CIS*3700 - Introduction to intelligent systems
Assignment 1 conclusion

How to use:

To use the software I wrote as part of this assignment one simply needs to launch the terminal, navigate to the folder that contains the 3 files (CGW.py, SearchProblem.py, SlidingTiles.py), and type "<interpreter> <problem>.py" as an example:

python CGW.py

Each of the two problem set algorithm's will run the necessary code to find a solution; CGW.py will run a depth first search once; SlidingTiles.py will generate 50 random 3*3 sliding tiles board, and for each of those boards will run once through a depth first search and a second time through a Breadth first search.

Results:

Depending on the problem size the length to problem solution will vary. The cabbage, goat, wolf problem although not taking long to run both solutions (under half a second) the breadth first wins out by ~.10 seconds. Despite this at larger problem sizes the breadth-first search starts to fall apart; when comparing the times for the sliding puzzle problem the Depth first search tends to be faster by 15 - 20 minutes.

Below I've laid out a comparison of each search algorithm in it's current implementation:

Depth-first search	Breadth-first search
Generates each state once	Generates each state n 25-n times (doesn't save states between rounds)
Compares each state to the destination state	Compares only the states at the current given level to the destination state
Touches more states overall	Touches less states overall
Given a level l has a solution and is less than the width of the tree t tends towards finding a solution faster	Given multiple solutions at varying depths and tends towards finding the shorter solutions faster (finds a solution at a lesser depth faster)

As one can see each of the search algorithms has things that it is better at, but in general if one was searching for a solution to a problem and wanted the solution that took the least steps or the solution in the fastest time, a breadth first search is the way to go. Below I've included the results of several run through's of the problem sets as a comparison of total time and the output given.

One problem in terms of getting accurate data for to compare the two functions is the length of time it takes for a problem set to complete. When each problem takes a combined 1/2 hour to 3/4 of an hour collecting large amounts of data in a shirt period of time for comparison is difficult

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[[3, 4, 1], [2, ' ', 6], [5, 7, 8]]
Depth first search results:
Time taken: 0:12:01.696698

Breadth search results:
Time taken: 0:33:28.766573



[[8, 1, 4], [7, 2, 6], [3, ' ', 5]]
Depth first search results:
Time taken: 0:10:28.079236

Breadth search results:
Time taken: 0:26:58.623006



[[5, 8, 7], [4, 2, ' '], [6, 1, 3]]
Depth first search results:
Time taken: 0:10:26.821016

Breadth search results:
Time taken: 0:26:56.972831



[[7, 1, 3], [2, 4, 5], [' ', 8, 6]]
Depth first search results:
Depth = 24 Total States = 99099 - Solution: ddluurdldrulurddluruldlu
Depth = 24 Total States = 117135 - Solution: ddlulurddluurrdlulddruul
Depth = 24 Total States = 123159 - Solution: ddlulurddruuldrdluurdlul
Depth = 24 Total States = 167575 - Solution: ddlulurrdldrulurddlurull
Depth = 22 Total States = 374291 - Solution: ddlluurdruldrullddrulu
Depth = 18 Total States = 390577 - Solution: ddlluurrdlulddrulu
Depth = 22 Total States = 391752 - Solution: ddlluurrdluldrdlurdluu
Depth = 24 Total States = 399614 - Solution: ddlluurrdllurdlurdldrulu
Depth = 24 Total States = 592271 - Solution: dluldruldrruldrdluurdlul
Depth = 24 Total States = 664142 - Solution: dluldrruldrdluurdluldrul
Depth = 24 Total States = 664243 - Solution: dluldrruldrdluurdllurdlu
Depth = 24 Total States = 718314 - Solution: dlurddlurulddruuldrdlulu
Depth = 18 Total States = 770442 - Solution: dlurdlurddluurdllu
Depth = 24 Total States = 771465 - Solution: dlurdlurddluldruurdldluu
Depth = 22 Total States = 772401 - Solution: dlurdlurddluruldruldlu
Depth = 24 Total States = 774681 - Solution: dlurdlurddllururdlldrulu
Depth = 24 Total States = 781570 - Solution: dlurdlurdldruldrulurdllu
Depth = 24 Total States = 1004901 - Solution: dldlurrruldldrurdluurdllu
Depth = 24 Total States = 1043386 - Solution: dldruulddruuldrulddrullu
Depth = 24 Total States = 1045410 - Solution: dldruulddrulurddlurdlulu
Depth = 22 Total States = 1045805 - Solution: dldruulddrulurdldrullu
Depth = 24 Total States = 1287299 - Solution: dllurdrulddruldruuldrull
Depth = 24 Total States = 1287377 - Solution: dllurdrulddruldrulurdlul
Depth = 20 Total States = 1294561 - Solution: dllurdruldrdluurdlul
Depth = 22 Total States = 1295331 - Solution: dllurdruldrdluruldrull
Depth = 24 Total States = 1302429 - Solution: dllurdrulldrrdlulurrdlul
Depth = 24 Total States = 1317188 - Solution: dllurdrdlluurrdlulddruul
Depth = 20 Total States = 1348315 - Solution: dllurrdlurddluurdlul
Depth = 22 Total States = 1349085 - Solution: dllurrdlurddluruldrull
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Depth = 24 Total States = 1457841 - Solution: dlldruruldddlurrdluurdllu
Depth = 24 Total States = 1528015 - Solution: dlldrruldluurdruldrdluul
Depth = 24 Total States = 1528691 - Solution: dlldrruldluurrdlurddluul
Depth = 22 Total States = 1798127 - Solution: lddrululdrdrullurrdllu
Depth = 24 Total States = 1843639 - Solution: lddruldruuldldruruldddluu
Depth = 18 Total States = 1844197 - Solution: lddruldruuldruldlu
Depth = 24 Total States = 1844598 - Solution: lddruldruuldrulldruldrul
Depth = 24 Total States = 1850615 - Solution: lddruldrulurdluldruldrul
Depth = 16 Total States = 1851457 - Solution: lddruldrulurdllu
Depth = 24 Total States = 1853145 - Solution: lddruldruldlururdlldrulu
Depth = 22 Total States = 1857367 - Solution: lddruldrulldruurdldluu
Depth = 24 Total States = 1862193 - Solution: lddrullurddrululdrurdllu
Depth = 24 Total States = 1925125 - Solution: ldlurddrululdrdrulurdllu
Depth = 24 Total States = 1930744 - Solution: ldlurddruldrululdrurdllu
Depth = 22 Total States = 1945512 - Solution: ldlurdlurdrdlulurrdllu
Depth = 24 Total States = 1992280 - Solution: ldlurdrdluulddruurdldluu
Depth = 20 Total States = 1993290 - Solution: ldlurdrdluuldrurdllu
Depth = 24 Total States = 1993791 - Solution: ldlurdrdluuldrruldruldlu
Depth = 22 Total States = 1996956 - Solution: ldlurdrdlulurdlurrdllu
Depth = 22 Total States = 2434484 - Solution: ldrdluurddlulurddrulul
Depth = 22 Total States = 2436966 - Solution: ldrdluurddlurdlurdlulu
Depth = 20 Total States = 2440254 - Solution: ldrdluurdluldruldrul
Depth = 22 Total States = 2444988 - Solution: ldrdluurdldlurdlurdluu
Depth = 24 Total States = 2447597 - Solution: ldrdluurdldrullurdrdluul
Depth = 12 Total States = 2447936 - Solution: ldrdluurdllu
Depth = 22 Total States = 2456966 - Solution: ldrdlulurdlurdlurrdllu
Depth = 18 Total States = 2474796 - Solution: ldrdluldruurdldluu
Depth = 24 Total States = 2475600 - Solution: ldrdluldruurdlldruldrulu
Depth = 24 Total States = 2478393 - Solution: ldrdluldruldruurdlldrulu
Depth = 24 Total States = 2480059 - Solution: ldrdluldruruldddlurruldlu
Depth = 22 Total States = 2480835 - Solution: ldrdluldruruldrulddluu
Depth = 24 Total States = 2492471 - Solution: ldrdlurulddlurruldldrulu
Depth = 22 Total States = 2498146 - Solution: ldrdluruldldruruldddluu
Depth = 16 Total States = 2499838 - Solution: ldrdluruldruldlu
Depth = 22 Total States = 2500927 - Solution: ldrdluruldrulldruldrul
Depth = 20 Total States = 2558052 - Solution: ldrdllururdldlurdluu
Depth = 18 Total States = 2559976 - Solution: ldrdllururdlldrulu
Depth = 20 Total States = 2563837 - Solution: ldrdllurdlururdldluu
Depth = 22 Total States = 2564544 - Solution: ldrdllurdlurdlururdllu
Depth = 24 Total States = 2565777 - Solution: ldrdllurdlurruldruldddluu
Depth = 24 Total States = 2573947 - Solution: ldrdllurrulddlurruldddluu
Depth = 22 Total States = 2575874 - Solution: ldrdllurruldldruruldlu
Depth = 24 Total States = 2576311 - Solution: ldrdllurruldruldddlurdluu
Depth = 22 Total States = 2576522 - Solution: ldrdllurruldruldldrulu
Depth = 20 Total States = 2697001 - Solution: llddrurdlluurrddlulu
Depth = 24 Total States = 2744721 - Solution: llddrruldruldluurrddlulu
Depth = 22 Total States = 2784227 - Solution: lldruldruldrrdluurdllu
Depth = 22 Total States = 2811005 - Solution: lldruldrrdluuldrurdllu
Depth = 24 Total States = 2812237 - Solution: lldruldrrdlulurdlurrdllu
Depth = 20 Total States = 2976419 - Solution: lldrdruldrullurrdllu
Depth = 24 Total States = 2978054 - Solution: lldrdrullurddruuldruldlu
Depth = 22 Total States = 2978314 - Solution: lldrdrullurddrulurdllu
Depth = 22 Total States = 3050268 - Solution: lldrrdluuldruldrurdllu
Depth = 24 Total States = 3062716 - Solution: lldrrdlulurdldruurdldluu
Depth = 22 Total States = 3063655 - Solution: lldrrdlulurdruldruldlu
Depth = 24 Total States = 3065563 - Solution: lldrrdlulurrdluldruldrul
Depth = 16 Total States = 3066425 - Solution: lldrrdlulurrdllu
Depth = 24 Total States = 3098025 - Solution: lldrrdllurdlurdluurrdllu
Time taken: 0:09:12.912250

Breadth search results:
Depth = 12 Total States = 2647 - Solution: ldrdluurdllu
Depth = 16 Total States = 23565 - Solution: lddruldrulurdllu
Depth = 16 Total States = 23565 - Solution: ldrdluruldruldlu
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Depth = 16 Total States = 23565 - Solution: lldrrdlulurrdllu
Depth = 18 Total States = 69993 - Solution: ddlluurrdlulddrulu
Depth = 18 Total States = 69993 - Solution: dlurdlurddluurdllu
Depth = 18 Total States = 69993 - Solution: lddruldruuldruldlu
Depth = 18 Total States = 69993 - Solution: ldrdluldruurdldluu
Depth = 18 Total States = 69993 - Solution: ldrdllururdlldrulu
Depth = 20 Total States = 209829 - Solution: dllurdruldrdluurdlul
Depth = 20 Total States = 209829 - Solution: dllurrdlurddluurdlul
Depth = 20 Total States = 209829 - Solution: ldlurdrdluuldrurdllu
Depth = 20 Total States = 209829 - Solution: ldrdluurdluldruldrul
Depth = 20 Total States = 209829 - Solution: ldrdllururdldlurdluu
Depth = 20 Total States = 209829 - Solution: ldrdllurdlururdldluu
Depth = 20 Total States = 209829 - Solution: llddrurdlluurrddlulu
Depth = 20 Total States = 209829 - Solution: lldrdruldrullurrdllu
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