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Advanced SQL

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Views and indices

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Views

An expression that describes a table without creating it. A relation that is defined by a query over other relations.

Two kinds:

1. *Virtual:* not stored in the database; just a query for constructing the relation.
2. *Materialized:* actually constructed and stored.

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Views: example

```
CREATE VIEW name AS query;
```

The view `CanDrink` is the set of drinker-beer pairs such that the drinker frequents at least one bar that serves the beer.

```
CREATE VIEW CanDrink AS
SELECT drinker, beer
FROM Frequents, Sells
WHERE Frequents.bar = Sells.bar;
```

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Accessing a view

Querying Views: Treat the view as if it was a materialized relation

```
SELECT beer FROM CanDrink WHERE drinker = 'Sally'
```

Indices

An index is a data structure used to speed access to tuples of a relation, given values of one or more attributes

```
CREATE INDEX BeerInd ON Beers(manufacturer);
```

```
CREATE INDEX SellInd ON Sells(bar, beer);
```

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Use of Indices

- *Pros*: The existence of an index on an attribute may speed up the execution of those queries which uses that attribute
- *Con*: An index slows down all modifications(insertions, deletions, and updates) on its relation because the index must be modified too.

Transactions in SQL

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Transactions

A database transaction comprises a unit of work performed within a database management system against a database.

“all-or-nothing” proposition:
each work-unit performed in a database must either complete in its entirety or have no effect whatsoever.

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Purpose

1. To provide consistency after recovery and system failures

2. To provide isolation between programs accessing a database concurrently

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The ACID Properties

- **Atomicity:** A transaction is an atomic unit of processing; it is either performed in its entirety or not performed at all.
- **Consistency:** A transaction is consistency preserving if its complete execution take the database from one consistent state to another.
- **Isolation:** A transaction should appear as though it is being executed in isolation from other transactions. That is, the execution of a transaction should not be interfered with by any other transaction execution concurrently.
- **Durability:** The changes applied to the database by a committed transaction must persist in the database. These changes must not be lost because of any failure.

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Concurrency control

1. Pessimistic concurrency control (Locking)
2. Optimistic concurrency control (Multiversioning)

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	Read	Write
Read	S	X
Write	X	X

Compatibility of locks

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Commit/Rollback

- The SQL statement COMMIT causes a transaction to complete.
  - Its database modifications are now permanent in the database.
- The SQL statement ROLLBACK also causes the transaction to end, but by aborting.
  - No effects on the database.

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Isolation Levels

SQL defines four *isolation levels*: choices about what interactions are allowed by transactions that execute concurrently.

SET TRANSACTION ISOLATION LEVEL X
where X is

- SERIALIZABLE
- REPEATABLE READ
- READ COMMITTED
- READ UNCOMMITTED

Only serializable level achieves complete ACID transactions.

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Transactions in MySQL

Use a transactional storage engine: *InnoDB*

SET autocommit = 0

START TRANSACTION

...

sql statements

...

COMMIT or ROLLBACK

Triggers

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Triggers

Trigger is a block of procedural code which is stored in the database and runs automatically on triggering events.

Routines are stored blocks of code that need to be called to operate

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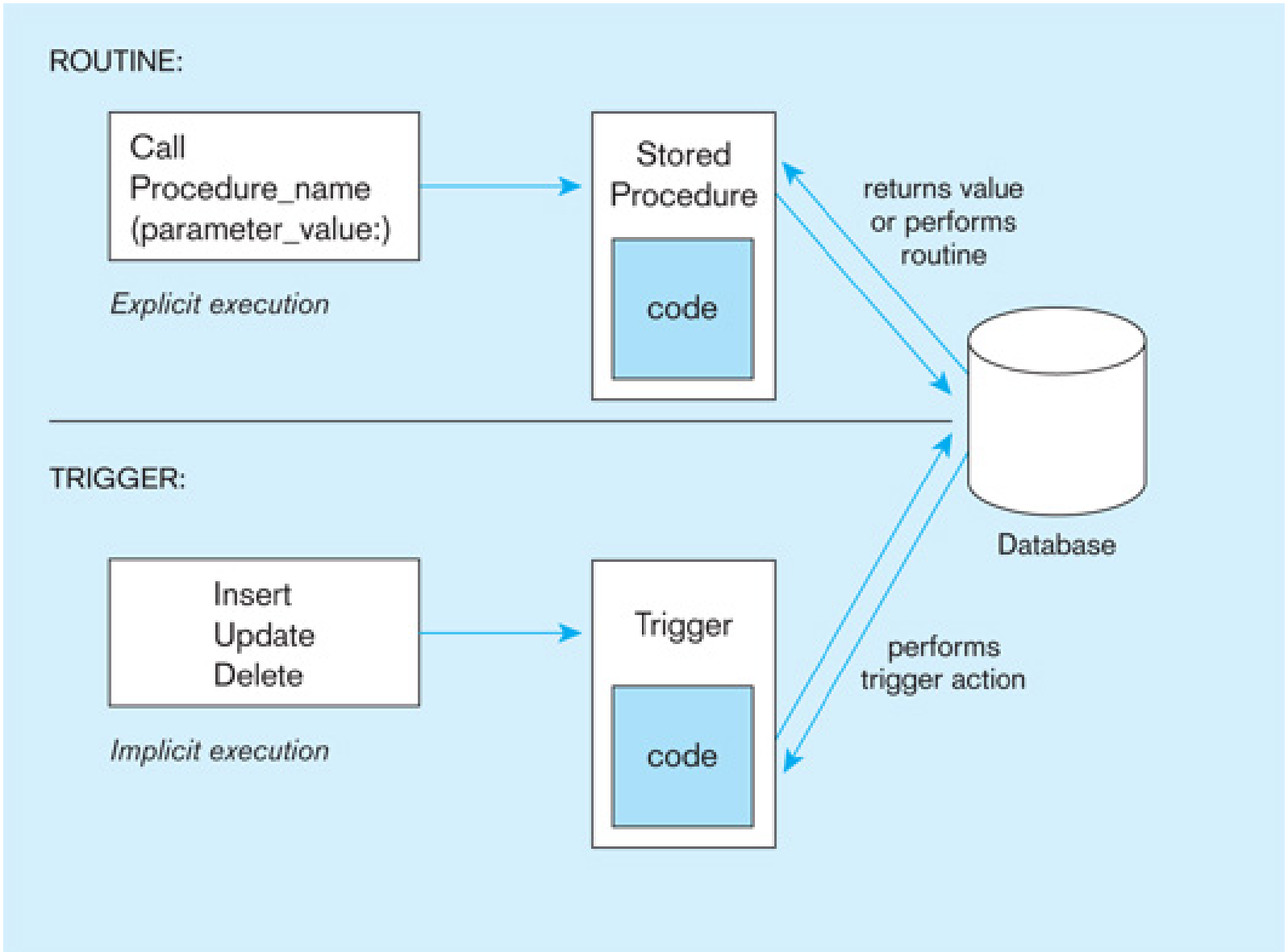
Triggers vs. routines



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Event-Condition-Action

- **Event** : typically a type of database modification, e.g.,*"insert on Sells"*
- **Condition**: Any SQL boolean-valued expression.
- **Action**: Any SQL statements.

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Triggers: examples

```
CREATE TRIGGER trigger_name
        {BEFORE | AFTER | INSTEAD OF} {INSERT | DELETE | UPDATE} ON
        table_name
        [FOR EACH {ROW | STATEMENT}] [WHEN (search condition)]
        <triggered SQL statement here>;
```

```
CREATE TRIGGER BeerTrig
AFTER INSERT ON Sells REFERENCING NEW ROW AS NewTuple
FOR EACH ROW
WHEN (NewTuple.beer NOT IN (SELECT name FROM Beers))
INSERT INTO Beers(name) VALUES(NewTuple.beer);
```

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Triggers:examples

```
CREATE TRIGGER PriceTrig AFTER UPDATE OF price ON Sells
REFERENCING OLD ROW AS ooo NEW ROW AS nnn
FOR EACH ROW
WHEN(nnn.price > ooo.price + 1.00)
INSERT INTO RipoffBars
VALUES(nnn.bar);
```