Project Proposal

**Project Title: Smart Fire Fighter**

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**Course: AI**

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# 1. Project Overview

## Project Topic:

The project simulates a grid-based environment where an AI agent must escape from a fire-spreading area using optimal pathfinding algorithms. It incorporates various classical AI search strategies with a custom graphical interface.

## Objective:

To design an intelligent agent that can escape dynamically changing environments (like fire spread) using different AI search algorithms such as A\*, BFS, DFS, UCS, and Greedy Search. The goal is to compare the performance and decision-making capability of each algorithm in real-time game-like conditions.

# 2. Game Description

## Original Game Background:

This is not based on a traditional board game but draws inspiration from grid-based strategy games and AI search problems like maze navigation.

## Innovations Introduced:

• Fire spread simulation adds urgency and dynamic obstacles.  
• Multiple AI algorithms integrated for comparison.  
• Graphical visualization using custom GUI (via pygame).  
• Real-time decision-making under constraints (time, hazard).  
These innovations significantly enhance complexity, requiring the AI to not only find a path but adapt to dynamic threats and make trade-offs between speed and safety.

# 3. AI Approach and Methodology

## AI Techniques to be Used:

• A\* (with heuristics like Manhattan distance)  
• BFS, DFS, UCS (to explore classical approaches)  
• Greedy Search (for fast, non-optimal solutions)  
• Future scope: Reinforcement Learning (for learning-based escape)

## Heuristic Design:

Heuristics include:  
• Distance to goal  
• Distance from fire  
• Obstacles and walls considered

## Complexity Analysis:

Time complexity ranges from O(b^d) in BFS/DFS to O(n log n) for A\* (with proper heuristic). Real-time fire simulation and multi-threaded GUI increase implementation challenges.

# 4. Game Rules and Mechanics

## Modified Rules:

• Agent starts at one position and must reach an exit.  
• Fire randomly spreads across the grid at each turn.  
• Walls and buckets exist to slow or block fire spread.

## Winning Conditions:

Agent successfully reaches the goal cell before being caught by fire.

## Turn Sequence:

Fire spreads → Agent chooses move → GUI updates → Repeat until win/lose condition met

# 5. Implementation Plan

## Programming Language:

Python

## Libraries and Tools:

• Pygame,tkinter (GUI)  
• NumPy (Data structures)  
• Custom modules for AI algorithms and game logic

## Milestones and Timeline:

• Week 1–2: Design grid, fire simulation, and environment setup  
• Week 3–4: Implement BFS, DFS, UCS, and Greedy algorithms  
• Week 5–6: Develop and integrate A\* and heuristic evaluations  
• Week 7: Finalize GUI and fire mechanics  
• Week 8: Test cases, performance comparison, final report

# 6. References

• Russell, S., & Norvig, P. (2016). Artificial Intelligence: A Modern Approach  
• https://www.geeksforgeeks.org/search-algorithms-in-ai/  
• <https://www.pygame.org/docs/>

# 7.Group Members

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