|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Methods | Expansions | | | | Time (seconds) | | | | Plan length | | | |
| P.1 | P.2 | P.3 | P.4 | P.1 | P.2 | P.3 | P.4 | P.1 | P.2 | P.3 | P.4 |
| Breadth First Search | 43 | 3343 | 14663 | 99736 | 0.006 | 1.808 | 9.568 | 89.44 | 6 | 9 | 12 | 14 |
| Depth First Graph Search | 21 | 624 | 408 | 25174 | 0.003 | 2.734 | 1.075 | 3654.2 | 20 | 619 | 392 | 24132 |
| Uniform Cost Search | 60 | 5154 | 18510 | 113339 | 0.008 | 3.074 | 13.237 | 157.41 | 6 | 9 | 12 | 14 |
| Greedy Best First Graph Search with h\_unmet\_goals | 7 | 17 | 25 | 29 | 0.001 | 0.017 | 0.0333 | 0.1179 | 6 | 9 | 15 | 18 |
| Greedy Best First Graph Search with h\_pg\_levelsum | 6 | 9 | 14 | 17 | 0.397 | 8.963 | 19.912 | 55.596 | 6 | 9 | 14 | 17 |
| Greedy Best First Graph Search with h\_pg\_maxlevel | 6 | 27 | 21 | 56 | 0.2966 | 17.998 | 24.308 | 133.89 | 6 | 9 | 13 | 17 |
| Greedy Best First Graph Search with h\_pg\_setlevel | 6 | 9 | 35 | 107 | 0.545 | 13.159 | 73.213 | 512.80 | 6 | 9 | 17 | 23 |
| Astar search with h\_unmet\_goals | 50 | 2467 | 7388 | 34332 | 0.008 | 2.048 | 8.121 | 61.149 | 6 | 9 | 12 | 14 |
| Astar search with h\_pg\_levelsum | 28 | 357 | 369 | 1208 | 1.014 | 228.51 | 579.93 | 3326.9 | 6 | 9 | 12 | 15 |
| Astar search with h\_pg\_maxlevel | 43 | 2887 | 9580 | 62077 | 1.0602 | 1311.7 | 9998.4 | 18535.2 | 6 | 9 | 12 | 14 |
| Astar search with h\_pg\_setlevel | 33 | 1037 | 3423 | 37912 | 1.2994 | 1190.1 | 9924.9 | 54569.5 | 6 | 9 | 12 | 14 |

**Table illustrating Expansion values, Time in seconds and Plan length for all 4 problems for different algorithms**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Methods | Expansions | | | | Actions | | | |
| P.1 | P.2 | P.3 | P.4 | P.1 | P.2 | P.3 | P.4 |
| Breadth First Search | 43 | 3343 | 14663 | 99736 | 20 | 72 | 88 | 104 |
| Depth First Graph Search | 21 | 624 | 408 | 25174 | 20 | 72 | 88 | 104 |
| Uniform Cost Search | 60 | 5154 | 18510 | 113339 | 20 | 72 | 88 | 104 |
| Greedy Best First Graph Search with h\_unmet\_goals | 7 | 17 | 25 | 29 | 20 | 72 | 88 | 104 |
| Greedy Best First Graph Search with h\_pg\_levelsum | 6 | 9 | 14 | 17 | 20 | 72 | 88 | 104 |
| Greedy Best First Graph Search with h\_pg\_maxlevel | 6 | 27 | 21 | 56 | 20 | 72 | 88 | 104 |
| Greedy Best First Graph Search with h\_pg\_setlevel | 6 | 9 | 35 | 107 | 20 | 72 | 88 | 104 |
| Astar search with h\_unmet\_goals | 50 | 2467 | 7388 | 34332 | 20 | 72 | 88 | 104 |
| Astar search with h\_pg\_levelsum | 28 | 357 | 369 | 1208 | 20 | 72 | 88 | 104 |
| Astar search with h\_pg\_maxlevel | 43 | 2887 | 9580 | 62077 | 20 | 72 | 88 | 104 |
| Astar search with h\_pg\_setlevel | 33 | 1037 | 3423 | 37912 | 20 | 72 | 88 | 104 |

**Table analyzing Expansion values vs Actions values for all 4 problems for different search algorithms**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Methods | Time (seconds) | | | | Actions | | | |
| P.1 | P.2 | P.3 | P.4 | P.1 | P.2 | P.3 | P.4 |
| Breadth First Search | 0.006 | 1.808 | 9.568 | 89.44 | 20 | 72 | 88 | 104 |
| Depth First Graph Search | 0.003 | 2.734 | 1.075 | 3654.2 | 20 | 72 | 88 | 104 |
| Uniform Cost Search | 0.008 | 3.074 | 13.237 | 157.41 | 20 | 72 | 88 | 104 |
| Greedy Best First Graph Search with h\_unmet\_goals | 0.001 | 0.017 | 0.0333 | 0.1179 | 20 | 72 | 88 | 104 |
| Greedy Best First Graph Search with h\_pg\_levelsum | 0.397 | 8.963 | 19.912 | 55.596 | 20 | 72 | 88 | 104 |
| Greedy Best First Graph Search with h\_pg\_maxlevel | 0.2966 | 17.998 | 24.308 | 133.89 | 20 | 72 | 88 | 104 |
| Greedy Best First Graph Search with h\_pg\_setlevel | 0.545 | 13.159 | 73.213 | 512.80 | 20 | 72 | 88 | 104 |
| Astar search with h\_unmet\_goals | 0.008 | 2.048 | 8.121 | 61.149 | 20 | 72 | 88 | 104 |
| Astar search with h\_pg\_levelsum | 1.014 | 228.51 | 579.93 | 3326.9 | 20 | 72 | 88 | 104 |
| Astar search with h\_pg\_maxlevel | 1.0602 | 1311.7 | 9998.4 | 18535.2 | 20 | 72 | 88 | 104 |
| Astar search with h\_pg\_setlevel | 1.2994 | 1190.1 | 9924.9 | 54569.5 | 20 | 72 | 88 | 104 |

**Table analyzing Times in seconds’ vs Actions values for all 4 problems for different search algorithms**

* Which algorithm or algorithms would be most appropriate for planning in a very restricted domain (i.e., one that has only a few actions) and needs to operate in real time?
* Uniformed search algorithms like Breadth First Search, Depth First Search, and Uniform Cost Search will be appropriate for planning in a very restricted domain as they outperform all other search algorithms in terms of time complexity for problem 1(problem 1 has very few actions).
* Which algorithm or algorithms would be most appropriate for planning in very large domains (e.g., planning delivery routes for all UPS drivers in the U.S. on a given day)?
* Greedy Best First Graph Search will be appropriate for this situation as they have better time complexity than A star algorithms and perform well on large domains as evident from results for problem 2 and 3. A star algorithms are also well suited; however, they are less efficient with respect to the time complexity.
* Which algorithm or algorithms would be most appropriate for planning problems where it is important to find only optimal plans?
* A star algorithms will prove to be the best of all if the sole aim is to find the optimal paths. As can be viewed from the Expansion values, the number of expansions by A star algorithms is much larger than other peer algorithms. This ensures that A star is more likely to find the optimal paths.