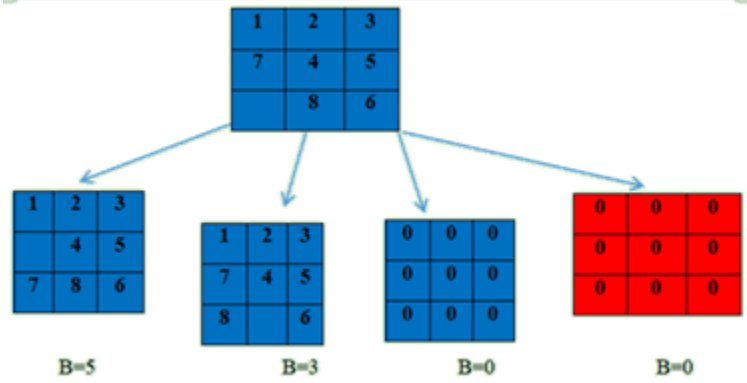

Figure 5. Iteration 3

4) Iteration 4
Check initial state = Goal
Current state = Initial state
The current state is subject to 5 operators at once then the result is

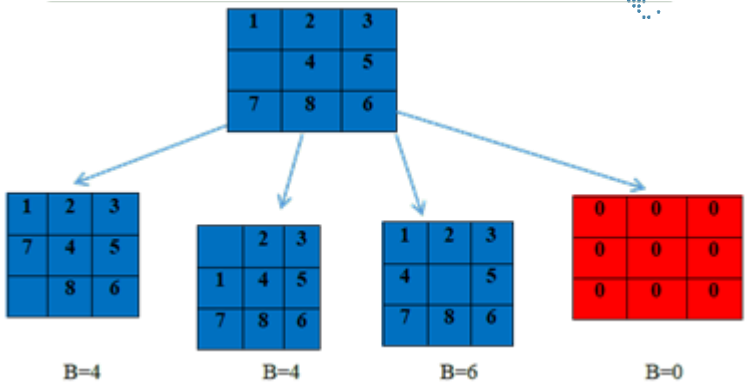

Figure 6. Iteration 4

5) Iteration 5
Check initial state = Goal
Current state = Initial state
The current state is subject to 6 operators at once then the result is

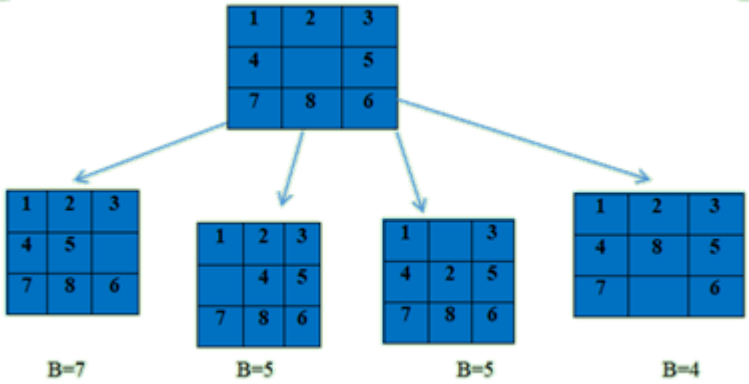

Figure 7. Iteration 5

6) Iteration 6
Check initial state = Goal
Current state = Initial state
The current state is subject to 7 operators at once then the result is

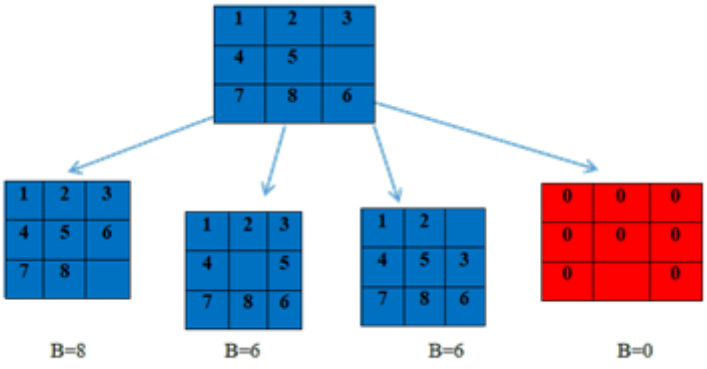

Figure 8. Iteration 6

7) Iteration 7
Check initial state = Goal
Current state = Initial state
The current state is subject to 8 operators at once then the result is

1	2	3
4	5	6
7	8	

Figure 9. Iteration 7

From the results above, it is obtained that the correct position has fulfilled B = 8, so the search is stopped. To get fast and correct results, it is necessary to follow the rules that have been determined. To find out the search process can be seen in the table below:

Table 1. Test

No	Process	Result
1	1+1+1+0+0+0+0+0	3
2	1+1+1+0+0+0+0+0	3
3	1+1+1+0+0+0+0+0	3
4	1+1+1+0+0+0+0+1	4
5	1+1+1+0+0+0+1+1	5
6	1+1+1+1+0+0+1+1	6
7	1+1+1+1+1+0+1+1	7
8	1+1+1+1+1+1+1+1	8

From the picture above, it can be explained that the position of the value 0 can be said to be a position that has the wrong sequence value and the value 1 states that the position of the value is correct.

4. Conclusion

The final result of the completed test can be concluded that the steepest ascent hill algorithm can be applied in solving the Puzzel-8 case by paying attention to the heuristic value used. Completion of -8 puzzles depends on the initial state, if the initial state of the position of the puzzle number is wrong, the search process will take a long time, and vice versa if the position of the correct value is a lot, it will take a little time to complete. Therefore, sometimes the puzzle reaches the best desired position which can be called the global optimum. If during the search process, if the same position value is found in the grid shift rule, then the next step is to carry out the search process one by one and must be considered, which process step is the fastest to find the Final Goal.

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