Unity Pathfinders Visualizer

Silent0Wings

October 31, 2024

Abstract

This report presents the Unity Pathfinders Visualizer, a project developed to visualize key pathfinding algorithms such as Breadth-First Search (BFS), Bidirectional BFS, Depth-First Search (DFS), and the Swarm Algorithm. The goal of the project is to provide an educational tool for understanding pathfinding algorithms in an interactive, visual format within the Unity engine.

1 Introduction

Pathfinding algorithms are essential in computer science and game development, especially for AI navigation. This project leverages Unity to create a visual representation of several classic pathfinding algorithms, allowing users to observe their behavior in real-time.

2 Algorithms Implemented

The Unity Pathfinders Visualizer includes the following algorithms:

- **Breadth-First Search (BFS)**: Explores nodes level by level, ensuring the shortest path in an unweighted grid.
- **Bidirectional BFS**: Runs two BFS operations from the start and target, meeting in the middle to reduce search time.
- **Depth-First Search (DFS)**: Explores as deep as possible along each branch before backtracking.
- **Swarm Algorithm**: Simulates the behavior of multiple agents moving toward a target, useful for group movement in games.

3 Methodology

Unity's GameObjects and scripts allow for dynamic, real-time visualization of each algorithm. Each algorithm is implemented as a separate C# script that interacts with the grid in Unity, dynamically updating nodes and paths based on the selected algorithm.

4 Project Structure

The project's directory is organized as follows:

- **Scenes**: Contains Unity scenes for each algorithm visualization.
- **ScreenShot**: Contains images showcasing each algorithm's visualization.
- **Script**: Houses C# scripts implementing each pathfinding algorithm.
- **Source**: Additional resources or references used in the project.

5 Visualization and Results

Each algorithm is visualized in Unity, with clear indicators for explored nodes, current paths, and final paths to the target. The following images demonstrate the visualization for each algorithm:

5.1 Breadth-First Search (BFS)

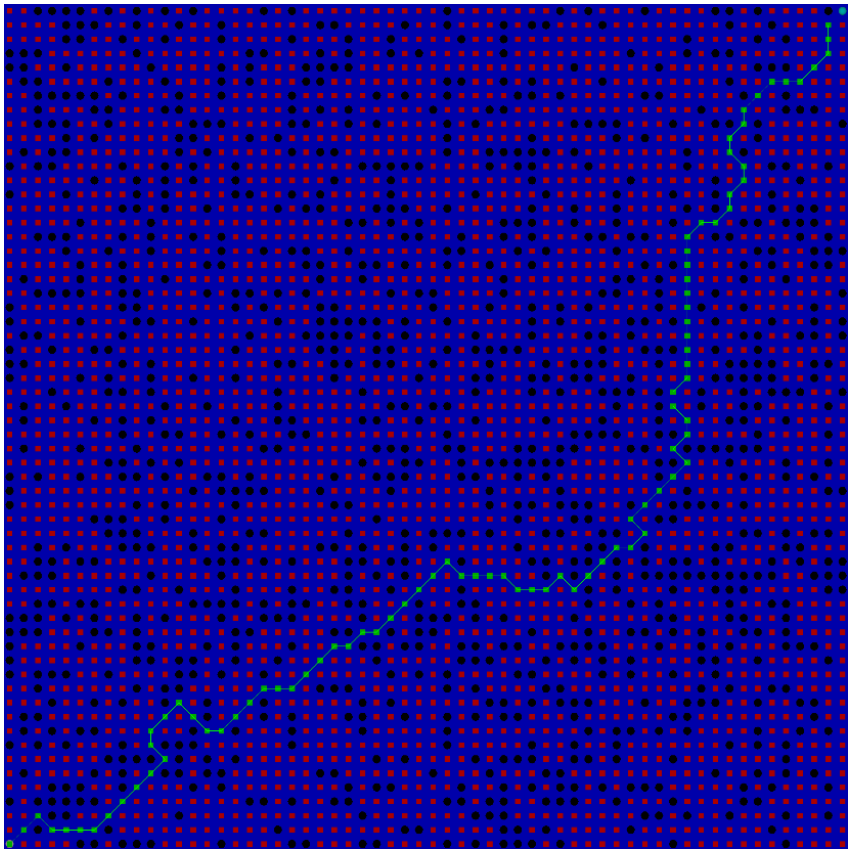

Figure 1: Breadth-First Search Visualization (Step 0)

5.2 Depth-First Search (DFS)

6 Conclusion

The Unity Pathfinders Visualizer successfully demonstrates the fundamental behavior of various pathfinding algorithms, offering an interactive tool for students and enthusiasts. Future work could involve implementing additional algorithms or enhancing the visualization to display path costs and efficiency metrics.

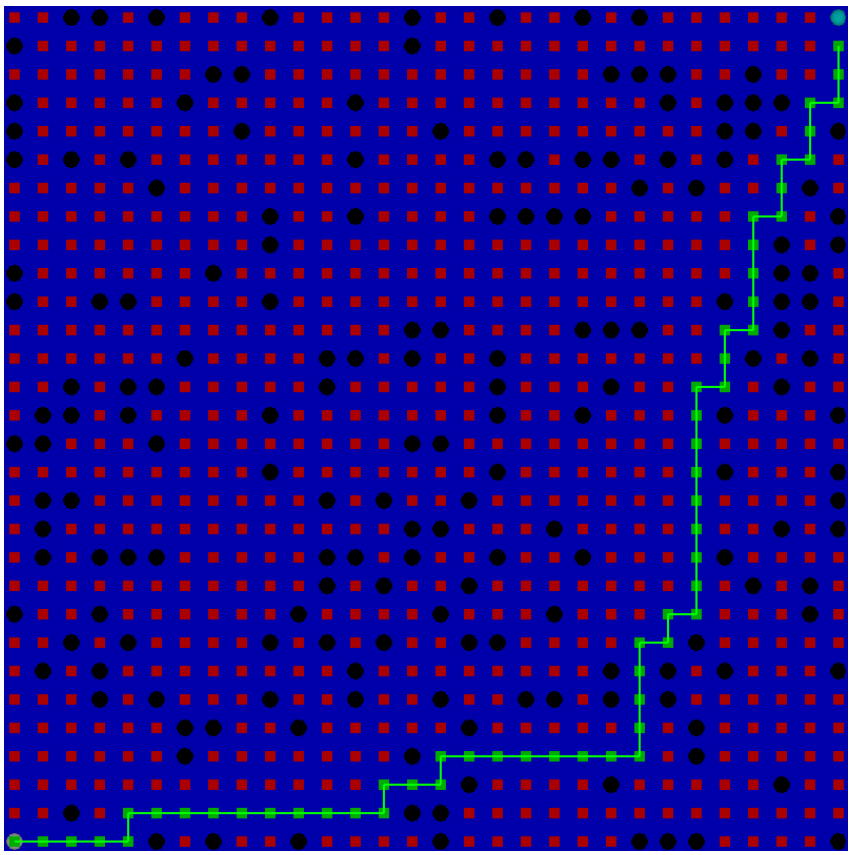

Figure 2: Breadth-First Search Visualization (Step 2)

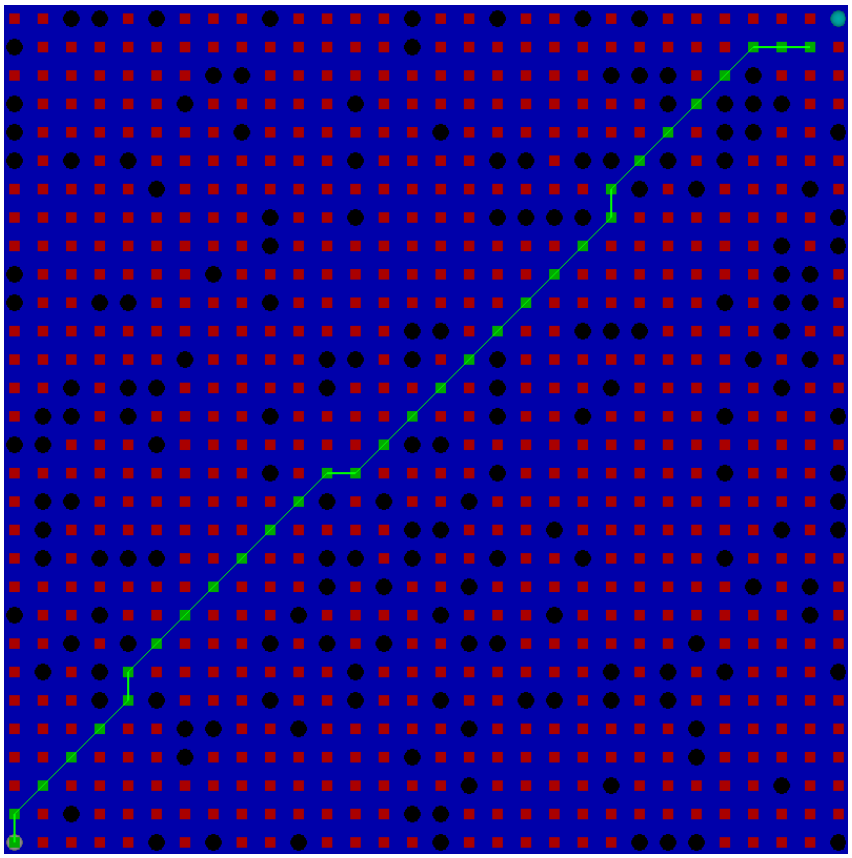

Figure 3: Breadth-First Search Visualization (Step 4)

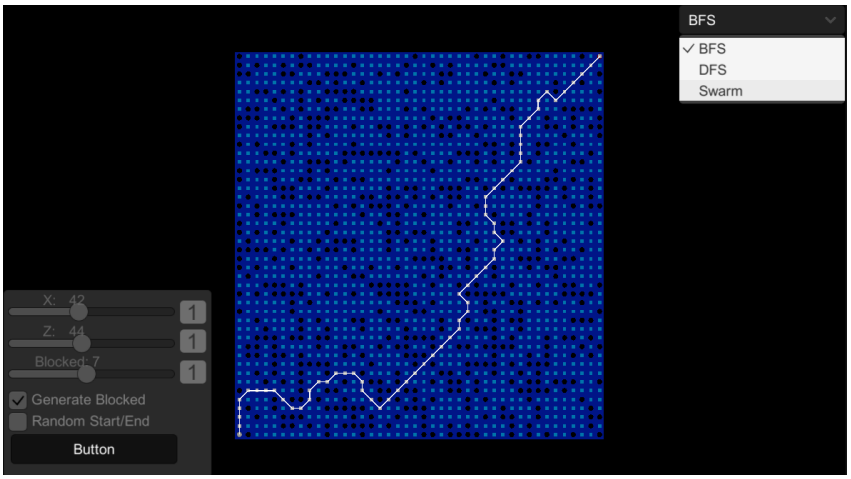

Figure 4: Breadth-First Search Visualization (Step 6)

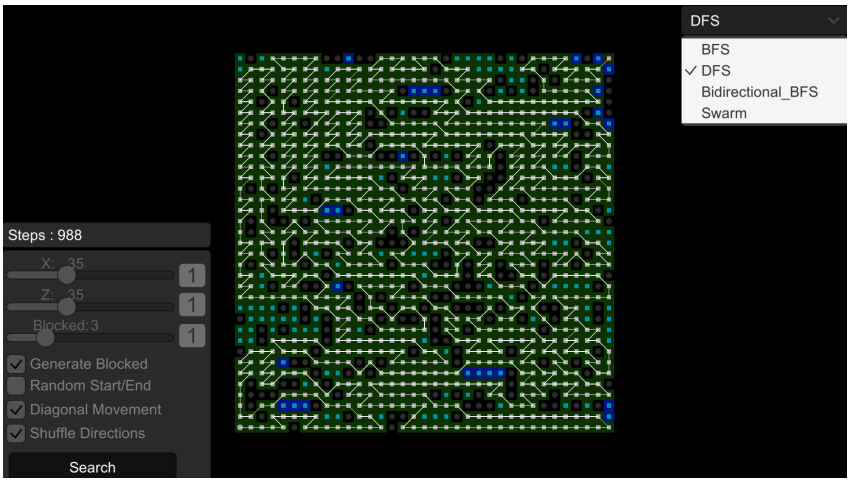

Figure 5: Depth-First Search Visualization