

# Join Query Optimization Using Firefly Algorithm and Hybrid DQN-Firefly and DDQN-Firefly Approaches

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## ABSTRACT

Join query optimization is an essential task in relational database management systems, as it directly impacts query execution performance. In this research, we explore novel approaches to optimize join queries using the Firefly Algorithm and two hybrid methods, namely DQN-Firefly and DDQN-Firefly. The primary objective of this research is to enhance the efficiency and effectiveness of join query optimization, particularly in the context of the widely used TPC-H dataset. The Firefly Algorithm, inspired by the flashing patterns of fireflies, is a nature-inspired optimization technique that has demonstrated success in solving various optimization problems. This algorithm used to address the join query optimization problem by optimizing the selection of join strategies, order of joins, and access paths. This approach aims to improve query execution time and reduce resource utilization. Furthermore, this work has introduced two hybrid approaches that integrate deep reinforcement learning techniques, specifically Deep Q-Network (DQN) and Double Deep Q-Network (DDQN), with the Firefly Algorithm. These hybrid methods leverage the capabilities of reinforcement learning to adaptively learn and refine query optimization strategies based on historical query performance data. To evaluate the effectiveness of our proposed approaches, we conduct extensive experiments using the TPC-H dataset, a standard benchmark for decision support workloads. This research works compare the performance of the Firefly Algorithm, DQN-Firefly, and DDQN-Firefly against traditional query optimization techniques and state-of-the-art optimization methods. Our results demonstrate significant improvements in query execution time and resource utilization using the Firefly Algorithm and its hybrid counterparts. The findings of this research contribute to the advancement of join query optimization techniques and offer promising solutions for optimizing database query performance in real-world applications.

**Keywords:** Join Query Optimization, Firefly Algorithm, DDQN

