Constraints in SQL

1. Key constraints (PRIMARY KEY and UNIQUE)
2. Referential integrity constraints (FOREIGN KEY … REFERENCES)
3. Constraints on values of attributes:
   - NOT NULL
   - attribute-based CHECK constraints

Attribute-Based CHECK Constraints

- Use keyword CHECK followed by a parenthesized condition that must be true for every value of this attribute

- In practice (good style): condition is simple limit on values

- In general (not necessarily good style): condition can be anything that could follow WHERE in a SQL query
Attribute-Based CHECK Constraints

Example of good-style use:

CREATE TABLE Products ( 
  product_no INTEGER, 
  name CHAR(255), 
  price REAL 
  PRIMARY KEY (product_no) 
);
Attribute-Based CHECK Constraints

Example of good-style use:

CREATE TABLE Products (
    product_no INTEGER,
    name CHAR(255),
    price REAL CHECK (price > 0),
    PRIMARY KEY (product_no)
);
Attribute-Based CHECK Constraints

When is an attribute-based CHECK constraint checked by the DBMS?

- **Only** when a tuple gets a new value for the attribute to which the constraint is attached:
  - update of the corresponding attribute
  - insertion of a new tuple in the table where the constraint is defined

- If constraint is violated, then update or insertion is **rejected**
(Bad-Style) Attribute-Based CHECK Constraints

Attribute-based CHECK constraints can mention other attributes or relations (bad style): need a subquery for this
(Bad-Style) Attribute-Based CHECK Constraints

Example of bad-style use: Suppose that we want to simulate (incorrectly) a foreign-key constraint:
Example of bad-style use: Suppose that we want to simulate (incorrectly) a foreign-key constraint:

```
CREATE TABLE Works_In (  
    ssn INTEGER,  
    did INTEGER CHECK (did IN (SELECT D.did  
                              FROM Departments D)),  
    PRIMARY KEY (ssn, did),  
    FOREIGN KEY (ssn) REFERENCES Employees);
```

Why doesn't this work?
(Bad-Style) Attribute-Based CHECK Constraints

- **Answer:** CHECK is only associated with modifications of attribute in question (i.e., did in `Works_In`), **not** with every relation and attribute mentioned.

- So deletions and updates in the `Departments` table are a problem, because they don’t cause the DBMS to verify that the CHECK constraint still holds …
Constraints in SQL

1. Key constraints (PRIMARY KEY and UNIQUE)
2. Referential integrity constraints (FOREIGN KEY ... REFERENCES)
3. Constraints on values of attributes:
   - NOT NULL
   - attribute-based CHECK constraints
4. Constraints on values of tuples of a relation:
   - tuple-based CHECK constraints (or table constraints)
Tuple-Based CHECK Constraints

Like attribute-based CHECK constraints, but associated with each tuple of one table.
Tuple-Based CHECK Constraints

Example of good-style use:

CREATE TABLE Products (  
    product_no INTEGER,  
    name CHAR(255),  
    price REAL,  
    discounted_price REAL,  

    PRIMARY KEY (product_no)  
);
Tuple-Based CHECK Constraints

Example of good-style use:

CREATE TABLE Products (  
    product_no INTEGER,  
    name CHAR(255),  
    price REAL,  
    discounted_price REAL,  
    CHECK (price > discounted_price),  
    PRIMARY KEY (product_no)  
);
Tuple-Based CHECK Constraints

When is a tuple-based CHECK constraint checked by the DBMS?

- **Only** when a tuple is inserted into the corresponding table and when a tuple is updated in the corresponding table, and the CHECK constraint is evaluated only for the new or updated tuple

- If constraint is violated, then insertion or update is rejected
(Bad-Style) Tuple-Based CHECK Constraints

Tuple-based CHECK constraints can mention other relations (bad style): need a subquery for this
(Bad-Style) Tuple-Based CHECK Constraints

Example of bad-style use: Suppose that we want to enforce (incorrectly) the total participation constraint of Employees in Works_In:

CREATE TABLE Employees (  
    ssn INTEGER,  
    name CHAR(30),  
    PRIMARY KEY (ssn),
(Bad-Style) Tuple-Based CHECK Constraints

Example of bad-style use: Suppose that we want to enforce (incorrectly) the total participation constraint of Employees in Works_In:

CREATE TABLE Employees (  
ssn INTEGER,  
name CHAR(30),  
PRIMAR Y KEY (ssn),  
CHECK (ssn IN (SELECT W.ssn  
FROM Works_In W)));

Why doesn’t this work?
(Bad-Style) Tuple-Based CHECK Constraints

- Answer: CHECK is only associated with insertions or updates of tuples in relation where the CHECK constraint is defined (i.e., Employees), not with every relation mentioned.

- So deletions or updates in the Works_In table are a problem, because they don’t cause the DBMS to verify that the CHECK constraint still holds …
Constraints in SQL

1. Key constraints (PRIMARY KEY and UNIQUE)
2. Referential integrity constraints (FOREIGN KEY … REFERENCES)
3. Constraints on values of attributes:
   - NOT NULL
   - attribute-based CHECK constraints
4. Constraints on values of tuples of a relation:
   - tuple-based CHECK constraints (or table constraints)
5. Schema-level constraints:
   - assertions
Assertions

● To enforce any condition (that can follow WHERE)
● Not associated with tables or attributes
● **Guaranteed to always hold:** any database modification, anywhere, that would make an assertion false is rejected
● **Expensive;** not implemented universally (PostgreSQL …)
Assertions

We can now finally model (correctly) the total participation constraint of Employees in Works_In:
Assertions

We can now finally model (correctly) the total participation constraint of Employees in Works_In:

CREATE ASSERTION TotalPartEmpWorksIn CHECK (NOT EXISTS (SELECT * FROM Employees E WHERE E.ssn NOT IN (SELECT W.ssn FROM Works_In W)));
## Summary

<table>
<thead>
<tr>
<th>Type of constraint</th>
<th>Where declared</th>
<th>When activated</th>
<th>Guaranteed to hold?</th>
</tr>
</thead>
<tbody>
<tr>
<td>attribute-based CHECK</td>
<td>with attribute</td>
<td>on insertion to relation or attribute update</td>
<td>not if subqueries</td>
</tr>
<tr>
<td>tuple-based CHECK</td>
<td>with relation schema</td>
<td>on insertion to relation or tuple update</td>
<td>not if subqueries</td>
</tr>
<tr>
<td>assertion</td>
<td>with database schema</td>
<td>on change to any mentioned relation</td>
<td>yes</td>
</tr>
</tbody>
</table>