Word Ladder Adventure

Game Development Report

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1. Introduction

The Word Ladder Adventure Game is intended to challenge players by asking them to convert one word to another via a series of legitimate intermediary terms. The game includes AI-powered tips that employ three separate search techniques to identify the best transformation pathways.

2. Approach

The game is constructed using a graph-based representation where:

- Each word is handled as a node.
- Edges exist between words that differ by exactly one letter.
- A specified dictionary assures that intermediate words are correct.
- The game offers varying degrees of difficulty and an AI-powered tip system.

3. Algorithms Implemented

3.1. Breadth-First Search (BFS)

- Investigates all feasible words at the current depth before going on.
- Provides the shortest transformation path in terms of number of movements.
- Useful for determining the shortest path in an unweighted graph.

3.2. Uniform Cost Search (UCS)

- Expands the least-cost node first using a priority queue.

- Prioritizes the least-cost node when transition costs differ (e.g., punishing fewer frequent words).
- Ensures the shortest path but may be slower than BFS.

3.3. A* Search Algorithm (A*)

- Utilizes a cost function: f(n) = g(n) + h(n).
  1. g(n): The number of steps taken from the first word.
  2. h(n): A heuristic function for calculating the remaining steps (such as the Hamming distance).
- Balances BFS and UCS, resulting in an ideal heuristic search.

4. Challenges Faced

4.1. Dictionary and Word Validation

- Ensuring that only legitimate terms are examined proved difficult.
- Used a preloaded dictionary to verify terms quickly.

4.2. Performance Optimization

- Large word lists make thorough searches computationally costly.
- Implemented priority queues for A* and UCS to improve search performance.

4.3. Game Interface and User Experience

- Creating an interactive UI that supports both manual and AI-assisted gaming.

- Used a graph to visualize the transformation route.

5. Conclusion

The Word Ladder Adventure Game successfully uses AI-based search algorithms to improve the user experience. The project gave participants practical experience with graph-based search, heuristic design, and realworld AI applications.