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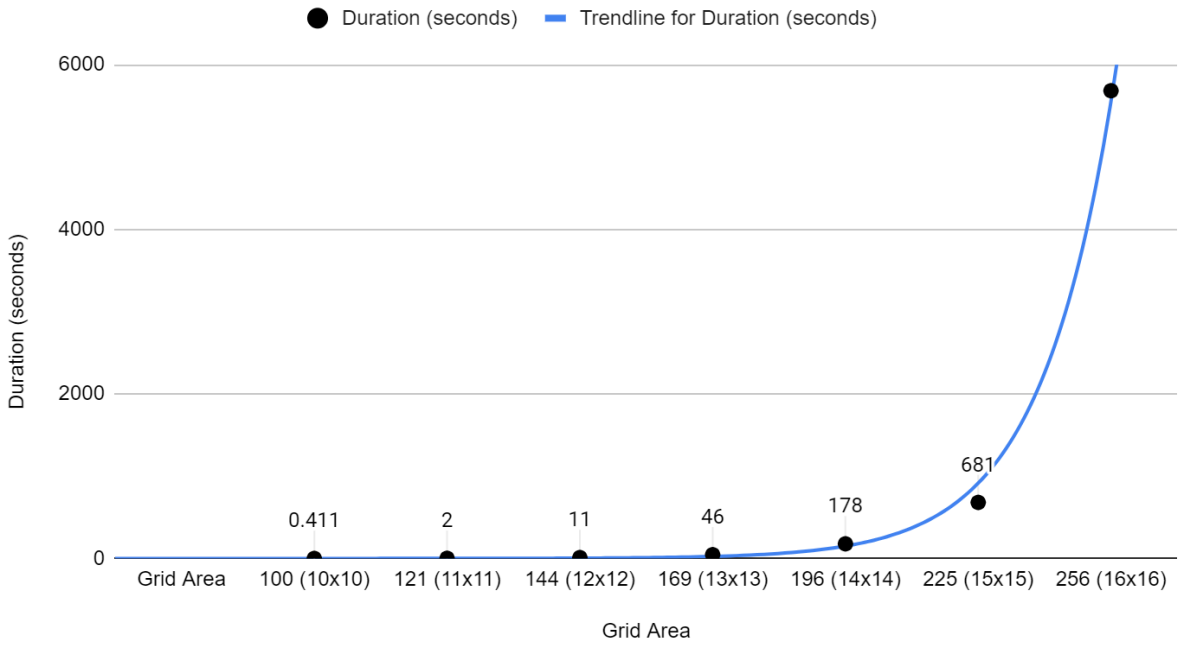
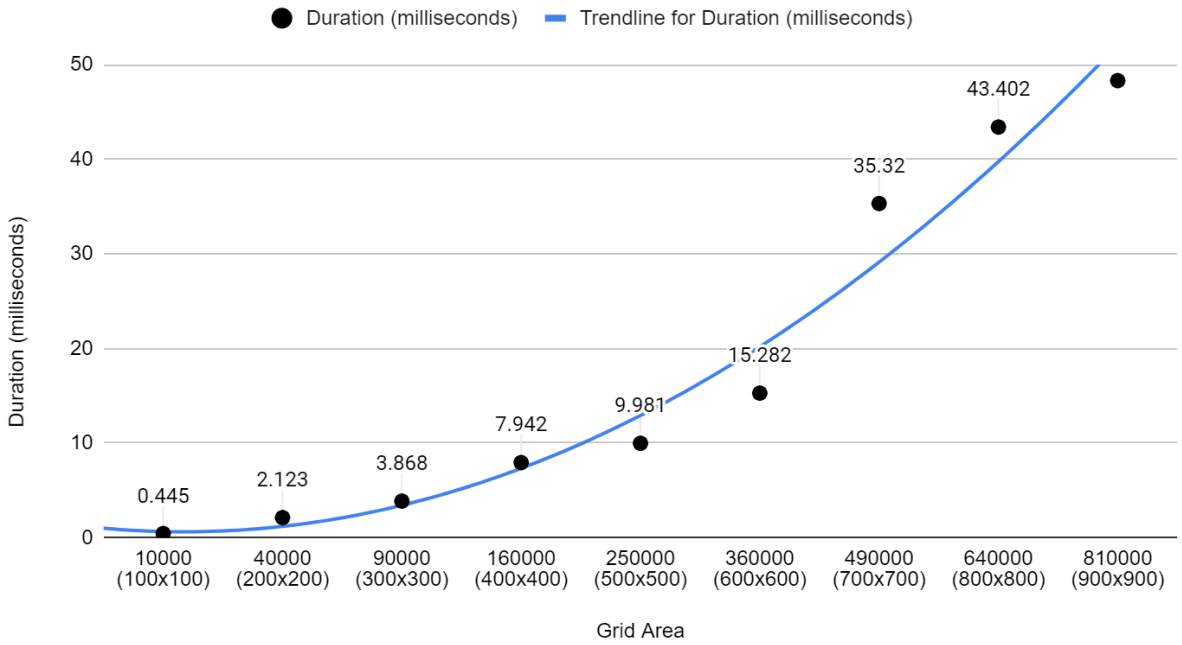
Exhaustive Search



Dynamic Program



Questions:

I. **Is there a noticeable difference in the performance of the two algorithms?**

Yes, there is a very noticeable difference in the performance of the two algorithms.

II. **According to your experimental observation, which of the implementations is faster, and by how much?**

The dynamic algorithm is much faster than the exhaustive algorithm. The exhaustive algorithm takes minutes to execute grids with areas in the 100s. The dynamic algorithm takes a few milliseconds to execute grids with areas in the 100,000s.

III. **Are your empirical analyses consistent with the predicted big-O efficiency class for each algorithm? Justify your answer.**

Regarding the exhaustive implementation of the algorithm, the predicted big-O efficiency class is consistent with the results of the trials. The predicted efficiency was $O(n2^n)$, which is exponential. The graphical representation of the execution times resembles an exponential function.
Regarding the dynamic implementation of the algorithm, the predicted big-O efficiency class is consistent with the results of the trials. The predicted big-O efficiency was $O(n^2)$, which is quadratic. The graphical representation of the execution times and grid sizes resembles a quadratic function.

IV. **Is this evidence consistent or inconsistent with hypothesis 1? Justify your answer.**

The evidence is consistent with the hypothesis that exhaustive search algorithms can be implemented, and produce correct outputs. The exhaustive implementation of the algorithm tests every possible path and includes only the valid paths in the final result.

V. **Is this evidence consistent or inconsistent with hypothesis 2? Justify your answer.**

The evidence is consistent with the hypothesis that algorithms with exponential or factorial running times are extremely slow, too slow to be of practical use. The exhaustive implementation of the algorithm was extremely slow compared to the dynamic implementation, taking around an hour and a half to complete a 16 x 16 grid. The dynamic implementation was able to handle a 900 x 900 grid in around 50

milliseconds. Therefore, algorithms with exponential or factorial running times make execution tedious and time consuming.