**Heuristic Analysis**

In this report, relevant analysis and optimal plans of three planning questions are presented. First, optimal plans and their lengths in shown in table 1. From this table, we know the plan length of three problems are 6, 9, and 12 respectively.

Table 2, 3, and 4 represents the results of analyses of three problems. I choose three different uniformed planning algorithms, including uniform\_cost\_search (UCS), breadth\_first\_search (BFS), and depth\_first\_graph\_search (DFGS) for comparison. From the video lectures, we learned that depth first search cannot guarantee a shortest path, which did not identify the optimal plan for the planning problems as well. Therefore, although DFGS requires the least expansion and time for computations in all of three problems it cannot be considered as a feasible approach. By comparing the performance of UCS and BFS in three problem, I notice that both approaches found optimal plans. However, BFS requires less expansion and time for computation, thus, I will consider BFS is the best algorithm among these three.

For the comparison of heuristic functions with A\* search, I choose ignore preconditions and level-sum functions. Level-sum function took too much time for problem 3, therefore, I didn’t provide the relevant result. From the observation on three tables, ignore preconditions function require less time for computation, but level-sum function needs less expansions. Due to the trade-off between the computation time and the performance, I would assume that there is no obvious winner between these two heuristic functions.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Problem 1** | **Problem 2** | **Problem 3** |
| **Plan Length** | 6 | 9 | 12 |
| **Optimal Plan** | Load(C1, P1, SFO)  Load(C2, P2, JFK)  Fly(P2, JFK, SFO)  Unload(C2, P2, SFO)  Fly(P1, SFO, JFK)  Unload(C1, P1, JFK) | Load(C1, P1, SFO)  Load(C2, P2, JFK)  Load(C3, P3, ATL)  Fly(P2, JFK, SFO)  Unload(C2, P2, SFO)  Fly(P1, SFO, JFK)  Unload(C1, P1, JFK)  Fly(P3, ATL, SFO)  Unload(C3, P3, SFO) | Load(C1, P1, SFO)  Load(C2, P2, JFK)  Fly(P2, JFK, ORD)  Load(C4, P2, ORD)  Fly(P1, SFO, ATL)  Load(C3, P1, ATL)  Fly(P1, ATL, JFK)  Unload(C1, P1, JFK)  Unload(C3, P1, JFK)  Fly(P2, ORD, SFO)  Unload(C2, P2, SFO)  Unload(C4, P2, SFO) |

Table 1 Optimal plans of three problmes



Table 2 Analysis of problem 1



Table 3 Analysis of problem 2



Table 4 Analysis of problem 3