**Testing & Validation Report**

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This report documents the functional smoke tests and performance profiling for the BFS/A\* grid‐pathfinding demo built in Unity.

My goals were to verify correctness on an empty grid, full‐block grid, and adjacent start/end, and to measure timing on larger grids (up to 30×30).

## **Functional Smoke Tests**

**Test 1:** Empty Grid

**Objective**: Ensure BFS/A\* algorithms find the optimal path on an empty grid.

A screenshot of a computer

AI-generated content may be incorrect.**Setup**:

* Grid size: 10×10
* Start point: bottom-left corner
* Endpoint: top-right corner

**Results:**

* BFS successfully identified the shortest path.
* A\* successfully identified the shortest path.

**Test 2:** Full-Block Grid

**Objective:** Ensure algorithms handle scenarios where no path exists.

A screenshot of a computer

AI-generated content may be incorrect.**Setup:**

* Grid size: 10×10
* All tiles are blocked except the start and end.

**Results:**

* BFS correctly identified no path exists.
* A\* correctly identified no path exists.

**Test 3:** Adjacent Start/End

**A screenshot of a computer game

AI-generated content may be incorrect.Objective:** Ensure that the minimal path scenario is correctly handled**.**

**Setup:**

* Grid size: 10×10
* Start and end tiles are adjacent.

**Results:**

* BFS successfully found the immediate next-tile path.
* A\* successfully found the immediate next-tile path.

## **Performance Profiling**

**Test 4: 30×30 Grid Performance**

A blue grid with green and blue squares

AI-generated content may be incorrect.**Objective**: Measure performance (frame-times and overall duration) for large grids.

**Setup**:

* Grid size: 30×30
* Start point: bottom-left corner
* Endpoint: top-right corner
* Moderate complexity (random blocks ~20% of tiles)

**Results**:

* **BFS**:
  + Average wave expansion delay: 0.05 seconds per step
  + Average path construction delay: 0.10 seconds per step
  + Total runtime: approximately 3.8 seconds
* **A**\*:
  + Average wave expansion delay: 0.04 seconds per step
  + Average path construction delay: 0.09 seconds per step
  + Total runtime: approximately 2.9 seconds

**Conclusion**

Both BFS and A\* demonstrated correct and expected behaviour across all smoke tests.

Performance results indicate A\* provides superior performance in larger grids, aligning with theoretical expectations.

This validation confirms both functional correctness and satisfactory performance benchmarks for the pathfinding implementation.