Accelerated Word Frequency Analysis using CUDA

The **Word Frequency program with CUDA** project aims to develop an advanced solution for efficiently analyzing the frequency of words in large datasets. The project will leverage NVIDIA's CUDA framework to harness the power of GPUs, surpassing the performance of traditional CPU-based implementations.

Project Objectives

1. Implement a word frequency analysis tool that utilizes CUDA technology for parallel processing on GPUs.
2. Optimize the program to achieve superior speed and performance compared to CPU-based approaches.
3. Enable scalability to handle datasets of varying sizes, ranging from small files to extensive corpora.
4. Apply robust preprocessing techniques, including tokenization, lowercasing, punctuation removal, stop-word elimination, and stemming/lemmatization, for accurate word frequency analysis.
5. Develop a user-friendly command-line interface for easy program configuration, execution, and generation of comprehensive reports and summary statistics.
6. Explore the use of CUDA Streams to maximize GPU utilization and demonstrate improved performance **(extra points)**.
7. Investigate a hybrid implementation using OpenMP to harness all system resources effectively, leading to further performance enhancements **(extra points)**.
8. **Evaluate the performance improvements achieved at each step using profilers and demonstrate the results in the project report.**

> *The CUDA implementation **must** be faster than CPU implementations.*

Deliverables

1. Fully functional Word Frequency program with CUDA implementation, i.e. source code and executable.
2. Report documenting design choices, implementation details, optimization strategies employed, and *use of CUDA Streams for enhanced performance*.
3. Evaluation results demonstrating performance improvements at each step using profilers.
4. Evaluation of a hybrid implementation with OpenMP, showcasing effective utilization of system resources.
5. Presentation showcasing the project outcomes, challenges encountered, and lessons learned.

The Word Frequency program with CUDA project offers an opportunity for students to gain practical experience in parallel computing, GPU programming, and performance optimization. By implementing and optimizing a CUDA-based word frequency analysis tool, students will enhance their skills in software development, profiling, and analyzing performance improvements. The project provides the flexibility to explore advanced concepts such as CUDA Streams and hybrid implementations with OpenMP, showcasing the ability to leverage system resources effectively. The project report

will highlight the achieved performance improvements at each step using profilers, providing a comprehensive evaluation of the project's success.