course:
**Database Systems** (NDBI025)
SS2017/18

lecture 4:

# SQL – data definition & modification, views

doc. RNDr. Tomáš Skopal, Ph.D.
RNDr. Michal Kopecký, Ph.D.

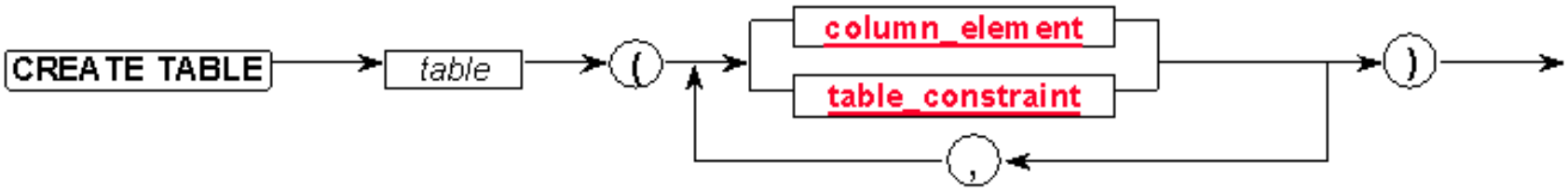
Department of Software Engineering, Faculty of Mathematics and Physics, Charles University in Prague

# Today's lecture outline

- data definition
  - definition of tables (their schemes) and integrity constraints – CREATE TABLE
  - altering the definitions – ALTER TABLE
- data manupulation
  - INSERT, UPDATE, DELETE
- database views

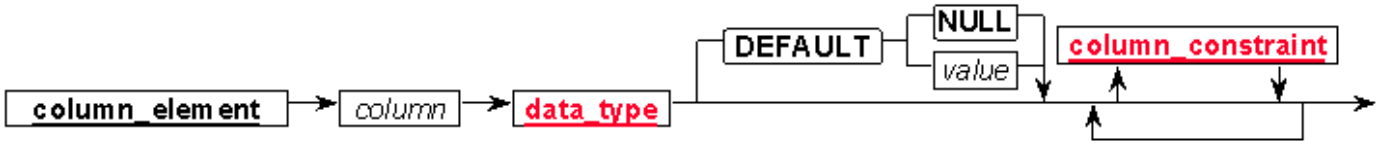
# CREATE TABLE – basic construction

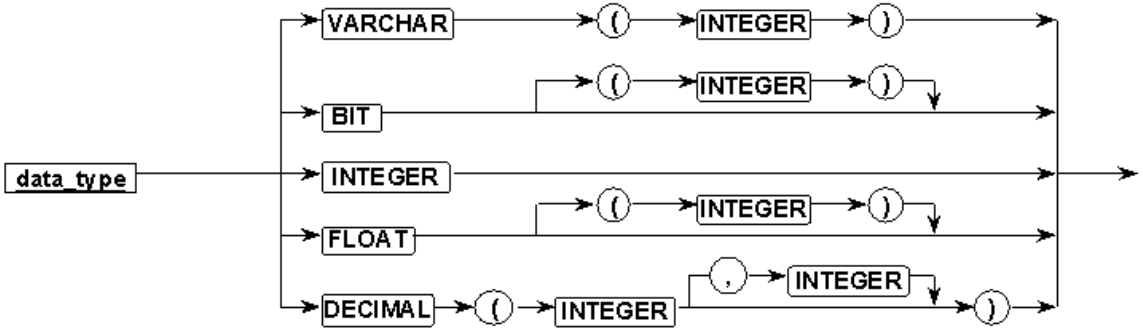
- construction of table schema and an empty table
- table name, columns defined, column-scope integrity constraints (IC), table-scope integrity constraints



# CREATE TABLE – column definition

- each column has a data_type
- optionally
  - default value within a new record (DEFAULT NULL | value)
  - column-scope integrity constraints



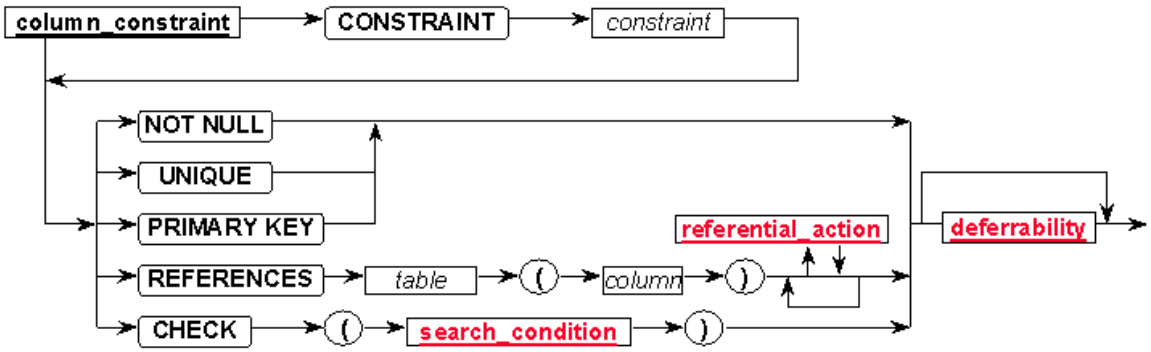



# Example – simple table (w/o IC)

```
CREATE TABLE Product
    (Id INTEGER, Name VARCHAR(128), Price DECIMAL(6,2),
    ProductionDate DATE, Available BIT DEFAULT TRUE, Weight FLOAT)
```

# CREATE TABLE – column-scope integrity constraint

- column-based IC allows to limit the domain of values in column in record (new or modified)
  - named **CREATE TABLE** … (…, **CONSTRAINT** constraint …)
  - unnamed
- 5 types limiting a valid value
  - **NOT NULL** – value cannot be null
  - **UNIQUE** – value must be unique (w.r.t all records in the table)
  - **PRIMARY KEY** – primary key definition (key = **NOT NULL** + **UNIQUE**, primary = primary index)
  - **REFERENCES** – one-column foreign key (both columns must share definition)
  - **CHECK** – generic condition, similarly as in **SELECT** … **WHERE**
    - applied only on the inserted/updated row(s)
    - data inserted/update only if TRUE
- if an IC is not validated, the record is not updated



# Example – definition of tables with column-scope ICs

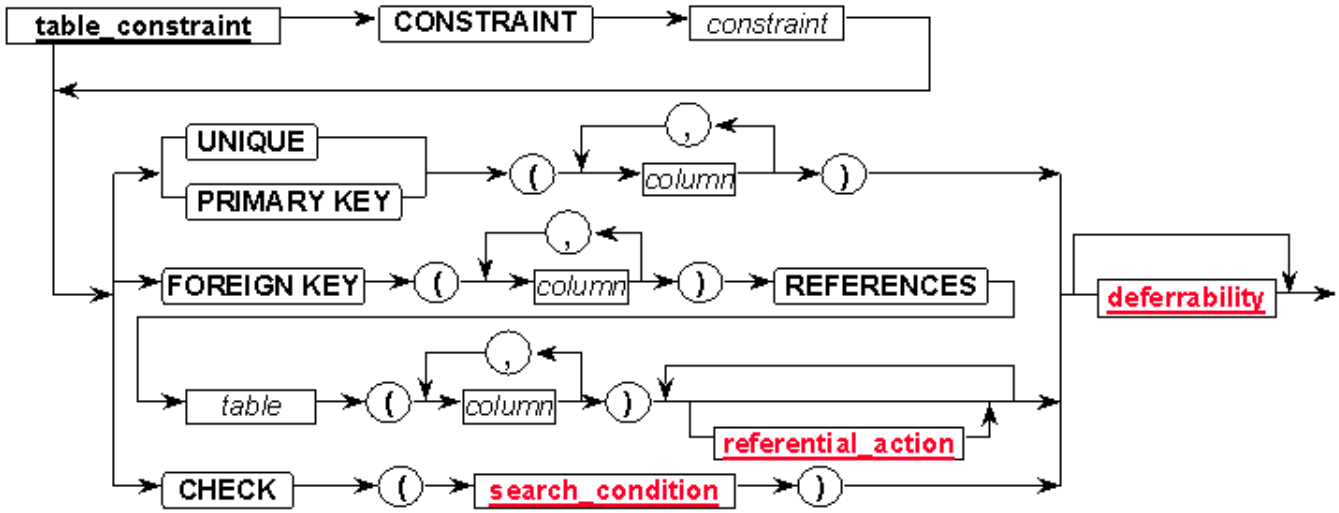
```
CREATE TABLE Product
    (Id INTEGER CONSTRAINT pk PRIMARY KEY, Name VARCHAR(128) UNIQUE,
    Price DECIMAL(6,2) NOT NULL, ProductionDate DATE, Available BIT DEFAULT
    TRUE, Weight FLOAT,
    Producer INTEGER REFERENCES Producer (Id))

CREATE TABLE Producer
    (Id INTEGER PRIMARY KEY, ProducerName VARCHAR(128),
    HQ VARCHAR(256))
```

# Example – foreign key (single table)

```
CREATE TABLE Employee
    (IdEmp INTEGER PRIMARY KEY, Name VARCHAR(128),
    Boss INTEGER REFERENCES Employee (IdEmp))
```

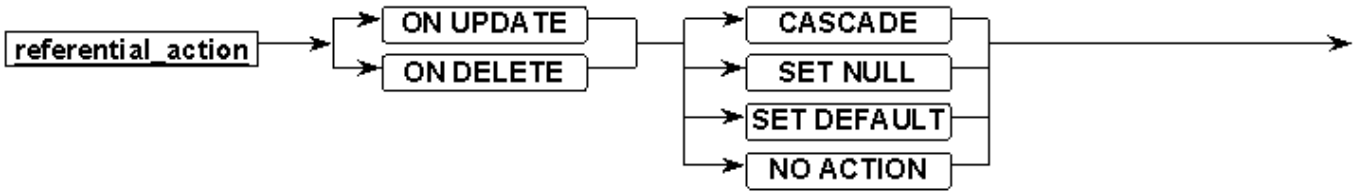
# CREATE TABLE – table-scope integrity constraint

- generalization of column-scope IC to use for multiple columns
  - apart NOT NULL, this is only meaningful for single column
- **UNIQUE** – n-tuple of values is unique
- **FOREIGN KEY** – the same as **REFERENCES** in column-scope IC
- **CHECK**



# Referential integrity

- when updating **referencing** or **referenced** table, violation of foreign keys may occur
  - record update with foreign key value that is not valid (not present in column of referenced table)
  - delete/update of a record in the referenced table (so that value in referencing table becomes not covered)
- when a violation of foreign keys occurs, there are two options
  - if there is no referential action defined, an error message appears, aborting the action (SQL 89)
  - referential action is triggered, **referential_action** (SQL 92)
    - ON UPDATE, ON DELETE – definition of when to trigger the action, either by update or delete of row in the referenced table
    - CASCADE – the row with the referencing value is treated the same (i.e., updated or deleted)
    - SET NULL – referencing value in the row is set to NULL
    - SET DEFAULT – referencing value in the row is set to a default value defined in CREATE TABLE
    - NO ACTION – default, no action takes place, resp., DBMS displays a message (SQL 89)



# Example – table with table-scope IC

```
CREATE TABLE Product
    (Id INTEGER PRIMARY KEY, Name VARCHAR(128) UNIQUE, Price
    DECIMAL(6,2) NOT NULL, ProductionDate DATE, Available BIT DEFAULT
    TRUE, Weight FLOAT, Producer VARCHAR(128), ProducerHQ VARCHAR(256),
    CONSTRAINT fk FOREIGN KEY (Producer, ProducerHQ) REFERENCES
    Producer (ProducerName,HQ))

CREATE TABLE Producer
    (ProducerName VARCHAR(128), HQ VARCHAR(256), Subject VARCHAR(64),
    CONSTRAINT pk PRIMARY KEY(ProducerName, HQ))
```

# Example – CHECK

```
CREATE TABLE Product
    (Id INTEGER PRIMARY KEY, Name VARCHAR(128) UNIQUE, Price
    DECIMAL(6,2) NOT NULL, ProductionDate DATE, Available BIT DEFAULT
    TRUE, Weight FLOAT,
    CONSTRAINT chk CHECK
    (Weight > 0))
```

# Example – ON DELETE, ON UPDATE

```
CREATE TABLE Product
    (Id INTEGER CONSTRAINT pk PRIMARY KEY, Name VARCHAR(128) UNIQUE,
    Price DECIMAL(6,2) NOT NULL, ProductionDate DATE, Available BIT DEFAULT
    TRUE, Weight FLOAT,
    Producer INTEGER REFERENCES Producer (Id)
    ON DELETE CASCADE)

CREATE TABLE Producer
    (Id INTEGER PRIMARY KEY, ProducerName VARCHAR(128),
    HQ VARCHAR(256))
```

# ALTER TABLE

- table scheme definition altering
  - column – add/remove column, change of DEFAULT value
  - IC – add/remove IC
- however, there may be data that won't allow the IC change (e.g., primary key definition)

**ALTER TABLE** table-name

… **ADD** [**COLUMN**] column-name column-definition

… **ADD** constraint-definition

… **ALTER** [**COLUMN**] column-name SET

… **ALTER** [**COLUMN**] column-name DROP

… **DROP COLUMN** column-name

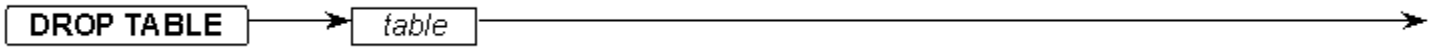
… **DROP CONSTRAINT** constraint-name

# Example – ALTER TABLE

```
CREATE TABLE Product
    (Id INTEGER PRIMARY KEY, Name VARCHAR(128) UNIQUE, Price
    DECIMAL(6,2) NOT NULL, ProductionDate DATE, Available BIT DEFAULT TRUE,
    Weight FLOAT,
    CONSTRAINT chk CHECK
    (AND Weight > 0))

ALTER TABLE Product DROP CONSTRAINT chk

ALTER TABLE Product ADD CONSTRAINT chk CHECK
    (Weight > 10))
```

# DROP TABLE

- **DROP TABLE *table***
- complementary to **CREATE TABLE *table***
- the table content is deleted and also the definition (i.e., scheme)
  - if we need to delete only the content we use **DELETE FROM *table*** (see next)

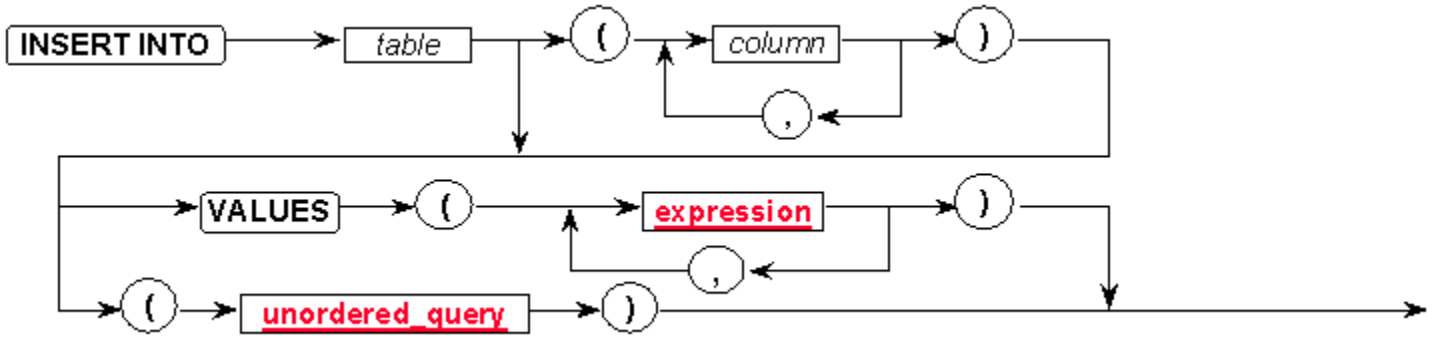


# Data modification

- apart SELECT, the SQL DML offers three commands for data manipulation
  - INSERT INTO – insertion of rows
  - DELETE FROM – deletion of rows
  - UPDATE – update of rows

# INSERT INTO

- insertion of row by enumeration, two options
  - **INSERT INTO** table (col1, col3, col5) **VALUES** (val1, val3, val5)
  - **INSERT INTO** table **VALUES** (val1, val2, val3, val4, val5)
- insertion of multiple rows that result from a SELECT
  - **INSERT INTO** table1 | (column list) | (**SELECT** … **FROM** …)



# Example – INSERT INTO

```
CREATE TABLE Product
    (Id INTEGER CONSTRAINT pk PRIMARY KEY, Name VARCHAR(128)
    UNIQUE, Price DECIMAL(6,2) NOT NULL, ProductionDate DATE, Available
    BIT DEFAULT TRUE, Weight FLOAT,
    Producer INTEGER REFERENCES Producer (Id))
```

```
INSERT INTO Product VALUES (0, 'Chair', 86, '2005-5-6', TRUE, 3, 123456)
```

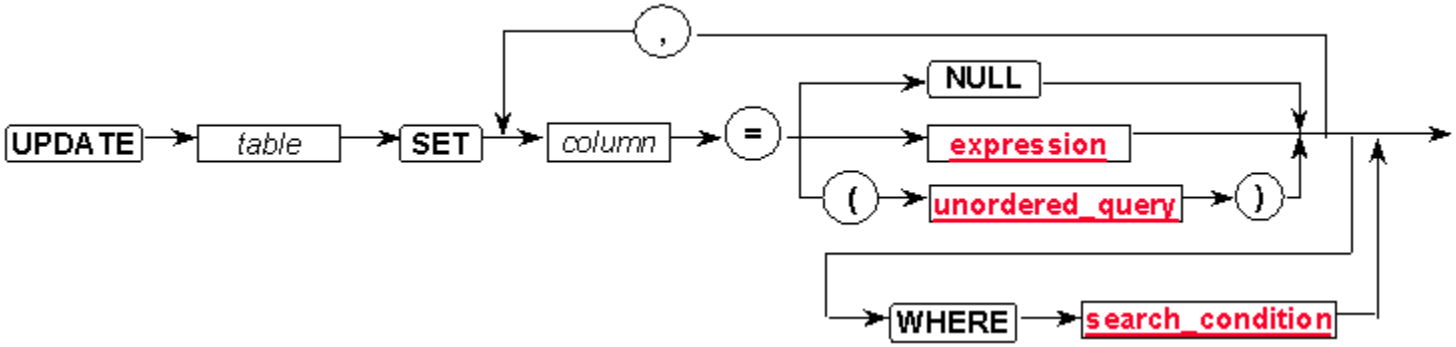
```
INSERT INTO Product (Id, Name, Price, ProductionDate, Weight, Producer)
    VALUES (0, 'Chair', 86, '2005-5-6', 3, 123456)
```

# Example – INSERT INTO

```
CREATE TABLE ProductInStore
    (Id INTEGER PRIMARY KEY, Name VARCHAR(128) UNIQUE, Price
    DECIMAL(6,2))

INSERT INTO ProductInStore
    (SELECT Id, Name, Price FROM Product WHERE Available = TRUE)
```

# UPDATE

- update of rows matching a condition
- the values of chosen columns are set to
  - NULL
  - value given by expression (also constant)
  - query result



# Example – UPDATE

```
UPDATE Product SET Name = 'Notebook' WHERE Name = 'Laptop'

UPDATE Product SET Price = Price * 0.9
    WHERE ProductionDate < CAST( '2017-01-01' AS DATE)

UPDATE Product SET Price = Price * 0.9
    WHERE ProductionDate < '2017-01-01' /* automatic conversion */

UPDATE Product AS V1 SET
    Weight = (SELECT AVG(Weight)
                  FROM Product AS V2
                  WHERE V1.Name = V2.Name)
```

# DELETE FROM

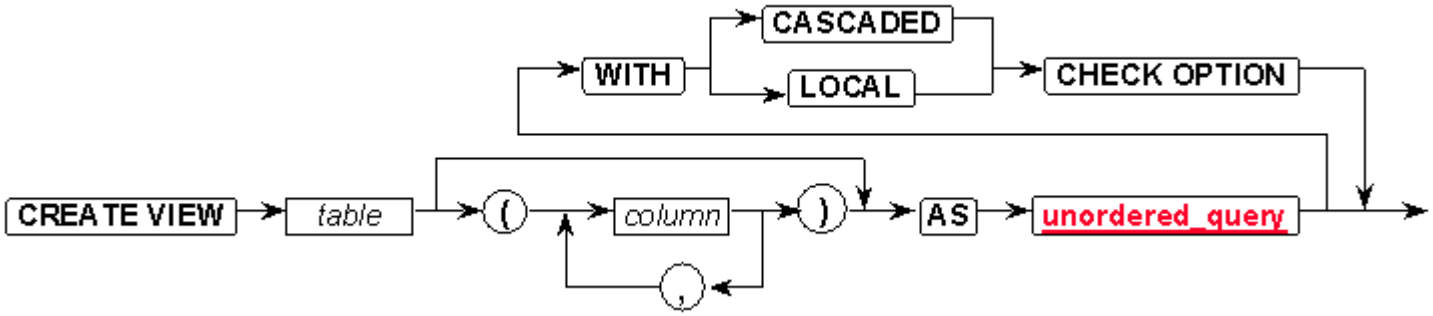
- deletes rows that match condition
- **DELETE FROM *table*** deletes all rows

Example:

**DELETE FROM** Product **WHERE** Price > 100

# Database views

- named query that could be used as a table (its result, resp.)
- evaluated dynamically
  - could be used also for data inserts/updates/deletes
- CHECK OPTION ensures that after row insert/update into the view the change will be visible
  - at least in this view
  - in all dependent views



# Example – views

```
CREATE VIEW NewProductInStore AS
    SELECT * FROM Product
        WHERE Available = TRUE
                AND ProductionDate > CAST('2017-01-01' AS DATE)
    WITH LOCAL CHECK OPTION

INSERT INTO  NewProductInStore VALUES
    (0, 'SwingChair', 135, '2017-05-06', TRUE, 4, 3215)
```

- inserted (transitivelly into table Product)

```
INSERT INTO NewProductInStore VALUES
    (0, 'Box', 135, '1999-11-07', TRUE, 4, 3215)
```

!! Error – this record cannot be inserted, as it wouldn't be visible (too old box)