

# **Chapter 9:**

# **Database Systems**

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**Computer Science: An Overview**  
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# Chapter 9: Database Systems

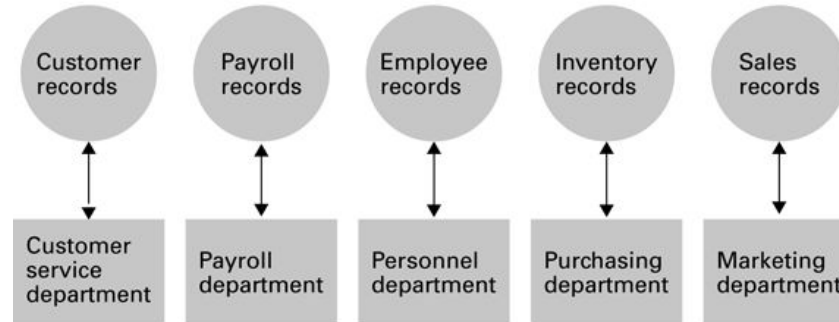
- 9.1 Database Fundamentals
- 9.2 The Relational Model
- 9.7 Social Impact of Database Technology

# Database

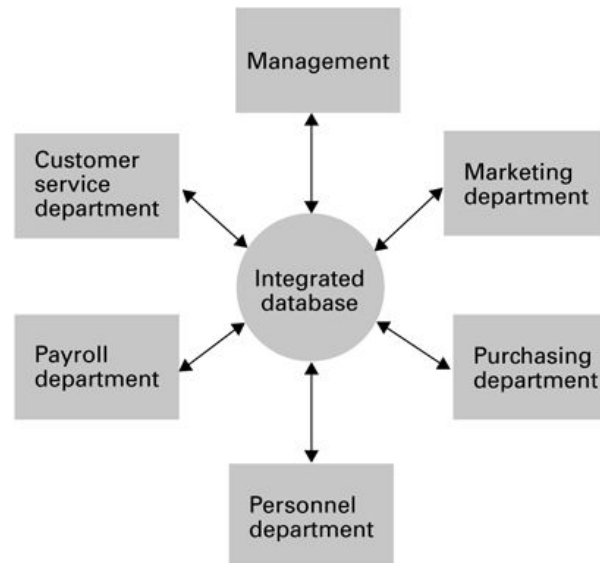
A collection of data that is multidimensional in the sense that internal links between its entries make the information accessible from a variety of perspectives

# Figure 9.1 A file versus a database organization

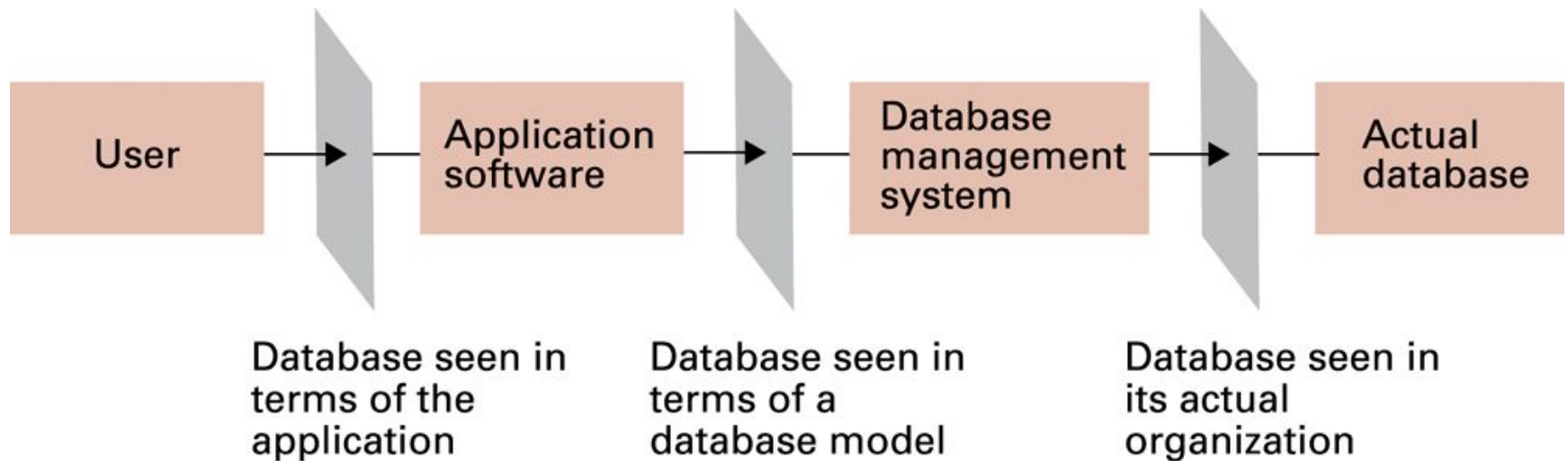
a. File-oriented information system



b. Database-oriented information system



# Figure 9.2 The conceptual layers of a database implementation



# Schemas

- **Schema:** A description of the structure of an entire database, used by database software to maintain the database
- **Subschema:** A description of only that portion of the database pertinent to a particular user's needs, used to prevent sensitive data from being accessed by unauthorized personnel

# Database Management Systems

- **Database Management System (DBMS):** A software layer that manipulates a database in response to requests from applications
- **Distributed Database:** A database stored on multiple machines
  - DBMS will mask this organizational detail from its users
- **Data independence:** The ability to change the organization of a database without changing the application software that uses it

# Database Models

- **Database model:** A conceptual view of a database
  - Relational database model
  - Object-oriented database model



# Relational Database Model

- **Relation:** A rectangular table
  - **Attribute:** A column in the table
  - **Tuple:** A row in the table

## Figure 9.3 A relation containing employee information

Empl Id	Name	Address	SSN
25X15	Joe E. Baker	33 Nowhere St.	111223333
34Y70	Cheryl H. Clark	563 Downtown Ave.	999009999
23Y34	G. Jerry Smith	1555 Circle Dr.	111005555
•	•	•	•
•	•	•	•
•	•	•	•

# Relational Design

- Avoid multiple concepts within one relation
  - Can lead to redundant data
  - Deleting a tuple could also delete necessary but unrelated information

# Improving a Relational Design

- **Decomposition:** Dividing the columns of a relation into two or more relations, duplicating those columns necessary to maintain relationships
  - **Lossless** or **nonloss** decomposition: A “correct” decomposition that does not lose any information

# Figure 9.4 A relation containing redundancy

Empl Id	Name	Address	SSN	Job Id	Job Title	Skill Code	Dept	Start Date	Term Date
25X15	Joe E. Baker	33 Nowhere St.	111223333	F5	Floor manager	FM3	Sales	9-1-2007	9-30-2008
25X15	Joe E. Baker	33 Nowhere St.	111223333	D7	Dept. head	K2	Sales	10-1-2008	*
34Y70	Cheryl H. Clark	563 Downtown Ave.	999009999	F5	Floor manager	FM3	Sales	10-1-2007	*
23Y34	G. Jerry Smith	1555 Circle Dr.	111005555	S25X	Secretary	T5	Personnel	3-1-1999	4-30-2006
23Y34	G. Jerry Smith	1555 Circle Dr.	111005555	S26Z	Secretary	T6	Accounting	5-1-2006	*
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.

# Figure 9.5 An employee database consisting of three relations

**EMPLOYEE relation**

Empl Id	Name	Address	SSN
25X15	Joe E. Baker	33 Nowhere St.	111223333
34Y70	Cheryl H. Clark	563 Downtown Ave.	999009999
23Y34	G. Jerry Smith	1555 Circle Dr.	111005555

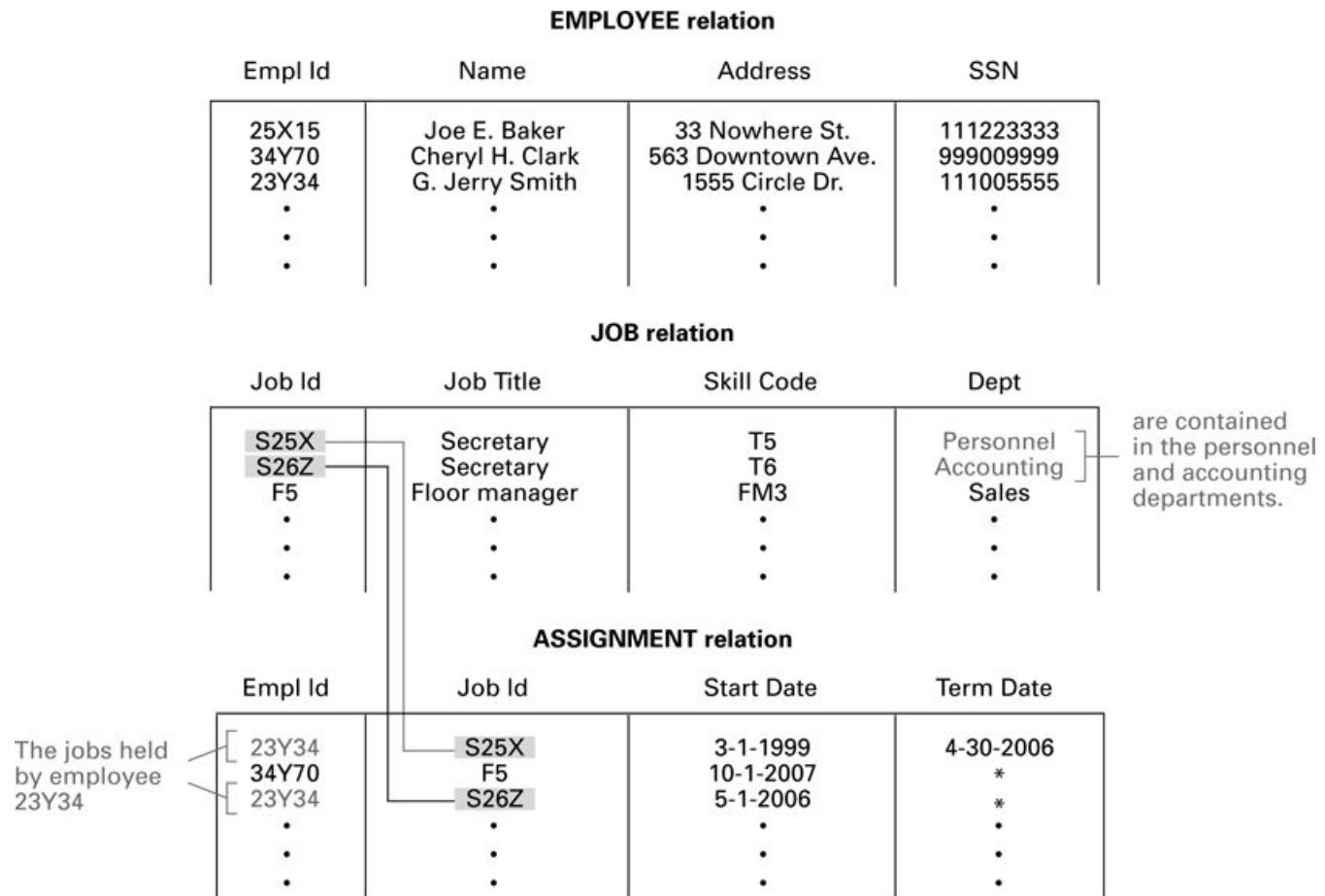
**JOB relation**

Job Id	JobTitle	Skill Code	Dept
S25X	Secretary	T5	Personnel
S26Z	Secretary	T6	Accounting
F5	Floor manager	FM3	Sales
.	.	.	.
.	.	.	.
.	.	.	.

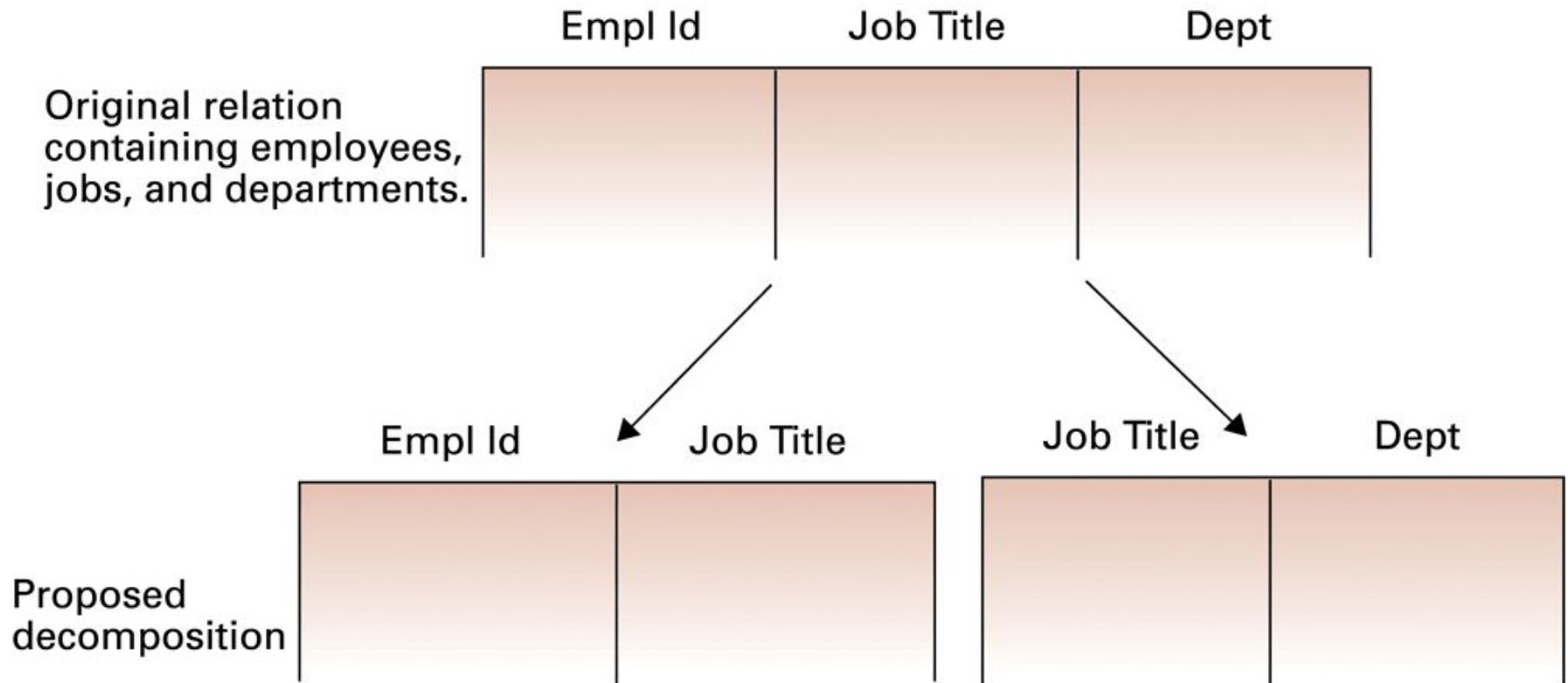
**ASSIGNMENT relation**

Empl Id	Job Id	Start Date	Term Date
23Y34	S25X	3-1-1999	4-30-2006
34Y70	F5	10-1-2007	*
23Y34	S26Z	5-1-2006	*
.	.	.	.
.	.	.	.
.	.	.	.

# Figure 9.6 Finding the departments in which employee 23Y34 has worked



# Figure 9.7 A relation and a proposed decomposition

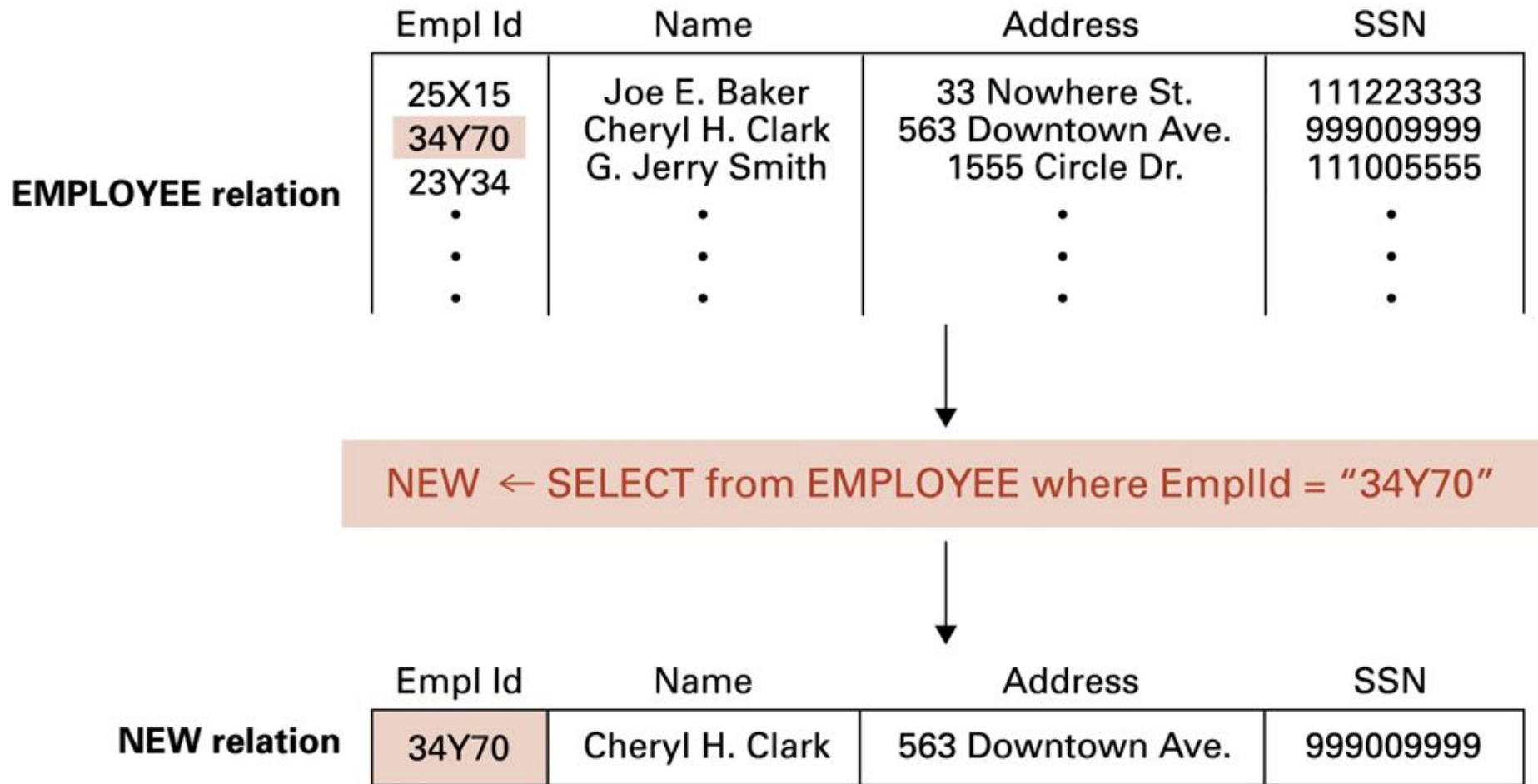




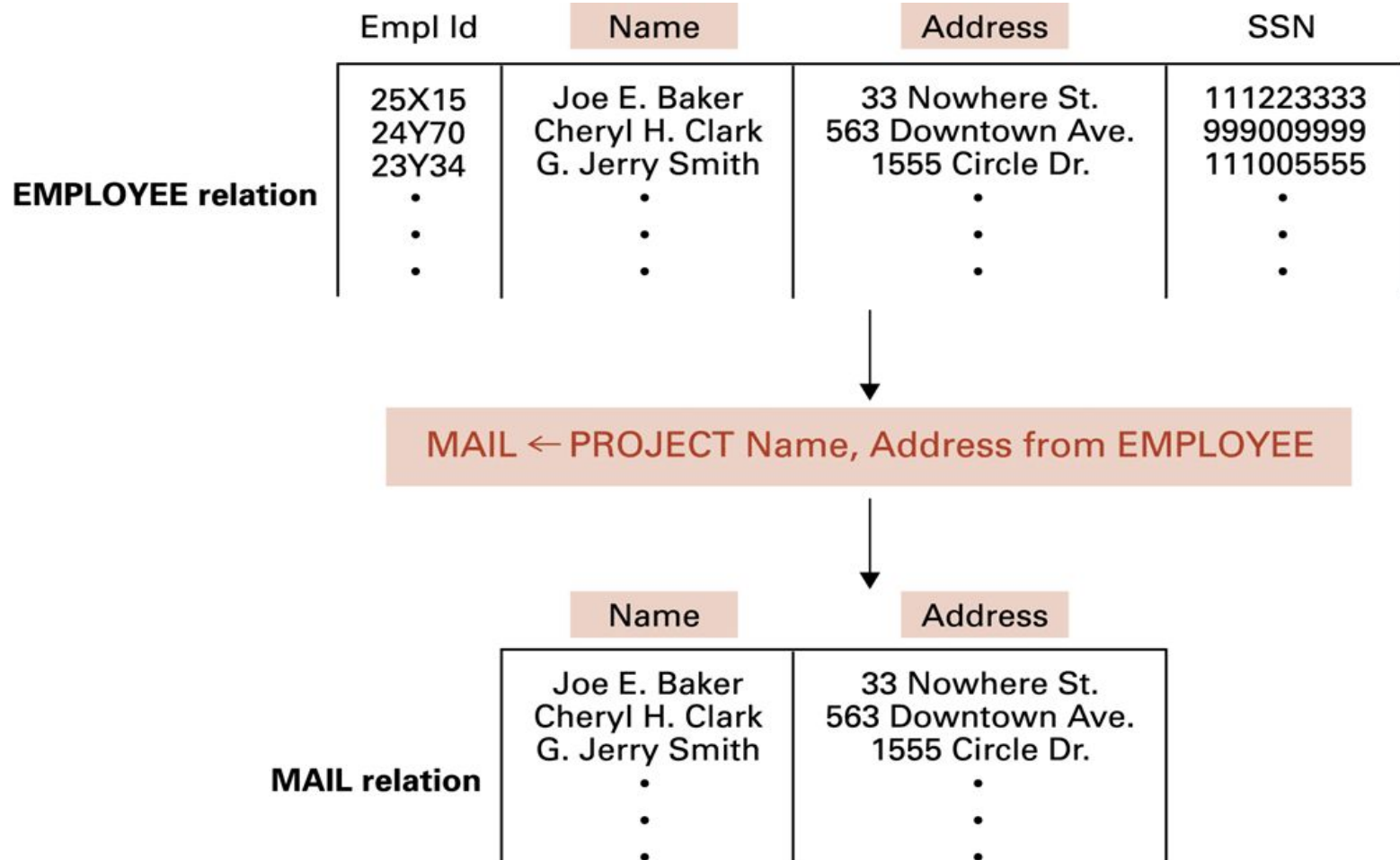
# Relational Operations

- **Select:** Choose rows
- **Project:** Choose columns
- **Join:** Assemble information from two or more relations

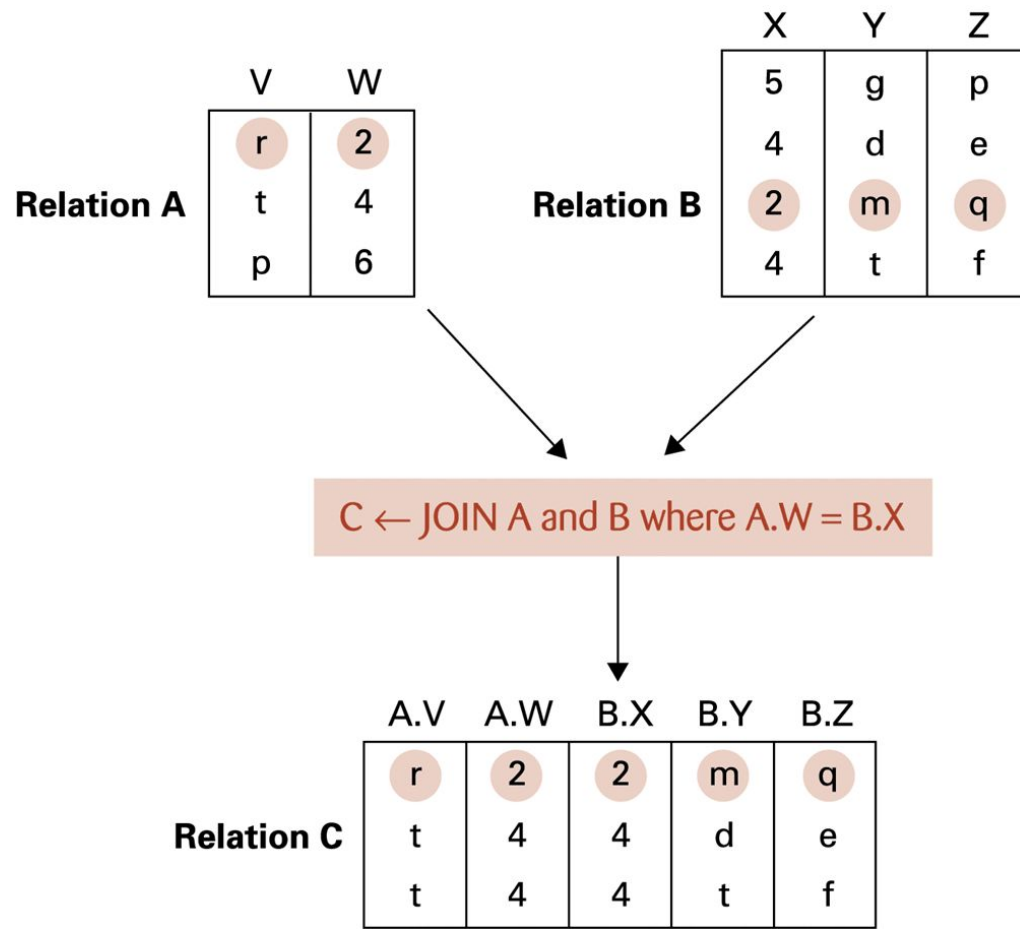
# Figure 9.8 The SELECT operation



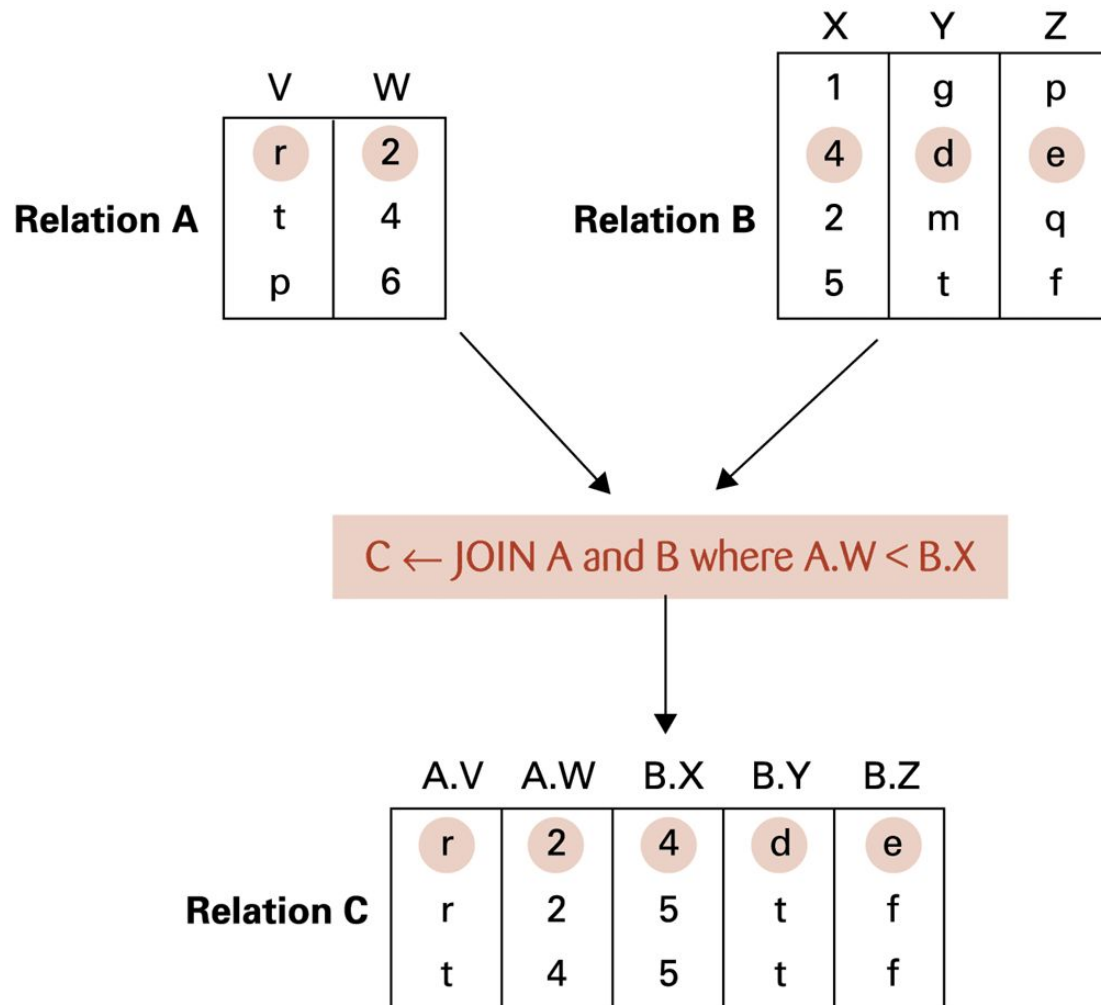
# Figure 9.9 The PROJECT operation



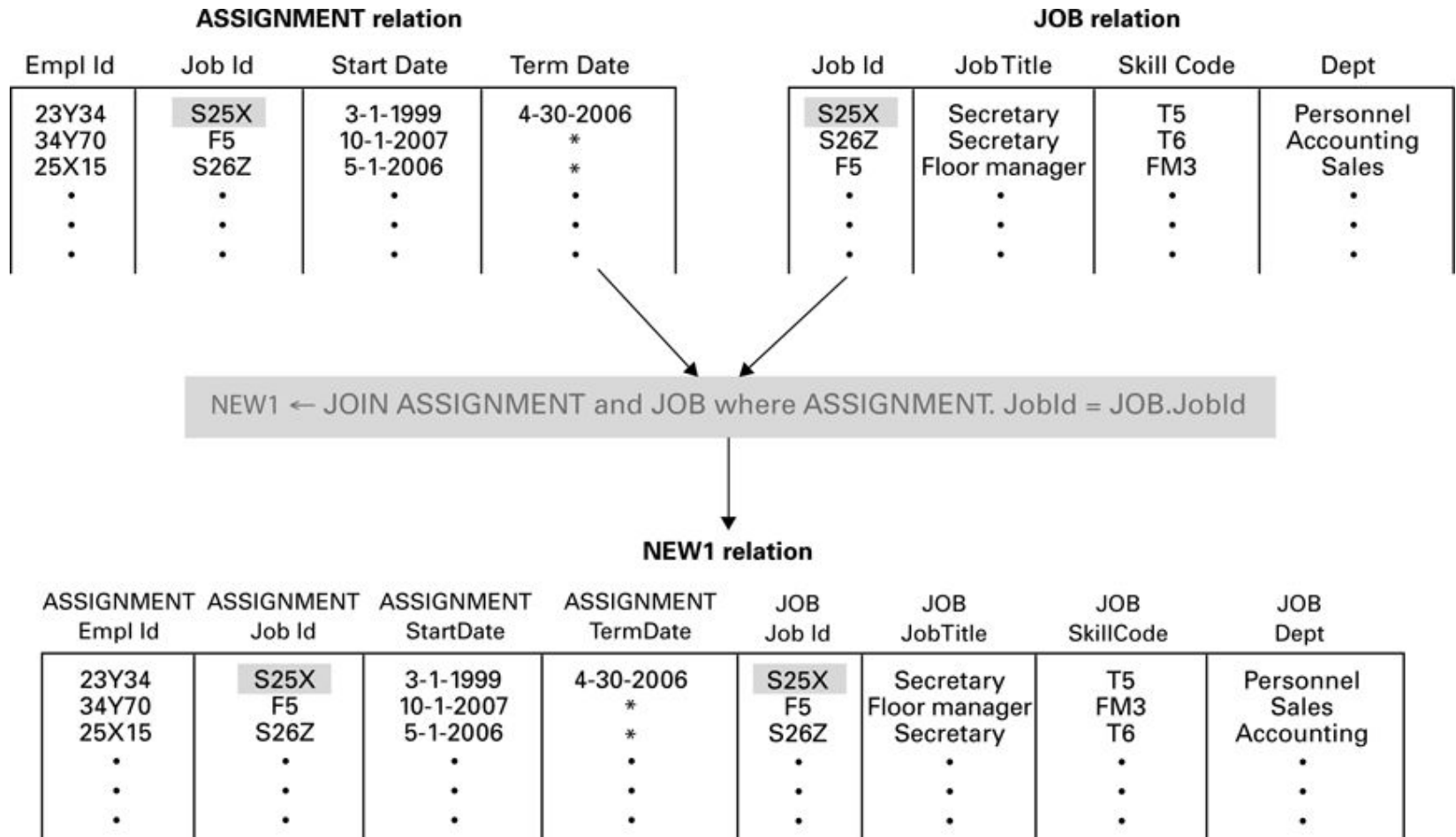
# Figure 9.10 The JOIN operation



# Figure 9.11 Another example of the JOIN operation



# Figure 9.12 An application of the JOIN operation



# Structured Query Language (SQL)

- Operations to manipulate tuples
  - insert
  - update
  - delete
  - select

# SQL Examples

- ```
SELECT EmpId, Dept
FROM Assignment, Job
WHERE Assignment.JobId = Job.JobId
AND Assignment.TermData = '*';
```
- ```
INSERT INTO Employee
VALUES ('43212', 'Sue A. Burt',
      '33 Fair St.', '444661111');
```



# SQL Examples (continued)

- `DELETE FROM Employee  
WHERE Name = 'G. Jerry Smith';`
- `UPDATE Employee  
SET Address = '1812 Napoleon Ave.'  
WHERE Name = 'Joe E. Baker';`

# Maintaining Database Integrity

- **Transaction:** A sequence of operations that must all happen together
  - Example: transferring money between bank accounts
- **Transaction log:** A non-volatile record of each transaction's activities, built before the transaction is allowed to execute
  - **Commit point:** The point at which a transaction has been recorded in the log
  - **Roll-back:** The process of undoing a transaction

# Social Impact of Database Technology

- Problems
  - Massive amounts of personal data are being collected
    - Often without knowledge or meaningful consent of affected people
  - Data merging produces new, more invasive information
  - Errors are widely disseminated and hard to correct
- Remedies
  - Existing legal remedies often difficult to apply
  - Negative publicity may be more effective