Requires Changes

**1 SPECIFICATION REQUIRES CHANGES**

Hi Udacity Learner,

Good job, this project is almost done! The project and report show diligence, effort, and understanding of the course material. There may have been some issues but I know you have the skills improve them. Also, I have provided some notes which may help in passing this project. I know you can do it and please don't hesitate to ask questions. Keep up the good work dear student!

**Recommendations**

* [Automated Planning and Scheduling](https://en.wikipedia.org/wiki/Automated_planning_and_scheduling)
* [State Space Planning](https://en.wikipedia.org/wiki/State_space_planning)
* [AI Planning](http://homepage.cs.uiowa.edu/~hzhang/c145/notes/10-Planning-6p.pdf)
* [Planning Agents](http://www.cs.ox.ac.uk/people/michael.wooldridge/pubs/ker95/subsubsectionstar3_3_1_1.html)

**Planning Problem Representation**

**The problems and class methods in the my\_air\_cargo\_problems.py module are correctly represented.**

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Test Result Summary

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air\_cargo\_p1 returns the correct initial fluents: .

air\_cargo\_p1 returns the correct goal fluents: .

air\_cargo\_p1 returns an object of type problem: .

air\_cargo\_p1 returns the correct initial values: .

air\_cargo\_p2 returns the correct initial fluents: .

air\_cargo\_p2 returns the correct goal fluents: .

air\_cargo\_p2 returns an object of type problem: .

air\_cargo\_p2 returns the correct initial values: .

air\_cargo\_p3 returns the correct initial fluents: .

air\_cargo\_p3 returns the correct goal fluents: .

air\_cargo\_p3 returns an object of type problem: .

air\_cargo\_p3 returns the correct initial values: .

AirCargoProblem correctly lists possible actions in a given state: .

AirCargoProblem correctly constructs all possible actions: .

AirCargoProblem correctly updates state for a given action: .

AirCargoProblem yields a correct solution when input to breadth\_first: .

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. - Test Passed F - Test Failed E - Error

**An optimal sequence of actions is identified for each problem in the written report.**

The correct optimal sequence of actions have been identified, i.e., **problem 1** with 6 steps, **problem 2** with 9 steps, and **problem 3** with 12 steps. Good job! 

**Automated Heuristics**

**Automated heuristics “ignore-preconditions” and “level-sum” (planning graph) are correctly implemented.**

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Test Result Summary

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AirCargoProblem implements the ignore preconditions heuristic: .

Action levels have the correct number of actions: .

Literal levels have the correct number of literals: .

competing\_needs\_mutex behaves correctly: .

inconsistent\_effects\_mutex behaves correctly: .

inconsistent\_support\_mutex behaves correctly: .

interference\_mutex behaves correctly: .

negation\_mutex behaves correctly: .

Serialization of mutexes is correct: .

levelsum heuristic behaves correctly: .

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. - Test Passed F - Test Failed E - Error

**Performance Comparison**

**At least three uninformed planning algorithms (including breadth- and depth-first search) are compared on all three problems, and at least two automatic heuristics are used with A\* search for planning on all three problems including “ignore-preconditions” and “level-sum” from the Planning Graph.**

Uninformed planning algorithms with automatic heuristics are compared and used for planning on all three algorithms. The write-up contains the comparison of these algorithms and the other two automatic heuristics on all problems. Impressive!

**Remarks**

For more information on the planning algorithms, check out the links below:

* [Search Techniques in AI](https://fr.slideshare.net/ameykerkar/control-strategies-in-ai)
* [Uninformed Search](http://cs.lmu.edu/~ray/notes/usearch/)

**A brief report lists (using a table and any appropriate visualizations) and verbally describes the performance of the algorithms on the problems compared, including the optimality of the solutions, time elapsed, and the number of node expansions required.**

Good work on providing appropriate visualizations and describing the performance of the search algorithms. The results were correct such that:

* breadth-first-search and uniform-cost-search provides optimality
* depth-first does not guarantee optimality
* A\* heuristic searches should also provide optimality
* level-sum should have the least number of expansions
* ignore-preconditions is a better heuristic design for the metric

The analysis is very clear and well-written. Congratulations on figuring it out!

**The report explains the reason for the observed results using at least one appropriate justification from the video lessons or from outside resources (e.g., Norvig and Russell’s textbook).**

The report has provided a conclusion and summarized the performance of the algorithms very well. However, some changes are required here.

**Changes Needed.**

Please explain the **reason** for the observed results **using at least one appropriate justification from the video lessons or from outside resources** (e.g., *Norvig and Russell’s textbook*).

**Extra Tips**

Some of the major aspects to consider when presenting the justification include the following:

* Which are the fastest and slowest uninformed algorithms and why?
* Which are the fastest and slowest heuristic searches and why?

Please don't forget to cite your references for this like you did in the research review.

**Research Review**

**The report includes a summary of at least three key developments in the field of AI planning and search.**

The development included in the report was excellent. The report summarizes some key developments of Distributed Multi-Agent Planning. This is well-written with appropriate references, great work!

**Remarks**

Here are additional materials regarding the topic that can help in future implementation of projects:

1. [Planning and Search](http://www.cs.nott.ac.uk/~psznza/G52PAS/lecture9.pdf)
2. [Overview of recent algorithms for AI planning](https://pdfs.semanticscholar.org/b089/5a0e741e2e3604a18ebb77df641742bf6077.pdf)