PROJECT REPORT

LEARNING ADAPTIVE MOVEMENT: ENHANCING PATHFINDING ALGORITHMS WITH LONG SHORT-TERM MEMORY (LSTM) NETWORKS FOR NON-PLAYABLE CHARACTER NAVIGATION

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ABSTRACT

This research explores a hybrid pathfinding framework by integrating Long Short-Term Memory (LSTM) networks with reinforcement learning to enable efficient and adaptive navigation within complex grid-based environments. The primary objective is to address limitations inherent in traditional deterministic algorithms such as A, which, despite their optimality in static scenarios, exhibit reduced flexibility in dynamic or unfamiliar contexts. Standalone LSTM models, although effective in capturing temporal dependencies, often yield suboptimal trajectories due to their step-by-step local decision-making and lack of global planning. To bridge this gap, the proposed method combines the sequential modeling capabilities of LSTM with the reward-driven learning paradigm of reinforcement learning, enabling the agent to improve its performance through iterative interaction with the environment. The reinforcement signal serves as a guiding mechanism, allowing the model to differentiate between effective and inefficient paths without explicit path supervision. Nonetheless, several limitations were observed. The LSTM-only baseline exhibited poor performance, often failing to reach the goal or producing excessively long paths, indicating the inadequacy of memory-based learning without strategic feedback. Additionally, the training process is computationally demanding and sensitive to reward structure and hyperparameter configurations. This research contributes to the understanding of neural path planning by demonstrating the necessity of reinforcement signals in enhancing sequential models and provides a foundation for future work involving more robust training strategies, including reward shaping, curriculum design, and global context incorporation.*

Keyword: pathfinding, lstm, cnn, reinforcement learning