Andrew Tanuwijaya, 2602158216

Assignment 1: Literature Review (https://doi.org/10.1155/2018/3234873)

Section 1: Summary of the Paper

This is a literature review for the paper "A Method for Fast Leaderboard Calculations in Massive Online Game-Based Environments". Online games are a massive part of so many people's lives. There are so many players in different games over different platforms, and in the world of today, the importance of a leaderboard in a game cannot be understated.

The paper aims to calculate leaderboard calculations quickly in online game-based environments. Here, it tries to create an efficient and scalable approach that improves older and more traditional database methods, especially in environments with a lot of users.

The authors of the paper introduce a solution, that being a Self-Balanced Order-Statistic Tree, and a hash table to make the calculations to properly fill up the leaderboard. The tree uses $O(\log_2 N)$, which will perform much better than the traditional methods like relational databases or linked lists. Experiments have been done, and it shows some serious speed improvements in larger-scale scenarios.

Section 2: Identification of Gaps

The paper focuses on the more technical aspects of the leaderboard calculations, but does not consider at all integrating more complex game ranking metrics like multidimensional scores. This works when the rankings are more sequential in nature, but for aspects like social metrics (unlocked achievements, team collaboration), different game-mode ranks, and skill based rankings, the subject matter needs to be looked into further.

Validation is also done based on simulations instead of live gaming services, so performance in actual distributed systems are not fully confirmed. For example, certain load conditions may not

be able to sustain the algorithm. This system may, hypothetically, work, but there is no way to know for sure until we test it on real-world distributed systems.

Section 3: Analysis of Ambiguities

Honestly, while the technical explanations are pretty good, using simple terms like “fast” and “cheap” implementations may be a bit lacking when talking about quantitative benchmarks. Having a more specific metric especially when talking about different gaming environments should have been explained.

Additionally, as mentioned earlier, the paper assumes the leaderboard will be universally handled by a single numeric score. While many games do this, there are some that use different methodologies for ranking their players.

Section 4: Evaluation of Methodologies

The authors did well in using established data structures for in-memory processing. They implemented a Red-Black Tree for balancing with hash tables for faster access, which is a very effective approach in my opinion. One big downside however is the fact that they did not mention the cost of maintaining such structures in a real-time distributed environment. Considering the fact that video game companies look for a heavy profit, especially with live service games, there is no guarantee that this implementation will be a preferred option.

Section 5: Discussion of Questions Raised

Two big questions that should be raised is whether this method is really feasible in real-world environments beyond simulation, and the limitations when multidimensional leaderboard systems are introduced. These are important as to understand the generalizability and scalability of the approach through every online environment, and not just gaming.

Section 6: Critical Reflection

The paper is definitely extremely relevant to modern gaming systems, and generally any system that involves a ranking alongside a leaderboard. Focusing on scalability is essential since expecting the player number to increase in large-scale games is very common. The structure itself is very clear, and the experimental results are presented really nicely. The only main issue may be the lack of discussion on adaptability of the method to different kinds of data and their implementation in different environments.

Section 7: Conclusion

Some very significant contributions are studied and handled well here to the field of leaderboard calculations. The scalability and efficiency of SBOST and hash tables are well done. The impact it may have is pretty large for single numeric scores, though it may be a much stronger study if real-world validation and multi-dimensional applications are looked into further.

Section 8: Future Research Proposal

Simply broadening the adaptability by integrating complex ranking systems would be a really great step. Testing the performance under variables like network conditions could also improve the quality of the research. The biggest upgrade would be applying this method into distributed systems and real-world games.

An interesting path would be collaborating with fields like education and healthcare, where games integrating with those sectors are becoming increasingly common. Seeing how this paper could be applied elsewhere is a way to broaden the implementations.

Section 9: Personal Insights

All in all, this method is one good way to create a leaderboard. The scalability aspect is in line with my project as handling large datasets are important. Still, seeing how to accommodate complex ranking systems are necessary to make sure that the project works out well in the end, and provide a comprehensive ranking system.