# Design decisions

**Solve 1**

The use of depth\_first\_graph\_search as the searching algorithm was the obvious choice for solve 1. Apart from the massively reduced time taken, depth first also presents benefits over breadth first. As the problem requires all steps to be taken to get to the solution depth first is the best option. This can be seen in the performance data for solve 1 and the two depth first searches.

**Solve 2**

Solve 2 was much the same as solve 1, using depth\_first\_graph\_search and depth\_first\_tree\_search produced the solution in 0.03s. A tangible benefit was still seen over breadth first tree search, however, the elapsed time wasn’t noticeable for breadth first graph search. (note: this difference may be significate if run on a slower machine). Massive improvements in compute times where seen due to the elimination of elements which did not appear in the final state.

**Solve 3**Implementation of rotation adds more completeness to the search as more combinations are possible within the goal state. However, as the assembly problem 3 doesn’t remove doomed states the search problem can get stuck in an infinite loop rotating a part continuously. Therefore, depth first tree search didn’t return a result for solve 3.

**Solve 4**

The use of the heuristic benefits the overall outcome of the result, reliability and repeatability. This can be seen in the reduced time in the time taken to solve. The heuristic also produces drastically more reliable results. Due to the nature of the depth first search you can get “lucky” and find the result quicker. This results in the occasional reduction in compute time when using depth first tree and graph search.

# Performance data for different search methods

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Search method | Solve 1 | Solve 2 | Solve 3 | Solve 4 |
| breadth\_first\_tree\_search (seconds) | 127.8 | 0.16 | 0.031 | 14.53 |
| depth\_first\_tree\_search  (seconds) | 13.4 | 0.03 | DNF | 0.015 |
| depth\_first\_graph\_search  (seconds) | 5.8 | 0.03 | 0.016 | 0.017 |
| breadth\_first\_graph\_search  (seconds) | 623.8 | 0.47 | 0.016 | 0.86 |
| A\* Heuristic | NA | NA | NA | 0.012 |