

CSCI235 Database Systems

Transaction Processing in ANSI SQL

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Transaction Processing in ANSI SQL

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[Non-repeatable read phenomenon](#)

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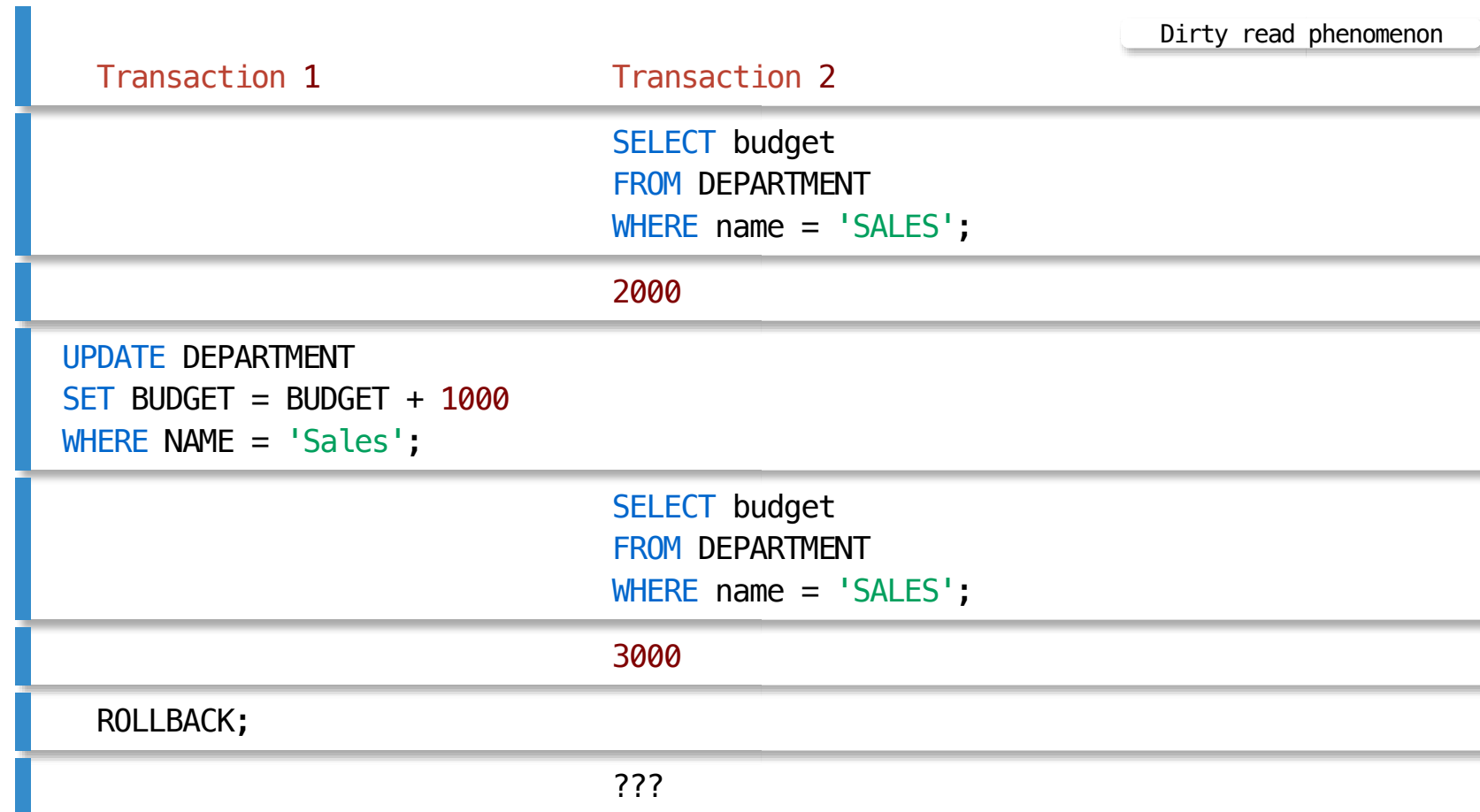
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Dirty read phenomenon

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



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Reading only committed data

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

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Non-repeatable read phenomenon

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

| Non-repeatable read phenomenon | |
|---|--|
| Transaction 1 | Transaction 2 |
| | <pre>SELECT budget FROM DEPARTMENT WHERE name = 'SALES';</pre> |
| | 2000 |
| <pre>UPDATE DEPARTMENT SET BUDGET = BUDGET + 1000 WHERE NAME = 'Sales';</pre> | |
| COMMIT; | |
| | <pre>SELECT budget FROM DEPARTMENT WHERE name = 'SALES';</pre> |
| | 3000 |
| | ??? |

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Phantom phenomenon

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

| Phantom phenomenon | |
|--|--|
| Transaction 1 | Transaction 2 |
| | <code>SELECT count(*) FROM DEPARTMENT</code> |
| | 20 |
| <code>DELETE DEPARTMENT WHERE NAME = 'Sales';</code> | |
| <code>COMMIT;</code> | |
| | <code>SELECT count(*) FROM DEPARTMENT</code> |
| | 19 |

No phantoms

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

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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