MINI-PROJECT 2 ANALYSIS

COMP 472
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1. SOLUTION COST

- Average solution length (Heuristic 1): 9.061
- Average solution length (Heuristic 2): 9.061
- Average solution length (Heuristic 3): 9.317
- Average solution length (Heuristic 4): 8.976

- Average solution length (UCS): 8.537
- Average solution length (GBFS): 9.543
- Average solution length (A/A*): 8.665

Lowest-cost solution when using Heuristic 4.

Lowest-cost solution when using the UCS algorithm. Hence in our case, uninformed search generally yields a smaller solution-cost.

2. ADMISSIBILITY (HEURISTIC 1)

H1 = The number of blocking vehicles

- This heuristic is admissible because it never overestimates the real cost. Indeed, for every blocking car, it is guaranteed that they will have to be at least moved once (cost = 1 for each moved car) to get them out of the way. If there's no car blocking, the cost = 1. Hence $h(n) \leq h^*(n)$ for all n.

2. ADMISSIBILITY (HEURISTIC 2)

H2 = The number of blocking positions

- This heuristic is not admissible. Indeed, in the case where there is only one blocking car (horizontal, of length at least 3), this heuristic returns a cost of 3. However, the real cost is only 2 because you have to move the car once to the valet, then the ambulance once to the valet. Therefore, $h(n) \not\leq h^*(n)$ for all n.

2. ADMISSIBILITY (HEURISTIC 3)

H3 = The value of h1 multiplied by a constant λ of your choice, where $\lambda > 1$

- This heuristic is not admissible. Indeed, in the case where $\lambda = 2$ and there are 2 vertical cars blocking the ambulance, this heuristic returns a cost of 4. However, the real cost could be only 3 if no cars are blocking the blocking cars because you would have to move each car once (cost = 1 for each moved car), and then the ambulance once. Therefore, $h(n) \not\leq h^*(n)$ for all n.

2. ADMISSIBILITY (HEURISTIC 4)

H4 = The number of blocking vehicles, but count the vehicle twice if it is directly blocked itself between two cars (cannot move at all).

- This heuristic is admissible because it never overestimates the real cost. Indeed, for every blocking car, it is guaranteed that they will have to be at least moved once (cost = 1 for each moved car) to get them out of the way. But if they are themselves directly blocked (absolutely cannot move) by two other cars, it is guaranteed that at least one of the secondary blocking cars has to be moved at least once before being able to move the actual blocking car. Also, if there's no car blocking blocking the ambulance, the cost = 1 because only the ambulance has to move. Hence $h(n) \leq h^*(n)$ for all n.

2. ADMISSIBILITY AND SOLUTION OPTIMALITY

H1: admissible, 9.061 avg solution length.

H2: not admissible, 9.061 avg solution length.

H3: not admissible, 9.317 avg solution length.

H4: admissible, 8.976 avg solution length.

After analyzing the heuristics admissibility and solution length results of our puzzles, we can conclude that an admissible heuristic definitely yields a shorter solution path.

3. EXECUTION TIMES

- Average execution time (Heuristic 1): 6.239 sec
- Average execution time (Heuristic 2): 6.511 sec
- Average execution time (Heuristic 3): 4.414 sec
- Average execution time (Heuristic 4): 5.873 sec

- Average execution time (UCS): 12.513 sec
- Average execution time (GBFS): 3.871 sec
- Average execution time (A/A*): 7.647 sec

Lowest execution time when using Heuristic 3 or GBFS.

In our case, informed search (GBFS, A/A*) is faster than uninformed search in the vast majority of the puzzles.

4. INTERESTING FACTS

H1: admissible, 6.239s avg execution time.

H2: not admissible, 6.511s avg execution time.

H3: not admissible, 4.414s avg execution time.

H4: admissible, 5.873s avg execution time.

After analyzing the heuristics admissibility and average execution time results of our puzzles, we can see that admissible heuristics sometimes yields a faster execution time than non-admissible ones, and sometimes not. Therefore, we can conclude that in our case, heuristic admissibility does not really have an impact on execution time, and that an admissible heuristic does not necessarily mean a faster execution time.