The goal of this research was to explore ways of analyzing and improving the efficiency of Faial, a program that scans kernels for data-race conditions using the Z3 SAT solver. The performance of Faial is dependent on the performance of Z3, which is subsequently dependent on the logic that is given to Z3 at runtime. As a result, this research focused on analyzing the performance of the logics supported by Z3 in order to determine the best logic for analyzing CUDA kernels.

For this research, the Faial program was used to look for data-race conditions in a data set of 227 CUDA kernels. A benchmarking application was developed in order to run Faial using one of 32 different logics supported by Z3. The benchmarking application saved the benchmark results for each logic to individual CSV files for further analysis. Afterwards, another application was developed in order to visualize the data that was gathered. Filtering was used on the raw data in order to gain a more comprehensive view of how each logic performed under various constraints. The top performing logics were then ranked based on several performance characteristics. Afterwards, an algorithm was created in an attempt to improve the efficiency of the Faial program based on the results of the analysis that was performed.

This research found that QF\_AUFBV was the best logic in terms of adjusted execution time when no filtering was applied to the data. However, AUFLIRA and QF\_AUFLIRA both outperformed QF\_AUFBV when comparing logics with the greatest number of successes and fewest number of failures. A proposed algorithm for the Faial program was also developed which analyzes a kernel using AUFNIRA with QF\_AUFBV as a fallback option. Preliminary findings show that this algorithm ranks highly among the other logics in the performance characteristics that were measured.