1. (10 points total) Schedules:

1. (1p) What is a schedule

Schedule is a chronological execution of sequences of transactions.

1. (3p) Explain the concept of se**rial schedule**.

Serial schedule is a schedule where operations of each transaction are executed consecutively without any operations from other transactions.

1. (3p) Explain the concept of **non-serial schedule**

Non-serial schedule is where the operations from set of transactions are interleaved.

1. (3p) Explain the concept of **serializable schedule**

Serializable schedule is where transactions do not have operations on same data item.

A serializable schedule is a schedule whose effect on any consistent database instance is guaranteed to be identical to that of some complete serial schedule over S

2. (5 points) Deadlocks are possible only when one of the transactions wants to obtain a(n)------------ lock on data item.

a. Binary

b. Shared

**c. Exclusive**

d. Complete

3. (5 point). When a program is abnormally terminated, the equivalent of \_\_\_\_\_\_\_\_occurs:

a. COMMIT

b. QUIT

c. EXIT

**d ROLLBACK**

4. (5 points) \_\_\_\_\_\_\_\_ ensures that once transaction changes are done, they cannot be undone or lost, even in the event of a system failure:

a. Atomicity

b. Consistency

**c. Durability**

d. Isolation

5. (5 points total) What is the difference between **timestamp-based protocol** and **lock-based protocol** ( as concurrency control mechanisms ) ?

Timestamp is a unique identifier created by DMBS. It represents starting time of transaction.

Unlike locking method timestamping lets transaction to occur if transaction attempts to read or write data, then operation is allowed if the last update on that data was made by older transaction. Otherwise transaction gets new timestamp.

6. (5 points) What are the objectives of query processing?

Objective of query processing is to transform a query that is written in high-level language like SQL into low level language like relational algebra. Then execute the strategy to retrieve the required data.

7. (total 40 points) Given the following database tables:

User( userId, firstname, lastname, email );

CreditCard ( userId, cardNumber, securityCode, expirationDate );

Item (itemId, name, description, pricePerUnit);

Orders (orderId, userId, cardNumber, orderTotalAmount )

ItemsInOrder (orderId, itemId, quantity);

Formulate the following SQL statements:

1. Write DDL to create the table Orders 5 points.

CREATE TABLE Orders (

orderId varchar(30) PRIMARY KEY,

userId varchar(30),

cardNumber varchar(30),

orderTotalAmount MONEY

)

1. Write a query that will return all items which did not sell at all. 5 points

SELECT \*

FROM Item I left outer join ItemsInOrder IO

ON I.itemId = IO.itemId

WHERE IO.itemID is null

1. Write a SQL query which will add a new column named ‘address’ to the table user.

alter table users

add address varchar(30);

1. List the emails of people which spent a total of 100$ or less per credit card ( the total does not have to be spent in one order ). The email should printed once.

select users.email, orders.cardnumber, sum(orders.orderTotalAmount) as amount

from orders orders inner join users users on orders.userid = users.userid

group by users.email , orders.cardNumber

having sum(ordertotalamount) <= 100;

1. Delete all users which have ALL cards expired. If user has no cards at all OR at least one card which is still valid, they should NOT be deleted.

select \* into #expiredCards

from CreditCard

where expirationDate < GETDATE()

select \* into #validCards

from creditCard

where expirationDate > getdate()

select vld.\* into #withAtleast1ValidCard

from #expiredCards exp

inner join #validCards vld

on exp.userId = vld.userId

select \*

from creditCard cc

where cc.expirationDate < getdate() and cc.userId NOT IN (select userid from #withAtleast1ValidCard)

DROP TABLE #expiredCards

DROP TABLE #validCards

DROP TABLE #withAtleast1ValidCard

8. What is the significance of the write-ahead log protocol? How do checkpoints affect the recovery protocol?

Using the immediate update recovery protocol, updates are applied to the database as they occur without waiting to reach the commit point. As well as having to redo the updates of committed transactions following a failure, it may now be necessary to undo the effects of transactions that had not committed at the time of falure. In this case we use the log file to Whenprotect against system failures.

* When a transaction start, write transaction start record to the log.
* When a write operation is performed, write a record containing the neccessary data to the log file.
* Once the log record is written, write the update to the database buffers.
* The updates to the database itself are written when the buffers are next flushed to secondary storage.
* When the transaction commits, write a transaction commit record to the log.

It’s important that log records are written before the corresponding write to the database. This is known as the write ahead log protocol.

Checkpoints are the point of synchronization between the database and transaction log file.

When event of failure happens we examine the log to identify the transactions that were in progress at the time of failure and go back to the most recond checkpoint record.

9. What is Thomas write rule and how does it affect the basic timestamp ordering protocol?

Thomas’s write rule allows schedules to be generated that wouldn’t be possible under other concurrency protocols.

Transaction T asks to write item whose value has already been read by younger transaction.

Transaction T asks to write an item whose value has already been written by younger transaction, means that later transaction has already updated the value. In this case write operation can be ignored.

10. What are the differences between materialization and pipelining?

Materialization stores the output of operation in temporary table for processing by the next operations. Pipeline pushes the output of operation to another without creating a temporary table.

11. What is the ‘path’ to get from thought to fulfillment (this is one of the Principles of SCI)? How does this relate to some topic in the Database systems course that you took?