1) After calculating how many nodes per second, BFS search always had the highest nodes per second, then A\*star search, then lastly ID-DFS search. I also printed out the total processed nodes and the total time to analyze what was different for each search.

BFS has high nodes per second because it processes a larger amount of nodes than ID-DFS but also completes the search much quicker, making the nodes per second pretty high.

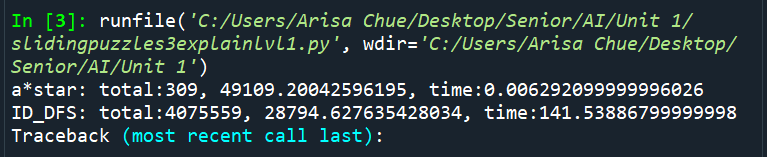
This makes sense because ID-DFS has to traverse all the way down before going sideways and then run the search again for every depth. There is also some inefficiency when the search wanders back up to a previous level, so it would take a longer time to find the solution, which causes the low nodes per second.

I was surprised with A\*star having pretty high nodes per second, but that’s because the search is very quick and also examines fewer nodes with the heuristic approach (small number divided by small) so the nodes per second would not be very small.

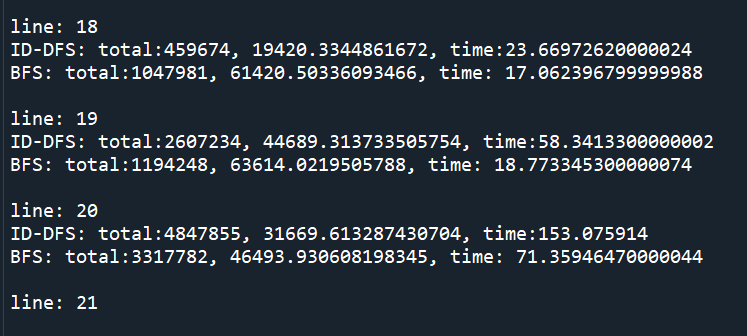
1) The searches from least nodes per second to highest nodes per second is: astar, ID-DFS, then BFS. The astar search has the least nodes per second because it has to run the heuristic function, and as explained in Optimize Level 1, it can be really inefficient to generate the taxicab distance each time, so astar would take more time.

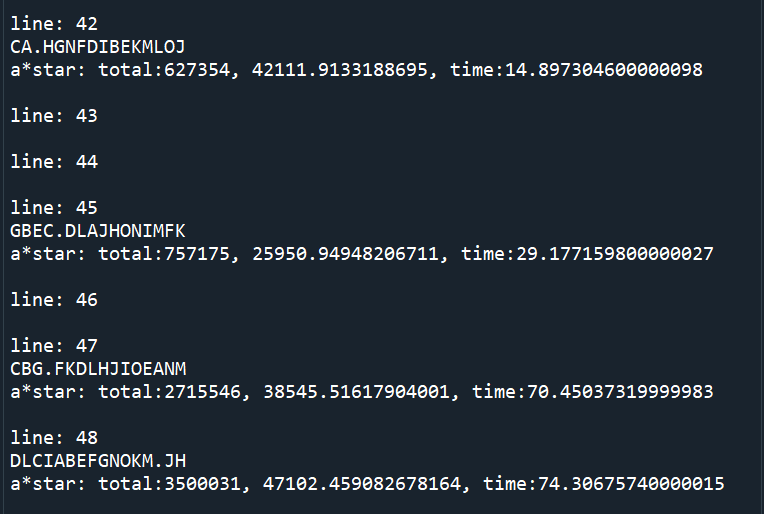
BFS and ID-DFS searches had similar nodes per second, but ID-DFS has less nodes per second because it uses sets, which needs to make more memory space if they get filled with a lot of items. ID-DFS also has to create a copy set of the ancestors each time, which takes more time. BFS, on the other hand, has a high nodes per second because it doesn’t require outside algorithms and doesn’t have to create copies for each child.











3) When I ran a 31-length puzzle for 8-puzzle, 15-puzzle, 24-puzzle, the nodes per second decreased as the puzzle size increased. This makes sense because it would take a longer time to solve a larger puzzle since you would have to add more children to the heap. A longer time would cause smaller nodes per second since the denominator increases.

1

ABCDEFGHIJKLMNOPQRSTUVW.X

ABCDEFGHIJKLMNOPQRS.UVWXT

2

ABCDEFGHIJKLMNOPQR.TUVWSX

ABCDEFGHIJKLMNOPQRSTUV.WX

ABCDEFGHIJKLMNOPQR.SUVWXT

ABCDEFGHIJKLMN.PQRSOUVWXT

3

ABCDEFGHIJKLMNOPQ.STUVRWX

ABCDEFGHI.KLMNJPQRSOUVWXT

ABCDEFGHIJKLMNOPQRSTU.VWX

ABCDEFGHIJKLMNOPQRXSUVW.T

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ABCDEFGHIJKLM.OPQRNTUVWSX

ABCDEFGHIJKLMNOPQ.RSUVWXT

4

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ABCDEFGHIJKLMNOPQRXSUV.WT

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ABCDEFGHIJKL.MOPQRNSUVWXT

ABCDEFGHIJKL.MOPQRNTUVWSX

ABCDEFGHIJKLMNOP.QRSUVWXT

ABCD.FGHIEKLMNJPQRSOUVWXT

ABCDEFGHIJKL.NOPQMSTUVRWX

ABCDEFGH.JKLMIOPQRNSUVWXT

ABCDEFGHIJKL.NOPQMRTUVWSX

ABCDEFGH.JKLMIOPQRNTUVWSX

ABCDEFGHIJKLMNOPQS.TUVRWX

ABCDEFGHIJKLMO.PQRNTUVWSX

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ABCDEFGHIJKLMNOP.RSTUQVWX

ABCDEFGHIJKLMNOPQRTXUVWS.

ABCDEFGHIJKLMNOPQWRSUV.XT

ABCDEFGHIJKLMNOPQWRTUV.SX

ABCDEFGHIJKLMSNPQR.OUVWXT

ABCDEFGH.JKLMINPQRSOUVWXT

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ABCDEFGHIJK.LNOPQMRSUVWXT

ABCDEFGHIJKLMSNPQRXOUVW.T

ABCDEFGHI.KLMOJPQRNSUVWXT

ABCDEFGHIJKLN.OPQMRTUVWSX

ABCDEFGHIJKLMNOPQWRTUVS.X

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