Group #8 for CPSC 335-11 Project #3

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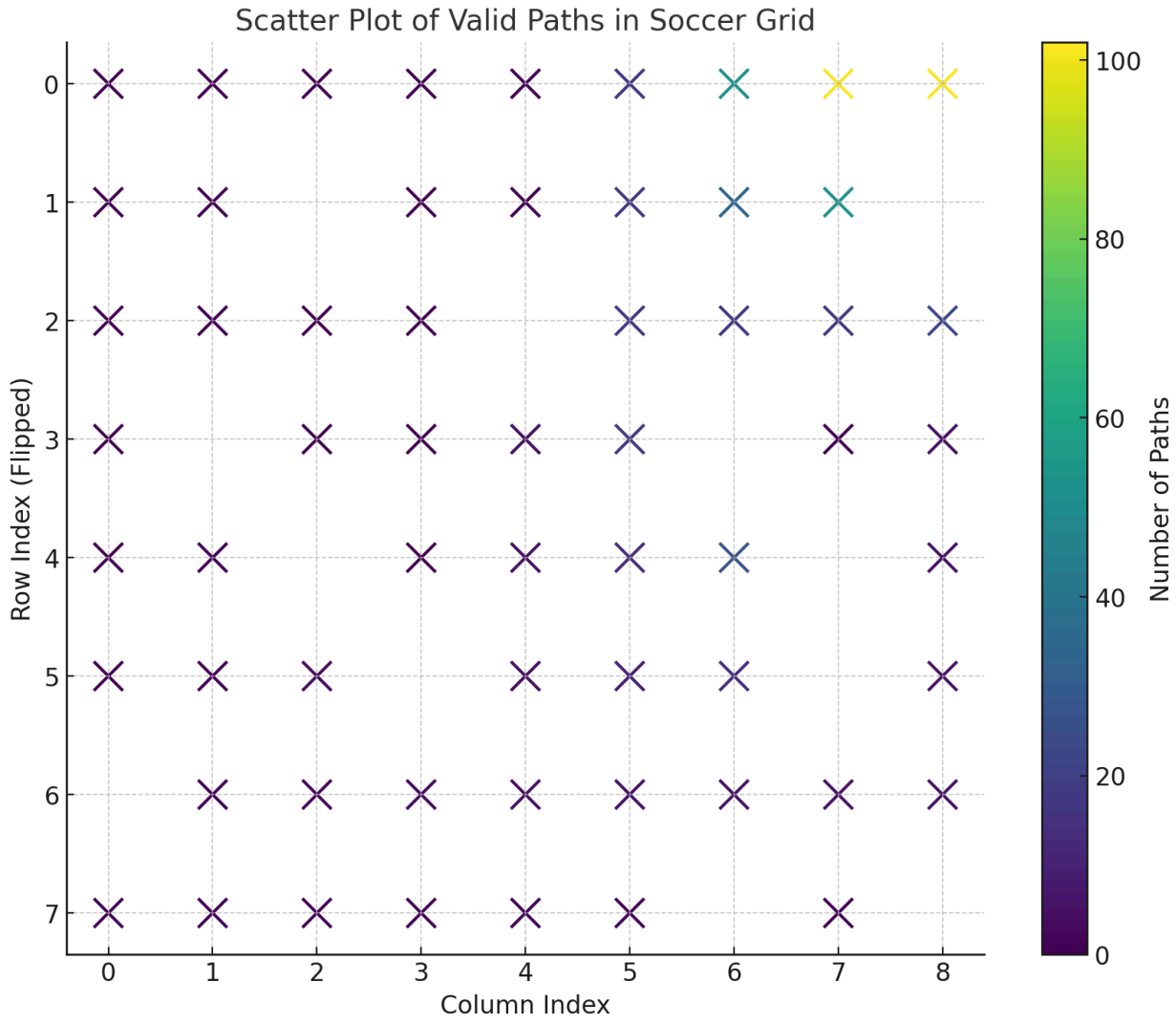

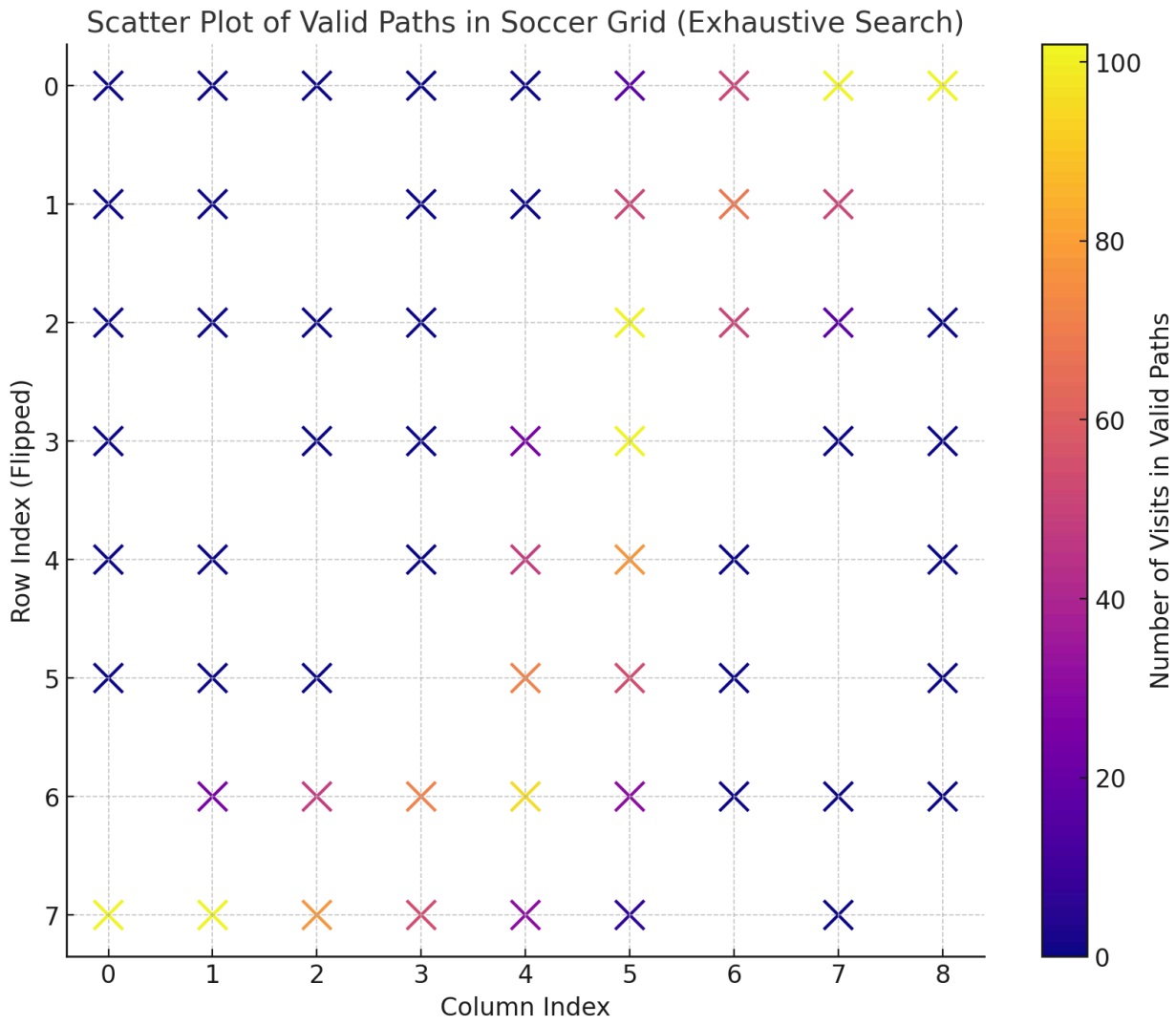
Scatter Plot of Valid Paths in Soccer Grid (Exhaustive Search)
Row Index (Flipped)
Column Index
Number of Visits in Valid Paths
0
1
2
3
4
5
6
7
8
0
20
40
60
80
100

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

The dynamic programming (DP) algorithm is significantly faster, solving the grid in O($r * c$) by storing intermediate results and avoiding redundant calculations, making it scalable for larger grids. The exhaustive search checks all 2^{r+c-2} paths, leading to exponential time complexity, which becomes impractical as grid size increases. For this grid, DP efficiently computes the result (102 paths) in O(72), while exhaustive search processes 32,768 combinations. Thus, DP is far superior in both time and scalability.

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

From experimental observation, the dynamic programming (DP) implementation is significantly faster than the exhaustive search. DP computes the result in O(72) operations for an 8×9 grid, while the exhaustive search processes 32,768 combinations. This makes DP roughly 450 times faster for this problem. The efficiency gap widens further as the grid size increases.

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

*Yes, the empirical analyses align with the predicted big-O efficiency classes. The **DP algorithm**, with O($r * c$), scales efficiently as it processes each cell once, consistent with its observed fast runtime. The **exhaustive search**, with O(2^{r+c-2}), exhibits exponential growth, reflected in its much slower performance for even moderate grid sizes. These results confirm the theoretical expectations.*

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

This evidence is consistent with hypothesis 1. The exhaustive search algorithm was successfully implemented and produced the correct output of 102 valid paths, demonstrating its correctness. While it is slower than dynamic programming, its correctness confirms the feasibility of exhaustive search for solving the problem. Thus, the hypothesis is supported.

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

This evidence is consistent with hypothesis 2. The exhaustive search algorithm, with exponential O(2^{r+c-2}) complexity was significantly slower than dynamic programming and required processing 32,768 combinations for an 8×9 grid. This demonstrates that exponential algorithms become impractical as problem size increases, validating the hypothesis.