Operations on Databases

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 "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, Project, Union, Difference, Product

Selection Operator

<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>Carillo</td>
<td>Nancy</td>
<td>01-May-1992</td>
<td>507 - 23th Ave, E</td>
</tr>
<tr>
<td>2</td>
<td>Fuller</td>
<td>Andrew</td>
<td>14-Aug-1992</td>
<td>908 W. Capital Way</td>
</tr>
<tr>
<td>3</td>
<td>Levering</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>Suyama</td>
<td>Michael</td>
<td>17-Oct-1993</td>
<td>Coventry House</td>
</tr>
</tbody>
</table>

Projection Operator

<table>
<thead>
<tr>
<th>Employee ID</th>
<th>Last Name</th>
<th>First Name</th>
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<th>Address</th>
</tr>
</thead>
<tbody>
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<td>Suyama</td>
<td>Michael</td>
<td>17-Oct-1993</td>
<td>Coventry House</td>
</tr>
</tbody>
</table>

We could create a subset from the Employee table of just those employees hired in 1992.

Table: 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>
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</tr>
</tbody>
</table>

Subset of Table A, 3 rows only

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

Subset of Table A, 2 columns only
**Union Operator**

**Union** combines two tables with like attributes: \(<\text{table}> + \text{<table>}\)

\[
\begin{array}{|c|c|c|}
\hline
\text{Name} & \text{Major} \\
\hline
\text{JONES} & \text{HISTORY} \\
\text{PAIKS} & \text{MATH} \\
\text{SMITH} & \text{HISTORY} \\
\hline
\end{array}
\]

(a) Table: Junior

\[
\begin{array}{|c|c|c|}
\hline
\text{Number} & \text{Name} & \text{Major} \\
\hline
123 & \text{JONES} & \text{HISTORY} \\
158 & \text{PAIKS} & \text{MATH} \\
271 & \text{SMITH} & \text{HISTORY} \\
165 & \text{ANDERSON} & \text{MANAGEMENT} \\
123 & \text{JONES} & \text{HISTORY} \\
\hline
\end{array}
\]

(b) Table: Honor_Student

(c) Union of Junior with Honor_Student

**Difference Operator**

**Difference** removes a table from a table with like attributes: \(<\text{table}> - \text{<table>}\)

\[
\begin{array}{|c|c|c|}
\hline
\text{Name} & \text{Honor} \\
\hline
\text{JONES} & \text{HISTORY} \\
\text{PAIKS} & \text{MATH} \\
\text{SMITH} & \text{HISTORY} \\
\hline
\end{array}
\]

(a) Table: Junior

\[
\begin{array}{|c|c|c|}
\hline
\text{Name} & \text{Honor} \\
\hline
\text{JONES} & \text{HISTORY} \\
\text{PAIKS} & \text{MATH} \\
\text{SMITH} & \text{HISTORY} \\
\text{ANDERSON} & \text{MANAGEMENT} \\
\hline
\end{array}
\]

(b) Table: Honor_Student

(c) Junior minus Honor_Student

**Table Operation: Product**

❖ **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 ...**

❖ 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 operator also combines tables and is actually a combination of the product, selection, and projection operators.

❖ 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.

Summary Of Table Operations

❖ The five basic operations on tables are:
  - Select
  - Project
  - Union
  - Difference
  - Product

❖ Join is a powerful operation created from product/project/select

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