

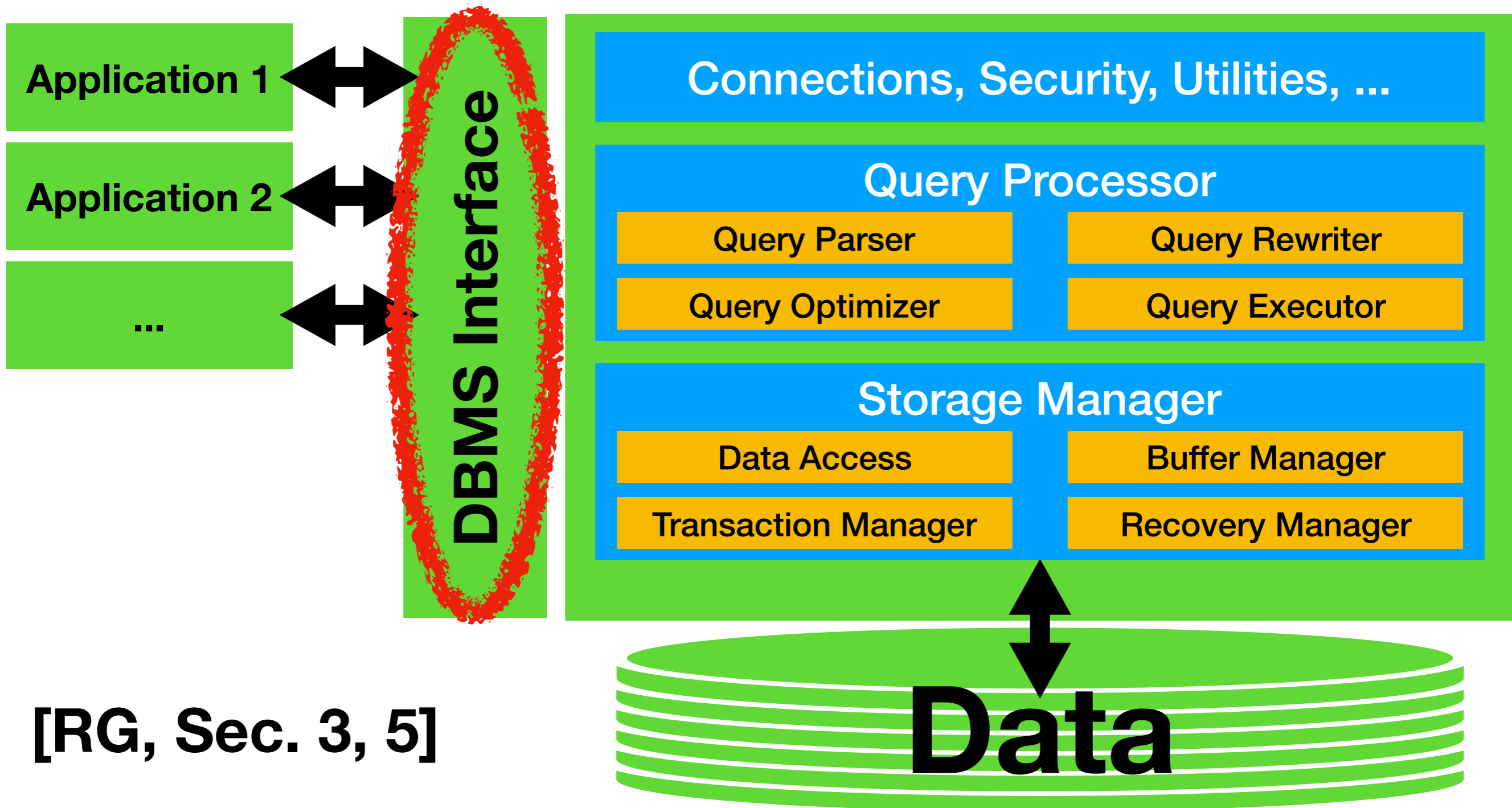
SQL Intro

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Database Management Systems (DBMS)



[RG, Sec. 3, 5]

The SQL Language

- Used to issue commands to the DBMS
- **SQL** = Structured Query Language
- The SQL standard is around since the **70s**
- Lots of features, we only see a **subset**

SQL Command Types

- **DDL: Data Definition Language**
 - Define admissible database content (schema)
- **DML: Data Manipulation Language**
 - Change and retrieve database content
- **TCL: Transaction Control Language**
 - Groups SQL commands (transactions)
- **DCL: Data Control Language**
 - Assign data access rights

SQL Command Types

- **DDL: Data Definition Language**

- Define admissible database content (schema)

Now

- **DML: Data Manipulation Language**

- Change and retrieve database content

Next

- **TCL: Transaction Control Language**

- Groups SQL commands (transactions)

Later

- **DCL: Data Control Language**

- Assign data access rights

-

Defining Database Schema

- Define relations with their **schemata**
 - What **columns** and column **types**?
- Define **constraints** restricting admissible content
 - Constraints on **single relations**
 - Constraints linking **multiple relations**

Schema Definition in SQL

- CREATE TABLE **<table>** (**<table-def>**)
- **<table>** is the table name
- **<table-def>** is comma-separated column definitions
- Column definition is of form **<col-name>** **<col-type>**

Defining Example Schema

Defining Example Schema

Students

Sid	Sname	Gpa
-----	-------	-----

```
CREATE TABLE Students(Sid int, Sname text, Gpa real);
```

Defining Example Schema

Students

Sid	Sname	Gpa
-----	-------	-----

Enrollment

Sid	Cid
-----	-----

```
CREATE TABLE Enrollment(Sid int, Cid int);
```

Defining Example Schema

Students

Sid	Sname	Gpa
-----	-------	-----

Enrollment

Sid	Cid
-----	-----

Courses

Cid	Cname
-----	-------

```
CREATE TABLE Courses(Cid int, Cname text);
```

*What Constraints Do
We Want?*

Integrity Constraints

- Constraints that **limit admissible content** of tables
- DBMS **enforces** integrity constraints
- Can be added to tables via "**ALTER TABLE**" command
- Alternatively, can define when **creating** table

Primary Key Constraint

- A primary key constraint refers to a **single table**
- It identifies a subset of columns as **key columns**
- Fixing values for key columns must **identify** row
- **No two rows** have same values in key columns

Primary Key Syntax

- ALTER TABLE **<table>**
ADD CONSTRAINT **Primary Key** (**<key-cols>**);
- **<table>** is the table name
- **<key-cols>** is comma-separated list of column names

Defining Example Schema

PKKey

Students

Sid	Sname	Gpa
-----	-------	-----

Enrollment

Sid	Cid
-----	-----

Courses

Cid	Cname
-----	-------

ALTER TABLE Students ADD PRIMARY KEY(Sid);

Defining Example Schema

PKKey

Students

Sid	Sname	Gpa
-----	-------	-----

PKKey

Enrollment

PKKey

Sid	Cid
-----	-----

Courses

Cid	Cname
-----	-------

```
ALTER TABLE Enrollment ADD PRIMARY KEY(Sid, Cid);
```

Defining Example Schema

PKKey **Students**

Sid	Sname	Gpa
-----	-------	-----

PKKey **Enrollment** **PKKey**

Sid	Cid
-----	-----

PKKey **Courses**

Cid	Cname
-----	-------

ALTER TABLE Courses ADD PRIMARY KEY(Cid);

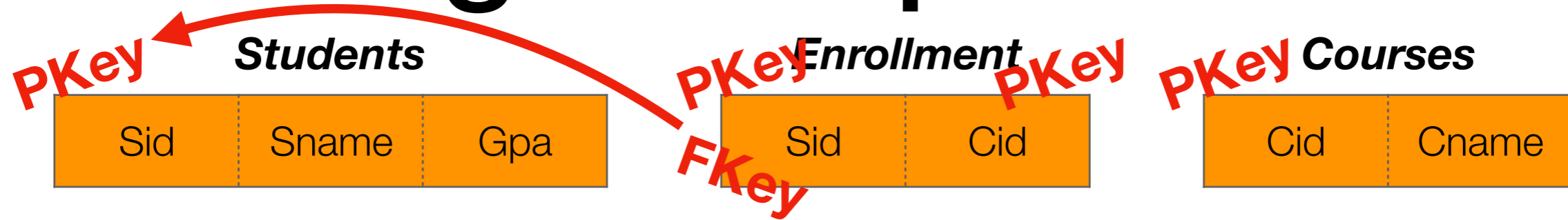
Foreign Key Constraint

- A foreign key constraint links **two tables**
- Identifies set of **foreign key columns** in table 1
- Maps foreign key columns to **primary key** of table 2
- Values in foreign key column **must appear** as primary key
- Maps **each row** in table 1 to a row from table 2

Foreign Key Syntax

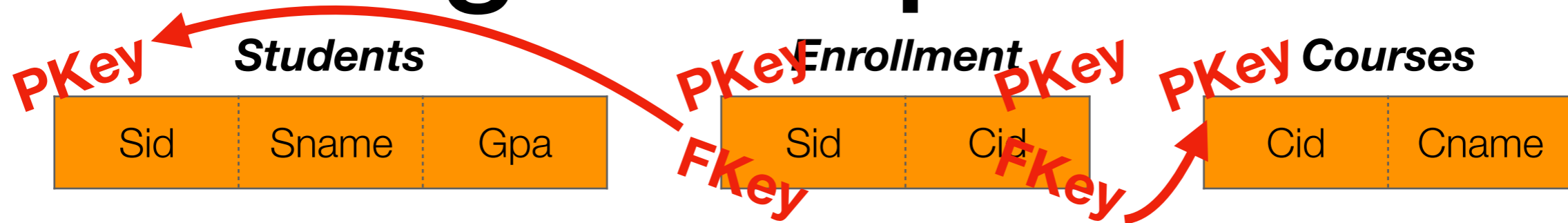
- ALTER TABLE **<table-1>**
ADD **Foreign Key** (**<fkey-columns>**)
REFERENCES **<table-2>** (**<pkey-columns>**);
- **<table-1>** is table with foreign key columns
- **<fkey-column>** is comma-separated foreign key columns
- **<table-2>** is table with primary key columns
- **<pkey-columns>** is comma-separated primary keys

Defining Example Schema



```
ALTER TABLE Enrollment  
ADD FOREIGN KEY(Sid) REFERENCES Students(Sid);
```

Defining Example Schema



```
ALTER TABLE Enrollment  
ADD FOREIGN KEY(Cid) REFERENCES Courses(Cid);
```

Exercise (5 Minutes)

- **Zamona** wants to start selling books via a Web shop
- Create a database for Zamona for information on books
- Each book has a **unique integer ID** and a book **title**
- Writers have a **unique name**
- Writers are the **authors** of books
- Define a database with **three tables** for this scenario

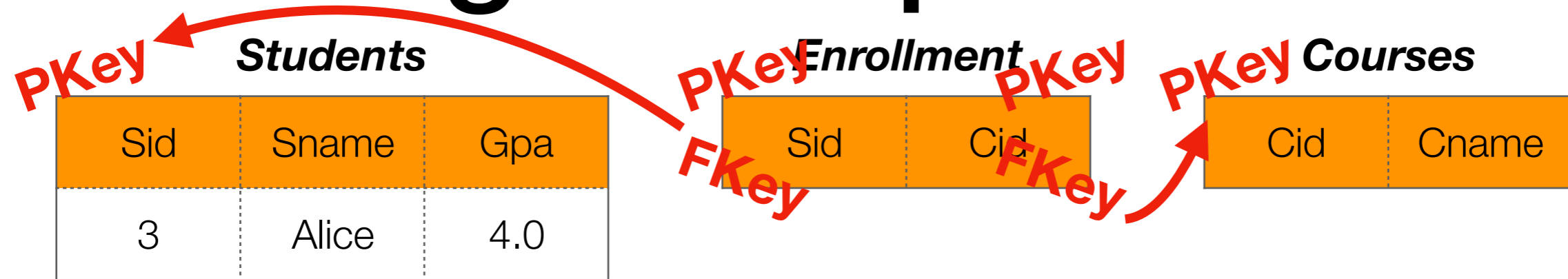
Working With Data (DML)

- Can **insert** data into a table
- Can **delete** data from a table
- Can **update** data in a table
- Can **analyze** data in a table

Inserting Data

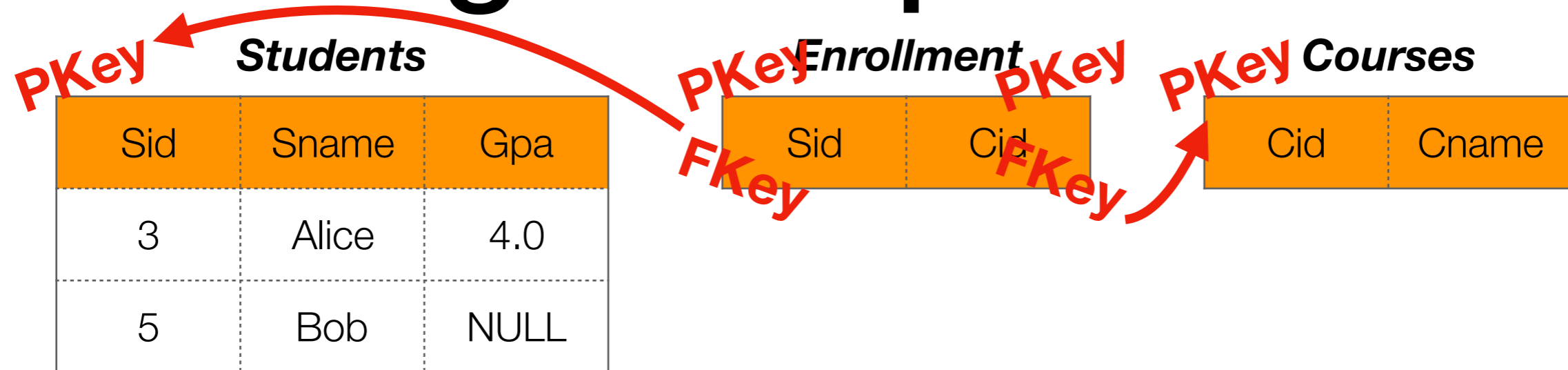
- Inserting one (**fully specified**) row into a table:
 - INSERT INTO **<table>** VALUES (**<value-list>**)
- Inserting one (**partially specified**) row into a table:
 - INSERT INTO **<table>** (**<column-list>**)
VALUES (**<value-list>**)

Defining Example Schema



INSERT INTO Students VALUES (3, 'Alice', 4.0)

Defining Example Schema

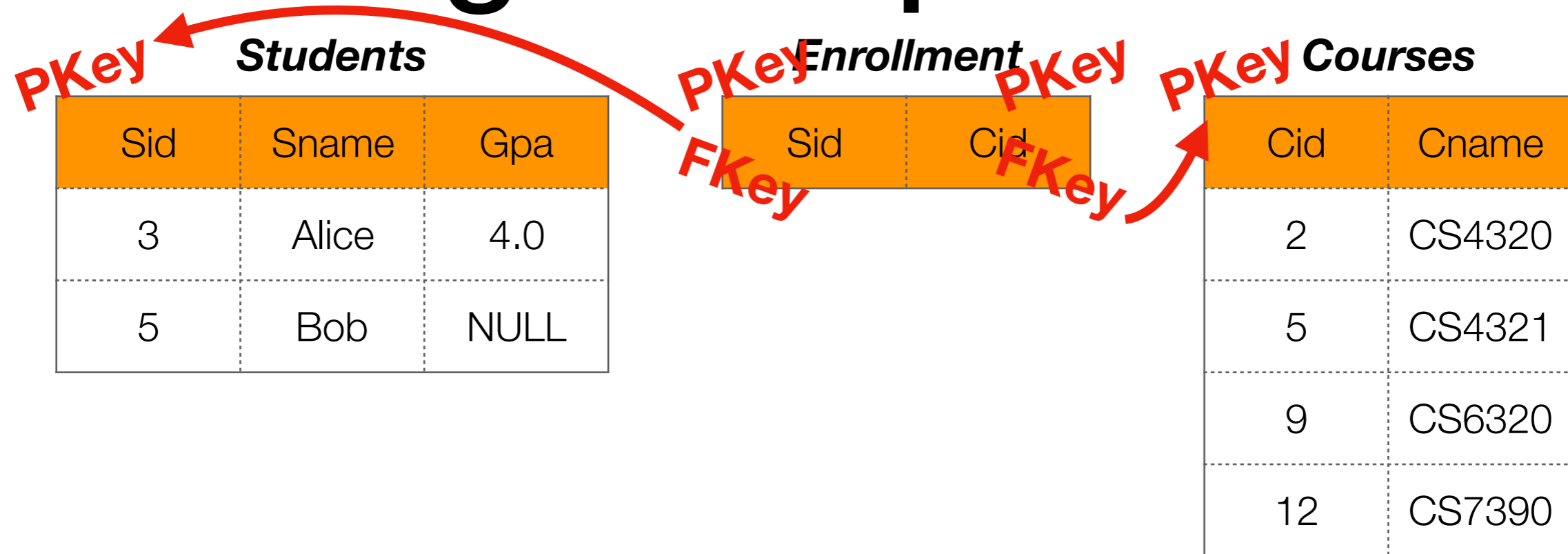


INSERT INTO Students (Sid, Sname) VALUES (5, 'Bob')

Inserting Data From Files

- Loading data from a file into a table:
 - COPY **<table>** FROM **<path>**
DELIMITER **<delimiter>** NULL **<null-string>** CSV

Defining Example Schema

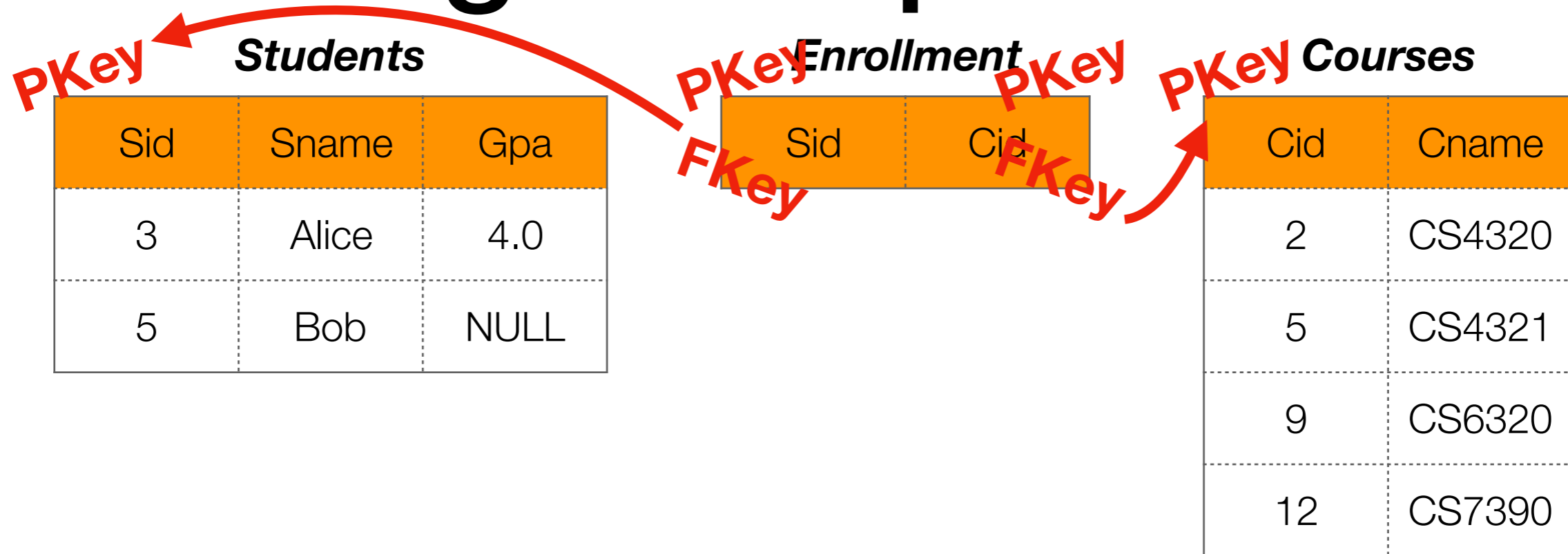


COPY Courses FROM 'courses.csv' DELIMITER ',' CSV

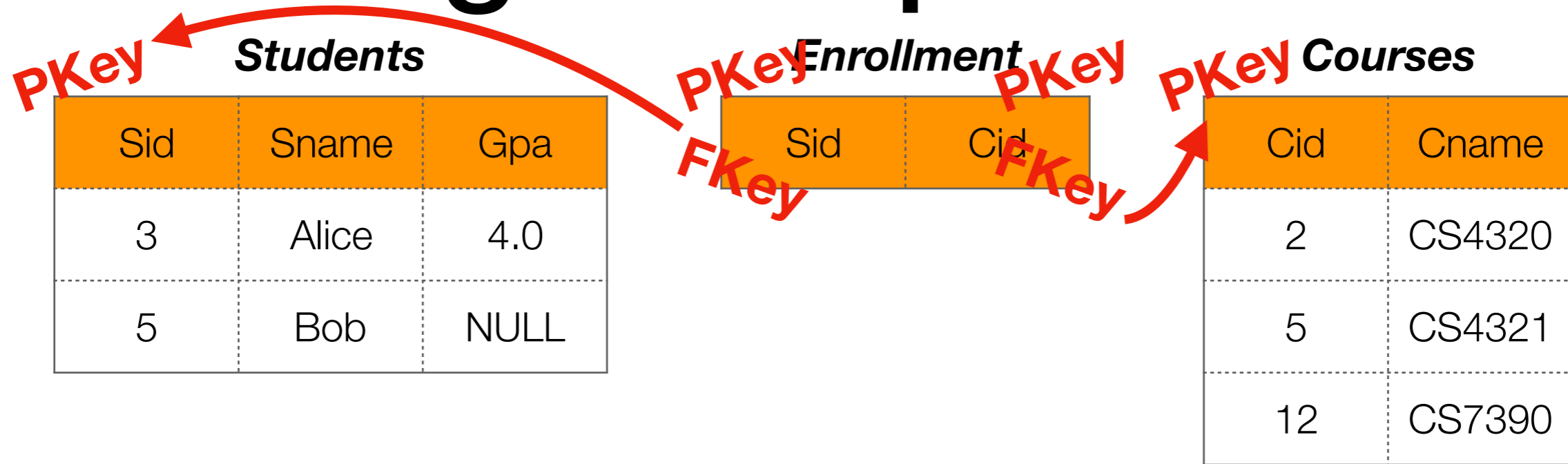
Deleting Data

- **Deleting rows** from a table that satisfy condition:
 - DELETE FROM **<table>** WHERE **<condition>**
 - **<condition>** specifies Boolean predicate
 - E.g., (in)equalities between columns
 - Will discuss conditions in detail later

Defining Example Schema



Defining Example Schema

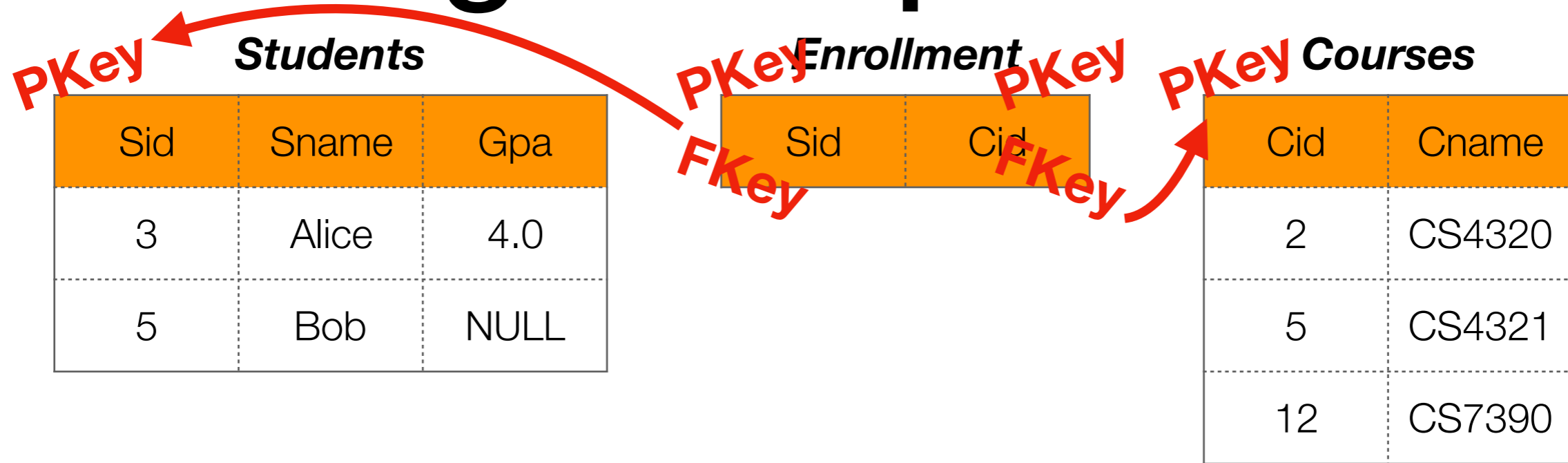


DELETE FROM Courses WHERE Cname = 'CS6320'

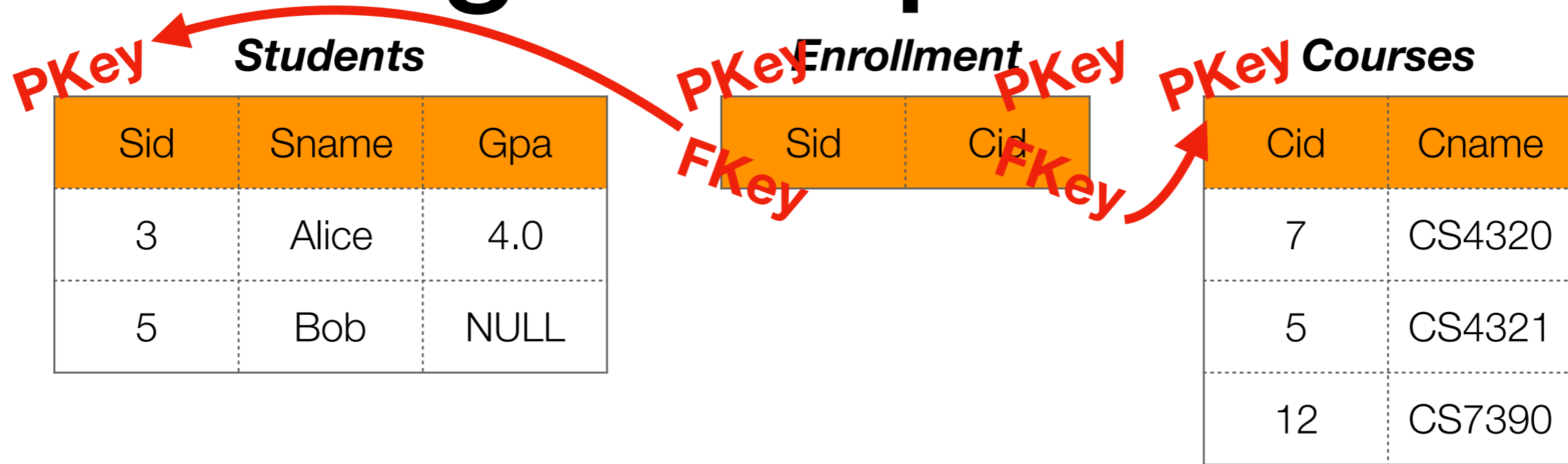
Updating Data

- Updating specific rows and columns to new value:
 - UPDATE **<table>**
SET **<column>** = **<value>**
WHERE **<condition>**
 - Changes rows satisfying **<condition>**
by writing **<value>** in **<column>**

Defining Example Schema



Defining Example Schema



UPDATE Courses SET Cid = 7 WHERE Cname = 'CS4320'

Exercise

- Try **inserting** books and authors into the database
- Try **deleting** and **updating** them as well
- Verify that updates violating **constraints** are rejected