**Core content homework assignment 6 (CC6)**

Qu 1. (40 points) Fill in the changeOrders() method of the provided CC6skeleton.java file. Note that you can use the TransactionDemo.java file as a useful model. Paste your code into your solution document. Do not submit a separate code file to Moodle.

Qu 2. The following table represents two transactions running in a database system, with operations interleaved over time. The two transactions interact with values stored at three locations in the database, named $A$, $B$ and $C$. The transactions also use local variables $x,y,z,u,v$.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| time | transaction 1 | transaction 2 | location $A$ | location $B$ | location $C$ |
| 1 | begin transaction  |  | 50 | 20 | 80 |
| 2 | $$x=read(A)$$ |  |  |  |  |
| 3 | $$y=read(B)$$ |  |  |  |  |
| 4 | $$y=y+4$$ |  |  |  |  |
| 5 |  | begin transaction  |  |  |  |
| 6 |  | $$u=read(A)$$ |  |  |  |
| 7 |  | $$v=read(C)$$ |  |  |  |
| 8 |  | $$u=u+2v$$ |  |  |  |
| 9 | $$z=read(C)$$ |  |  |  |  |
| 10 | $$z=z+1$$ |  |  |  |  |
| 11 | $$x=x+2y$$ |  |  |  |  |
| 12 | $$write(A,x)$$ |  |  |  |  |
| 13 | $$write(B,y)$$ |  |  |  |  |
| 14 | $$write(C,z)$$ |  |  |  |  |
| 15 | commit |  |  |  |  |
| 16 |  | $$write(A,u)$$ |  |  |  |
| 17 |  | commit |  |  |  |

(a) (5 points) Assume the database is using no concurrency control. Under this assumption, what are the final values stored in locations $A$, $B$ and $C$?

(b) (10 points) What type of concurrency problem occurred in part (a)? Use terminology from section 14.4.1 of the textbook, and briefly explain how and why the problem occurred.

(c) (5 points) Now assume the database is using the *rigorous two-phase locking* protocol, as defined in the textbook. (This is the default setting in MySQL, but not in Postgres.) Also assume that the transaction manager eliminates deadlocks as follows: if two transactions are deadlocked, the transaction that began most recently is canceled. Under these assumptions, what are the final values stored in locations $A$, $B$ and $C$?

(d) (10 points) Explain your answer to part (c). Make sure to explain how and why it differs from part (a). Mention which transactions commit successfully and which need to be rolled back.

Qu 3. Suppose that a database is performing recovery after a power failure. At the beginning of the recovery process, the four database locations $A$, $B$, $C$ and $D$ have the following values recorded on the disk: $A=45$, $B=20$, $C=70$, $D=150$. The contents of the log file on the disk are:

|  |  |
| --- | --- |
| transactionID | Operation |
| 8818 | begin transaction |
| 8818 | change $B$ from 125 to 20 |
| 8818 | change $A$ from 45 to 68 |
| 9253 | begin transaction |
| 8818 | change $A$ from 68 to 109 |
| 9253 | change $C$ from 95 to 82 |
| 8818 | Commit |
| 9253 | change $D$ from 150 to 180 |
| 9253 | change $C$ from 82 to 70 |

(a) (5 points) Once the recovery is complete, what values are stored in the four database locations? Justify your answer by explaining the sequence of operations in the recovery process.

(b) (15 points) Justify your answer to (a) by explaining the sequence of operations in the recovery process.

Total points on assignment: 90 points