

# 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.

© Copyright 2000-2001, University of Washington

## 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

© Copyright 2002-2003, University of Washington

### Restrict (Select) Operation

Employee ID	Last Name	First Name	Hire Date	Address
1	Davolio	Nancy	01-May-1992	507 - 20th Ave. E.
2	Fuller	Andrew	14-Aug-1992	908 W. Capital Way
3	Leverling	Janet	01-Apr-1992	722 Moss Bay Blvd.
4	Peacock	Margaret	03-May-1993	4110 Old Redmond Rd
5	Buchanan	Steven	17-Oct-1993	14 Garrett Hill
6	Suyama	Michael	17-Oct-1993	Coventry House

↑ **Table A: Employee**

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 extracts records.

Employee ID	Last Name	First Name	Hire Date	Address
1	Davolio	Nancy	01-May-1992	507 - 20th Ave. E.
2	Fuller	Andrew	14-Aug-1992	908 W. Capital Way
3	Leverling	Janet	01-Apr-1992	722 Moss Bay Blvd.

↑ **Subset of Table A, 3 rows only**

### Project Operation

Employee ID	Last Name	First Name	Hire Date	Address
1	Davolio	Nancy	01-May-1992	507 - 20th Ave. E.
2	Fuller	Andrew	14-Aug-1992	908 W. Capital Way
3	Leverling	Janet	01-Apr-1992	722 Moss Bay Blvd.
4	Peacock	Margaret	03-May-1993	4110 Old Redmond Rd
5	Buchanan	Steven	17-Oct-1993	14 Garrett Hill
6	Suyama	Michael	17-Oct-1993	Coventry House

↑ **Table A: Employee**

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

Last Name	First Name
Davolio	Nancy
Fuller	Andrew
Leverling	Janet
Peacock	Margaret
Buchanan	Steven
Suyama	Michael

← **Subset of Table A, 2 columns only**

## Union Operation

Union creates a new table by “adding” two tables with like attributes:  $\langle \text{table} \rangle + \langle \text{table} \rangle$

Snum	Name	Major
123	JONES	HISTORY
158	PARKS	MATH
271	SMITH	HISTORY

(a) Table: Junior

Number	Name	Interest
105	ANDERSON	MANAGEMENT
123	JONES	HISTORY

(b) Table: Honor\_Student

Snum or Number	Name	Major or Interest
123	JONES	HISTORY
158	PARKS	MATH
271	SMITH	HISTORY
105	ANDERSON	MANAGEMENT

(c) Union of Junior with Honor\_Student

(c) Union of Junior with Honor\_Student

## 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  $\langle \text{table} \rangle - \langle \text{table} \rangle$

Snum	Name	Major
123	JONES	HISTORY
158	PARKS	MATH
271	SMITH	HISTORY

(a) Table: Junior

Number	Name	Interest
105	ANDERSON	MANAGEMENT
123	JONES	HISTORY

(b) Table: Honor\_Student

Snum	Name	Major
158	PARKS	MATH
271	SMITH	HISTORY

(c) Junior minus Honor\_Student

(c) Union of Junior with Honor\_Student

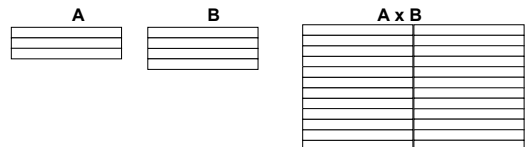
## Product Operation

- Product multiplies two tables together creating a “super table”
- For each row in the first table, concatenate every row in the second table  
 $\langle \text{table} \rangle \times \langle \text{table} \rangle$
- 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

© Copyright 2002-2003, University of Washington

## 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

© Copyright 2002-2003, University of Washington

## Product Example

Table A

StudentID	LName	FName	AdvisorID
1	Crowley	Caro	2
2	Jordan	Michael	1
12	Jennings	Waylan	2

Table B

AdvisorID	LName	FName
1	Dickey	Martin
2	Whiteaker	Grace
3	Oyler	Mel
4	Borning	Alan
5	Cusak	John

Table AB

StudentID	tbiStudent.LName	tbiStudent.FName	tbiStudent.A	tbiAdvisor.LName	tbiAdvisor.FName
1	Crowley	Caro	2	1 Dickey	Martin
2	Jordan	Michael	1	1 Dickey	Martin
12	Jennings	Waylan	2	1 Dickey	Martin
1	Crowley	Caro	2	2 Whiteaker	Grace
2	Jordan	Michael	1	2 Whiteaker	Grace
12	Jennings	Waylan	2	2 Whiteaker	Grace
1	Crowley	Caro	2	3 Oyler	Mel
2	Jordan	Michael	1	3 Oyler	Mel
12	Jennings	Waylan	2	3 Oyler	Mel
1	Crowley	Caro	2	4 Borning	Alan
2	Jordan	Michael	1	4 Borning	Alan
12	Jennings	Waylan	2	4 Borning	Alan
1	Crowley	Caro	2	5 Cusak	John
2	Jordan	Michael	1	5 Cusak	John
12	Jennings	Waylan	2	5 Cusak	John

University of Washington

## 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:  $<$ ,  $>$ ,  $\leq$ , etc.
- Join is very useful because it allows us to construct more complete database views from small tables

© Copyright 2002-2003, University of Washington

## Natural Join Example on 2 Tables

Table A

StudentID	LName	FName	AdvisorID
1	Crowley	Caro	2
2	Jordan	Michael	1
12	Jennings	Waylan	2

Table B

AdvisorID	LName	FName
1	Dickey	Martin
2	Whiteaker	Grace
3	Oyler	Mel
4	Borning	Alan
5	Cusak	John

© Copyright 2002-2003, University of Washington

## First: A Product of Table A and Table B

Table AB:  
Before removing rows where keys don't match

StudentID	tbiStudent.LName	tbiStudent.FName	tbiStudent.A	tbiAdvisor.LName	tbiAdvisor.FName
1	Crowley	Caro	2	1 Dickey	Martin
2	Jordan	Michael	1	1 Dickey	Martin
12	Jennings	Waylan	2	1 Dickey	Martin
1	Crowley	Caro	2	2 Whiteaker	Grace
2	Jordan	Michael	1	2 Whiteaker	Grace
12	Jennings	Waylan	2	2 Whiteaker	Grace
1	Crowley	Caro	2	3 Oyler	Mel
2	Jordan	Michael	1	3 Oyler	Mel
12	Jennings	Waylan	2	3 Oyler	Mel
1	Crowley	Caro	2	4 Borning	Alan
2	Jordan	Michael	1	4 Borning	Alan
12	Jennings	Waylan	2	4 Borning	Alan
1	Crowley	Caro	2	5 Cusak	John
2	Jordan	Michael	1	5 Cusak	John
12	Jennings	Waylan	2	5 Cusak	John

## Next: Remove Rows Where Keys Don't Match

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

StudentID	tblStudent.LN	tblStudent.F	tblStudent	tblAdvisor.LN	tblAdvisor.F
1	Crowley	Caro	2	2	Whiteaker
2	Jordan	Michael	1	1	Dickey
12	Jennings	Waylan	2	2	Whiteaker

© Copyright 2002-2003, University of Washington

## Last: Remove Duplicate Columns

If the matching columns are duplicates, remove one

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

StudentID	tblStudent.LN	tblStudent.F	AdvisorID	tblAdvisor.LN	tblAdvisor.F
2	Jordan	Michael	1	Dickey	Martin
1	Crowley	Caro	2	Whiteaker	Grace
12	Jennings	Waylan	2	Whiteaker	Grace

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

© Copyright 2002-2003, University of Washington

## 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

© Copyright 2002-2003, University of Washington