

Write two C++ programs using MPI technology for distributed clustering performance evaluation. Before you write the programs, prepare a dataset with numerical values and no less than 1000 rows (for example, you can use Brooklyn sales map dataset).

Process 0 (root) reads data from file into an array and sends the data to all the processes in the communicator. Each other process starts K-means clustering algorithm and finds a solution. When solution is obtained, it is evaluated by using a clustering index. You can select any Min/Max clustering index in the "Clustering Quality Measures" PDF-file (page 21).

Process 0 collects the performance indices from all the processes and finds the best clustering solution based on Min or Max criteria. Process 0 outputs the best solution and its clusters' centroids.

First version of program uses only point-to-point communication functions (like MPI_Send and MPI_Recv) for data transmission. Second version of program is based on collective communication (MPI_Bcast or MPI_Reduce). Compare the time performance of both versions and make conclusions.