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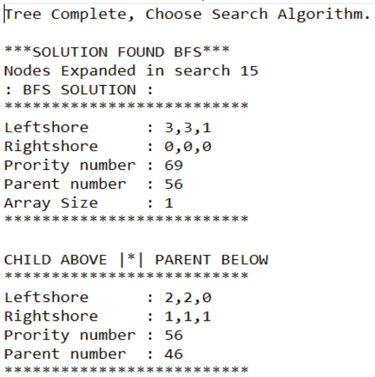
Artificial Intelligence

Project 1

Methodology:

The idea behind my program is to create every possible outcome for every possible valid move to generate a graph. This graph completes when one of the states in the graph is equivalent to the Goal.txt file. It loops until a solution is found. The graph takes care of game rules, meaning that every option generated is a valid move. Graphmaker.cpp creates an unweighted graph. If a node in that graph is equivalent to another node, that nodes priority becomes the same as the equivalent node. I.E a loop is formed.



```
Tree Complete, Choose Search Algorithm.

***SOLUTION FOUND BFS***
Nodes Expanded in search 15
: BFS SOLUTION :
**************************
Leftshore       : 3,3,1
Rightshore      : 0,0,0
Prority number : 69
Parent number  : 56
Array Size      : 1
**************************

CHILD ABOVE |*| PARENT BELOW
**************************
Leftshore       : 2,2,0
Rightshore      : 1,1,1
Prority number : 56
Parent number  : 46
**************************
```

Figure 1 Example of BFS output

Figure 1 on the right shows two nodes, When Graph maker creates the graph, it creates a BFS Heap. The node number is the priority, a nodes parent number is that nodes connection to the previous node. By doing this method I create an even playing field for all the algorithms. Since they don't have to make anything, I just plug them into the graph to run. The graph also turns in on itself when it gets a duplicate Right Shore, Left Shore value. This way it avoids turning into a Tree graph.

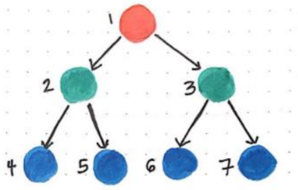


Figure 2 How Graph maker creates the starting graph Each number is a priority; each priority has their parents' priority

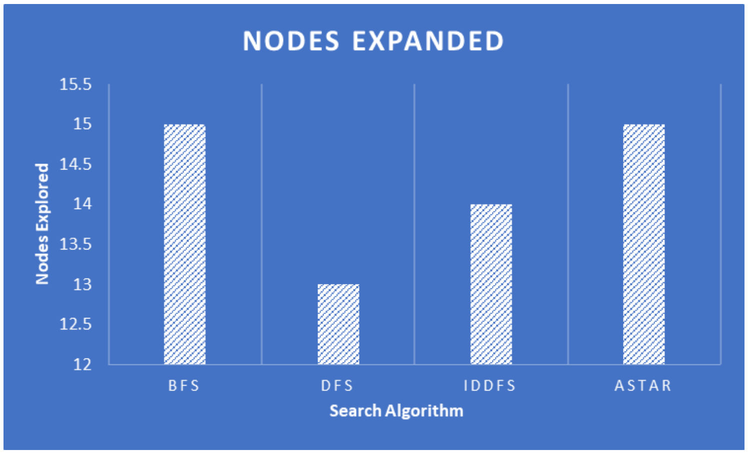
BFS: The graph from graphmaker.cpp is generated as a priority queue that's a solution for BFS. It goes left to right one level at a time. Not a whole lot to say on this one. I could have just run a for loop and gotten the same result as the BFS. However, my BFS assumes that the graph is not in order. It creates a queue of my custom struct and pops it every time it looks for a new node. it then adds the pop nodes children to the back of the queue.

DFS: Only needed around 2-3 lines of code to change from BFS for DFS to work, instead of loading all the structs to the back of queue, we instead send them to the front. Now the left-hand side of the array is completed before the right.

IDDFS: The way this works in my program, is a DFS search with a limit of depth 5 (5 nodes away from the root node). During my search if a parent enters the queue with a depth of over 5 it gets added to another history queue. When the current queue is zero then I append history queue to the current queue. Then Increment the depth limit by 5, this results in checking 5 levels every time.

ASTAR: This one was fun, to computer ASTAR heuristic I added up right shores wolfs and sheep. The more animals that ASTAR had on Right Shore the larger the heuristic, The movement cost was the nodes away from the root. The final cost of ASTAR was f = (animals – nodes from Root.) ASTAR generates this data for all items in the queue then goes down the best path, generates the numbers again and repeats.

Results: My Results are poor, The algorithms run fine, the space complexity of Graphmaker is really bad. Like O(n!) bad. So, that basicaly makes every test outside of the first one impossible to do. My computer just wont run it. However that being said DFS was my best preformer with a result of 13 Nodes Explored and the correct solution. Astar got 15 nodes and so did BFS and IDDFS got 14 nodes making it my second place winner. But Astar is still my favorite, just because I feel like I made it work, instead of a formula.



Discussion:

I did not expect to fail tests 2,3 because of my solution, But that's hindsight for you. In the future I'll avoid testing just one set of conditions. That being said, I thought Astar would have been the winner fullstop, and perhaps with a bigger sample size that would work. From the graph it seems that smaller scale problems don't really beenfit from more complex search algorithms. Which would explain why the other algorithms show up so often.

Conclusion:

The Results where not what I had expected. I wish I could have gone back to day one and tried again using a different method to achieve this result. What I can say is that this was a incredible hard programing feat for me, but the learning experience was good. DFS was the best preformer, and that makes sence if the solution is in the left half of the graph. Though my solution didn't work perfectly it was still an intresting experiment. I think its pretty cool that Astar was not the best pick, it shows that in small scale problems sometimes its better to keep it simple.