

- A. Design and implementation:
- a. There are three independent programs running concurrently. The dispatcher and the consolidator run as a single main program, whereas the workers and the file server run as different programs. All the necessary inter-process communication occurs via gRPCs, defined in a proto file (Each process listens to a dedicated port).
 - b. There are four services and four message types in the go protocol buffer.
 - c. After the dispatcher, the consolidator and the file server start, spawned workers make a gRPC call to the dispatcher to get details of the job, which would contain the filePath, StartSeg and EndLen fields, as defined in the RPC response message type.
 - d. Workers use this information to query streaming bytes of data from file server which hosts server side streaming gRPC service.
 - e. Once a worker has computed the result corresponding to the file segment, it then sends this partial result via gRPC to the consolidator listening on a predefined port.
 - f. Once all the worker goroutines finish working on job segments, the main thread of the worker program would perform a gRPC client call with Empty message buffer to the consolidator, indicating that there are no more partial results to be expected and to compute the final result.
 - g. Once the consolidator receives this gRPC call to terminate, it returns the final result.
- B. Least elapsed time for a random data-file of 1GB in my implementation was 83957 ms.
- a. Setting (command-line arguments) for all M, N, and C parameters:
 - i. 661 64000 1000
 - b. Min jobs completed by a worker: 4
 - c. Max jobs completed by a worker: 25
 - d. Average jobs completed by a worker: 11.89
 - e. Median jobs completed by a worker: 12
 - f. Elapsed time (ms): 83957 ms
- C. Largest datafile processed within 3 mins elapsed time was of size 2.3GB.
- a. Setting (command-line arguments) for all M, N, and C parameters:
 - i. 661 64000 1000
 - ii. Min jobs completed by a worker: 12
 - iii. Max jobs completed by a worker: 44
 - iv. Average jobs completed by a worker: 28.16
 - v. Median jobs completed by a worker: 28
 - vi. Elapsed time (ms): 150719 ms
- D.
- a. A 2.5GB file with 1323 workers took 250719 ms to process.
 - b. The same file with:
 - i. 661 workers took 156036 ms.
 - ii. 330 workers took 175501 ms.
 - iii. 165 workers took 181959 ms.

- iv. 82 workers took 273636 ms.
 - v. 41 workers took 530107 ms.
 - vi. 20 workers took 1076803 ms.
- c. Plot of how elapsed time changes against values of M for a 2.5GB size file:

