CE 533 Homework 1 Report

Explanation of Code

There are three main classes in coding part. These are for A* algorithm, tower of hanoi structure, and arranging the rods in tower of hanoi structure. The main method which search the route to the goal is search_route method. Shortly, a queue data structure is implemented for searching since it suit best for tower of hanoi problem. All the results are sorted by their f-scores in queue, so selecting the disk with the least f-score is done without effort. As in all other A* implementations, open set stores the points which we know how to go, but their neighbors are not yet explored. Closed set stores the points which we explored all of their neighbors.

Heuristics

I used 6 different heuristics although 3 heuristics are required since all the heuristics I used do not contribute to the solution much. However, when I used different coefficients for the heuristics I observed that number of visited nodes and f-scores starts change. These heuristics are listed below:

1-) Number of disks at the third rod
2-) Number of disks to the third rod
3-) Size of disks at the third rod
4-) Size of disks other than the third rod
5-) Distance of disks to the third rod
6-) Size of disks other than the third rod according to distance

Since we have a basic type of structure in our case(three rods, and different number of disks), these are the ones I could think of as heuristics. I thought, number of disks are not much effective since the numbers are low. Therefore, size of disks can give better results. Since our goal case is ordering all the disks in the third rod, all the heuristics are calculated according to it. At first, these heuristics seemed admissible to me because of the mentioned explanation before sentences. However, as I mentioned before, no change was observed by implementing purely them. So, I decided to add coefficients to them. After this, I got different results. Results are also listed below:

All of the 6 heuristics give the same results without coefficients:

Number of disks	Number of visited nodes	Cost
4	16	141
5	32	291
6	64	588
7	128	1186
8	256	2380
9	512	4770

As seen, number of visited nodes increases by 2' s powers, and cost is twice the previous one. If we add coefficients, we get differents results.

For example, sixth heuristic is calculated by sum of size of disks other than the third like below:

```
heuristic_6 = sum(position.rods[0])*2 + sum(position.rods[1])
```

However, if we calculate this heuristic with below coefficients:

```
heuristic_6 = sum(position.rods[0])*94 + sum(position.rods[1])*24
```

We get:

Number of disks	Number of visited nodes	Cost
4	24	239
5	32	313
6	86	821
7	128	1209
8	334	3149
9	512	4793

Therefore, to my understanding, there are some thresholds while calculating heuristics. When we surpass those thresholds, we start to get different results.

In conclusion, according to different heuristics, the path and cost can be affected greatly. So, by working on more admissible heuristics and trying them, we can get much better results.