YUSUF AKGÜL

CSE 344

Final Project

1 Requirements

I have successfully implemented all the desired features in this project. There is no warning that comes from -Wall flag or memory leak showed by valgrind including CTRL-C interruption signal.

2 Design Decisions

a.) In this assigment I used mutexses and conditional variables to synchronization.

b.) I created a queue for client connection requests. I send incoming requests to this queue. The available thread receives the request from here.

c.) I created struct named server config, in this struct, there are variables, mutexes and conditional variables that the server and threads will need.

d.) I created a struct called Database. In this struct, I keep the number of rows and columns in the database. I also kept a pointer showing the first row of the database.

e.) I used a linked list for my database implementation. My database consists of nodes.Each node points to a row. In these nodes, I keep the columns of that row in the form of an string array.Also, each node keeps the reference of the next row.

f.) I created an enum named type. In this enum, I set the query types (select, select distinct, update).

g.) I created structs named Query and QueryRespond. Incoming requests are determined within the query struct. In the queryRespond struct, incoming requests are answered.

h.) I created the int volatile style global variable. I am changing this variable when the ctrl-c signal arrives. I use this signal where necessary, and do the desired action. When CTRL-C is pressed, the program leaves whatever it is doing, and frees the memory created by returning to the machine as soon as possible.

i.) Since there is both writing and reading processes in the database, I implemented the reader-writer algorithm between the threads and ensured synchronization.

j.) I preferred fixed size when sending data from Socket.I'm sending from the socket line by line, I have defined the line size.

3 Algorithms

Database, Query, Socket, Request, Threads

I started the project by creating a database structure. I used the link list structure for the database structure. Each row is connected to each other. Each node has a string array in which the columns are kept. In this way, I can access the columns with an index.

Then i wrote a struct to make sense of the incoming query string. In this query struct, features such as the type of query that comes in, how many columns it will affect, or what the properties of the column searched for update should be, and which values will change.I kept the results of this query in the queryRespond struct, which is a separate struct.(Note : Queries and columns are not case sensitive. I've converted everything to lowercase.)

In the Query respond struct, I kept the information on how many rows are affected at the end of the query, and which rows and columns will be sent to the client as a response.

In order to be able to respond to incoming requests from client, I added each request to a queue.Available threads receive these requests from the queue.

Since adding and removing requests to the queue should be in the critical section, I used the producer consumer algorithm between the threads and the main thread to here. While the main thread becomes a producer, the threads become consumers. The mutex I use for the queue is called qm, the conditional variable is called qcond.

Since the roles of the threads can change, I implemented a reader-writer algorithm to ensure synchronization between threads.According to this algorithm, writers have priority.I used 2 conditional variables (okToRead and okToWrite), 1 mutex (m) and 4 int values (AR, AW, WR, WW) for the algorithm.
(Note : I implemented this algorithm based on the lecture textbook.)

I preferred fixed size when sending data from socket.First I send the information of how many lines to send, then I start sending the lines.

4 Input Outputs

I tried it with many different input files.The output below is the temp.

SERVER OUTPUT

```
Thu Jun 10 02:19:37 2021 Executing with parameters:
                         -p 8081
                         -o abc
                         -l 2
                         -d test.csv
Thu Jun 10 02:19:37 2021 Loading dataset...
Thu Jun 10 02:19:37 2021 Dataset loaded in 0.00 seconds with 9 records.
Thu Jun 10 02:19:37 2021 A pool of 2 threads has been created
Thu Jun 10 02:19:37 2021 Thread #0: waiting for connection
Thu Jun 10 02:19:37 2021 Thread #1: waiting for connection
Thu Jun 10 02:19:41 2021 A connection has been delegated to thread id #1
Thu Jun 10 02:19:41 2021 Thread #1: received query SELECT DISTINCT
 Series_reference FROM TABLE;
Thu Jun 10 02:19:41 2021 Thread #1: query completed, 2 records have been returned.
Thu Jun 10 02:19:41 2021 Thread #1: received query SELECT DISTINCT *
 FROM TABLE;
Thu Jun 10 02:19:41 2021 Thread #1: query completed, 8 records have been returned.
Thu Jun 10 02:19:41 2021 Thread #1: received query SELECT DISTINCT
 Series_reference,Period,Data_value FROM TABLE;
Thu Jun 10 02:19:41 2021 Thread #1: query completed, 8 records have been returned.
Thu Jun 10 02:19:41 2021 Thread #1: received query SELECT DISTINCT
 Series_reference,Period,Data_value FROM TABLE;
Thu Jun 10 02:19:41 2021 Thread #1: query completed, 8 records have been returned.
Thu Jun 10 02:19:41 2021 Thread #1: waiting for connection
Thu Jun 10 02:19:43 2021 A connection has been delegated to thread id #1
Thu Jun 10 02:19:43 2021 Thread #1: received query SELECT DISTINCT Series_reference
 FROM TABLE;_value
Thu Jun 10 02:19:43 2021 Thread #1: query completed, 2 records have been returned.
Thu Jun 10 02:19:43 2021 Thread #1: received query SELECT DISTINCT * FROM TABLE;
Thu Jun 10 02:19:43 2021 Thread #1: query completed, 8 records have been returned.
Thu Jun 10 02:19:43 2021 Thread #1: received query SELECT DISTINCT Series_reference,
Period,Data_value FROM TABLE;
Thu Jun 10 02:19:43 2021 Thread #1: query completed, 8 records have been returned.
Thu Jun 10 02:19:43 2021 Thread #1: received query SELECT DISTINCT Series_reference,
Period,Data_value FROM TABLE;
Thu Jun 10 02:19:43 2021 Thread #1: query completed, 8 records have been returned.
Thu Jun 10 02:19:43 2021 Thread #1: waiting for connection
Thu Jun 10 02:25:45 2021 Termination signal received, waiting
 for ongoing threads to complete.
Thu Jun 10 02:25:45 2021 All threads have terminated, server shutting down.
```

CLIENT OUTPUT

```
Thu Jun 10 02:19:43 2021 Client-2 connecting to 127.0.0.1:8081
Thu Jun 10 02:19:43 2021 Client-2 connected and sending query 'SELECT DISTINCT
 Series_reference FROM TABLE;'
Server's response to Client-2 is 2 records, and arrived in 0.00 seconds
    series_reference,
1   bdcq.sf1aa3ca,
2   bdcq.sf1aa2ca,
Thu Jun 10 02:19:43 2021 Client-2 connected and sending query 'SELECT DISTINCT * FROM TABLE;'
Server's response to Client-2 is 8 records, and arrived in 0.00 seconds
    series_reference,period,data_value,suppressed,status,units,magnitude,...
1   bdcq.sf1aa3ca,2016.12,1390.589,,f,dollars,6,business data collection -...
2   bdcq.sf1aa2ca,2016.06,1116.386,,f,dollars,6,business data collection -...
3   bdcq.sf1aa3ca,2016.06,1189.735,,b,dollars,6,business data collection -...
4   bdcq.sf1aa2ca,2016.09,1070.874,,,dollars,6,business data collection -...
5   bdcq.sf1aa2ca,2016.12,1054.408,,f,dollars,6,business data collection -...
6   bdcq.sf1aa3ca,2016.09,1144.938,,f,dollars,6,business data collection - ...
7   bdcq.sf1aa3ca,2016.11,1390.589,,f,dollars,6,business data collection -...
8   bdcq.sf1aa3ca,2016.12,1390.588,,f,dollars,6,business data collection - ...
Thu Jun 10 02:19:43 2021 Client-2 connected and sending query 'SELECT DISTINCT
 Series_reference,Period,Data_value FROM TABLE;'
Server's response to Client-2 is 8 records, and arrived in 0.00 seconds
    series_reference,period,data_value,
1   bdcq.sf1aa3ca,2016.12,1390.589,
2   bdcq.sf1aa2ca,2016.06,1116.386,
3   bdcq.sf1aa3ca,2016.06,1189.735,
4   bdcq.sf1aa2ca,2016.09,1070.874,
5   bdcq.sf1aa2ca,2016.12,1054.408,
6   bdcq.sf1aa3ca,2016.09,1144.938,
7   bdcq.sf1aa3ca,2016.11,1390.589,
8   bdcq.sf1aa3ca,2016.12,1390.588,
Thu Jun 10 02:19:43 2021 Client-2 connected and sending query 'SELECT DISTINCT
 Series_reference,Period,Data_value FROM TABLE;'
Server's response to Client-2 is 8 records, and arrived in 0.00 seconds
    series_reference,period,data_value,
1   bdcq.sf1aa3ca,2016.12,1390.589,
2   bdcq.sf1aa2ca,2016.06,1116.386,
3   bdcq.sf1aa3ca,2016.06,1189.735,
4   bdcq.sf1aa2ca,2016.09,1070.874,
5   bdcq.sf1aa2ca,2016.12,1054.408,
6   bdcq.sf1aa3ca,2016.09,1144.938,
7   bdcq.sf1aa3ca,2016.11,1390.589,
8   bdcq.sf1aa3ca,2016.12,1390.588,
A total of 4 queries were executed, client is terminating.
```