

CSCI235 Database Systems

Transaction Processing in ANSI SQL

Dr Janusz R. Getta

School of Computing and Information Technology -
University of Wollongong

Transaction Processing in ANSI SQL

Outline

Dirty read phenomenon

Non-repeatable read phenomenon

Phantom phenomenon

Isolation levels

Phenomena

Isolation levels versus phenomena

Setting isolation levels in ANSI SQL

[TOP](#)

Created by Janusz R. Getta, CSCI235 Database Systems, Spring 2020

2/19

Dirty read phenomenon

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

Dirty read phenomenon	
Transaction 1	Transaction 2
	<code>SELECT budget</code> <code>FROM DEPARTMENT</code> <code>WHERE name = 'SALES';</code>
	2000
<code>UPDATE DEPARTMENT</code> <code>SET BUDGET = BUDGET + 1000</code> <code>WHERE NAME = 'Sales';</code>	
	<code>SELECT budget</code> <code>FROM DEPARTMENT</code> <code>WHERE name = 'SALES';</code>
	3000
<code>ROLLBACK;</code>	
	???

[TOP](#)

Created by Janusz R. Getta, CSCI235 Database Systems, Spring 2020

3/19

Reading only committed data

Reading only committed data	
Transaction 1	Transaction 2
	<code>SELECT budget</code> <code>FROM DEPARTMENT</code> <code>WHERE name = 'SALES';</code>
	2000
<code>UPDATE DEPARTMENT</code> <code>SET BUDGET = BUDGET + 1000</code> <code>WHERE NAME = 'Sales';</code>	
	<code>SELECT budget</code> <code>FROM DEPARTMENT</code> <code>WHERE name = 'SALES';</code>
	2000
<code>ROLLBACK;</code>	

Transaction Processing in ANSI SQL

Outline

[Dirty read phenomenon](#)

[Non-repeatable read phenomenon](#)

[Phantom phenomenon](#)

[Isolation levels](#)

[Phenomena](#)

[Isolation levels versus phenomena](#)

[Setting isolation levels in ANSI SQL](#)

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
	<code>SELECT budget</code> <code>FROM DEPARTMENT</code> <code>WHERE name = 'SALES';</code>
	2000
<code>UPDATE DEPARTMENT</code> <code>SET BUDGET = BUDGET + 1000</code> <code>WHERE NAME = 'Sales';</code>	
<code>COMMIT;</code>	
	<code>SELECT budget</code> <code>FROM DEPARTMENT</code> <code>WHERE name = 'SALES';</code>
	3000
	???

[TOP](#)

Created by Janusz R. Getta, CSCI235 Database Systems, Spring 2020

6/19

Transaction Processing in ANSI SQL

Outline

[Dirty read phenomenon](#)

[Non-repeatable read phenomenon](#)

[Phantom phenomenon](#)

[Isolation levels](#)

[Phenomena](#)

[Isolation levels versus phenomena](#)

[Setting isolation levels in ANSI SQL](#)

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
	<code>SELECT count(*)</code> <code>FROM DEPARTMENT</code>
	20
<code>DELETE DEPARTMENT</code> <code>WHERE NAME = 'Sales';</code>	
<code>COMMIT;</code>	
	<code>SELECT count(*)</code> <code>FROM DEPARTMENT</code>
	19

No phantoms

No phantoms	
Transaction 1	Transaction 2
	<code>SELECT count(*)</code> <code>FROM DEPARTMENT</code>
	20
<code>DELETE DEPARTMENT</code> <code>WHERE NAME = 'Sales';</code>	
<code>COMMIT;</code>	
	<code>SELECT count(*)</code> <code>FROM DEPARTMENT</code>
	20

Transaction Processing in ANSI SQL

Outline

[Dirty read phenomenon](#)

[Non-repeatable read phenomenon](#)

[Phantom phenomenon](#)

[Isolation levels](#)

[Phenomena](#)

[Isolation levels versus phenomena](#)

[Setting isolation levels in ANSI SQL](#)

[TOP](#)

Created by Janusz R. Getta, CSCI235 Database Systems, Spring 2020

10/19

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**

[TOP](#)

Created by Janusz R. Getta, CSCI235 Database Systems, Spring 2020

11/19

Transaction Processing in ANSI SQL

Outline

Dirty read phenomenon

Non-repeatable read phenomenon

Phantom phenomenon

Isolation levels

Phenomena

Isolation levels versus phenomena

Setting isolation levels in ANSI SQL

[TOP](#)

Created by Janusz R. Getta, CSCI235 Database Systems, Spring 2020

12/19

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

Transaction Processing in ANSI SQL

Outline

[Dirty read phenomenon](#)

[Non-repeatable read phenomenon](#)

[Phantom phenomenon](#)

[Isolation levels](#)

[Phenomena](#)

[Isolation levels versus phenomena](#)

[Setting isolation levels in ANSI SQL](#)

[TOP](#)

Created by Janusz R. Getta, CSCI235 Database Systems, Spring 2020

14/19

Isolation levels versus phenomena

At **READ UNCOMMITTED** isolation level a transaction may exhibit:

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

At **READ COMMITTED** 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

Transaction Processing in ANSI SQL

Outline

[Dirty read phenomenon](#)

[Non-repeatable read phenomenon](#)

[Phantom phenomenon](#)

[Isolation levels](#)

[Phenomena](#)

[Isolation levels versus phenomena](#)

[Setting isolation levels in ANSI SQL](#)

[TOP](#)

Created by Janusz R. Getta, CSCI235 Database Systems, Spring 2020

17/19

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