Hierarchical Approach to Path Planning Algorithm Based on Obstacle Clustering and Graph Search

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Idea

Our proposal is centered around the paper Wang, L.; Sun, L. Path Planning Algorithm Based on Obstacle Clustering Analysis and Graph Search. Symmetry 2023, 15, 1498.

This paper proposes a graph search path planning algorithm that is based on map preprocessing for creating a weighted graph in the map, thus obtaining a structured search framework.

Idea

Their algorithm is structured as follows-

1. Use DBSCAN to cluster obstacle points to form obstacle clusters
2. Use obstacle detection algorithms to construct a graph around the obstacles, where each edge of the graph represents a path from one obstacle to another(or from start to goal state).
3. After constructing a weighted graph, use shortest path algorithms for weighted graphs.

Research Gap

1. As noted by the authors themselves, their algorithm is not very scalable and struggles as number of obstacles increases.
2. Moreover, use cases of their algorithm will be for real time path planning, such as a drone taking a picture of a map and using their algorithm to find a path. In this case, a drone would also be focused on its safety. For example, the optimal path given by their algorithm might ask the drone to move right next to an obstacle, which may endanger the drone.
3. In this case, we would be happy with an approximate solution, which might also be faster to calculate than optimal.

Proposed Solution

1. Use a hierarchical approach to simplify the grid into a "meta-grid". For example converting a 100x100 grid to 50x50 grid.
2. Find an optimal path in this meta-grid
3. Then go back to the original grid and find an optimal path only considering the subgrids chosen by the optimal path of the meta-grid

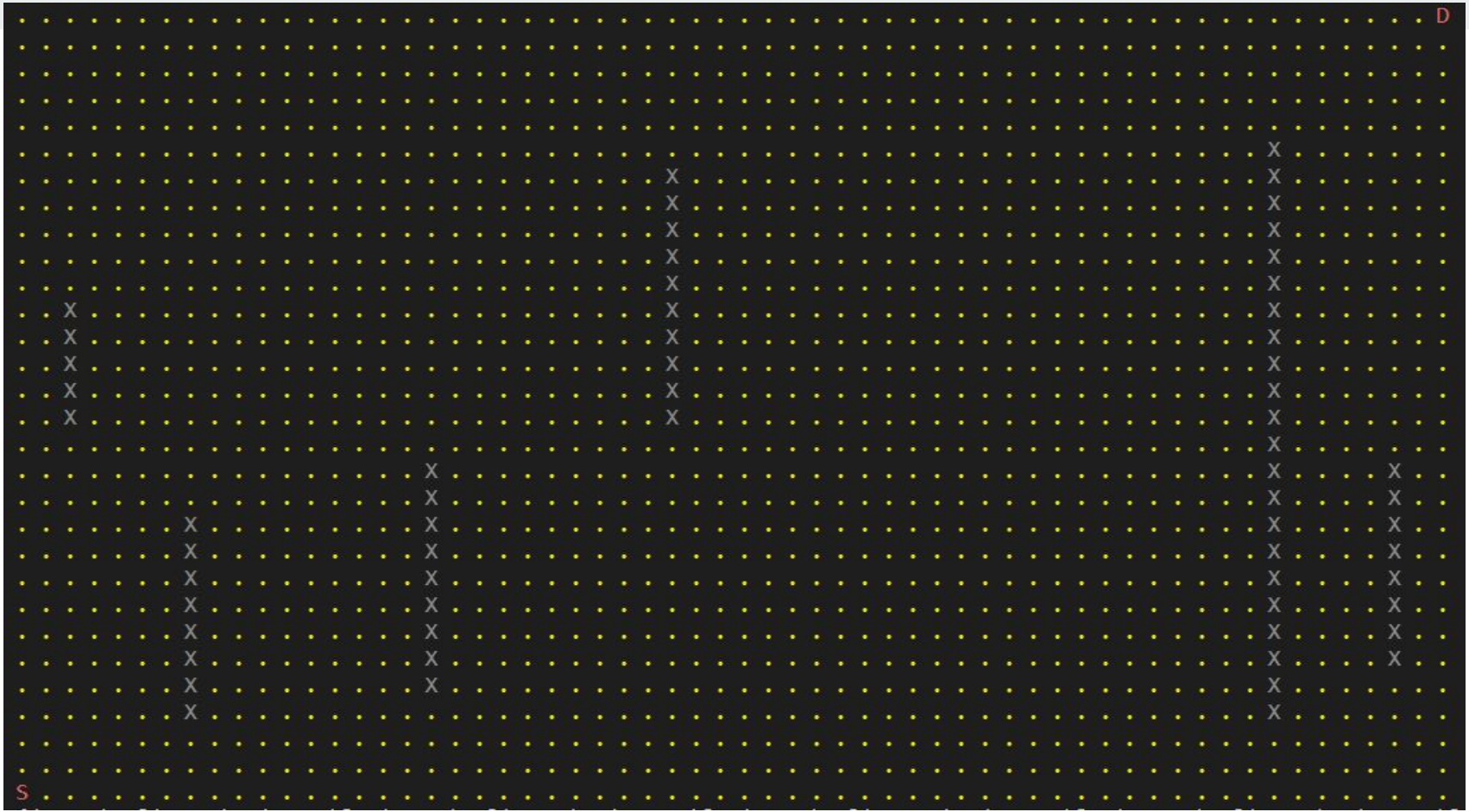
Challenges

The biggest challenge is that there is no code available for the paper, even the input files used in the algorithm are not available.

1. Therefore our first task is to implement their paper from scratch
2. Then we need to implement our proposed approach to this implementation
3. We then compare the vanilla and hierarchical approaches

Work so far

We have implemented the input map generation and weighted graph formation from scratch. We show the following example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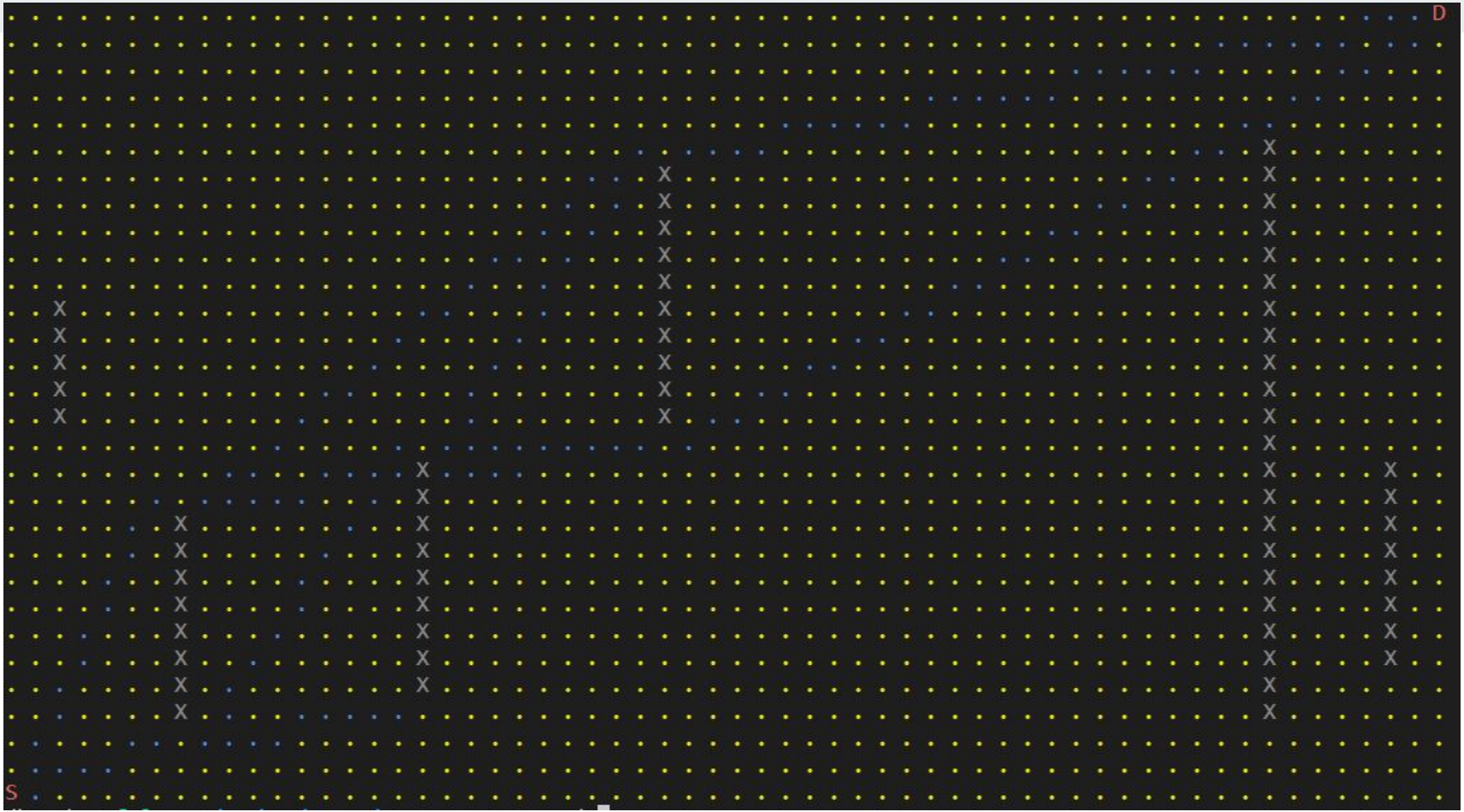
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Thanks