Lecture 13:
• Database Design (cont)

Announcements:
• HW-3 due
• HW-4 out
• PS-3 out soon (not due for a bit)
• Exam 1 on Tues

Exam 1

Basics:
• 3-4 multipart questions
• worth 40 points (plus extra credit)
• closed notes, etc.

Topics:
• relational model (terminology, keys, foreign keys)
• SQL data definition (create table, etc.)
• SQL queries
• Possibly high-level questions on dynamic SQL

To Study: quizzes, problem sets, lecture notes, homework
Database Design: Issues with Redundancy

EmpDept

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>eid</td>
<td>name</td>
<td>dept</td>
<td>dept_name</td>
</tr>
<tr>
<td>A01</td>
<td>Alice</td>
<td>12</td>
<td>CS</td>
</tr>
<tr>
<td>A12</td>
<td>Bob</td>
<td>10</td>
<td>HR</td>
</tr>
<tr>
<td>A13</td>
<td>Bob</td>
<td>12</td>
<td>CS</td>
</tr>
<tr>
<td>A03</td>
<td>Anne</td>
<td>12</td>
<td>CS</td>
</tr>
</tbody>
</table>

Update Anomaly: If CS changes name, must change multiple rows

Insertion Anomaly: If no employees, where to store department info?

Deletion Anomaly: If A12 leaves, HR department info lost

Anomalies are in addition to wasted space
- e.g., the department name is stored multiple times

Database Normal Forms and Decomposition

Normal forms: “levels” of allowed redundancy based on attribute dependencies
- First Normal Form ... atomic values
- Second & Third Normal Form ... allow some redundancy
- Boyce–Codd Normal Form (BCNF) ... no redundancy from functional deps
- Fourth & Fifth Normal Forms ... for multivalued dependencies

Normalization: “decomposes” a table into smaller tables
- Decomposition based on the attribute dependencies that exist
- Follows a decomposition algorithm
- We’ll give a sense for how this works (but not dive into algorithms)

Note: assumes a universal relation
- All relations in a database “come from” a single (large) relation