

Working With Databases: Relational Data Model

Dr. Ilkay Altintas

- Describe the structural components of a relational data model
- Demonstrate which components make up a data model's 'schema'
- Explain the purpose of primary and foreign keys
- Describe a "Join" operation

A Collection of Tables

| ID | FName | LName | Department | Title | Salary |
|-----|--------|----------|------------|---------------------|--------|
| 202 | John | Gonzales | IT | DB Specialist | 104750 |
| 203 | Mary | Roberts | Research | Director | 175400 |
| 204 | Janaki | Rao | HR | Financial Analyst | 63850 |
| 205 | Alex | Knight | IT | Security Specialist | 123500 |
| 206 | Pamela | Ziegler | IT | Programmer | 85600 |
| 207 | Harry | Dawson | HR | Director | 115450 |

No Duplicates

| ID | FName | LName | Department | Title | Salary |
|----------------|------------------|-------------------|---------------|---------------------|-------------------|
| 202 | John | Gonzales | IT | DB Specialist | 104750 |
| 203 | Mary | Roberts | Research | Director | 175400 |
| 204 | Janaki | Rao | HR | Financial Analyst | 63850 |
| 205 | Alex | Knight | IT | Security Specialist | 123500 |
| 206 | Pamela | Ziegler | IT | Programmer | 85600 |
| 207 | Harry | Dawson | HR | Director | 115450 |
| 207 | Harry | Dawson | HR | Director | 115450 |

Dissimilar Tuples Disallowed

| ID | Fname | Lname | Department | Title | Salary |
|------|--------|----------|----------------|---------------------|----------|
| 202 | John | Gonzales | IT | DB Specialist | 104750 |
| 203 | Mary | Roberts | Research | Director | 175400 |
| 204 | Janaki | Rao | HR | Financial Analyst | 63850 |
| 205 | Alex | Knight | IT | Security Specialist | 123500 |
| 206 | Pamela | Ziegler | IT | Programmer | 85600 |
| 207 | Harry | Dawson | HR | Director | 115450 |
| Jane | Doe | 208 | Res. Associate | 65800 | Research |

Foreign Keys

| EmpSalaries | | |
|-------------|-----------|--------|
| EmpID | Date | Salary |
| 202 | 1/1/2016 | 104750 |
| 203 | 2/15/1016 | 175400 |
| 204 | 6/1/2015 | 63850 |
| 205 | 9/15/2015 | 123500 |
| 206 | 10/1/2015 | 85600 |
| 207 | 4/15/2015 | 115450 |
| 202 | 9/15/2014 | 101250 |
| 204 | 3/1/2015 | 48000 |
| 207 | 9/15/2013 | 106900 |
| 205 | 10/1/2014 | 113400 |

EmpSalaries.EmpID **References**

Employees.ID

Foreign key

Primary key

| ID | FName | LName |
|-----|--------|----------|
| 202 | John | Gonzales |
| 203 | Mary | Roberts |
| 204 | Janaki | Rao |
| 205 | Alex | Knight |
| 206 | Pamela | Ziegler |
| 207 | Harry | Dawson |

| EmpID | Date | Salary |
|-------|-----------|--------|
| 202 | 1/1/2016 | 104750 |
| 203 | 2/15/1016 | 175400 |
| 204 | 6/1/2015 | 63850 |
| 205 | 9/15/2015 | 123500 |
| 206 | 10/1/2015 | 85600 |
| 207 | 4/15/2015 | 115450 |
| 202 | 9/15/2014 | 101250 |
| 204 | 3/1/2015 | 48000 |
| 207 | 9/15/2013 | 106900 |
| 205 | 10/1/2014 | 113400 |

Joining Relations

| ID | FName | LName | Date | Salary |
|-----|--------|----------|-----------|--------|
| 202 | John | Gonzales | 1/1/2016 | 104750 |
| 202 | John | Gonzales | 9/15/2014 | 101250 |
| 203 | Mary | Roberts | 2/15/1016 | 175400 |
| 204 | Janaki | Rao | 6/1/2015 | 63850 |
| 204 | Janaki | Rao | 3/1/2015 | 48000 |
| 205 | Alex | Knight | 9/15/2015 | 123500 |
| 205 | Alex | Knight | 10/1/2014 | 113400 |
| 206 | Pamela | Ziegler | 10/1/2015 | 85600 |
| 207 | Harry | Dawson | 4/15/2015 | 115450 |
| 207 | Harry | Dawson | 9/15/2013 | 106900 |

| ID | FName | LName |
|-----|--------|----------|
| 202 | John | Gonzales |
| 203 | Mary | Roberts |
| 204 | Janaki | Rao |
| 205 | Alex | Knight |
| 206 | Pamela | Ziegler |
| 207 | Harry | Dawson |

| EmpID | Date | Salary |
|-------|-----------|--------|
| 202 | 1/1/2016 | 104750 |
| 203 | 2/15/1016 | 175400 |
| 204 | 6/1/2015 | 63850 |
| 205 | 9/15/2015 | 123500 |
| 206 | 10/1/2015 | 85600 |
| 207 | 4/15/2015 | 115450 |
| 202 | 9/15/2014 | 101250 |
| 204 | 3/1/2015 | 48000 |
| 207 | 9/15/2013 | 106900 |
| 205 | 10/1/2014 | 113400 |

Summary

| ID | FName | LName | Date | Salary |
|-----|--------|----------|-----------|--------|
| 202 | John | Gonzales | 1/1/2016 | 104750 |
| 202 | John | Gonzales | 9/15/2014 | 101250 |
| 203 | Mary | Roberts | 2/15/1016 | 175400 |
| 204 | Janaki | Rao | 6/1/2015 | 63850 |
| 204 | Janaki | Rao | 3/1/2015 | 48000 |
| 205 | Alex | Knight | 9/15/2015 | 123500 |
| 205 | Alex | Knight | 10/1/2014 | 113400 |
| 206 | Pamela | Ziegler | 10/1/2015 | 85600 |
| 207 | Harry | Dawson | 4/15/2015 | 115450 |
| 207 | Harry | Dawson | 9/15/2013 | 106900 |

Working With Databases: Structured Query Language

- Describe what data retrieval means
- Explain the purpose of SQL
- Create simple SELECT queries

What is Data Retrieval?

- Data retrieval
 - The way in which the desired data is specified and retrieved from a data store
- Our focus
 - How to specify a data request
 - The internal mechanism of data retrieval

Structured Query Language

- The standard for structured data
- Example Database Schema

Bars(name, addr, license)

Beers(name, manf)

Sells(bar, beer, price)

| <u>name</u> | <u>addr</u> | <u>license</u> |
|--------------------|---------------------------------|----------------|
| Great American Bar | 363 Main St., SD, CA 92390 | 41-437844098 |
| Beer Paradise | 6450 Mango Drive, SD, CA 92130 | 41-973428319 |
| Have a Good Time | 8236 Adams Avenue, SD, CA 92116 | 32-032263401 |

SELECT-FROM-WHERE

- Which beers are made by Heineken?

```
SELECT name  
FROM Beers  
WHERE manf = 'Heineken'
```

Output attribute(s)

Table(s) to use

The condition(s) to satisfy

Strings like 'Heineken' are case-sensitive and are put in quotes

| name |
|---------------------|
| Heineken Lager Beer |
| Amstel Lager |
| Amstel Light |
| ... |

Select_{manf='Heineken'} (Beers)



Project(name)

More Example Queries

- Find expensive beer
 - SELECT DISTINCT beer, price
 - FROM Sells
 - WHERE price > 15
- Which businesses have a Temporary License (starts with 32) in San Diego?
 - SELECT name
 - FROM Bars
 - WHERE addr LIKE '%SD%' **AND** license LIKE '32%' LIMIT 5

| <u>name</u> | <u>addr</u> | <u>license</u> |
|--------------------|---------------------------------|----------------|
| Great American Bar | 363 Main St., SD, CA 92390 | 41-437844098 |
| Beer Paradise | 6450 Mango Drive, SD, CA 92130 | 41-973428319 |
| Have a Good Time | 8236 Adams Avenue, SD, CA 92116 | 32-032263401 |
| | | |

Summary

- SQL is the standard querying language for structured relational data
- Resembles pandas data frames operations
- Allow for selection of data and more