CS 542 – DATABASE MANAGEMENT SYSTEMS

INTERNALS PROGRAMMING OPTION

Project 4 – Undo/Redo Logging

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INTRODUCTION

A database management system (DBMS) is a collection of programs that enables storage, modification, and information extraction from a database. Fault Recovery is an important part of DBMS. Data must be protected in the face of a system failure. Data must not be corrupted simply because several error-free queries or database modifications are being done at once. There are different techniques to handle the Fault Recovery in a DBMS. The Undo/Redo is a very popular technique used in many DBMS.

PURPOSE OF THE PROJECT

The purpose of this project is to programmatically make this change in all records and to generate undo/redo logs as we are doing it. Then move those logs to another machine that has a copy of the same data and apply the logs and observe that the data has changed.

TECHNOLOGIES INVOLVED

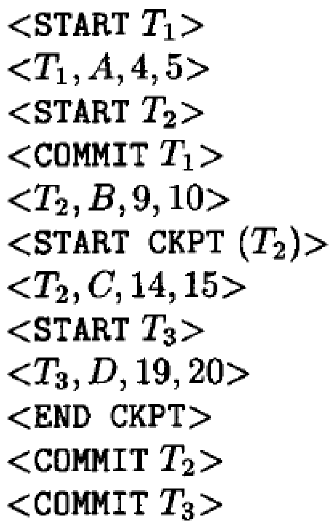
Language Implemented: Java (JDK 8)

Platform used: Eclipse

FILES USED

1. DemoApplication.java
2. Log.java
3. City.db
4. Country.db
5. LogCity.txt (created during program run)
6. LogCountry.txt (created during program run)

UNDO/REDO LOG STRUCTURE:



<START T_1>

<$T_1, A, 4, 5$>

<START T_2>

<COMMIT T_1>

<$T_2, B, 9, 10$>

<START CKPT (T_2)>

<$T_2, C, 14, 15$>

<START T_3>

<$T_3, D, 19, 20$>

<END CKPT>

<COMMIT T_2>

<COMMIT T_3>

A sample undo/redo log with three transactions

1. When the population of the existing database is updated by 2%, a log file is created by the program (either LogCity.txt or LogCountry.txt based on which database is worked on).
2. The above mentioned update is done using an operator by fetching all the populations in the database and updating the population with an increase in 2%.
3. The old and the new values are updated in the log file.
4. This log file is worked on a new system with the same but old version of the database.
5. Now, if the database finds that the log file has an update over that database, the values from the log file are taken and updated in the database.
6. Now the database is updated with the latest transactions.

INSTRUCTIONS TO RUN THE PROGRAM:

1. DemoApplication.java is the main file. This program is built on the previous assignments.

2. When running the program for the first time, a prompt appears:

   ```
   Select Project: Enter '1' for Logging. Enter '2' for
   Query Execution.
   ```

   Press ‘1’ and ‘Enter’

3. After pressing ‘1’, the next prompt asks for:

   ```
   Which table do you want to work on?
   Enter '1' for City Population
   Enter '2' for Country Population
   ```

   Enter ‘1’ or ‘2’ based on your choice.

   Note: Make sure that City.db and Country.db is already present in the system.

4. The next prompt asks you to select if you want to move the Log to a new system (or replace the updated population database with the unchanged old database) to update the old database, or to update the database with all the populations with an increase in 2%.

   ```
   Which do you want to do in the City Table?

   Enter '1' for Checking if the database is updated with a
   new Log File. Please make sure that the Log File is
   placed in the same location as the City.DB File

   Enter '2' for increasing the population of all the cities
   by 2% will considered as '2' by default
   ```

   Based on the option you enter, the respective processes are performed.

ASSUMPTIONS

1. City.db and Country.db must be already present in the same folder as DemoApplication.java and Log.java, during the program run.
2. The log file must be present in the same folder as mentioned above if the database is being checked for updating from the log file.
3. This program doesn't insert or delete records from the tables. The scope of this project is only to demonstrate Fault Recovery using Undo/Redo Logging.

CLASSES AND METHODS

1. **public class Log**
    a. public void begin() – The main function from the DemoApplication.java calls this function. All the activities of the Logging process starts here.

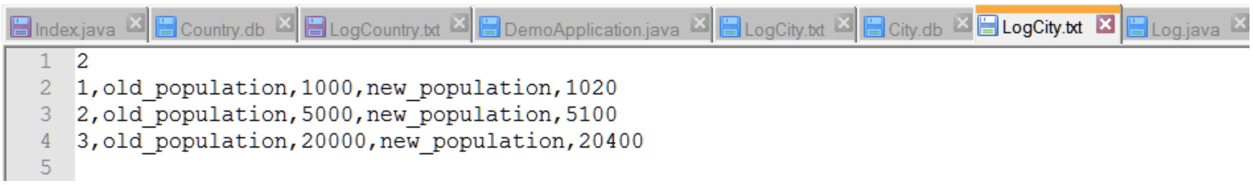
2. **public class LogCity** and **public class LogCountry** (both classes performs same function but for different databases)
    a. public void read() – Reads contents form the database
    b. public void write() – Writes contents to the database
    c. public void printDB() – Prints the contents of the database
    d. public void updatePop() – Updates the population of the all the tuples database by 2% increase
    e. public void updateLog() – Compare the versions of the database and the log file and updates the database based on the new values from the log file if necessary.

TEST CASES

Test Case 1: Checking for Log File creation

```
Select Project: Enter '1' for Logging. Enter '2' for Query Execution.
1
Which table do you want to work on?
Enter '1' for City Population
Enter '2' for Country Population
1
****Starting to Read****
****Read Completed****

Which do you want to do in the City Table?
Enter '1' for Checking if the database is updated with a new Log File. Please
make sure that the Log File is placed in the same location as the City.DB File
Enter '2' for Increasing the population of all the cities by 2%
Enter '3' to display the contents of the database
2
****Updating Population****
****Population Increased by 2%****

****Starting to Write****
****Write Completed****
```

Log File “LogCity” Created. The contents of the Log File is displayed below:



```
2
1,old_population,1000,new_population,1020
2,old_population,5000,new_population,5100
3,old_population,20000,new_population,20400

```

Test Case 2: Testing the 2% increase in population

Before updating:

```
Select Project: Enter '1' for Logging. Enter '2' for Query Execution.
1
Which table do you want to work on?
Enter '1' for City Population
Enter '2' for Country Population
1
****Starting to Read****
****Read Completed****
```

```
Which do you want to do in the City Table?
Enter '1' for Checking if the database is updated with a new Log File. Please
make sure that the Log File is placed in the same location as the City.DB File
Enter '2' for Increasing the population of all the cities by 2%
Enter '3' to display the contents of the database
3
****Printing City DB****
1,Worcester,MA,USA,1000
2,Boston,MA,USA,5000
3,New York,NY,USA,20000
****Print Completed****
```

After updating:

```
Select Project: Enter '1' for Logging. Enter '2' for Query Execution.
1
Which table do you want to work on?
Enter '1' for City Population
Enter '2' for Country Population
1
****Starting to Read****
****Read Completed****

Which do you want to do in the City Table?
Enter '1' for Checking if the database is updated with a new Log File. Please
make sure that the Log File is placed in the same location as the City.DB File
Enter '2' for Increasing the population of all the cities by 2%
Enter '3' to display the contents of the database
2
****Updating Population****
****Population Increased by 2%****

****Starting to Write****
****Write Completed****




Select Project: Enter '1' for Logging. Enter '2' for Query Execution.
1
Which table do you want to work on?
Enter '1' for City Population
Enter '2' for Country Population
1
****Starting to Read****
```

```
****Read Completed****

Which do you want to do in the City Table?
Enter '1' for Checking if the database is updated with a new Log File. Please
make sure that the Log File is placed in the same location as the City.DB File
Enter '2' for Increasing the population of all the cities by 2%
Enter '3' to display the contents of the database
3
****Printing City DB****
1,Worcester,MA,USA,1020
2,Boston,MA,USA,5100
3,New York,NY,USA,20400
****Print Completed****
```

Test Case 3: Check if Log File updates an old database properly

Contents of the old database:

```
Select Project: Enter '1' for Logging. Enter '2' for Query Execution.
1
Which table do you want to work on?
Enter '1' for City Population
Enter '2' for Country Population
1
****Starting to Read****
****Read Completed****

Which do you want to do in the City Table?
Enter '1' for Checking if the database is updated with a new Log File. Please
make sure that the Log File is placed in the same location as the City.DB File
Enter '2' for Increasing the population of all the cities by 2%
Enter '3' to display the contents of the database
3
****Printing City DB****
1,Worcester,MA,USA,1000
2,Boston,MA,USA,5000
3,New York,NY,USA,20000
****Print Completed****
```

Now make a copy of the old database and save it somewhere else.

Updating population by 2%:

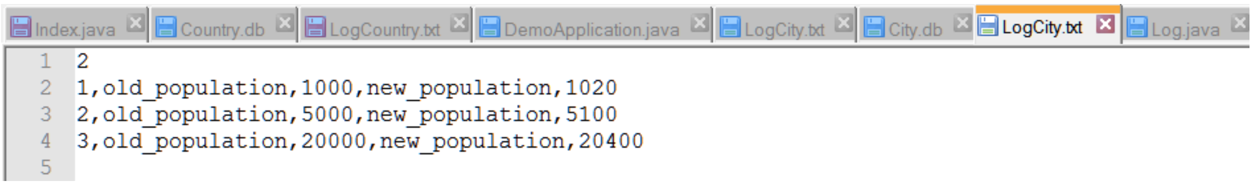
```
Select Project: Enter '1' for Logging. Enter '2' for Query Execution.
```

```
1
Which table do you want to work on?
Enter '1' for City Population
Enter '2' for Country Population
1
****Starting to Read****
****Read Completed****

Which do you want to do in the City Table?
Enter '1' for Checking if the database is updated with a new Log File. Please
make sure that the Log File is placed in the same location as the City.DB File
Enter '2' for Increasing the population of all the cities by 2%
Enter '3' to display the contents of the database
2
****Updating Population****
****Population Increased by 2%****

****Starting to Write****
****Write Completed****
```

Contents of the new database:

```
Select Project: Enter '1' for Logging. Enter '2' for Query Execution.
1
Which table do you want to work on?
Enter '1' for City Population
Enter '2' for Country Population
1
****Starting to Read****
****Read Completed****

Which do you want to do in the City Table?
Enter '1' for Checking if the database is updated with a new Log File. Please
make sure that the Log File is placed in the same location as the City.DB File
Enter '2' for Increasing the population of all the cities by 2%
Enter '3' to display the contents of the database
3
****Printing City DB****
1,Worcester,MA,USA,1020
2,Boston,MA,USA,5100
3,New York,NY,USA,20400
****Print Completed****
```

Contents of the log file:



```
2
1,old_population,1000,new_population,1020
2,old_population,5000,new_population,5100
3,old_population,20000,new_population,20400

```

Now, let us replace the updated database with the new old one.

Contents of the database:

```
Select Project: Enter '1' for Logging. Enter '2' for Query Execution.
1
Which table do you want to work on?
Enter '1' for City Population
Enter '2' for Country Population
1
****Starting to Read****
****Read Completed****

Which do you want to do in the City Table?
Enter '1' for Checking if the database is updated with a new Log File. Please
make sure that the Log File is placed in the same location as the City.DB File
Enter '2' for Increasing the population of all the cities by 2%
Enter '3' to display the contents of the database
3
****Printing City DB****
1,Worcester,MA,USA,1000
2,Boston,MA,USA,5000
3,New York,NY,USA,20000
****Print Completed****
```

Processing the log file on the database.

```
Select Project: Enter '1' for Logging. Enter '2' for Query Execution.
1
Which table do you want to work on?
Enter '1' for City Population
Enter '2' for Country Population
1
****Starting to Read****
****Read Completed****

Which do you want to do in the City Table?
Enter '1' for Checking if the database is updated with a new Log File. Please
make sure that the Log File is placed in the same location as the City.DB File
```

```
Enter '2' for Increasing the population of all the cities by 2%
Enter '3' to display the contents of the database
1
Checking for Database updation
****Updated Database based on the Log File****
****Starting to Write****
****Write Completed****
```

Now let us check the contents of the database after processing the log file:

```
Select Project: Enter '1' for Logging. Enter '2' for Query Execution.
1
Which table do you want to work on?
Enter '1' for City Population
Enter '2' for Country Population
1
****Starting to Read****
****Read Completed****

Which do you want to do in the City Table?
Enter '1' for Checking if the database is updated with a new Log File. Please
make sure that the Log File is placed in the same location as the City.DB File
Enter '2' for Increasing the population of all the cities by 2%
Enter '3' to display the contents of the database
3
****Printing City DB****
1,Worcester,MA,USA,1020
2,Boston,MA,USA,5100
3,New York,NY,USA,20400
****Print Completed****
```