Operations on Database Tables

Tables are useful, but they become much more powerful when we can manipulate them to create new tables from existing tables. For that, we need special operations.

Tables that Produce Other Tables

- Table operations can involve one or many tables.
- These basic operations are usually used together to create specific user “views” of the database.
  - These views are tables created from other tables. They do not exist by themselves in the database.
  - They are created to show certain rows and columns of data.
- Let’s look at the basic operations performed on tables...
  - Select (also known as Restrict), Project, Union, Difference, Product.

Restrict (Select) Operation

We could create a subset from the Employee table of just those employees hired in 1992. Restrict, by itself, returns all columns but only certain rows. Restrict extract records.

Table A: Employee

<table>
<thead>
<tr>
<th>Employee ID</th>
<th>Last Name</th>
<th>First Name</th>
<th>Hire Date</th>
<th>Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Davolio</td>
<td>Nancy</td>
<td>01-May-1992</td>
<td>507 - 20th Ave. E</td>
</tr>
<tr>
<td>2</td>
<td>Fuller</td>
<td>Andrew</td>
<td>16-Aug-1992</td>
<td>908 W. Capital Way</td>
</tr>
<tr>
<td>3</td>
<td>Levetting</td>
<td>Janet</td>
<td>01-Apr-1992</td>
<td>722 Moss Bay Blvd</td>
</tr>
<tr>
<td>4</td>
<td>Peacock</td>
<td>Margaret</td>
<td>03-May-1993</td>
<td>4110 Old Redmond Rd</td>
</tr>
<tr>
<td>5</td>
<td>Buchanan</td>
<td>Steven</td>
<td>17-Oct-1993</td>
<td>14 Sweet Hill</td>
</tr>
<tr>
<td>6</td>
<td>Sugarya</td>
<td>Michael</td>
<td>17-Oct-1993</td>
<td>Coventry House</td>
</tr>
</tbody>
</table>

Project Operation

Project extracts columns from a table, but you get all rows.

Table A: Employee

<table>
<thead>
<tr>
<th>Employee ID</th>
<th>Last Name</th>
<th>First Name</th>
<th>Hire Date</th>
<th>Address</th>
</tr>
</thead>
<tbody>
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<td>14 Sweet Hill</td>
</tr>
<tr>
<td>6</td>
<td>Sugarya</td>
<td>Michael</td>
<td>17-Oct-1993</td>
<td>Coventry House</td>
</tr>
</tbody>
</table>

Subset of Table A, 2 columns only

<table>
<thead>
<tr>
<th>Last Name</th>
<th>First Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Davolio</td>
<td>Nancy</td>
</tr>
<tr>
<td>Fuller</td>
<td>Andrew</td>
</tr>
<tr>
<td>Levetting</td>
<td>Janet</td>
</tr>
<tr>
<td>Peacock</td>
<td>Margaret</td>
</tr>
<tr>
<td>Buchanan</td>
<td>Steven</td>
</tr>
<tr>
<td>Sugarya</td>
<td>Michael</td>
</tr>
</tbody>
</table>
Union Operation

Union creates a new table by "adding" two tables with like attributes: \( \text{table} + \text{table} \)

- **Example:**
  - **Table: Junior**
    - Name: JONES
    - Major: HISTORY
  - **Table: Honor_Student**
    - Number: 165
    - Name: ANDERSON
    - Major: MANAGEMENT

- **Union of Junior with Honor_Student**
  - Number: 123
  - Name: JONES
  - Major: HISTORY
  - Number: 165
  - Name: ANDERSON
  - Major: MANAGEMENT

Difference Operation

The Difference of two tables is a third table that contains records which appear in the first, but not in the second. It "subtracts" a table from a table with like attributes: \( \text{table} - \text{table} \)

- **Example:**
  - **Table: Junior**
    - Number: 123
    - Name: JONES
    - Major: HISTORY
  - **Table: Honor_Student**
    - Number: 165
    - Name: ANDERSON
    - Major: MANAGEMENT

- **Junior minus Honor_Student**
  - Number: 123
  - Name: JONES
  - Major: HISTORY
  - Number: 165
  - Name: ANDERSON
  - Major: MANAGEMENT

Product Operation

- **Product multiplies two tables together creating a "super table"**
- **For each row in the first table, concatenate every row in the second table**
  - \( \text{table} \times \text{table} \)
- **Product creates a table of "all pairs"**
- **Column Rule:** If TableA has \( m \) columns and TableB has \( n \) columns, then the product of TableA and TableB has \( m + n \) columns
- **Row Rule:** If TableA has \( m \) rows and TableB has \( n \) rows, then the product of TableA and TableB has \( mn \) rows

**Product: The Rules Always Apply**

- **Visualize a Product...**
  - A
  - B
  - A \times B

- **The row and column rules always apply**
- **Column Rule:** If TableA has \( m \) columns and TableB has \( n \) columns, then the product of TableA and TableB has \( m + n \) columns
- **Row Rule:** If TableA has \( m \) rows and TableB has \( n \) rows, then the product of TableA and TableB has \( mn \) rows
Join – Product With a Match

The join operation also combines tables and is actually a combination of the product, restrict, and project operations.

Natural Join... suppose two tables have the same attribute, then use the Product operation to pair all rows of the two tables, but keep only those rows that match on the common attribute and remove duplicates.

Other joins are those done with other relational operators: <, >, <=, etc.

Join is very useful because it allows us to construct more complete database views from small tables.

Natural Join Example on 2 Tables

First: A Product of Table A and Table B
Next: Remove Rows Where Keys Don’t Match

Table AB: After removing rows where keys don’t match

<table>
<thead>
<tr>
<th>StudentID</th>
<th>L1</th>
<th>L2</th>
<th>L3</th>
<th>L4</th>
<th>L5</th>
<th>L6</th>
<th>L7</th>
<th>L8</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>7</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Last: Remove Duplicate Columns

If the matching columns are duplicates, remove one

Natural Join of Table A and Table B:
Removes duplicate key column

<table>
<thead>
<tr>
<th>StudentID</th>
<th>L1</th>
<th>L2</th>
<th>L3</th>
<th>L4</th>
<th>L5</th>
<th>L6</th>
<th>L7</th>
<th>L8</th>
<th>L9</th>
<th>L10</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Joins between tables reveal stored relationships and provide the data users want to see

Summary Of Table Operations

- The five basic operations on tables are
  - Restrict (also called Select)
  - Project
  - Union
  - Difference
  - Product

- Join is a powerful operation created from product/project/restrict(select)

- Table operations allow the data to be exhibited to users in whatever form they want