

Simple Description of Relational Databases

Simple Diagrams

- A schema is represented by a networked diagram
 - Nodes represent tables
 - Name of the table labels the node
 - Interior of the node are the name of the attributes
 - Underline the primary key
 - Optionally, add domain to each attribute

Simple Diagrams

Sales

<u>purchase_number</u> :	int
date_of_purchase :	date
customer_id:	int
item_code:	varchar(10)

Customers

<u>customer_id</u> :	int
first_name :	varchar(255)
last_name :	varchar(255)
email_address :	varchar(10)
number of complaints :	int

Items

<u>item_code</u> :	int
item :	varchar(255)
unit_price:	decimal(10,2)
company_id:	int

Companies

<u>company_id</u> :	int
company_name :	varchar(63)
headquarters_ph_nr:	char(25)

Constraints in MySQL

- Constraints in MySQL have names
 - Often automatically generated
 - Use the SHOW CREATE TABLE query

```
Table, "Create Table"  
customers, "CREATE TABLE `customers` (  
  `customer_id` int NOT NULL AUTO_INCREMENT,  
  `first_name` varchar(255) DEFAULT NULL,  
  `last_name` varchar(255) DEFAULT NULL,  
  `email_address` varchar(255) DEFAULT NULL,  
  `number_of_complaints` int DEFAULT (0),  
  PRIMARY KEY (`customer_id`),  
  UNIQUE KEY `email_address` (`email_address`)  
) ENGINE=InnoDB AUTO_INCREMENT=3 DEFAULT CHARSET=utf8mb4  
COLLATE=utf8mb4_0900_ai_ci"
```

Constraints in MySQL

- Missing values are usually a NULL
- Can automatically assign INT with AUTO_INCREMENT
 - Used widely to assign artificial primary keys

Constraints in MySQL

- NOT NULL constraint
 - When inserting a tuple with NULL value in the constrained column, error will be thrown

```
CREATE TABLE tasks (  
    id INT AUTO_INCREMENT PRIMARY KEY,  
    title VARCHAR(255) NOT NULL,  
    start_date DATE NOT NULL,  
    end_date DATE  
);
```

- Considered good practice to include in all columns where a NULL value is not expected

Constraints in MySQL

- ALTER TABLE allows to introduce new / remove old constraint
 - Need to check that the inserted values comply

```
ALTER TABLE tasks  
CHANGE  
    end_date  
    end_date DATE NOT NULL;
```

```
ALTER TABLE tasks  
MODIFY  
    end_date  
    end_date DATE NOT NULL;
```

Constraints in MySQL

- UNIQUE
 - Values in a single attribute are different
 - Value groups in a group of attributes are different
- Creating a constraint:
 - Specify in CREATE TABLE for a single attribute
 - Add a CONSTRAINT cstr_name UNIQUE(attr1, attr2, ...)
 - Can leave out constraint name, will be replaced by an automatically created name
 - Use ALTER TABLE ADD CONSTRAINT

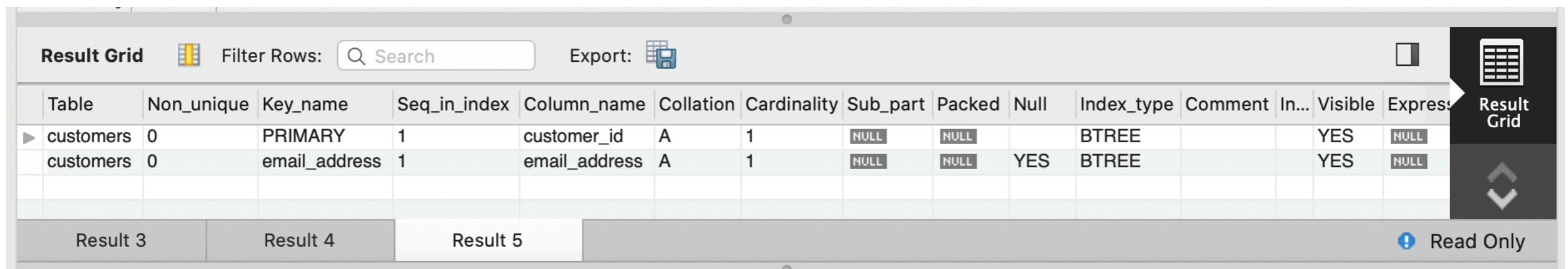
Constraints in MySQL

- UNIQUE

```
CREATE TABLE suppliers (  
    supplier_id INT AUTO_INCREMENT,  
    name VARCHAR(255) NOT NULL,  
    phone VARCHAR(15) NOT NULL UNIQUE,  
    address VARCHAR(255) NOT NULL,  
    PRIMARY KEY (supplier_id),  
    CONSTRAINT uc_name_address UNIQUE (name , address)  
);
```

Constraints in MySQL

- UNIQUE constraint creates an *index*
 - Index is a data structure with quick look-up
- Access indices through the SHOW INDEX FROM table command



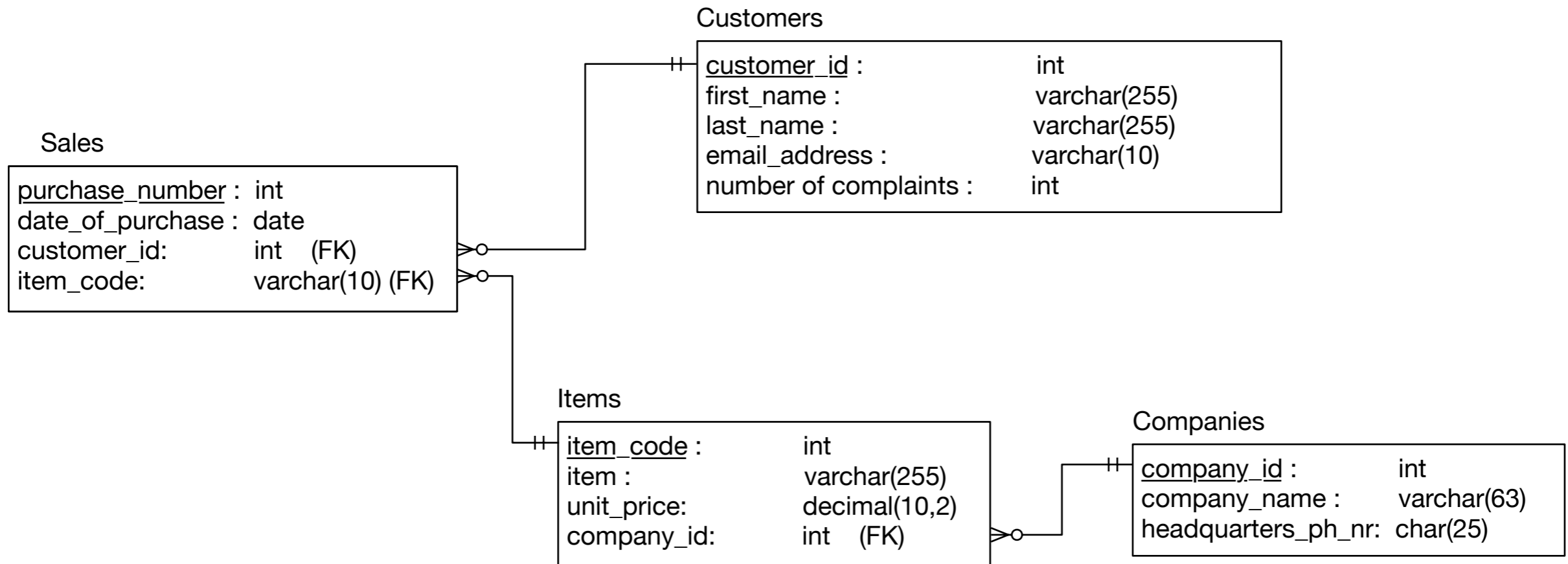
The screenshot shows a 'Result Grid' window with a search bar and an 'Export' button. The main area displays a table of index information for the 'customers' table. The table has 15 columns: Table, Non_unique, Key_name, Seq_in_index, Column_name, Collation, Cardinality, Sub_part, Packed, Null, Index_type, Comment, In..., Visible, and Express. Two rows of data are visible, representing the primary key and a unique index on the email_address column. The interface also includes a 'Result Grid' button on the right and a 'Read Only' status indicator at the bottom right.

Table	Non_unique	Key_name	Seq_in_index	Column_name	Collation	Cardinality	Sub_part	Packed	Null	Index_type	Comment	In...	Visible	Express
customers	0	PRIMARY	1	customer_id	A	1	NULL	NULL		BTREE			YES	NULL
customers	0	email_address	1	email_address	A	1	NULL	NULL	YES	BTREE			YES	NULL

Foreign Keys

- Relationships between tables are sometimes constructed with shared values
 - Sales has an attribute `client_id`
 - Customers has a primary key `client_id`
 - Need not be named the same
 - But it is usually convenient to do so
- We prevent entering a sale without a valid customer

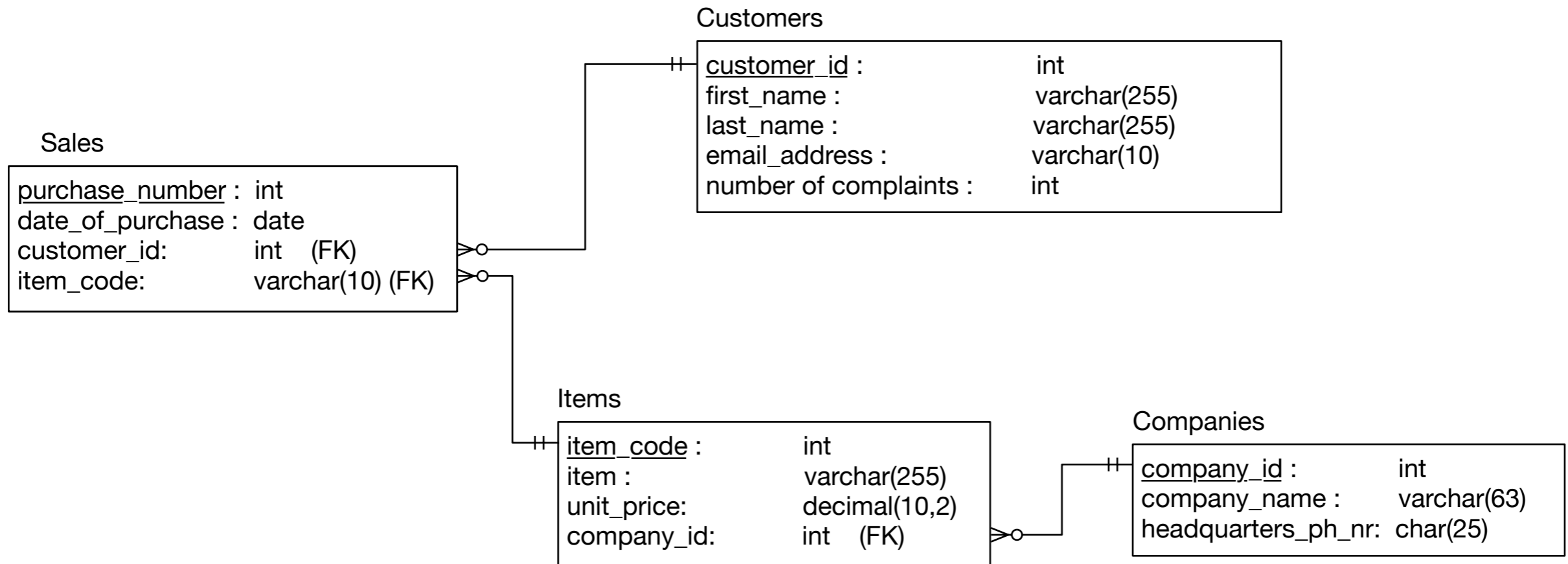
Constraints in MySQL



Constraints in MySQL

- Example:
 - A customer can have many sales
 - But each sale has only one customer
 - Relationship customers sales is a **one-to-many** relationship
 - customers is the referenced (or parent) table
 - sales is the referencing (or child) table
 - As is typical, the referenced attribute is a primary key in the referenced table

Constraints in MySQL



Constraints in MySQL

- In a diagram:
 - crow-feet with ball indicate many
 - double bar indicates one

Constraints in MySQL

- Foreign key constraint
 - Once established, insures that action is taken upon insertion or deletion of a record affecting the other table

Constraints in MySQL

- Possible Actions:
 - CASCADE: if a tuple from the referenced table is deleted or updated, the corresponding tuple in the referencing table is also deleted / updated
 - SET NULL: If a row from the referenced table is deleted or updated, the values of the foreign key in the referencing table are set to NULL

Constraints in MySQL

- Possible Actions:
 - RESTRICT: if a row from the referenced table has a matching row in the referencing table, then deletion and updates are rejected
 - SET DEFAULT: Accepted by MySQL parser but action not performed

Constraints in MySQL

- Foreign keys constraint actions
 - Are for
 - ON UPDATE
 - ON DELETE

Constraints in MySQL

- Creating foreign key constraints:

```
CREATE TABLE categories (  
    categoryId INT AUTO_INCREMENT PRIMARY KEY,  
    categoryName VARCHAR(100) NOT NULL  
);
```

```
CREATE TABLE products (  
    productId INT AUTO_INCREMENT PRIMARY KEY,  
    productName varchar(100) not null,  
    categoryId INT,  
    CONSTRAINT fk_category  
    FOREIGN KEY (categoryId)  
        REFERENCES categories(categoryId)  
        ON UPDATE CASCADE  
        ON DELETE CASCADE  
);
```

Constraints in MySQL

- You can drop a foreign key restraint using the ALTER TABLE statement

```
ALTER TABLE table_name  
DROP FOREIGN KEY constraint_name;
```

Constraints in MySQL

- When loading a database from (e.g.) .csv files
 - Can carefully create referenced tables before referencing tables
 - Temporarily disable foreign key checks

```
SET foreign_key_checks = 0;
```

```
SET foreign_key_checks = 1;
```

Constraints

- Primary key constraints
- Foreign key constraints
- Unique constraints
- Check restraints

Constraints

```
CREATE TABLE Persons (  
    ID int NOT NULL,  
    LastName varchar(255) NOT NULL,  
    FirstName varchar(255),  
    Age int,  
    CHECK (Age >= 18)  
);
```


Constraints

```
CREATE TABLE Persons (  
    ID int NOT NULL,  
    LastName varchar(255) NOT NULL,  
    FirstName varchar(255),  
    Age int,  
    City varchar(255),  
    CONSTRAINT CHK_Person CHECK (Age>=18 AND City='Sandnes')  
);
```