SEC1

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# Relational Databases

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# Agenda

SEC1

- Before we Begin
- Relational Databases (DB)
- Structured Query Language (SQL)
- Data locking strategies
- Advanced Databases Topics
- Modeling databases
- Assignments

# Agenda

SEC1

- **Before we Begin**
- Relational Databases (DB)
- Structured Query Language (SQL)
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# Agenda


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# What is this database thing?

- **Database (DB)** – organized collection of data
- **Database Management System (DBMS)** – computer software, allows the definition, creation, querying, update, and administration of databases.
- In our daily work we usually mix those two terms.

# Why do we need databases?

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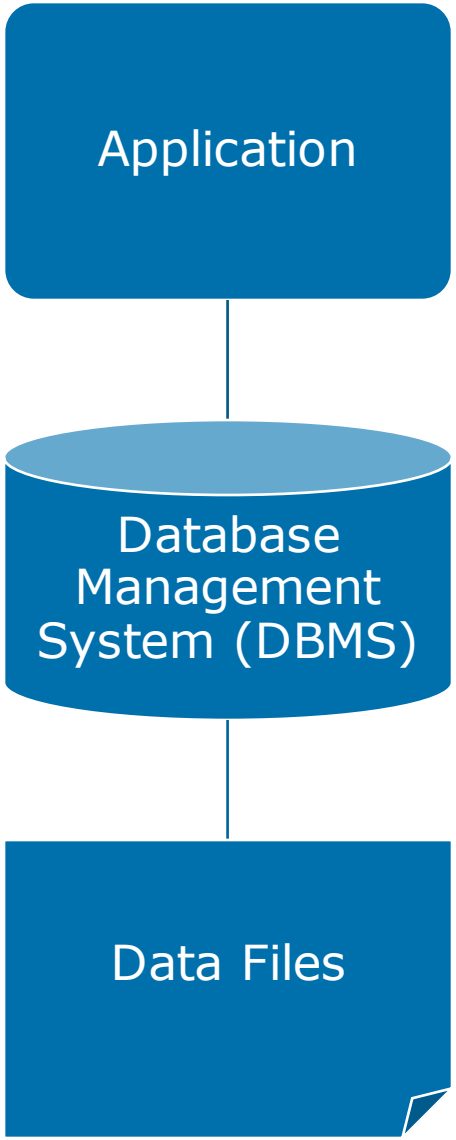
## Is it really needed? Do we care?

- Abstraction layer between data and application
- It's about speed, scalability, integrity, security, transaction support, availability, consistency… You don't want to implement it yourself.
- NOTE: Our development environments might give an impression, that the database is irrelevant (in-memory database, initialized on applications start and destroyed when application stops). It is not



# Who is using DB?

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- **Everyone!**

- End-users
- Developers of the applications
- Testers
- Designers of the database
- System analytics
- Business Analytics
- Database Administrators
- …

# Different database types




**Relational**

- **Oracle**
- **MySQL**
- **MS SQL Server**
- PostgreSQL
- IBM Db2
- MariaDB

**Object oriented**

- InterSystem Caché
- Db4o
- Matisse
- Perst
- ZopeDB

**Column**

- Cassandra
- HBase
- Accumulo
- Scylla
- HBase

**Document**

- MongoDB
- Amazon DynamoDB
- Microsoft Azure Cosmos DB
- CouchDB
- DocumentDB
- MemcacheDB

**Key-Value**

- Redis
- Amazon DynamoDB
- Oracle NoSQL
- Apache Ignite

**Graph**

- Neo4j
- Microsoft Azure Cosmos DB
- OrientDB
- ArangoDB
- AllegroGraph

Source:https://www.alooma.com/blog/types-of-modern-databases ; https://db-engines.com/en/ranking

# Rankings of popularity

URL: https://db-engines.com/en/ranking

361 systems in ranking, January 2021

| Rank | | | DBMS | Database Model | Score | | |
|---|---|---|---|---|---|---|---|
| Jan 2021 | Dec 2020 | Jan 2020 | | | Jan 2021 | Dec 2020 | Jan 2020 |
| 1. | 1. | 1. | Oracle | Relational, Multi-model | 1322.93 | -2.66 | -23.75 |
| 2. | 2. | 2. | MySQL | Relational, Multi-model | 1252.06 | -3.40 | -22.60 |
| 3. | 3. | 3. | Microsoft SQL Server | Relational, Multi-model | 1031.23 | -6.85 | -67.31 |
| 4. | 4. | 4. | PostgreSQL | Relational, Multi-model | 552.23 | +4.65 | +45.03 |
| 5. | 5. | 5. | MongoDB | Document, Multi-model | 457.22 | -0.51 | +30.26 |
| 6. | 6. | 6. | IBM Db2 | Relational, Multi-model | 157.17 | -3.26 | -11.53 |
| 7. | 7. | ↑ 8. | Redis | Key-value, Multi-model | 155.01 | +1.38 | +6.26 |
| 8. | 8. | ↓ 7. | Elasticsearch | Search engine, Multi-model | 151.25 | -1.24 | -0.19 |
| 9. | 9. | ↑ 10. | SQLite | Relational | 121.89 | +0.21 | -0.25 |
| 10. | 10. | ↑ 11. | Cassandra | Wide column | 118.08 | -0.76 | -2.59 |
| 11. | 11. | ↓ 9. | Microsoft Access | Relational | 115.33 | -1.41 | -13.24 |
| 12. | 12. | ↑ 13. | MariaDB | Relational, Multi-model | 93.79 | +0.18 | +6.34 |
| 13. | 13. | ↓ 12. | Splunk | Search engine | 87.66 | +0.66 | -1.01 |
| 14. | 14. | ↑ 15. | Teradata | Relational, Multi-model | 72.59 | -1.24 | -5.70 |
| 15. | ↑ 16. | ↑ 25. | Microsoft Azure SQL Database | Relational, Multi-model | 71.36 | +1.87 | +43.16 |
| 16. | ↓ 15. | ↓ 14. | Hive | Relational | 70.43 | +0.16 | -13.81 |
| 17. | 17. | ↓ 16. | Amazon DynamoDB | Multi-model | 69.14 | +0.01 | +7.11 |

# Cloud Computing, Cloud Databases


Database as a Service

SaaS IaaS PaaS

Source:https://www.supportpro.com/blog/dbms-and-dbaas/

# Relational databases

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- Based on the mathematical model of relation (you know, a subset of a cartesian product).
- A database consists of multiple tables.

Column

Each column has name and a defined type (like string, number, enum, date…)

Table name

employee

| id | first_name | last_name | hired | email | created_by | created_at |
|---|---|---|---|---|---|---|
| 1 | Maciej | Kowalski | 2017-01-01 | mkowalski@capg.com | hr1 | 2019-02-17 |
| 2 | Armando | Roggio | 2014-03-13 | armando@some.com | hr1 | 2019-01-01 |
| 3 | Barack | Obama | 2017-01-20 | barack@usa.com | admin | 2019-01-02 |
| 4 | Bono | Vox | 2014-07-13 | bono@u2.com | admin | 2019-01-01 |
| 5 | Bill | Gates | 2009-02-20 | bill@microsoft.com | admin | 2019-01-01 |
| 6 | Steve | Jobs | 1988-02-08 | steve@apple.com | null | null |
| 7 | Larry | Ellison | 2000-08-09 | larry@oracle.com | admin | 2019-01-01 |
| 8 | Maciej | Nowak | 2017-02-01 | mnowak@capg.com | hr2 | 2017-02-01 |

Row, tuple

# Primary Key


- Attribute or set of attributes, which identifies row
- Can be natural or technical (some ‚id' field)

| first_name | last_name | hired | email | created_by | created_at |
|---|---|---|---|---|---|
| Maciej | Kowalski | 2017-01-01 | mkowalski@capg.com | hr1 | 2019-02-17 |
| Armando | Roggio | 2014-03-13 | armando@some.com | hr1 | 2019-01-01 |
| Barack | Obama | 2017-01-20 | barack@usa.com | admin | 2019-01-02 |
| Bono | Vox | 2014-07-13 | bono@u2.com | admin | 2019-01-01 |
| Bill | Gates | 2009-02-20 | bill@microsoft.com | admin | 2019-01-01 |
| Steve | Jobs | 1988-02-08 | steve@apple.com | null | null |
| Larry | Ellison | 2000-08-09 | larry@oracle.com | admin | 2019-01-01 |
| Maciej | Nowak | 2017-02-01 | mnowak@capg.com | hr2 | 2017-02-01 |

# Foreign Key


- Attribute or set of attributes, which points to row in other (or same) table

Employee

| id | first_name | last_name | position_id | manager_id |
|---|---|---|---|---|
| 1 | Maciej | Kowalski | 1 | null |
| 2 | Armando | Roggio | 2 | 1 |
| 3 | Barack | Obama | 2 | 1 |
| 4 | Bono | Vox | 3 | 2 |
| 5 | Bill | Gates | 3 | 2 |
| 6 | Steve | Jobs | 3 | 2 |
| 7 | Larry | Ellison | 3 | 3 |
| 8 | Maciej | Nowak | 3 | 3 |

Position

| id | position |
|---|---|
| 1 | CEO |
| 2 | Head of department |
| 3 | Developer |

Mails of employees

| employee_id | email |
|---|---|
| 1 | kowalski@capg.com |
| 2 | roggio@some.com |
| 3 | barack@usa.com |
| 1 | m.kowalski@test.pl |

# Normalizations and relations


- Re-structure tables and relations in order to satisfy so called normal forms
- Goal: reduce data duplications, improve integrity etc

| id | name | email |
|---|---|---|
| 1 | Maciej Kowalski | mkowalski@capg.com |
| 2 | Armando Roggio | armando@some.com |
| 3 | Barack Obama | barack@usa.com |
| 4 | Bono Vox | bono@u2.com |

| id | first_name | last_name | email |
|---|---|---|---|
| 1 | Maciej | Kowalski | mkowalski@capg.com |
| 2 | Armando | Roggio | armando@some.com |
| 3 | Barack | Obama | barack@usa.com |
| 4 | Bono | Vox | bono@u2.com |

| id | first_name | last_name | address |
|---|---|---|---|
| 1 | Maciej | Kowalski | Legnicka 48H, 54-202 Wrocław |
| 2 | Armando | Roggio | Tęczowa 301, 53-601 Wrocław |

| id | first_name | last_name | zip_code | city | street | apartment |
|---|---|---|---|---|---|---|
| 1 | Maciej | Kowalski | 54-202 | Wrocław | Legnicka | 48H |
| 2 | Armando | Roggio | 53-601 | Wrocław | Tęczowa | 301 |

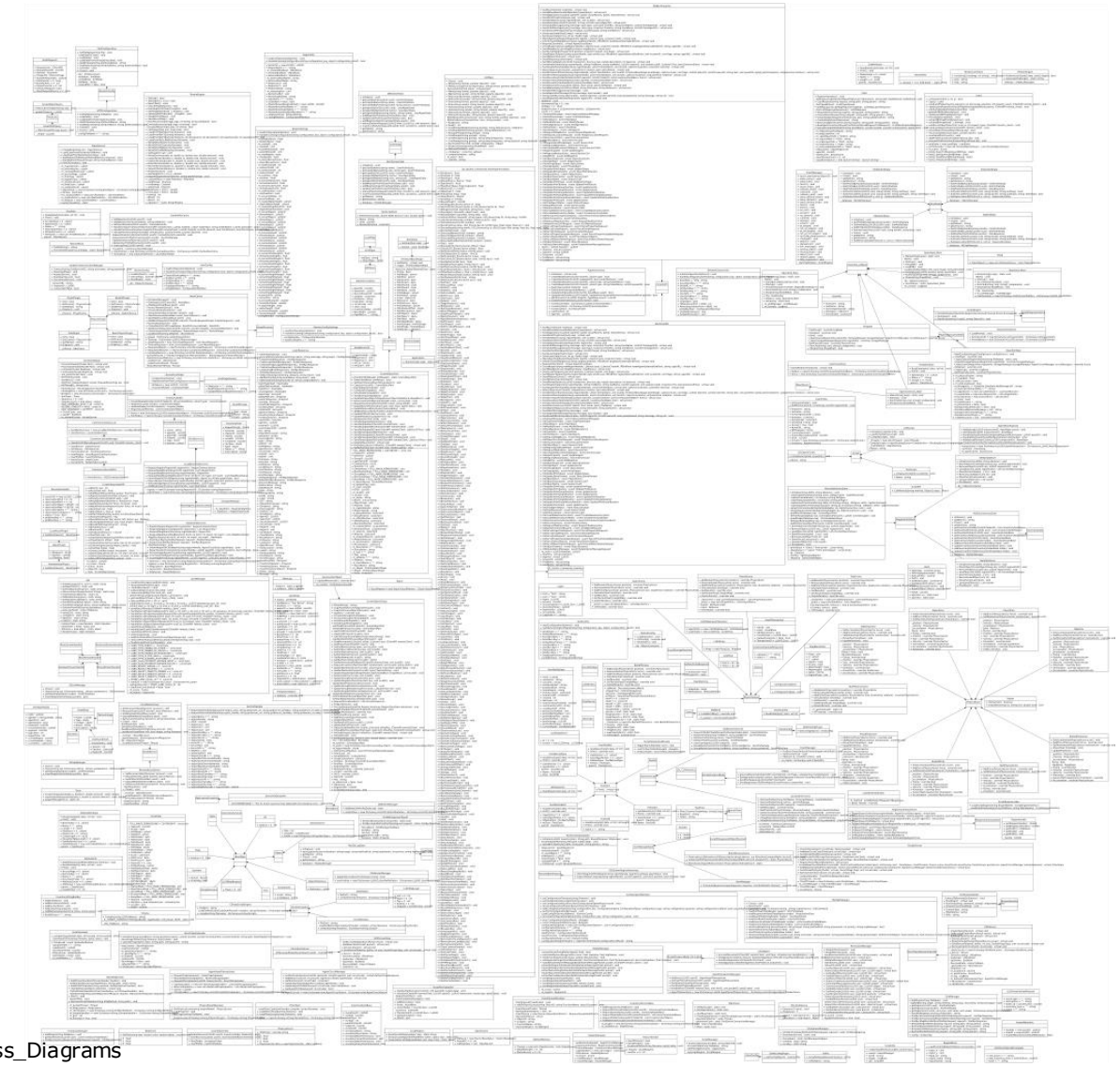
| id | last_name | email1 | email2 |
|---|---|---|---|
| 1 | Kowalski | kowal@capg.com | mkowalski@test.pl |
| 2 | Roggio | roggio@some.com | |
| 3 | Obama | barack@usa.com | |
| 4 | Vox | | |

| id | last_name |
|---|---|
| 1 | Kowalski |
| 2 | Roggio |
| 3 | Obama |
| 4 | Vox |

| emp_id | email |
|---|---|
| 1 | kowal@capg.com |
| 2 | roggio@some.com |
| 3 | barack@usa.com |
| 1 | mkowalski@test.pl |

https://en.wikipedia.org/wiki/Database_normalization

# Relations… everywhere… relations



Source:http://opensimulator.org/wiki/OpenSim:_Class_Diagrams

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# SQL


Source:https://learnsql.com/blog/sql-or-sequel/

# Structured Query Langauge (SQL)

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## Standardized

Current version: SQL:2016

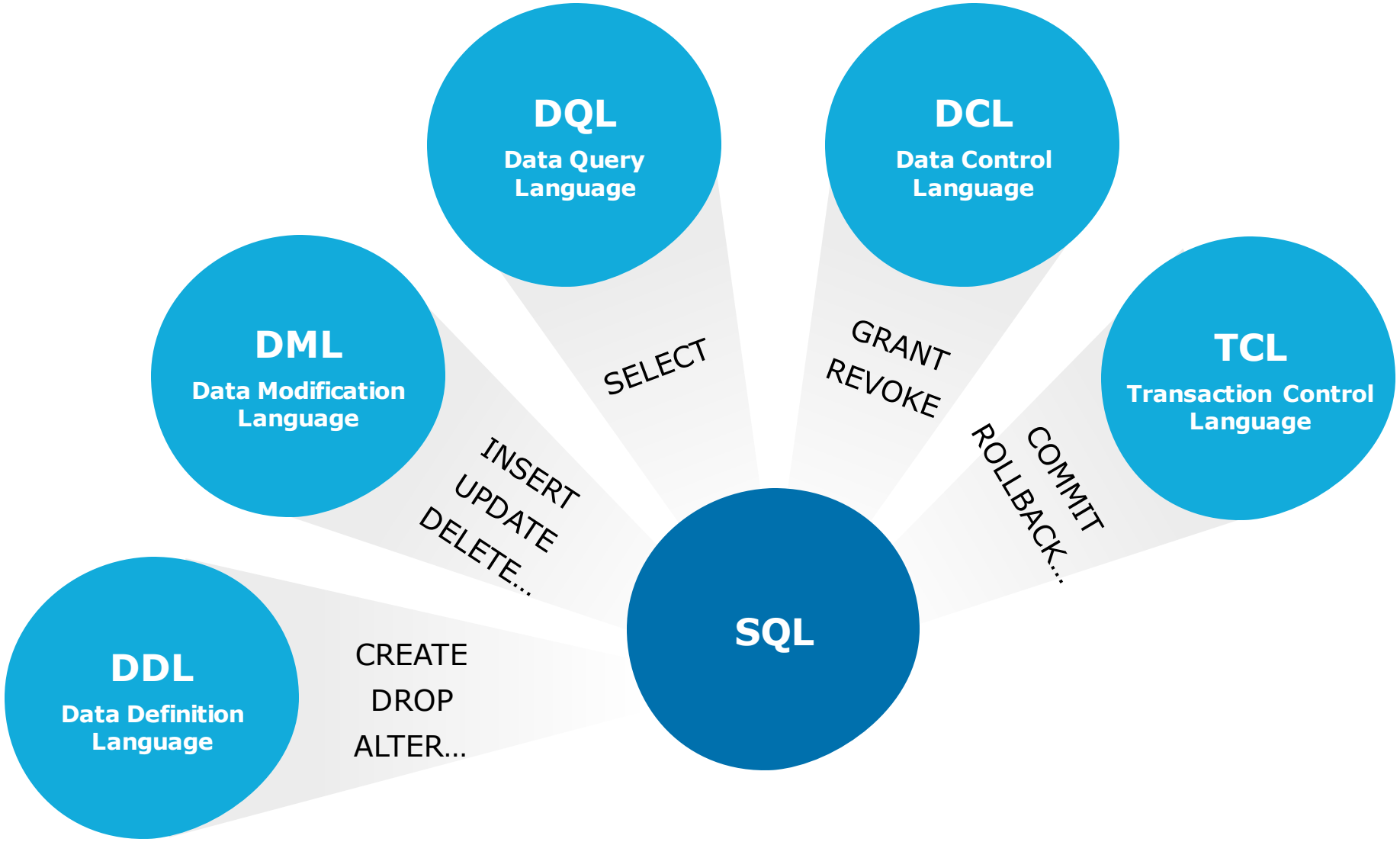
## Every vendor adds his own flavors

## Declarative language

Define how the output should look like.

in contrast with imperative programming, where you define an algorithm.

# SQL commands are categorized into categories



# Our trip…

SEC1

**Other**

subqueries, views,
functions, procedures

**DQL**

SELECT with JOIN

**DQL**

SELECT with GROUP BY

**DQL**

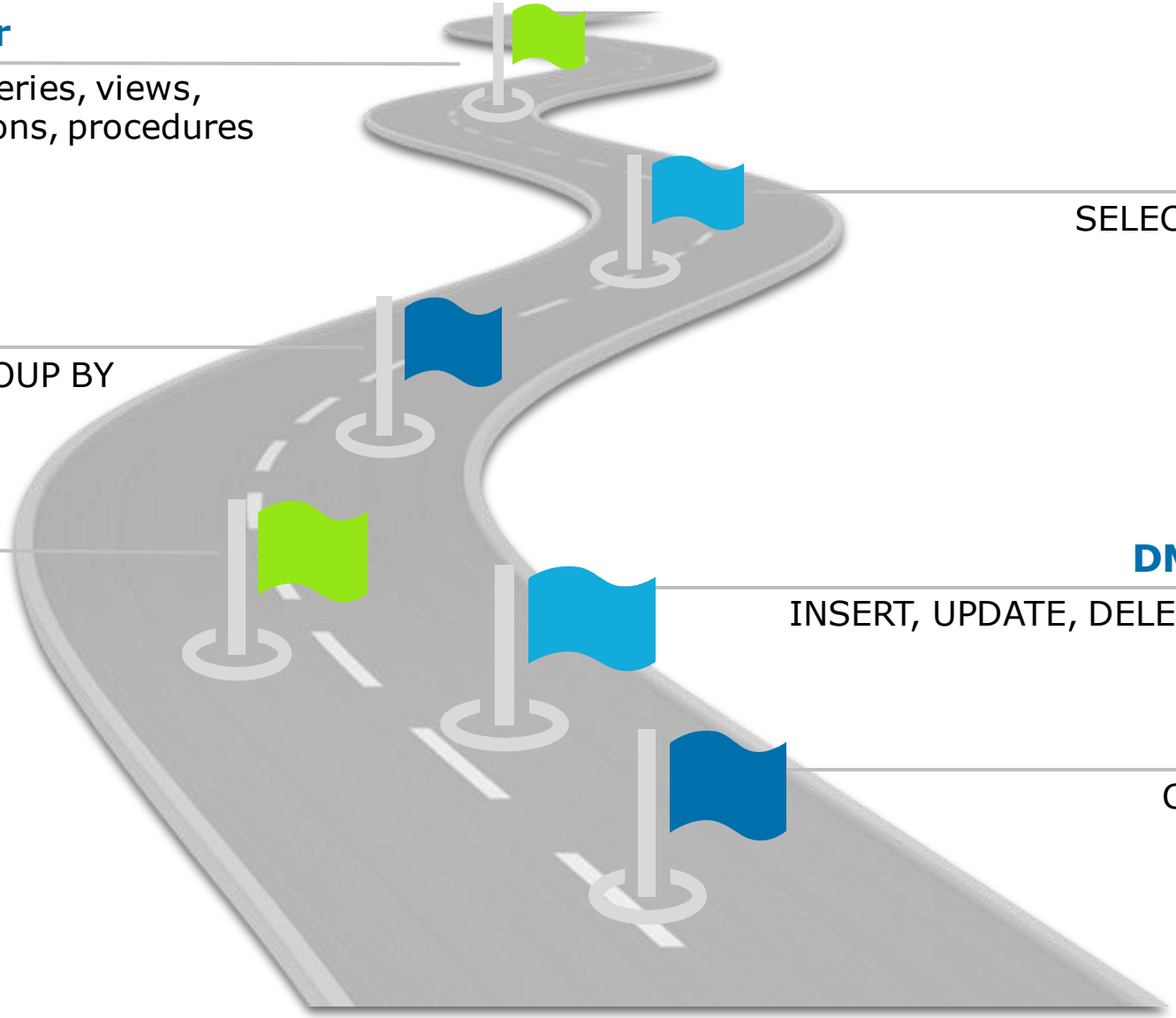
Simple SELECT

**DML**

INSERT, UPDATE, DELETE

**DDL**

CREATE TABLE



# DDL: CREATE TABLE

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Table name

```
CREATE TABLE employee (
  id INT NOT NULL AUTO_INCREMENT,
  first_name VARCHAR(45) NOT NULL,
  last_name VARCHAR(45) NOT NULL,
  hired DATE NOT NULL,
  mail VARCHAR(50) NOT NULL,
  created_by VARCHAR(50) NULL,
  created_at DATETIME NULL
    DEFAULT CURRENT_TIMESTAMP,
  PRIMARY KEY (id),
  UNIQUE INDEX uq_employee_mail (mail ASC)
);
```

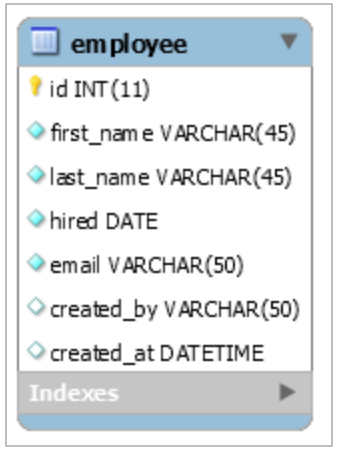
Table column definition:
<name> <type> <options>

Optional constraints

https://dev.mysql.com/doc/refman/8.0/en/sql-data-definition-statements.html

## Common types:

- CHAR
- VARCHAR
- INT
- ENUM
- DATE, DATETIME
- TIMESTAMP…




## Common options:

- NULL / NOT NULL
- DEFAULT <value>
- AUTO_INCREMENT
- ON UPDATE…

## Significance of Primary Key (PK):

- PK identifies one table row
- PK can span over multiple columns
- Usually, all tables have a PK
- DB usually creates an index for a PK

# Data types of columns

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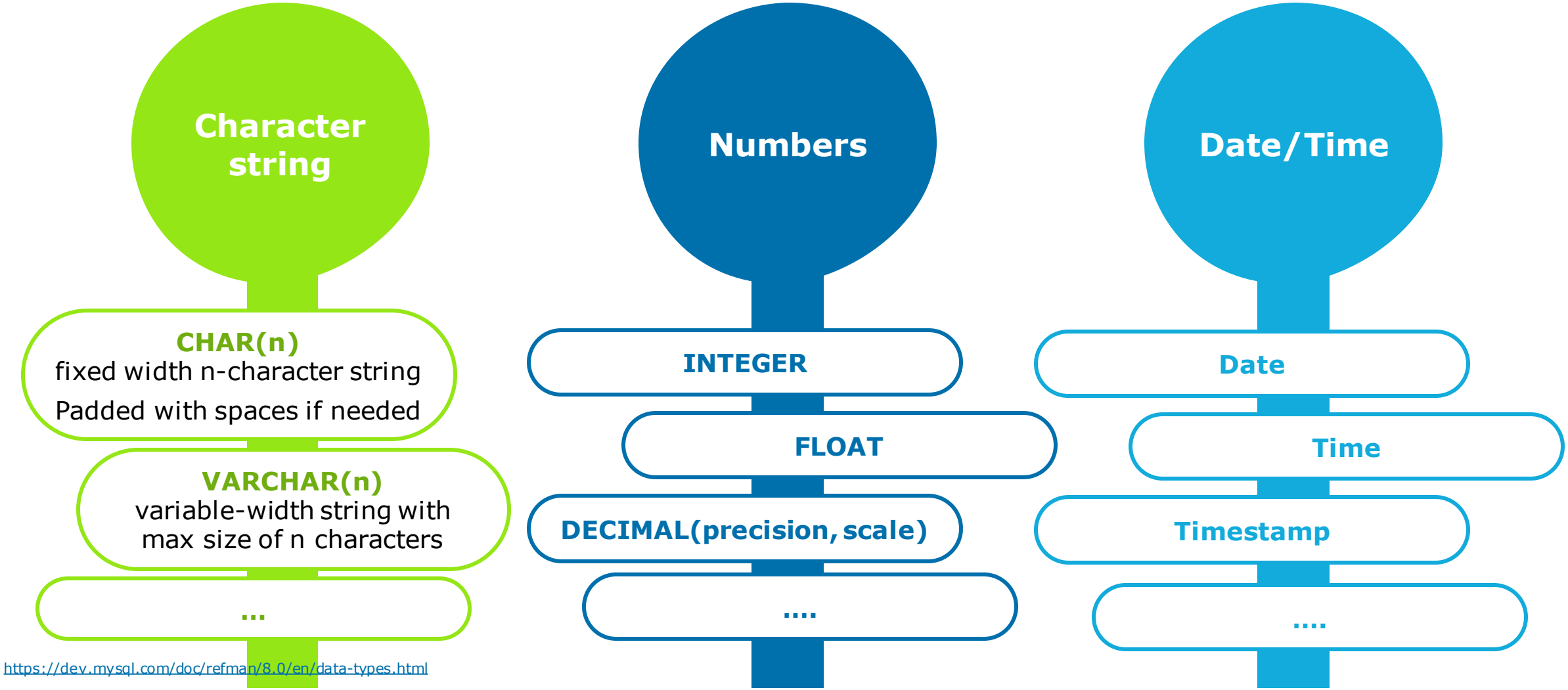
Every database can have its own data types




https://dev.mysql.com/doc/refman/8.0/en/data-types.html

# DML: INSERT INTO


Schema name

Table name

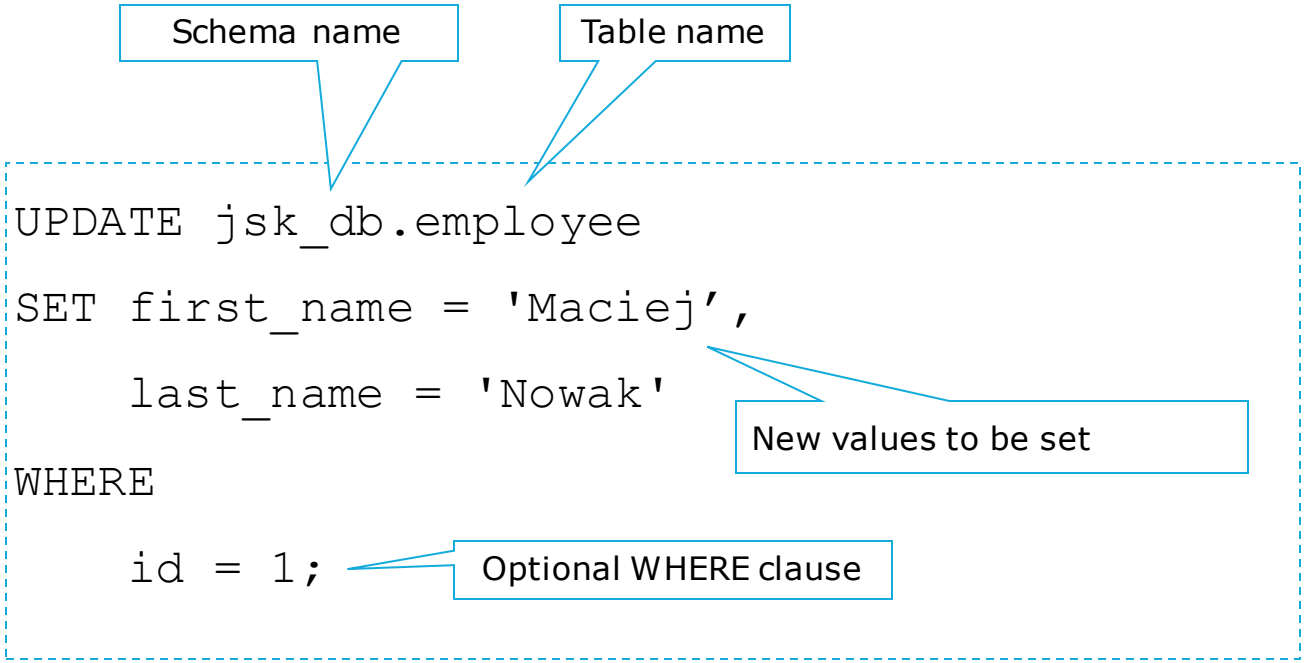
Optional, comma separated list of columns.
All NOT NULL columns without DEFAULT or AUTO_INCREMENT value must be present.

```
INSERT INTO jsk_db.employee(first_name, last_name, hired, email)
VALUES
        ('Armando', 'Roggio', '2014-03-13', 'armando@some.com'),
        ('Barack', 'Obama', '2017-01-20', 'barack@usa.com'),
        ('Bono', 'Vox', '2014-07-13', 'bono@u2.com', 'admin');
```

Comma separated list of values for each row.

https://dev.mysql.com/doc/refman/8.0/en/insert.html

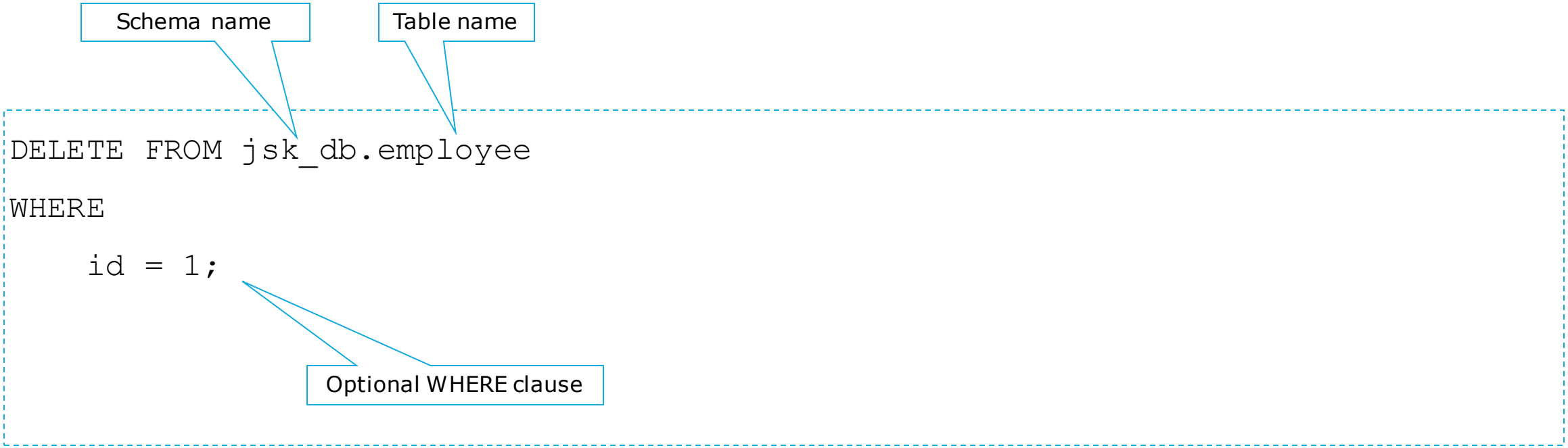
# DML: UPDATE




- **DANGER**: Since WHERE clause is optional, running the statement without it will change all rows in the table.
- NOTE: there is no UNDO button in the DB. And it's surprisingly easy to screw things up (BUT there are Transactions)
- When doing difficult migrations it might be wise to store table data as backup (CREATE TABLE … AS SELECT …).

https://dev.mysql.com/doc/refman/8.0/en/update.html

# DML: DELETE FROM




https://dev.mysql.com/doc/refman/8.0/en/delete.html

# Let’s do some excersises…


Sample table „employee”

| id | first_name | last_name | hired | email | created_by | created_at |
|---|---|---|---|---|---|---|
| 1 | Maciej | Kowalski | 2017-01-01 | mkowalski@capg.com | hr1 | 2019-02-17 |
| 2 | Armando | Roggio | 2014-03-13 | armando@some.com | hr1 | 2019-01-01 |
| 3 | Barack | Obama | 2017-01-20 | barack@usa.com | admin | 2019-01-02 |
| 4 | Bono | Vox | 2014-07-13 | bono@u2.com | admin | 2019-01-01 |
| 5 | Bill | Gates | 2009-02-20 | bill@microsoft.com | admin | 2019-01-01 |
| 6 | Steve | Jobs | 1988-02-08 | steve@apple.com | null | null |
| 7 | Larry | Ellison | 2000-08-09 | larry@oracle.com | admin | 2019-01-01 |
| 8 | Maciej | Nowak | 2017-02-01 | mnowak@capg.com | hr2 | 2017-02-01 |

https://dev.mysql.com/doc/refman/8.0/en/select.html

# Understanding GROUP BY


| id | first_name | last_name | hired | created_by | created_at |
|---|---|---|---|---|---|
| 1 | Maciej | Kowalski | 2017-01-01 | hr1 | 2019-02-17 |
| 2 | Armando | Roggio | 2014-03-13 | hr1 | 2019-01-01 |
| 3 | Barack | Obama | 2017-01-20 | admin | 2019-01-02 |
| 4 | Bono | Vox | 2014-07-13 | admin | 2019-01-01 |
| 5 | Bill | Gates | 2009-02-20 | admin | 2019-01-01 |
| 6 | Steve | Jobs | 1988-02-08 | null | null |
| 7 | Larry | Ellison | 2000-08-09 | admin | 2019-01-01 |
| 8 | Maciej | Nowak | 2017-02-01 | hr2 | 2017-02-01 |

```
SELECT e.created_by,
       COUNT(*),
       MAX(e.id)
FROM employee AS e
GROUP BY e.created_by;
```

| created_by | COUNT(*) | MAX(e.id) |
|---|---|---|
| hr1 | 2 | 2 |
| admin | 4 | 7 |
| null | 1 | 6 |
| hr2 | 1 | 8 |

| id | first_name | last_name | hired | created_by | created_at |
|---|---|---|---|---|---|
| 1 | Maciej | Kowalski | 2017-01-01 | hr1 | 2019-02-17 |
| 2 | Armando | Roggio | 2014-03-13 | hr1 | 2019-01-01 |

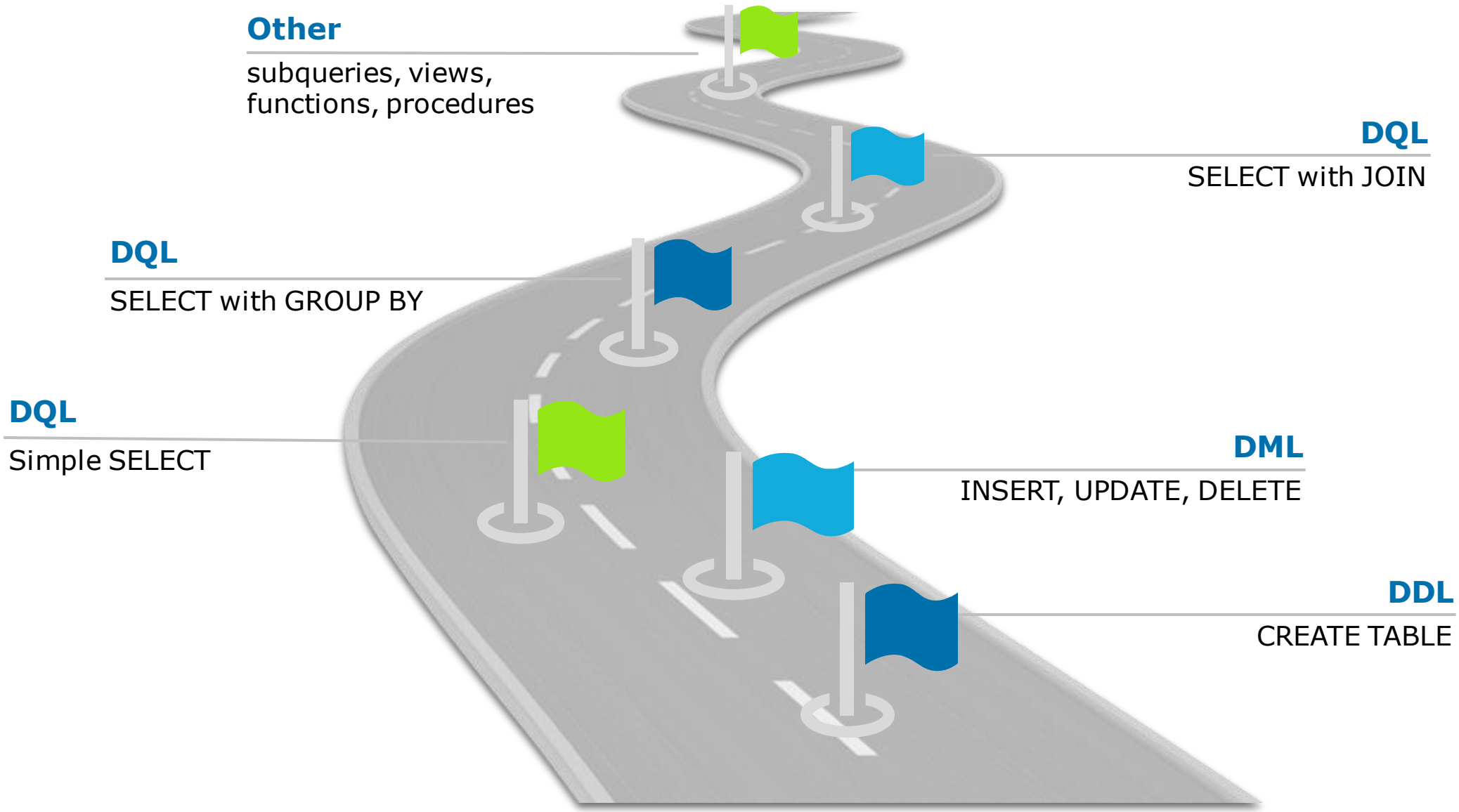
| id | first_name | last_name | hired | created_by | created_at |
|---|---|---|---|---|---|
| 3 | Barack | Obama | 2017-01-20 | admin | 2019-01-02 |
| 4 | Bono | Vox | 2014-07-13 | admin | 2019-01-01 |
| 5 | Bill | Gates | 2009-02-20 | admin | 2019-01-01 |
| 7 | Larry | Ellison | 2000-08-09 | admin | 2019-01-01 |

| id | first_name | last_name | hired | created_by | created_at |
|---|---|---|---|---|---|
| 6 | Steve | Jobs | 1988-02-08 | null | null |

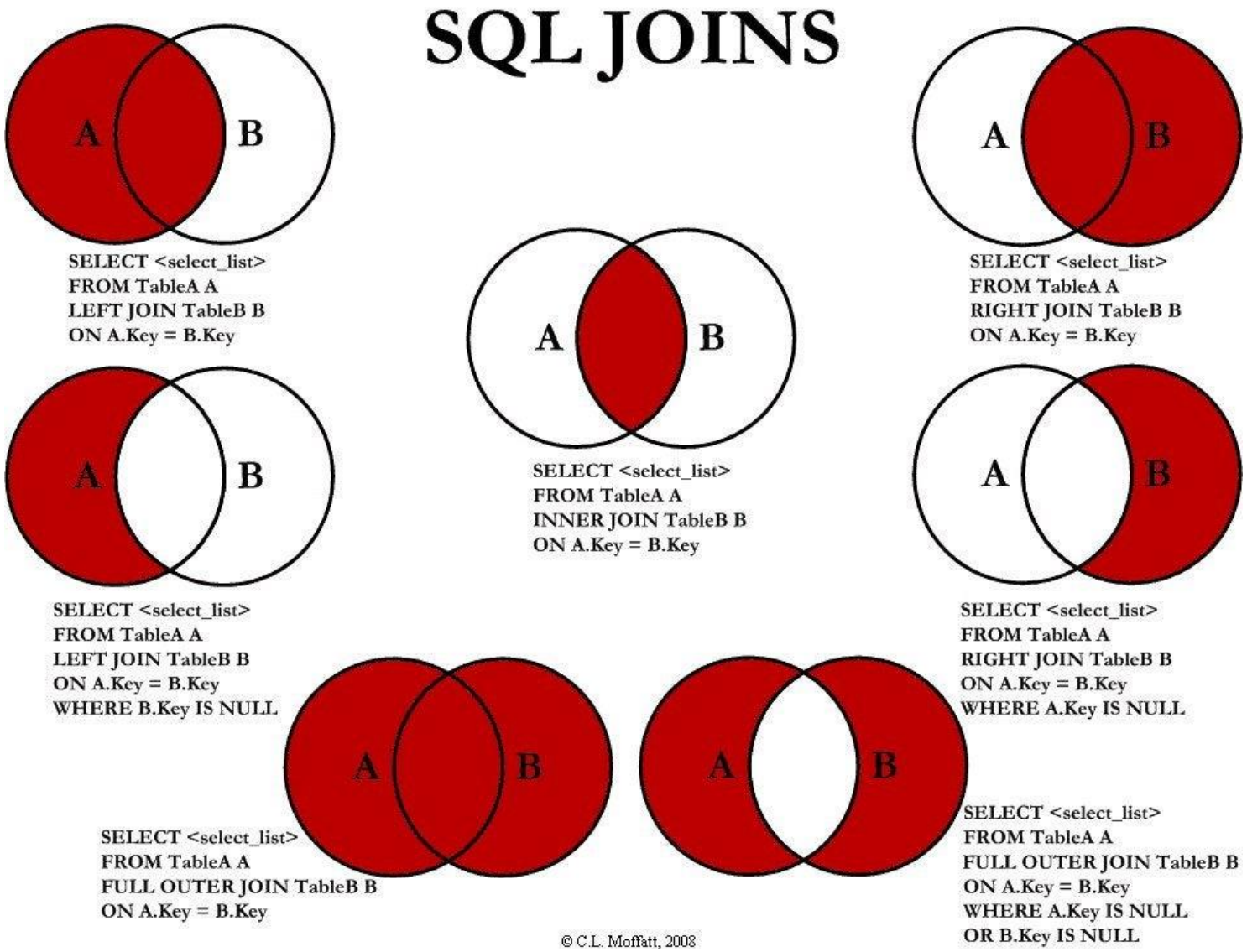
| id | first_name | last_name | hired | created_by | created_at |
|---|---|---|---|---|---|
| 8 | Maciej | Nowak | 2017-02-01 | hr2 | 2017-02-01 |

https://dev.mysql.com/doc/refman/8.0/en/select.html

# Almost there…



# Join - Types

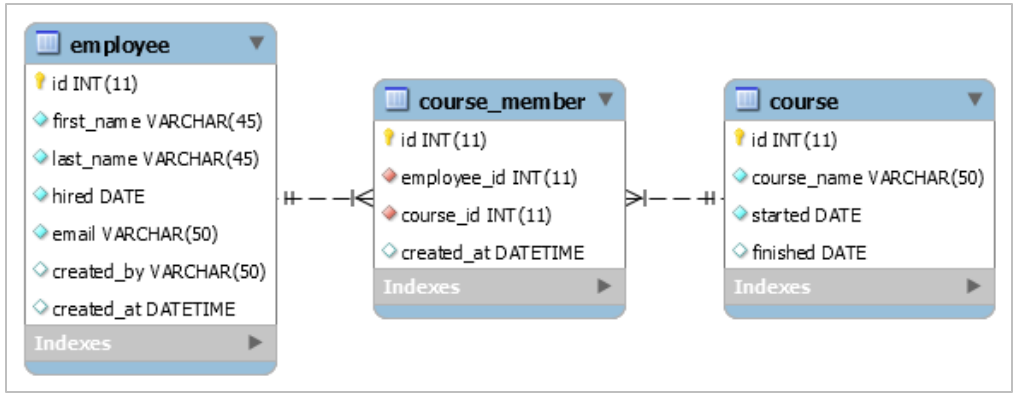



https://dev.mysql.com/doc/refman/8.0/en/join.html ; Source: https://pawelwiejkut.net/sql-on-conditions-in-left-join/

# Let’s create more tables

SEC1

```
CREATE TABLE jsk_db.course (
  id INT NOT NULL AUTO_INCREMENT,
  course_name VARCHAR(50) NOT NULL,
  started DATE NOT NULL,
  finished DATE DEFAULT NULL,
  PRIMARY KEY (id),
  UNIQUE INDEX uq_course_name (course_name)
);
```




```
CREATE TABLE jsk_db.course_member (
  id INT NOT NULL AUTO_INCREMENT,
  employee_id INT NOT NULL,
  course_id INT NOT NULL,
  PRIMARY KEY (id),
  UNIQUE INDEX uq_course_member
         (employee_id, course_id),
  CONSTRAINT fk_employee_id
     FOREIGN KEY (employee_id)
     REFERENCES employee (id),
  CONSTRAINT fk_course_id
     FOREIGN KEY (course_id)
     REFERENCES course (id)
);
```

https://dev.mysql.com/doc/refman/8.0/en/sql-data-definition-statements.html

# JOIN


Table: employee

| id | first_name | last_name | hired | created_by | created_at |
|---|---|---|---|---|---|
| 1 | Maciej | Kowalski | 2017-01-01 | hr1 | 2019-02-17 |
| 2 | Armando | Roggio | 2014-03-13 | hr1 | 2019-01-01 |
| 3 | Barack | Obama | 2017-01-20 | admin | 2019-01-02 |
| 4 | Bono | Vox | 2014-07-13 | admin | 2019-01-01 |
| 5 | Bill | Gates | 2009-02-20 | admin | 2019-01-01 |
| 6 | Steve | Jobs | 1988-02-08 | null | null |
| 7 | Larry | Ellison | 2000-08-09 | admin | 2019-01-01 |
| 8 | Maciej | Nowak | 2017-02-01 | hr2 | 2017-02-01 |

Table: course

| id | course_name | started | finished |
|---|---|---|---|
| 1 | Deutschkurs 101 | 2019-02-20 | null |
| 2 | Deutschkurs 102 | 2019-02-20 | null |
| 3 | English course 101 | 2019-01-21 | 2019-01-31 |
| 4 | English course 102 | 2019-02-20 | null |
| 5 | English course 201 | 2019-02-20 | |

Table: course_member

| id | employee_id | course_id | created_at |
|---|---|---|---|
| 1 | 1 | 1 | 2019-02-20 |
| 2 | 1 | 2 | 2019-02-20 |
| 3 | 1 | 3 | 2019-02-20 |
| 4 | 1 | 4 | 2019-02-20 |
| … | … | … | … |

| employee_id | first_name | last_name | Deutschkrus 101 | Deutshkurs 102 | English course 101 | English course 102 | English course 201 |
|---|---|---|---|---|---|---|---|
| 1 | Maciej | Kowalski | | | | | |
| 2 | Armando | Roggio | | | | | |
| 3 | Barack | Obama | | | | | |
| 4 | Bono | Vox | | | | | |
| 5 | Bill | Gates | | | | | |
| 6 | Steve | Jobs | | | | | |
| 7 | Larry | Ellison | | | | | |
| 8 | Maciej | Nowak | | | | | |

https://dev.mysql.com/doc/refman/8.0/en/join.html

# Oracle syntax vs ANSI syntax


```
SELECT e.*
FROM
    employee e,
    course_member cm
WHERE
    cm.employee_id = e.id;
```

```
SELECT e.*
FROM employee e
JOIN course_member cm ON (cm.employee_id = e.id);
```

Source: https://asktom.oracle.com/pls/apex/asktom.search?tag=recommended-join-style ; https://docs.oracle.com/en/database/oracle/oracle-database/12.2/sqlrf/Joins.html#GUID-794F7DD5-FB18-4ADC-9E46-ADDA8C30C3C6

# DQL: SELECT - subqueries


```
SELECT c.*
FROM curse c
WHERE c.id IN (
  SELECT cm.course_id
  FROM course_member cm
  WHERE cm.created_at < '2019-02-01'
);
```

```
SELECT c.*
FROM course c
WHERE EXISTS (
  SELECT 1
  FROM course_member cm
  WHERE cm.course_id = c.id
    AND cm.created_at < '2019-02-01'
);
```

```
SELECT c.*
FROM comments c
JOIN properties p ON (p.comments_id = c.id)
WHERE p.property = 'OLD';
```

https://dev.mysql.com/doc/refman/8.0/en/subqueries.html ; https://dev.mysql.com/doc/refman/8.0/en/optimizing-subqueries.html ; https://dev.mysql.com/doc/refman/8.0/en/subquery-optimization-with-exists.html

# VIEW

SEC1

```
CREATE OR REPLACE VIEW v_employees AS
SELECT e.id, e.first_name, e.last_name
FROM employee e;
```

```
SELECT e.* FROM v_employees e;
```

```
CREATE OR REPLACE VIEW v_courses_and_attendants
SELECT c.id AS course_id,
  c.course_name,
  COUNT(cm.id) AS num_participiants
FROM course c
LEFT JOIN course_member cm ON (cm.course_id = c.id)
GROUP BY c.id, c.course_name
ORDER BY c.course_name ASC;
```

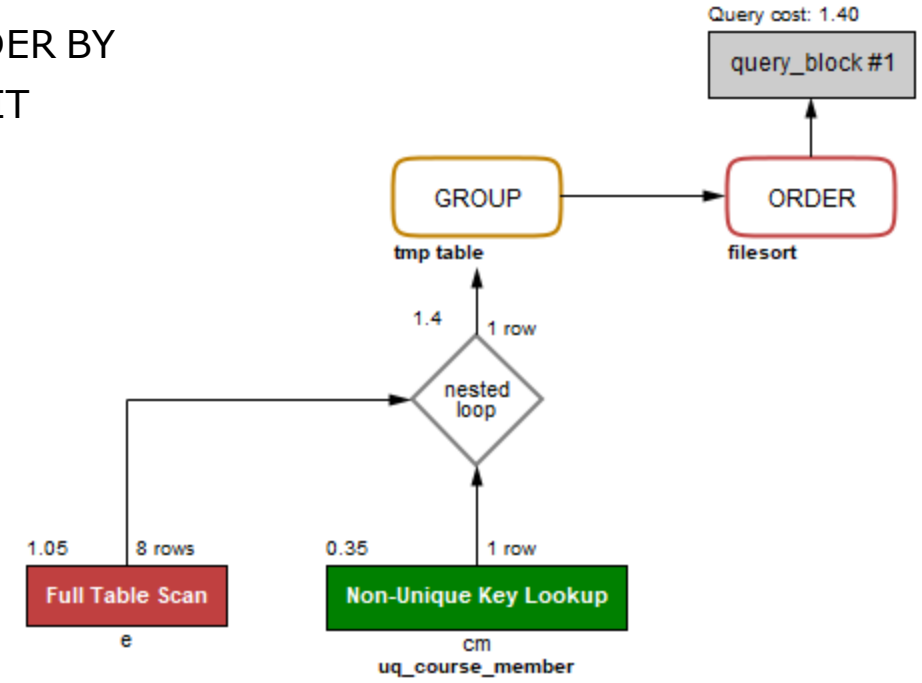
```
SELECT c.*,
  v.num_participiants
FROM course c
JOIN v_courses_and_attendants v
  ON (v.course_id = c.id)
WHERE v.num_participiants > 2;
```

https://dev.mysql.com/doc/refman/8.0/en/create-view.html ; https://dev.mysql.com/doc/refman/8.0/en/with.html

# Order of execution

```
SELECT e.id, e.first_name, e.last_name,
        COUNT(cm.id) AS num_courses
FROM employee e
JOIN course_member cm ON (cm.employee_id = e.id)
WHERE e.first_name LIKE '%a%'
GROUP BY e.id, e.first_name, e.last_name
HAVING COUNT(*) > 1
ORDER BY e.first_name ASC, e.last_name ASC;
```

1. FROM & JOIN
2. WHERE
3. GROUP BY & aggregate functions
4. HAVING
5. WINDOW functions
6. ORDER BY
7. LIMIT




Source:https://www.eversql.com/sql-order-of-operations-sql-query-order-of-execution/

# Functions and procedures


- Functions – processing input data and returns result / modify function's parameters
- Procedures – processing data / returns rowset

```
DROP FUNCTION IF EXISTS fn_hello;

DELIMITER $$

CREATE FUNCTION fn_hello(name VARCHAR(50))
  RETURNS VARCHAR(100) DETERMINISTIC
BEGIN
  RETURN CONCAT('Hello ', name, '!');
END
$$

DELIMITER ;
```

```
-- Sample call
SELECT fn_hello('Jan');

-- Use with data from table
SELECT e.id,
  e.first_name,
  e.last_name,
  fn_hello(e.first_name) AS hello
FROM employee e
ORDER BY e.first_name ASC;
```

https://dev.mysql.com/doc/refman/8.0/en/create-procedure.html

# Why it is worth to alias tables/columns?

SEC1

```
SELECT DISTINCT
              serial_no AS BARCODE_NO
              , org_id AS ORG_ID
              , wip_entity_id AS WOID
              , model_suffix AS MTRLID
              , model AS MODLID
              , suffix AS SFFX_NAME
              , line_id AS PCSGID
              , buyer_code AS CUSTOMERID
              , serial AS LBL_SERIAL_NO
              , quantity
              , wip_entity_name
              , serial_no AS BUYER_SERIAL_NO
              , TO_CHAR(sysdate, 'YYYYMMDD') AS PUB_YMD
              , TO_TIMESTAMP(SYSDATE, 'YYYY-MM-DD HH24:MI:SS') AS CREATED_AT
FROM prodplan.daily_prod_plan pln
JOIN matmgmt.workorder wo ON (WOID = wip_entity_id)
LEFT JOIN matmgmt.serialnumbers snb ON (
              division_code = division
              AND work_order = mfg_order)
LEFT JOIN matmgmt.serialnumbers_sent sns ON (
              division_code = division
              AND work_order = mfg_order
              AND serial = serial)
LEFT JOIN prodplan.xxx_register_inf lph ON (barcode_no = serial_no)
WHERE 1=1
              AND org_id = '1111'
              AND division = 'ABC'
              AND item_type = 'F'
              AND barcode_no is null
              AND mfg_order = '111X0123'
              AND serial = 'KP001'
              AND ROWNUM = 1;
```

```
SELECT DISTINCT
              snb.serial_no AS BARCODE_NO
              , pln.org_id AS ORG_ID
              , wo.wip_entity_id AS WOID
              , wo.model_suffix AS MTRLID
              , wo.model AS MODLID
              , wo.suffix AS SFFX_NAME
              , pln.line_id AS PCSGID
              , wo.buyer_code AS CUSTOMERID
              , snb.serial AS LBL_SERIAL_NO
              , wo.quantity
              , wo.wip_entity_name
              , sns.serial_no AS BUYER_SERIAL_NO
              , TO_CHAR(sysdate, 'YYYYMMDD') AS PUB_YMD
              , TO_TIMESTAMP(SYSDATE, 'YYYY-MM-DD HH24:MI:SS') AS CREATED_AT
FROM prodplan.daily_prod_plan pln
JOIN matmgmt.workorder wo ON (pln.WOID = wo.wip_entity_id)
LEFT JOIN matmgmt.serialnumbers snb ON (
              snb.division_code = wo.division
              AND snb.work_order = pln.mfg_order)
LEFT JOIN matmgmt.serialnumbers_sent sns ON (
              sns.division_code = wo.division
              AND sns.work_order = pln.mfg_order
              AND sns.serial = snb.serial)
LEFT JOIN prodplan.xxx_register_inf lph ON (lph.barcode_no = snb.serial_no)
WHERE 1=1
              AND pln.org_id = '1111'
              AND wo.division = 'ABC'
              AND wo.item_type = 'F'
              AND lph.barcode_no is null
              AND pln.mfg_order = '111X0123'
              AND snb.serial = 'KP001'
              AND ROWNUM = 1;
```

# Window Functions (MySQL) / Analytic Functions (Oracle)


```
mysql> SELECT
         val,
         ROW_NUMBER() OVER w AS 'row_number',
         RANK()       OVER w AS 'rank',
         DENSE_RANK() OVER w AS 'dense_rank'
       FROM numbers
       WINDOW w AS (ORDER BY val);
+------+------------+------+------------+
| val  | row_number | rank | dense_rank |
+------+------------+------+------------+
|    1 |          1 |    1 |          1 |
|    1 |          2 |    1 |          1 |
|    2 |          3 |    3 |          2 |
|    3 |          4 |    4 |          3 |
|    3 |          5 |    4 |          3 |
|    3 |          6 |    4 |          3 |
|    4 |          7 |    7 |          4 |
|    4 |          8 |    7 |          4 |
|    5 |          9 |    9 |          5 |
+------+------------+------+------------+
```

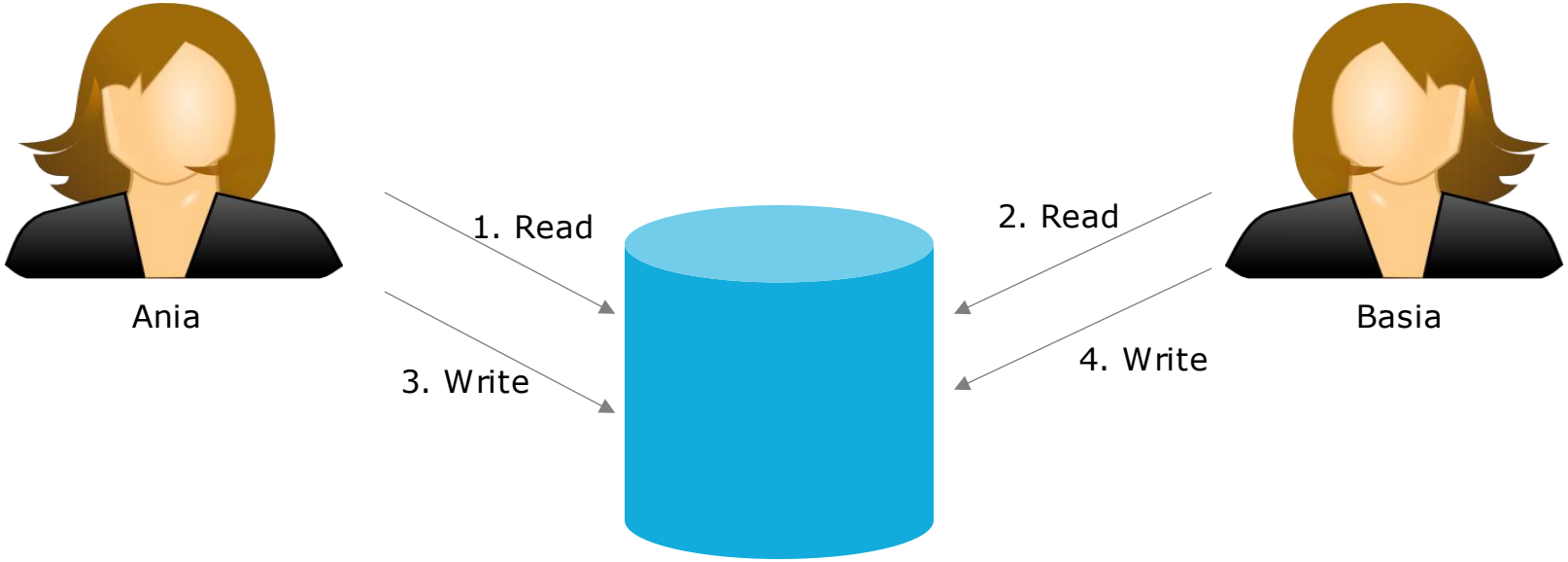
MySQL: https://dev.mysql.com/doc/refman/8.0/en/window-function-descriptions.html ; Oracle: https://docs.oracle.com/cd/E11882_01/server.112/e41084/functions004.htm#SQLRF06174

# Agenda


- Before we Begin
- Relational Databases (DB)
- Structured Query Language (SQL)
- **Data locking strategies**
- Advanced Databases Topics
- Modeling databases
- Assignments

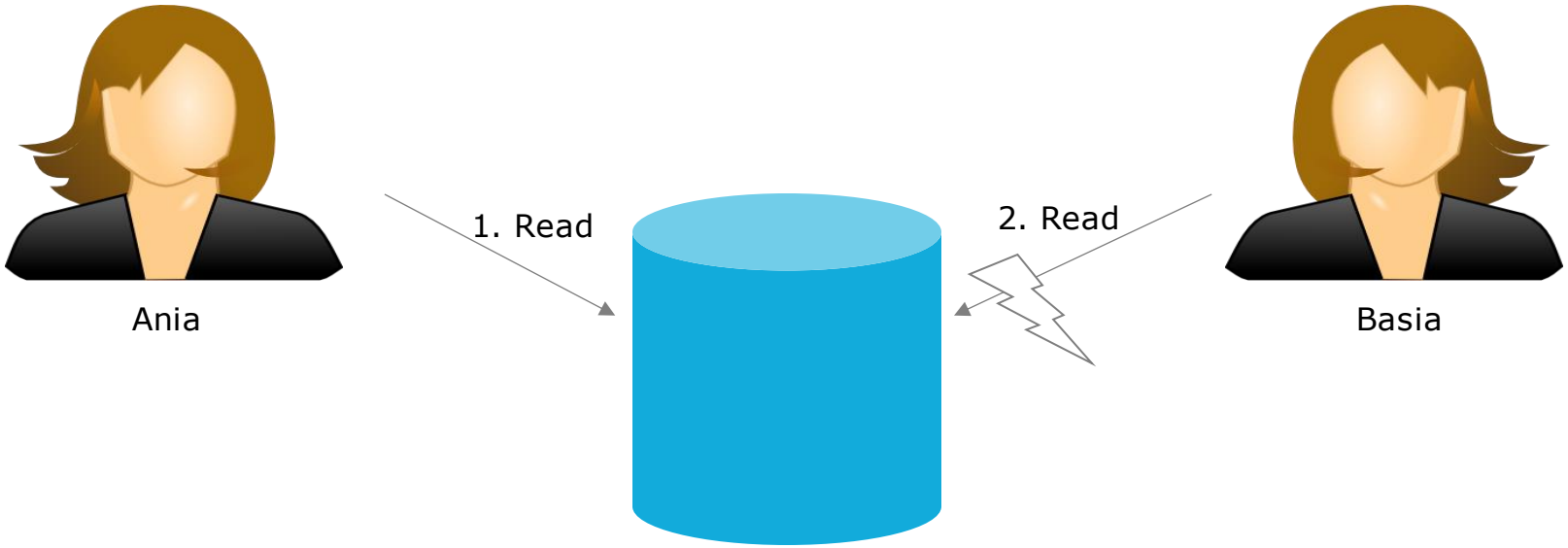
# No locking

- Effect: Last one wins.
- Problematic from the business point of view.



# Pesimistic locking

- Effect: First one locks the data.
- Can result in long lasting locks that disturb the work.



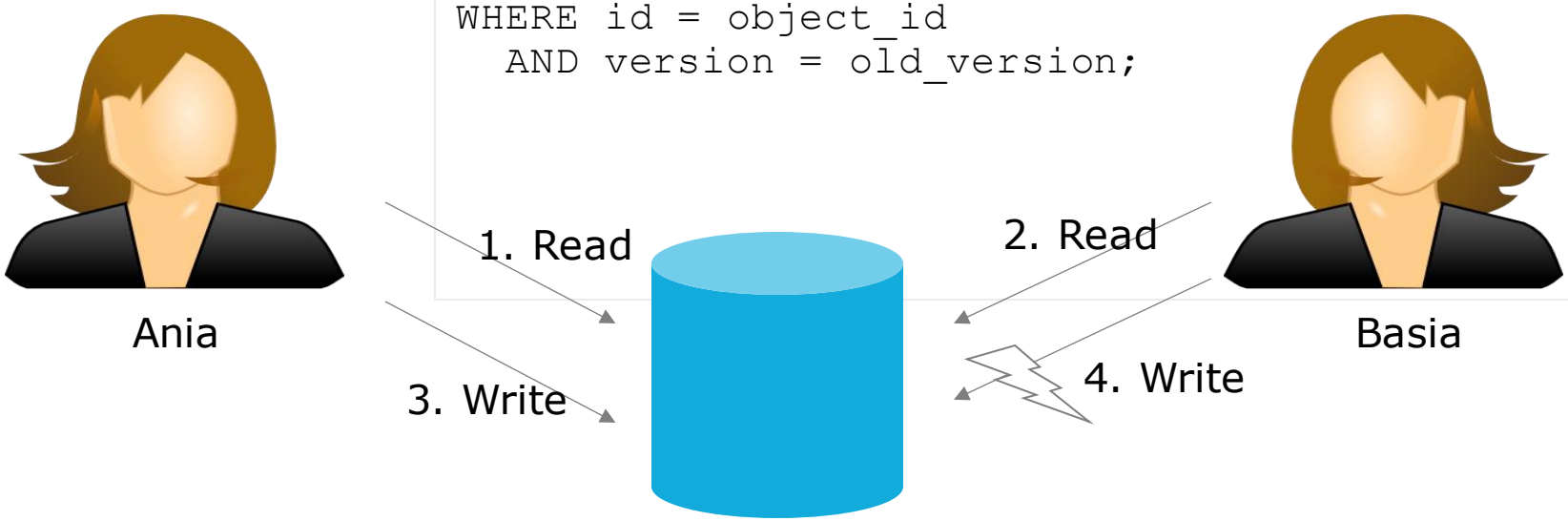
# Optimistic locking

- Effect: Only the first write is successful.
- Standard approach

Implementation:

1. Table has an attribute: version (int)
2. When you update the row, you increment the version
3. You can only update if row's version matches Yours's version

```
UPDATE table
SET attribute = new_value
  , version = version+1
WHERE id = object_id
  AND version = old_version;
```



# Agenda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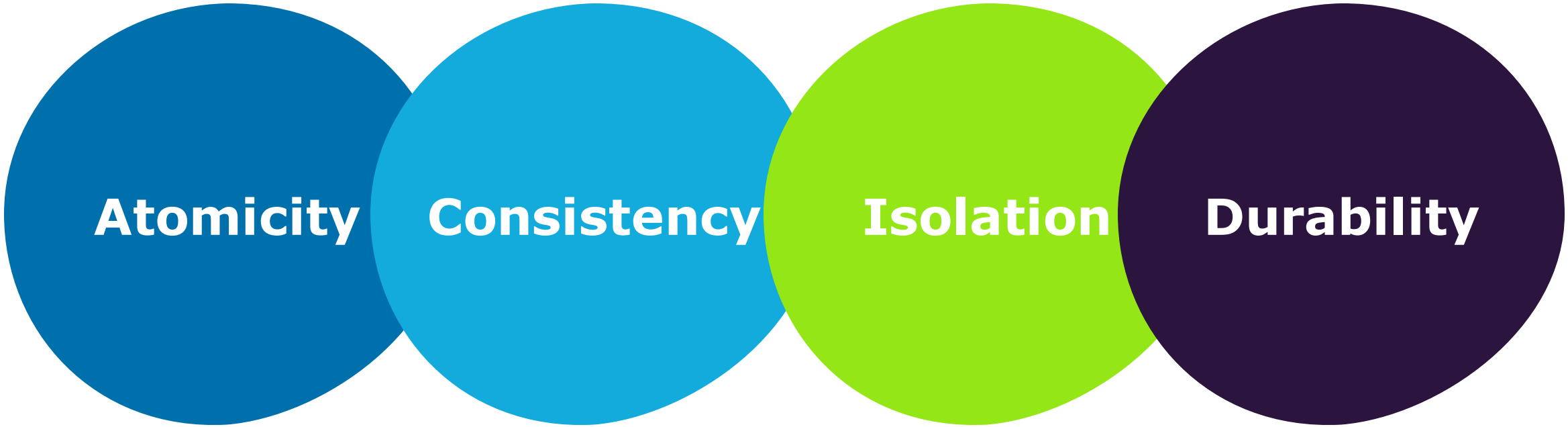
# Transactions. ACID Properties




Isolation levels:

1. Serializable
2. Repeatable read
3. **Read committed**
4. Read uncommitted

# Transactions


## Connection 1

```
SHOW VARIABLES LIKE 'transaction_isolation’;
-- REPEATABLE-READ
```

```
INSERT INTO test (comment) VALUES ('test2');
COMMIT; -- or ROLLBACK
```

```
BEGIN; -- start transaction
INSERT INTO test (comment) VALUES ('test1');
```

```
SELECT * FROM test;
-- test1 not visible
```

```
SELECT * FROM test;
-- test1 and test2 visible
```

## Connection 2

# Agenda


- Before we Begin
- Relational Databases (DB)
- Structured Query Language (SQL)
- Data locking strategies
- Advanced Databases Topics
- **Modeling databases**
- Assignments

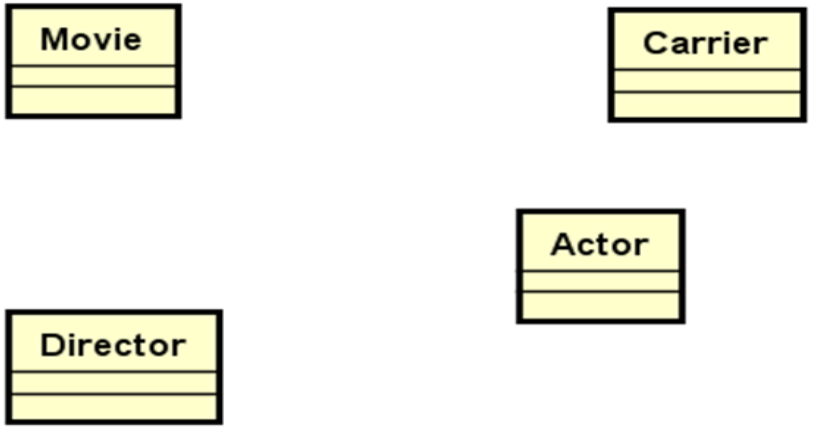
# Consider this simple excercise


## Description of the domain:

1. The database is to be used for personal movie organization purposes.
2. All movies are stored on some kind of a data carrier (e.g. VideoCD, DVD, BlueRay).
3. More than one movie can be stored on a carrier.
4. Each carrier is identified by a unique number.
5. The database must contain a photo of the carriers front cover.
6. For each and every movie a title, year of production and one director must be present and all actors must be listed.
7. …

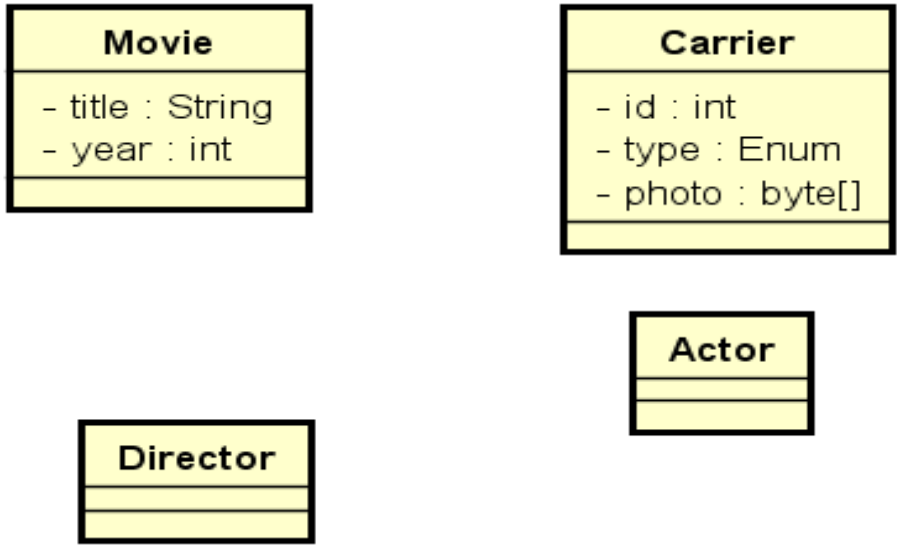
# Identify all entities


The database is to be used for personal movie organization purposes. All **movies** are stored on some kind of a data **carrier** (e.g. VideoCD, DVD, BlueRay), more than one **movie** can be stored on a **carrier**. Each **carrier** is identified by a unique number. The database must contain a photo of the **carriers** front cover. For each and every movie a title, year of production and one **director** must be present and all **actors** must be listed. ...



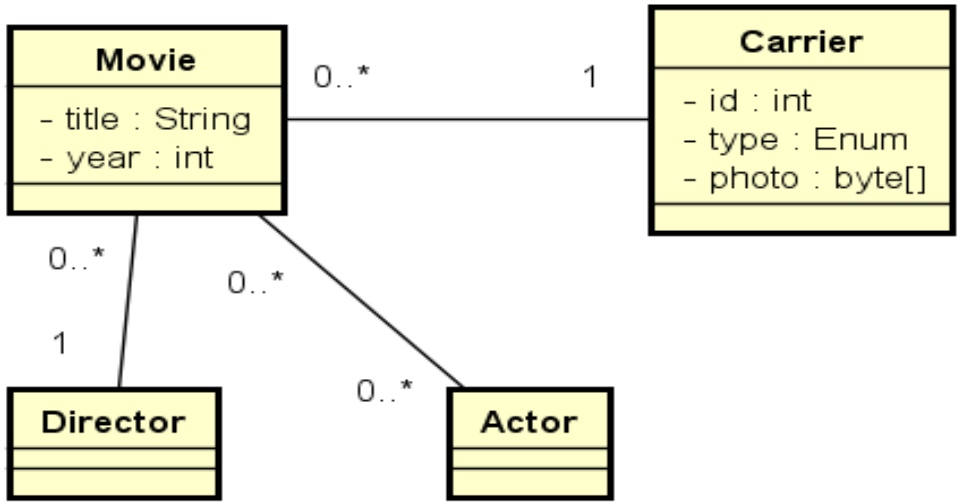
# Identify entity attributes

The database is to be used for personal movie organization purposes. All **movies** are stored on some kind of a data **carrier** (e.g. VideoCD, DVD, BlueRay), more than one **movie** can be stored on a **carrier**. Each **carrier** is identified by a unique number. The database must contain a photo of the **carriers** front cover. For each and every movie a title, year of production and one **director** must be present and all **actors** must be listed. ...

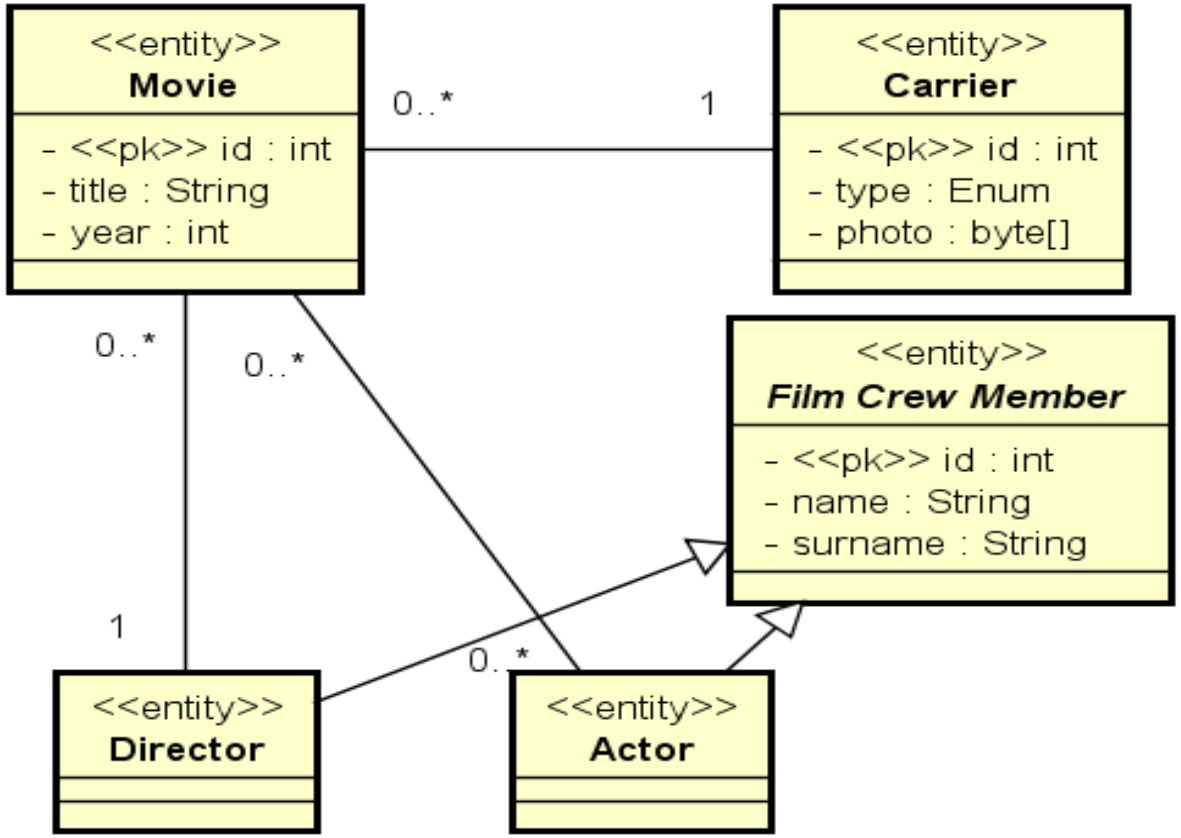


# Identify the relations between the entities

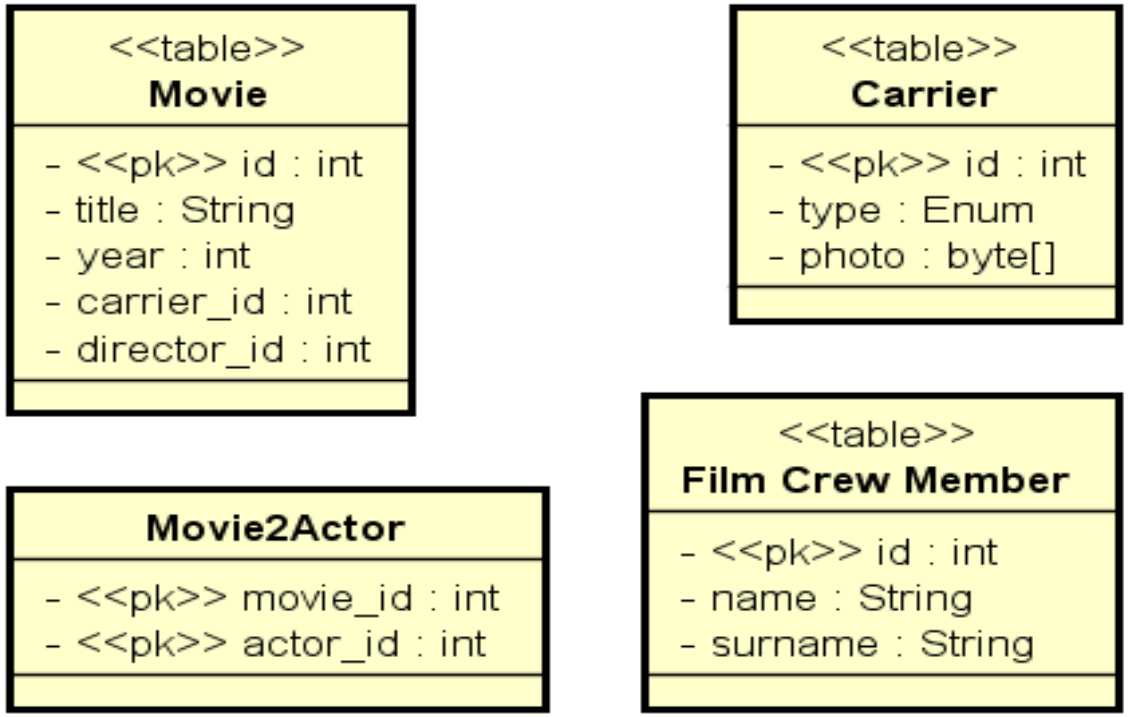
The database is to be used for personal movie organization purposes. All **movies** are stored on some kind of a data **carrier** (e.g. VideoCD, DVD, BlueRay), more than one **movie** can be stored on a **carrier**. Each **carrier** is identified by a unique number. The database must contain a photo of the **carriers** front cover. For each and every movie a title, year of production and one **director** must be present and all **actors** must be listed. ...



# Validate, normalize, do a sanity check.
# What you get is a business database model.



# Create a technical database model



# Agenda

SEC1

- Before we Begin
- Relational Databases (DB)
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- Modeling databases
- **Assignments**

# Assignments

1. Proszę zwrócić uwagę na informacje zawarte w mailu powitalnym
   1. zwróćcie uwagę na sugestie
   2. pomocne linki
   3. pytajcie trenerów!

2. Niektóre zadania pozwalają na interpretacje
   1. proponujcie rozwiązania, argumentujcie „dlaczego tak a nie inaczej”
   2. doprecyzujcie niektóre tematy na konsultacjach
   3. brońcie Waszego rozwiązania podczas konsultacji

3. Przydatny plik do analizy: „JSK  DB, live sample*.sql”

# Things to remember

1. Carefully read questions
2. Listen Your trainer
3. Assignments:
    1. Use aliases on tables / subqueries
    2. Do not use subqueries in places, where they are inefficient
    3. Sample scripts were prepared in a way, in which they could be easily re-created; do the same

# Questions?

SEC1

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