CSCI235 Database Systems

Transaction Processing in ANSI SQL

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Transaction Processing in ANSI SQL

Outline

Dirty read phenomenon

A transaction reads uncommitted data created by a transaction that fails later on

Dirty read phenomenon

Transaction 1	Transaction 2
	`SELECT budget FROM DEPARTMENT WHERE name = 'SALES';`
	`2000`
`UPDATE DEPARTMENT SET BUDGET = BUDGET + 1000 WHERE NAME = 'Sales';`	
	`SELECT budget FROM DEPARTMENT WHERE name = 'SALES';`
	`3000`
`ROLLBACK;`	
	`???`

Reading only committed data

Reading only committed data

Transaction 1	Transaction 2
	`SELECT budget FROM DEPARTMENT WHERE name = 'SALES';`
	`2000`
`UPDATE DEPARTMENT SET BUDGET = BUDGET + 1000 WHERE NAME = 'Sales';`	
	`SELECT budget FROM DEPARTMENT WHERE name = 'SALES';`
	`2000`
`ROLLBACK;`	

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Non-repeatable read phenomenon

A transaction reads the same data item few times and each a data item has a different value

Non-repeatable read phenomenon

Transaction 1	Transaction 2
	`SELECT budget FROM DEPARTMENT WHERE name = 'SALES';`
	`2000`
`UPDATE DEPARTMENT SET BUDGET = BUDGET + 1000 WHERE NAME = 'Sales';`	
`COMMIT;`	
	`SELECT budget FROM DEPARTMENT WHERE name = 'SALES';`
	`3000`
	`???`

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Phantom phenomenon

A transaction counts the total number of rows in the same table several times and each time the total number of rows is different

Phantom phenomenon

Transaction 1	Transaction 2
	`SELECT count(*) FROM DEPARTMENT`
	`20`
`DELETE DEPARTMENT WHERE NAME = 'Sales';`	
`COMMIT;`	
	`SELECT count(*) FROM DEPARTMENT`
	`19`

No phantoms

No phantoms

Transaction 1	Transaction 2
	`SELECT count(*) FROM DEPARTMENT`
	20
`DELETE DEPARTMENT WHERE NAME = 'Sales';`	
`COMMIT;`	
	`SELECT count(*) FROM DEPARTMENT`
	20

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Isolation levels

SQL provides four levels of isolation for database transactions

Isolation levels are equivalent to correctness levels

Isolation levels are defined in terms of several possible phenomena, or weird hard-to-explain occurrences of operations

The following isolation levels are defined in ANSI SQL

- READ UNCOMMITTED
- READ COMMITTED
- REPEATABLE READ
- SERIALIZABLE

Isolation levels are defined in the terms of so called phenomena

The following phenomena are considered

- Dirty read phenomenon
- Non-repeatable read phenomenon
- Phantom phenomenon

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Phenomena

Dirty read phenomenon

- Read operations may access dirty data, i.e. data written by uncommitted transactions

Non-repeatable read phenomenon

- Different reads by a single transaction to the same data will not be repeatable, i.e. they may return different values

Phantom phenomenon

- A set of rows that transaction reads once might be a different set of rows if the transaction attempts to read them again

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Isolation levels versus phenomena

At READ UNCOMMITED isolation level a transaction may exhibit:

- dirty read phenomenon,
- non-repeatable read phenomenon,
- phantom phenomenon

At READ COMMITED isolation level a transaction may exhibit:

- non-repeatable read phenomenon,
- phantom phenomenon

At REPEATABLE READ isolation level a transaction may exhibit:

- phantom phenomenon

At SERIALIZABLE isolation level a transaction may exhibit:

- none of the phenomena

Isolation levels versus phenomena

Isolation levels versus phenomena

Level	Dirty Read	Nonrepeatable Read	Phantom
READ UNCOMMITTED	Possible	Possible	Possible
READ COMMITTED	not possible	Possible	Possible
REPEATABLE READ	not possible	not possible	Possible
SERIALIZABLE	not possible	not possible	not possible

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Setting isolation levels in ANSI SQL

```
SET TRANSACTION ISOLATION LEVEL READ UNCOMMITTED;
SET TRANSACTION ISOLATION LEVEL READ COMMITTED;
SET TRANSACTION ISOLATION LEVEL REPEATABLE READ;
SET TRANSACTION ISOLATION LEVEL SERIALIZABLE;
```

References

Elmasri R. and Navathe S. B., Fundamentals of Database Systems, Chapter 20.6 Transaction Support in SQL, 7th ed., The Pearson Education Ltd, 2017