AI Pathfinder - Uninformed Search Visualization

GOOD PERFORMANCE TIME APP

A Python GUI application that visualizes 6 uninformed search algorithms navigating a grid with dynamic obstacles.

Features

Algorithms Implemented: - BFS, DFS, UCS, DLS, IDDFS, Bidirectional Search

Key Features: - Step-by-step visualization of algorithms - 8-directional movement with diagonals - Dynamic obstacles spawning during search - Interactive grid: click to add/remove walls - Pause/Resume, Reset, and Clear Path controls - Real-time statistics: nodes explored, path length, time

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Installation

Prerequisites: Python 3.8+, pip

```
# Clone the repository
git clone https://github.com/yourusername/ai-pathfinder.git
cd ai-pathfinder

# Install dependencies
pip install -r requirements.txt
# Or manually
pip install pygame

# Run the app
python ai_pathfinder_gui.py
```

Controls

- **Left Click:** Toggle walls
- **Green Cell:** Start
- **Red Cell:** Target
- **Black Cells:** Static walls
- **Dark Red:** Dynamic obstacles

- **Algorithm Selection:** Click buttons at top
- **Start / Pause / Resume / Reset / Clear Path**

Grid & Visualization

Colors: | Color | Meaning | |-------|---------| | Green | Start | | Red | Target | | Black | Static walls | | Purple | Explored nodes | | Blue | Frontier nodes | | Yellow | Final path | | Dark Red | Dynamic obstacles |

Stats Panel: Nodes Explored, Frontier Size, Path Length, Time

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Parameters (Customizable in `ai_pathfinder_gui.py`)

```
GRID_SIZE = 25                  # Grid cells
step_delay = 50                 # Visualization speed (ms)
dynamic_obstacle_probability = 0.01
dls_limit = 10                  # Depth limit for DLS
```

Algorithm Comparison

Algorithm	Complete?	Optimal?	Time Complexity	Space Complexity
BFS	Yes	Yes	O(b^d)	O(b^d)
DFS	Yes	No	O(b^m)	O(bm)
UCS	Yes	Yes	O(b^(C*/ε))	O(b^(C*/ε))
DLS	No	No	O(b^l)	O(bl)
IDDFS	Yes	Yes	O(b^d)	O(bd)
Bidirectional	Yes	Yes	O(b^(d/2))	O(b^(d/2))

Troubleshooting

- **App won't start:**

```
pip uninstall pygame
pip install pygame
```

- **Slow performance:** Reduce `GRID_SIZE`, increase `step_delay`, reduce `dynamic_obstacle_probability`

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