## **PROJECT SPECIFICATION**

### **Build a Forward Planning Agent**

**Planning Graph Implementation**

| CRITERIA | MEETS SPECIFICATIONS | Student Comments |
| --- | --- | --- |
| Mutexes pass all test cases | (AUTOGRADED) Student code passes all Project Assistant test cases for:   * ActionLayer mutual exclusion rules:   + \_inconsistent\_effects()   + \_interference()   + \_competing\_needs() * LiteralLayer mutual exclusion rules:   + \_inconsistent\_support()   + \_negation() | * ActionLayer mutual exclusion rules implemented in my\_planning\_graph.py:   + \_inconsistent\_effects() → lines 13-29   + \_interference()→ lines 33-49   + \_competing\_needs() → 53-69 * LiteralLayer mutual exclusion rules implemented in my\_planning\_graph.py :   + \_inconsistent\_support() → lines 75-91   + \_negation() → lines 93-97 |

**Heuristic Implementation**

| CRITERIA | MEETS SPECIFICATIONS | Student comments |
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| Planning graph heuristics pass all test cases | (AUTOGRADED) Student code passes all Project Assistant test cases for: Correctly implemented   * PlanningGraph class heuristics:   + h\_levelsum()   + h\_maxlevel()   + h\_setlevel() | * PlanningGraph class heuristics implemented in my\_planning\_graph.py:   + h\_levelsum() → lines 144-180   + h\_maxlevel() → lines 183-221   + h\_setlevel() → lines 225-277 |

**Experimental Results**

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**Measurements with scaling expansions and Search Time 100% normalization**

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| Analyze the search complexity as a function of domain size, search algorithm, and heuristic. | Report includes a table or chart to analyze the number of nodes expanded against number of actions in the domain.   * The chart or table includes data for all search & heuristic combinations for air cargo problems 1 and 2 * The chart or table includes data **at least** one uninformed search, two heuristics with greedy best first search, and two heuristics with A\* on air cargo problems 3 and 4 * Report includes at least a one paragraph discussion of these results that analyzes the growth trends as the problem size increases | The table in the previous section involves results for all problems and all algorithms in the table below and the graph. Generally we see a positive correlation between the number of nodes and the number of actions except in the case of depth\_first\_search and greedy\_best\_first\_search with h\_pg\_max\_level. The growth of the new nodes is also dependent on the search method along with the number of actions.  The graph in the next page shows the correlation better. |

**Actions Vs New Nodes:**

| CRITERIA | MEETS SPECIFICATIONS |  |
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| Analyze search time as a function of domain size, search algorithm, and heuristic. | Report includes a table or chart to analyze the search time against the number of actions in the domain.   * The chart or table includes data for all search & heuristic combinations for air cargo problems 1 and 2 * The chart or table includes data **at least** one uninformed search, two heuristics with greedy best first search, and two heuristics with A\* on air cargo problems 3 and 4 * Report includes at least a one paragraph discussion of these results that analyzes the growth trends as the problem size increases | The table in the previous section involves results for all problems and all algorithms in the table below. The number of actions and the search time for all search algorithms and all problems is reported below.  The results indicate that there is a positive correlation between the problem size, number of actions and the search method used. More than the number of actions, the search time is sensitive to the search algorithm and the type of problem used. This can be observed in search algorithms greedy\_best\_first\_graph\_search with h\_pg\_set\_level, astar\_search with h\_pg\_level\_sum, astar\_search with h\_pg\_max\_level, astar\_search with h\_pg\_set\_level |

**Actions Vs Search Time**

| CRITERIA | MEETS SPECIFICATIONS |  |
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| Analyze the optimality of solution as a function of domain size, search algorithm, and heuristic. | Report includes a table or chart to analyze the length of the plans returned by each algorithm on all search problems.   * The chart or table includes data for all search & heuristic combinations for air cargo problems 1 and 2 * The chart or table includes data **at least** one uninformed search, two heuristics with greedy best first search, and two heuristics with A\* on air cargo problems 3 and 4 | The table in the previous section involves results for all problems and all algorithms in the table below. All the algorithms are generating a proportinal plan lengths except for the depth\_first\_graph\_search. depth\_first\_graph\_search is growing exponentially. The graph in the next page shows depth\_first\_graph\_search as outlier very clearly. |

**Plan Lengths for each algorithm:**

| CRITERIA | MEETS SPECIFICATIONS |  |
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| Report answers all required questions | Submission includes a short answer to each of the following questions. (A short answer should be at least 1-2 sentences at most a small paragraph.)   * 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? * 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) * Which algorithm or algorithms would be most appropriate for planning problems where it is important to find only optimal plans? | * greedy\_best\_first\_graph\_searchwithh\_unmet\_goals would be the most appropriate for planning in a very restricted domain and also operate in real time mainly due the the minimal search times. * greedy\_best\_first\_graph\_searchwithh\_unmet\_goals is the one that fits better. * astar\_searchwithh\_unmet\_goals, breadth\_first\_search, uniform\_cost\_search suit better to do the planning for the optimal as they exhaust all the possibilities |