More on SQL:
Joins and Set operators

Chapter 7 p. 260 -265 in
Kroenke textbook

Today

- Inner join
- Natural join
- Outer join
- Set Operators: Union, Intersect, Except
JOIN ON Syntax

List the students and the courses they are enrolled in

\[
\begin{align*}
\text{Students} & \quad \text{Enrolled} \\
\text{SNb} & \quad \text{SName} & \quad \text{Email} & \quad \text{SNb} & \quad \text{Cid} & \quad \text{Semester} \\
190 & \quad \text{Smith} & \quad \text{jsmith@usna.edu} & \quad 190 & \quad \text{IT340} & \quad \text{Spring2006} \\
673 & \quad \text{Doe} & \quad \text{jdoe@usna.edu} & \quad 312 & \quad \text{IT360} & \quad \text{Fall2008} \\
312 & \quad \text{Doe} & \quad \text{jdoe2@usna.edu} & \quad 312 & \quad \text{IT430} & \quad \text{Fall2008}
\end{align*}
\]

JOIN ON Syntax

\[
\begin{align*}
\text{SELECT S.Nb, SName, E.Cid} & \quad \text{SELECT S.SNb, SName, E.Cid} \\
\text{FROM Students S, Enrolled E} & \quad \text{FROM Students S JOIN Enrolled E} \\
\text{WHERE S.Snb = E.Snb} & \quad \text{ON S.Snb=E.Snb} \\
\text{SELECT S.SNb, SName, E.Cid, C.Cname} & \quad \text{ON S.Snb=E.Snb} \\
\text{FROM Students AS S JOIN Enrolled AS E} & \quad \text{JOIN Courses AS C} \\
\text{ON E.Cid = C.Cid} & \quad \text{ON E.Cid = C.Cid}
\end{align*}
\]

JOIN ON Syntax

Only enrolled students listed

\[
\begin{align*}
\text{SELECT S.Nb, SName, E.Cid} & \quad \text{SELECT S.SNb, SName, E.Cid} \\
\text{FROM Students S, Enrolled E} & \quad \text{FROM Students S JOIN Enrolled E} \\
\text{WHERE S.Snb = E.Snb} & \quad \text{ON S.Snb=E.Snb} \\
\text{SELECT S.SNb, SName, E.Cid, C.Cname} & \quad \text{ON S.Snb=E.Snb} \\
\text{FROM Students AS S JOIN Enrolled AS E} & \quad \text{JOIN Courses AS C} \\
\text{ON E.Cid = C.Cid} & \quad \text{ON E.Cid = C.Cid}
\end{align*}
\]

JOIN .. USING Syntax

List the students and the courses they are enrolled in

JOIN .. USING Syntax

Only enrolled students listed

\[
\begin{align*}
\text{SELECT S.Nb, SName, E.Cid} & \quad \text{SELECT S.SNb, SName, E.Cid} \\
\text{FROM Students S, Enrolled E} & \quad \text{FROM Students S JOIN Enrolled E} \\
\text{WHERE S.Snb = E.Snb} & \quad \text{USING (Snb)} \\
\text{SELECT S.SNb, SName, E.Cid, C.Cname} & \quad \text{ON S.Snb=E.Snb} \\
\text{FROM Students AS S JOIN Enrolled AS E} & \quad \text{JOIN Courses AS C} \\
\text{USING (Snb)} & \quad \text{USING (Cid)}
\end{align*}
\]

JOIN .. USING Syntax

\[
\begin{align*}
\text{SELECT S.Nb, SName, E.Cid} & \quad \text{SELECT S.SNb, SName, E.Cid} \\
\text{FROM Students S, Enrolled E} & \quad \text{FROM Students S JOIN Enrolled E} \\
\text{WHERE S.Snb = E.Snb} & \quad \text{USING (Snb)} \\
\text{SELECT S.SNb, SName, E.Cid, C.Cname} & \quad \text{ON S.Snb=E.Snb} \\
\text{FROM Students AS S JOIN Enrolled AS E} & \quad \text{JOIN Courses AS C} \\
\text{USING (Snb)} & \quad \text{USING (Cid)}
\end{align*}
\]

JOIN .. USING Syntax

Only enrolled students listed
Outer Joins

List all students and the courses they are enrolled in

```
SELECT S.SNb, SName, E.Cid
FROM Students S LEFT JOIN Enrolled E
ON S.Snb=E.Snb
```

ALL students listed (even if not enrolled)

<table>
<thead>
<tr>
<th>SNb</th>
<th>SName</th>
<th>Email</th>
</tr>
</thead>
<tbody>
<tr>
<td>190</td>
<td>Smith</td>
<td><a href="mailto:jsmith@usna.edu">jsmith@usna.edu</a></td>
</tr>
<tr>
<td>673</td>
<td>Doe</td>
<td><a href="mailto:jdoe@usna.edu">jdoe@usna.edu</a></td>
</tr>
<tr>
<td>312</td>
<td>Doe</td>
<td><a href="mailto:jdoe2@usna.edu">jdoe2@usna.edu</a></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SNb</th>
<th>Cid</th>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>190</td>
<td>IT340</td>
<td>Spring2006</td>
</tr>
<tr>
<td>312</td>
<td>IT360</td>
<td>Fall2008</td>
</tr>
<tr>
<td>312</td>
<td>IT430</td>
<td>Fall2008</td>
</tr>
</tbody>
</table>

Join Summary

- Inner join
  - … JOIN … ON cond
  - … JOIN … USING(cols)
- Natural join
  - … NATURAL JOIN … -- uses the columns with the same name
- Left | Right | Full Outer join
  - … LEFT JOIN .. ON cond
Set Operators

- UNION
- UNION ALL
- INTERSECT (not in MySQL)
- EXCEPT (not in MySQL)

**UNION**

- Enrolled(Alpha, Cid, Semester, Grade)
- List all Alpha of students enrolled in IT360 or IC322

```sql
SELECT Alpha
FROM enrolled
WHERE Cid = 'IT360'
UNION
SELECT Alpha
FROM enrolled
WHERE Cid = 'IC322'
```

- Same number of columns and data types in the 2 select
- Duplicates in results are eliminated by default (use UNION ALL if want to keep duplicates)
INTERSECT

- Enrolled(Alpha, Cid, Semester, Grade)
- List all Alpha of students enrolled in IT360 and IC322

SELECT Alpha
FROM enrolled
WHERE Cid = 'IT360'
INTERSECT
SELECT Alpha
FROM enrolled
WHERE Cid = 'IC322'

• Same number of columns and data types in the 2 select
• NOT SUPPORTED in MYSQL

EXCEPT

- Enrolled(Alpha, Cid, Semester, Grade)
- List all Alpha of students enrolled in IT360 but not in IC322

SELECT Alpha
FROM enrolled
WHERE Cid = 'IT360'
EXCEPT
SELECT Alpha
FROM enrolled
WHERE Cid = 'IC322'

• Same number of columns and data types in the 2 select
• NOT SUPPORTED in MYSQL