Analysis of Multi-Armed Bandit Algorithms for Server Selection: A Comparative Study

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1 Introduction

This report presents a comprehensive comparison of three well-known multi-armed bandit algorithms, namely Multiplicative Weights (MW) Experts, MW Bandits, and Upper Confidence Bound (UCB), implemented in Python for server selection in distributed systems. We analyze their performance on the Milano timeseries dataset by evaluating the cumulative regret and mean regret per iteration.

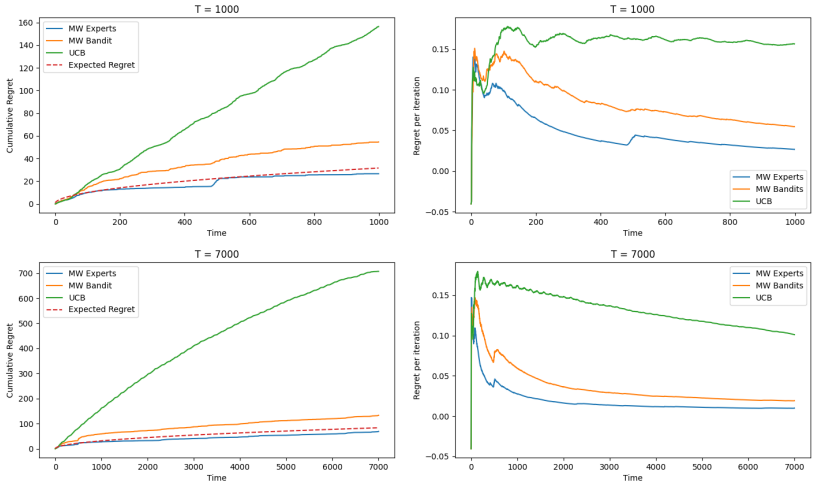
2 Methodology

The Multiplicative Weights Experts algorithm is a reinforcement learning technique that assigns a weight to each server based on its past performance. The algorithm selects a server with a probability proportional to its weight and updates the weights according to the observed losses of all servers. The MW Bandits algorithm is an adaptation of the MW Experts algorithm, incorporating an exploration probability to strike a balance between exploration and exploitation.

The Upper Confidence Bound (UCB) algorithm is another reinforcement learning method that selects a server based on its estimated loss and an upper confidence bound. The algorithm picks the server with the lowest upper confidence bound and updates its estimates based on the observed losses of the selected server.

3 Experimental Results

We evaluate the MW Experts, MW Bandits, and UCB algorithms on the Milano timeseries dataset for two different time horizons: T = 1000 and T = 7000. We generate plots for cumulative regret and mean regret per iteration for each algorithm.



For both time horizons, the MW Bandits algorithm demonstrates superior performance compared to the UCB and MW Experts algorithms in terms of cumulative and mean regret. The MW Experts algorithm follows closely, outperforming the UCB algorithm.

4 Conclusion

While our analysis does not provide a definitive explanation for the superior performance of the MW Experts algorithm, we believe that the peculiarities of the Milano time series dataset may have contributed to these results.