HIGH-PERFORMANCE PARALLEL DATA PROCESSING FOR TIME SERIES AND GEOGRAPHIC ANALYSIS

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Introduction

Project showcases an approach to parallel data extraction using High Performance Computing (HPC) principles. Uses a distributed data processing system with MPI for parallel computations across multiple processors, augmented by OpenMP for intra-processor parallel processing.

Methods

- MPI (Message Passing Interface): For distributed parallel computations.
- OpenMP: For intra-processor parallel processing.
- C++ and Python: Implementation languages for processing and server management.
- Pandas and Matplotlib: For data congregation and
- Distributed File Processing Using MPI Parallel Data Cleaning and Processing with OpenMP

Dataset

NYC Parking Dataset: For the empirical dataset.
Size: 2.2 GB, 10 million rows x 43 columns

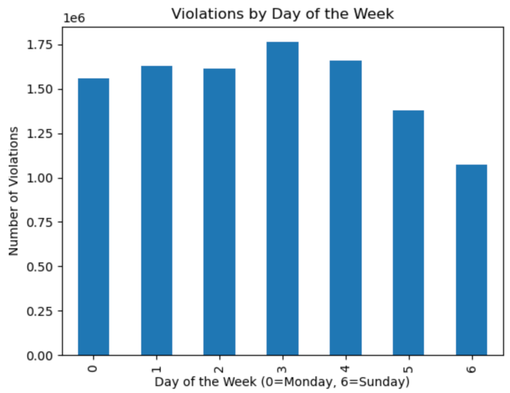
Relevant Features

- Issue Date
- Violation Location
- Street Name
- Violation County
- Violation Code

Procedure

- Data is divided and distributed across processors to minimize idle time and maximize read operations.
- Each processor works on its local data to reduce latency and network traffic for higher efficiency.
- Ensures even distribution of data among processors to prevent delays and achieve optimal utilization.
- Within each processor, OpenMP facilitates multi-threading, allowing multiple data operations to be performed concurrently.
- Multi-threading significantly decreases the time required for data cleaning and transformation.
- System scales effectively by utilizing processor cores to their full potential, processing records in parallel.

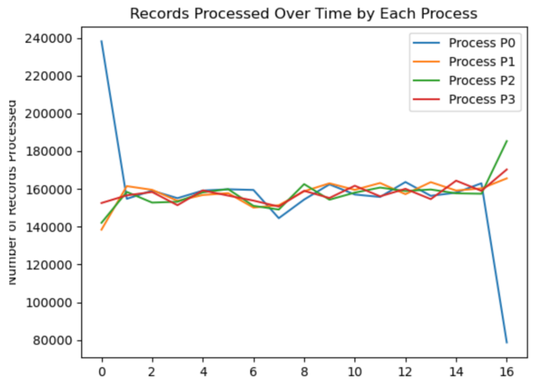
Results



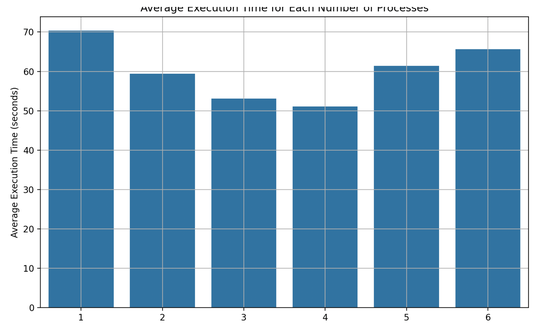
Time Analysis

Geographic Analysis

Performance 1



Performance 2



Conclusion

This project successfully integrates high-performance computing techniques to efficiently process large-scale datasets. The combination of MPI and OpenMP leads to a substantial reduction in processing time and improves the system's scalability and flexibility for complex analyses