

# Relationships within the Relational Database

- **Exercise:** Convert the M:N relationship into two 1:M relationships.

A user account can download many media files, and a media file can be downloaded by many user accounts.

- ✓ Account(accountID, username, password, type, email)
- ✓ Media(mediaID, type, name, path, lastAccess)
- ✓ Download(downloadID, accountID, mediaID, ip, downloadTime)

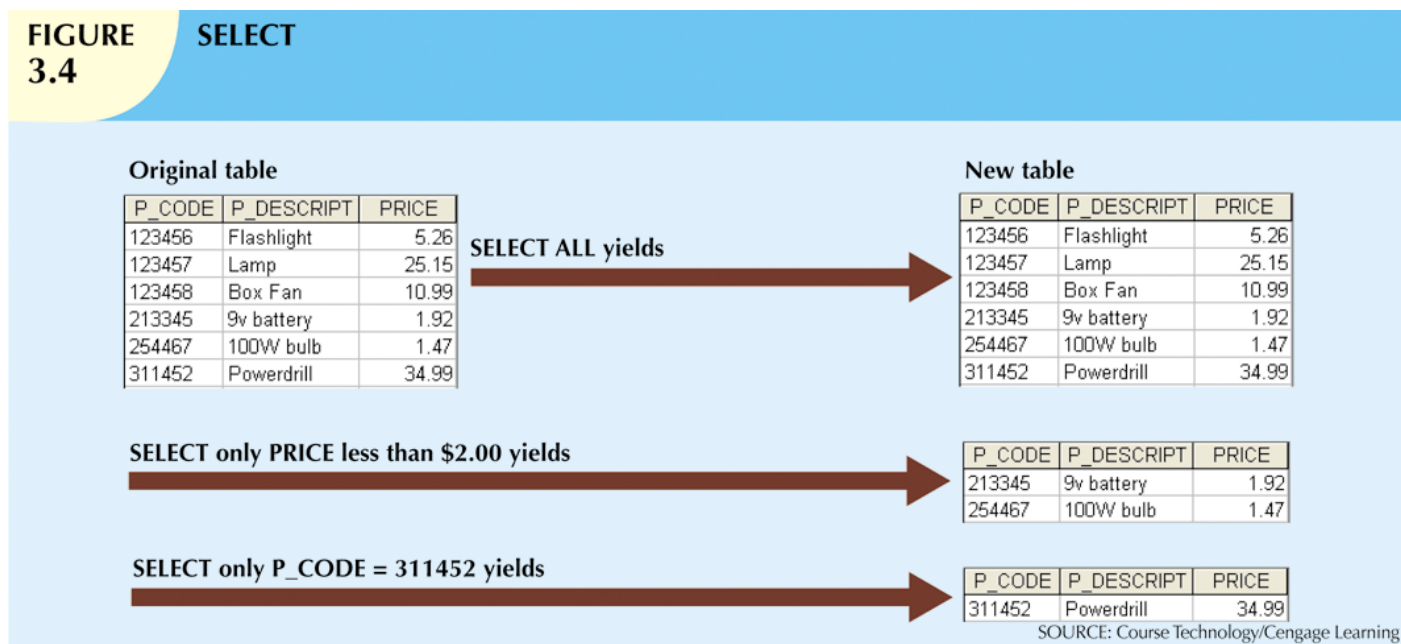
# Relational Algebra

- Defines theoretical way of manipulating table contents using relational operators
- Use of relational algebra operators on existing relations produces new relations

- SELECT
- PROJECT
- JOIN
- INTERSECT
- UNION
- DIFFERENCE
- PRODUCT
- DIVIDE

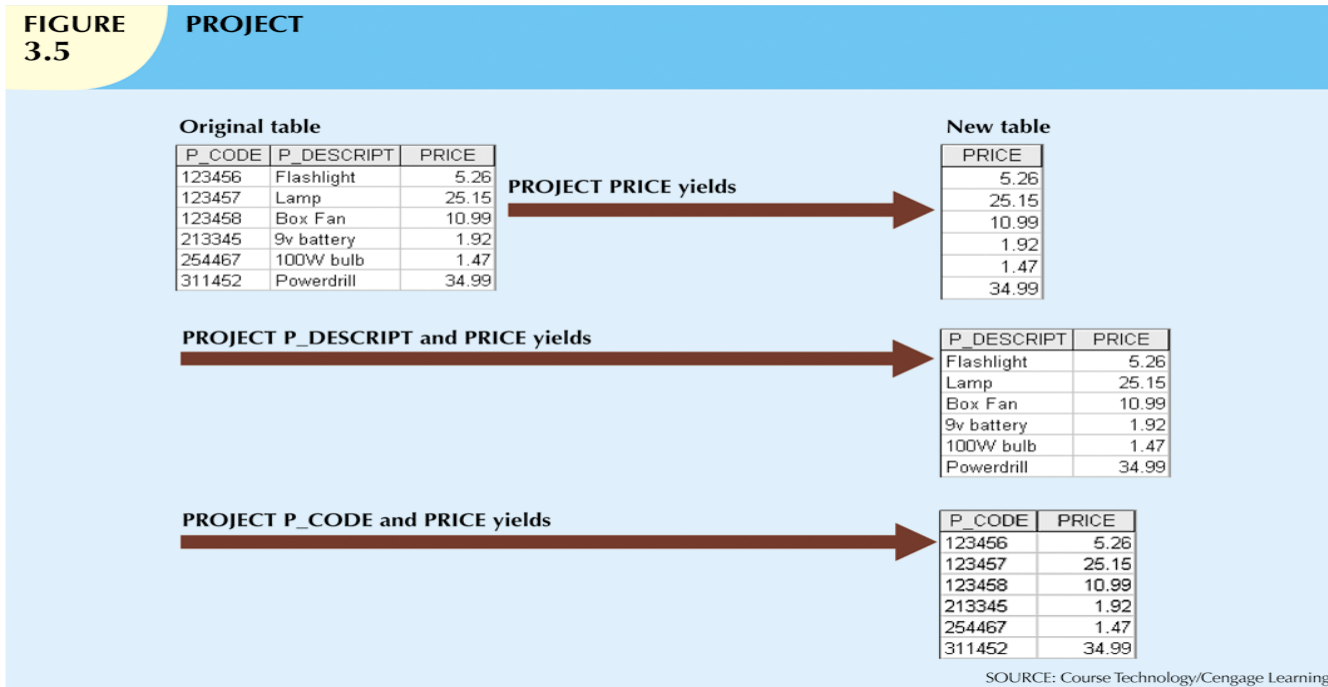
# SELECT

- SELECT yields values for all rows found in a table that satisfy a given condition.



# PROJECT

- PROJECT yields all values for selected attributes (removing duplication)



# UNION

- UNION combines all rows from two tables, **excluding duplicate rows**.
- The tables must have the same number of columns, and the columns share the same or compatible domains.

**FIGURE  
3.6**

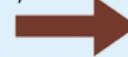
## UNION

P_CODE	P_DESCRIPT	PRICE
123456	Flashlight	5.26
123457	Lamp	25.15
123458	Box Fan	10.99
213345	9v battery	1.92
254467	100W bulb	1.47
311452	Powerdrill	34.99

UNION

P_CODE	P_DESCRIPT	PRICE
345678	Microwave	160.00
345679	Dishwasher	500.00
123458	Box Fan	10.99

yields



P_CODE	P_DESCRIPT	PRICE
123456	Flashlight	5.26
123457	Lamp	25.15
123458	Box Fan	10.99
213345	9v battery	1.92
254467	100W bulb	1.47
311452	Powerdrill	34.99
345678	Microwave	160
345679	Dishwasher	500

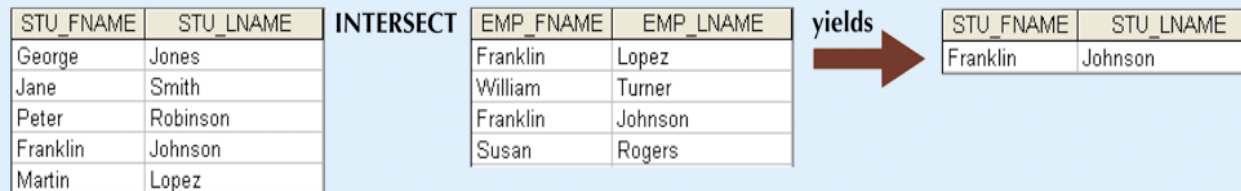
SOURCE: Course Technology/Cengage Learning

# INTERSECT

- INTERSECT yields only the rows that appear in **both** tables.
- The tables must have the same number of columns, and the columns share the same or compatible domains.

**FIGURE  
3.7**

## INTERSECT



SOURCE: Course Technology/Cengage Learning

# DIFFERENCE

- DIFFERENCE yields all rows in one table that are **not found** in the other table.
- The tables must have the same number of columns, and the columns share the same or compatible domains.

**FIGURE  
3.8**

## DIFFERENCE

STU_FNAME	STU_LNAME
George	Jones
Jane	Smith
Peter	Robinson
Franklin	Johnson
Martin	Lopez

DIFFERENCE

EMP_FNAME	EMP_LNAME
Franklin	Lopez
William	Turner
Franklin	Johnson
Susan	Rogers

yields

STU_FNAME	STU_LNAME
George	Jones
Jane	Smith
Peter	Robinson
Martin	Lopez

SOURCE: Course Technology/Cengage Learning

# PRODUCT

- PRODUCT yields all possible pairs of rows from two tables – **Cartesian Product**

**FIGURE 3.9**

## PRODUCT

P_CODE	P_DESCRIPTION	PRICE
123456	Flashlight	5.26
123457	Lamp	25.15
123458	Box Fan	10.99
213345	9v battery	1.92
254467	100W bulb	1.47
311452	Powerdrill	34.99

6 rows

STORE	aisle	shelf
23	W	5
24	K	9
25	Z	6

3 rows



yields

18 rows

P_CODE	P_DESCRIPTION	PRICE	STORE	aisle	shelf
123456	Flashlight	5.26	23	W	5
123456	Flashlight	5.26	24	K	9
123456	Flashlight	5.26	25	Z	6
123457	Lamp	25.15	23	W	5
123457	Lamp	25.15	24	K	9
123457	Lamp	25.15	25	Z	6
123458	Box Fan	10.99	23	W	5
123458	Box Fan	10.99	24	K	9
123458	Box Fan	10.99	25	Z	6
213345	9v battery	1.92	23	W	5
213345	9v battery	1.92	24	K	9
213345	9v battery	1.92	25	Z	6
311452	Powerdrill	34.99	23	W	5
311452	Powerdrill	34.99	24	K	9
311452	Powerdrill	34.99	25	Z	6
254467	100W bulb	1.47	23	W	5
254467	100W bulb	1.47	24	K	9
254467	100W bulb	1.47	25	Z	6

SOURCE: Course Technology/Cengage Learning



# DIVIDE

FIGURE  
3.16

DIVIDE

two-columns

CODE	LOC
A	5
A	9
A	4
B	5
B	3
C	6
D	7
D	8
E	8

DIVIDE

single-column

CODE
A
B

yields



LOC
5

(A, 5) (A, 9) (A, 4)  
(B, 5) (B, 3)

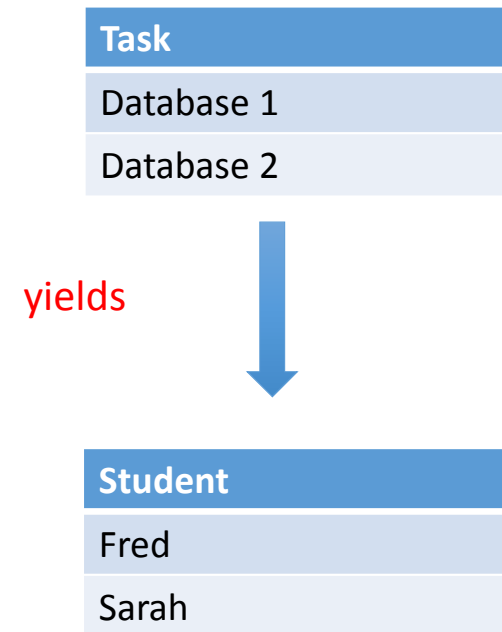
SOURCE: Course Technology/Cengage Learning

# DIVIDE

- Exercise

STUDENT	TASK
Fred	Database 1
Fred	Database 2
Fred	Compiler 1
Tim	Database 1
Tim	Compiler 1
Sarah	Database 1
Sarah	Database 2

DIVIDE



# JOIN

- Natural Join (Inner Join): Links tables by selecting rows with **common values** in **common attributes** (i.e. primary/foreign key)

Employee

Name	EmpId	DeptName
Harry	3415	Finance
Sally	2241	Sales
George	3401	Finance
Harriet	2202	Sales

Dept

DeptName	Manager
Finance	George
Sales	Harriet
Production	Charles

Natural Join

yields



Name	EmpId	DeptName	Manager
Harry	3415	Finance	George
Sally	2241	Sales	Harriet
George	3401	Finance	George
Harriet	2202	Sales	Harriet

# JOIN

- Outer Join: Matched pairs are retained, and any unmatched values in other table are left null.

Employee

Name	EmpId	DeptName
Harry	3415	Finance
Sally	2241	Sales
George	3401	Finance
Harriet	2202	Sales
Tim	1123	Executive

Dept

DeptName	Manager
Sales	Harriet
Production	Charles

Outer Join

yields



Name	EmpId	DeptName	Manager
Harry	3415	Finance	NULL
Sally	2241	Sales	Harriet
George	3401	Finance	NULL
Harriet	2202	Sales	Harriet
Tim	1123	Executive	NULL
NULL	NULL	Production	Charles

# JOIN

- Left Outer Join: Yields all of the rows in the left table, including those that do not have a matching value in the right table.

Employee

Name	Empld	DeptName
Harry	3415	Finance
Sally	2241	Sales
George	3401	Finance
Harriet	2202	Sales
Tim	1123	Executive

Dept

DeptName	Manager
Sales	Harriet
Production	Charles

Left Outer  
Join

yields

Name	Empld	DeptName	Manager
Harry	3415	Finance	NULL
Sally	2241	Sales	Harriet
George	3401	Finance	NULL
Harriet	2202	Sales	Harriet
Tim	1123	Executive	NULL

# JOIN

- Right Outer Join: Yields all of the rows in the right table, including those that do not have a matching value in the left table.

Employee

Name	EmpId	DeptName
Harry	3415	Finance
Sally	2241	Sales
George	3401	Finance
Harriet	2202	Sales
Tim	1123	Executive

Dept

DeptName	Manager
Sales	Harriet
Production	Charles

Right  
Outer  
Join

yields



Name	EmpId	DeptName	Manager
Sally	2241	Sales	Harriet
Harriet	2202	Sales	Harriet
NULL	NULL	Production	Charles

# Exercise

Product Name	Product Quantity
Melon	10
Strawberry	20
Apple	20
Lemon	26

PROJECT Product Name



Product Name
Melon
Strawberry
Apple
Lemon

Product Name	Unit Price
Melon	3.5
Strawberry	4.5

SELECT Unit Price > 4



Product Name	Unit Price
Strawberry	4.5

# Exercise

Sales Table

Export Dest. Code	Export Dest. Name	Date
12	France	3/5/2015
12	France	3/10/2015
23	Italy	3/5/2015
25	China	03/21/2015
30	Germany	03/25/2015

DIVIDE

Export Destination Table

Export Dest. Code	Export Dest. Name
12	France
23	Italy



Date
3/5/2015



# Exercise

Product Code	Product Name	Unit Price
101	Melon	3.5
102	Strawberry	4.5
103	Apple	3.0

PRODUCT



Export Dest. Code	Export Dest. Name
12	France
23	Italy
30	Germany

Product Code	Product Name	Unit Price	Export Dest. Code	Export Dest. Name
101	Melon	3.5	12	France
101	Melon	3.5	23	Italy
101	Melon	3.5	30	Germany
102	Strawberry	4.5	12	France
102	Strawberry	4.5	23	Italy
102	Strawberry	4.5	30	Germany
103	Apple	3.0	12	France
103	Apple	3.0	23	Italy
103	Apple	3.0	30	Germany

# Exercise

Product Table

Product Code	Product Name	Unit Price
101	Melon	3.5
102	Strawberry	4.5
103	Apple	3.0
104	Lemon	1.5

NATURAL  
JOIN



Sales Table

Date	Product Code	Quantity
11/1/2014	102	100
11/1/2014	101	30
11/5/2014	103	50
11/8/2014	101	40

Date	Product Code	Product Name	Unit Price	Quantity
11/1/2014	102	Strawberry	4.5	100
11/1/2014	101	Melon	3.5	30
11/5/2014	103	Apple	3.0	50
11/8/2014	101	Melon	3.5	40

# Exercise

Product Table

Product Code	Product Name	Unit Price
101	Melon	3.5
102	Strawberry	4.5
103	Apple	3.0
104	Lemon	1.5

LEFT  
OUTER  
JOIN



Sales Table

Date	Product Code	Quantity
11/1/2014	102	100
11/1/2014	101	30
11/5/2014	103	50
11/8/2014	101	40
11/9/2014	105	80

Product Code	Product Name	Unit Price	Date	Quantity
101	Melon	3.5	11/1/2014	30
101	Melon	3.5	11/8/2014	40
102	Strawberry	4.5	11/1/2014	100
103	Apple	3.0	11/5/2014	50
104	Lemon	1.5	NULL	NULL

# Exercise

Product Table

Product Code	Product Name	Unit Price
101	Melon	3.5
102	Strawberry	4.5
103	Apple	3.0
104	Lemon	1.5

RIGHT  
OUTER  
JOIN



Sales Table

Date	Product Code	Quantity
11/1/2014	102	100
11/1/2014	101	30
11/5/2014	103	50
11/8/2014	101	40
11/9/2014	105	80

Product Code	Product Name	Unit Price	Date	Quantity
101	Melon	3.5	11/1/2014	30
101	Melon	3.5	11/8/2014	40
102	Strawberry	4.5	11/1/2014	100
103	Apple	3.0	11/5/2014	50
105	NULL	NULL	11/9/2014	80

# Exercise

Product Name	Unit Price
Melon	3.5
Strawberry	4.5
Apple	3.0
Lemon	1.5



UNION

Product Name	Unit Price
Melon	3.5
Strawberry	4.5
Chestnut	6.0
Pineapple	2.5

Product Name	Unit Price
Melon	3.5
Strawberry	4.5
Apple	3.0
Lemon	1.5
Chestnut	6.0
Pineapple	2.5

# Exercise

Product Name	Unit Price
Melon	3.5
Strawberry	4.5
Apple	3.0
Lemon	1.5

INTERSECTION



Product Name	Unit Price
Melon	3.5
Strawberry	4.5
Chestnut	6.0
Pineapple	2.5

Product Name	Unit Price
Melon	3.5
Strawberry	4.5

# Exercise

Product Name	Unit Price
Melon	3.5
Strawberry	4.5
Apple	3.0
Lemon	1.5

DIFFERENCE



Product Name	Unit Price
Melon	3.5
Strawberry	4.5
Chestnut	6.0
Pineapple	2.5

Product Name	Unit Price
Apple	3.0
Lemon	1.5