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 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, Project, Union, Difference, Product

Selection Operator

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. Select, by itself, returns all
columns but only certain rows.

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

Projection Operator

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**

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Union Operator

Union combines two tables with like attributes: <table> **+** <table>

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

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Difference Operator

Difference removes a table from a table with like attributes
<table> **-** <table>

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
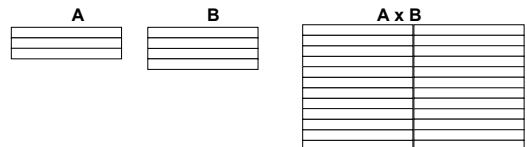
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Table Operation: Product

❖ Product multiplies two tables together creating a "super table"

❖ For each row in the first table, concatenate every row in the second table
    <table> **x** <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

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Product: The Rules Always Apply

❖ Visualize a Product …

A   B   A x 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

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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	tblStudent.LN	tblStudent.F	tblStudent.A	tblAdvisor.	tblAdvisor.LNam	tblAdvisor.FNan
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

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

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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

First: A Product of Table A and Table B

	Table AB: Before removing rows where keys don't match					
StudentID	tblStudent.LN	tblStudent.F	tblStudent.A	tblAdvisor.	tblAdvisor.LNan	tblAdvisor.FNan
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

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.LNam	tblAdvisor.FNar
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

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