

CMPS1134

Fundamentals of Computing

Database Systems 1

Computer Science: An Overview

Eleventh Edition

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Chapter 9

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Chapter 9: Database Systems

☐ **Database Fundamentals**

☐ **The Relational Model**

- ☐ Object-Oriented Databases
- ☐ Maintaining Database Integrity
- ☐ Traditional File Structures
- ☐ Data Mining
- ☐ Social Impact of Database Technology

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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

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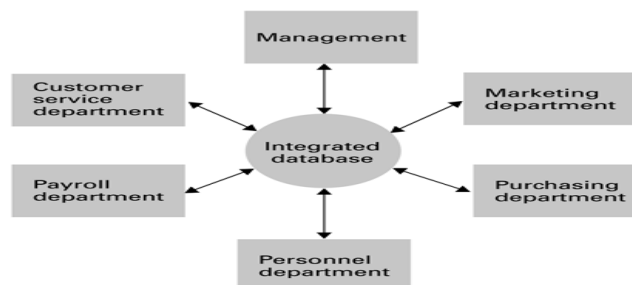
Database Fundamentals

A file versus a database organization (Fig 9.1)

a. File-oriented information system



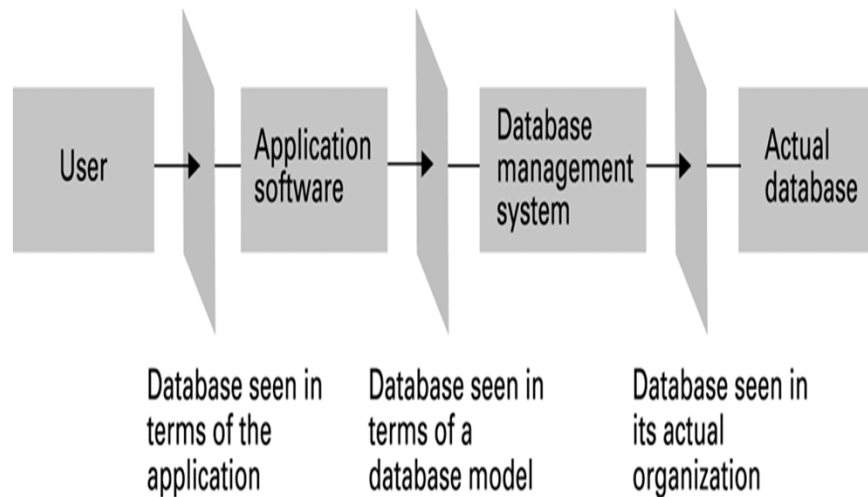
b. Database-oriented information system



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Database Fundamentals

The conceptual layers of a database implementation (Fig 9.2)

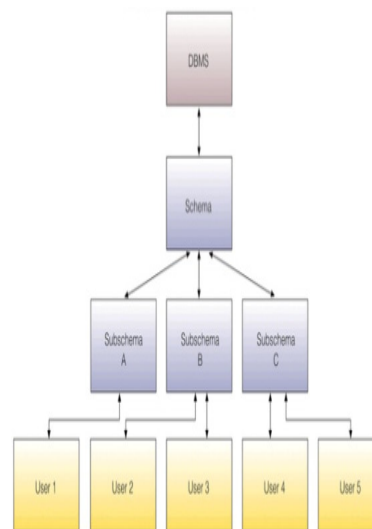


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Database Fundamentals

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 (subset) of the database pertinent to a particular user's needs, used to prevent sensitive data from being accessed by unauthorized personnel



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Database Fundamentals

Database Management Systems

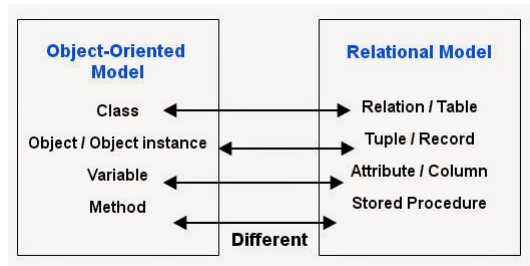
- ❑ **Database Management System (DBMS):** A software layer that manipulates a database in response to requests from applications
- ❑ **Distributed Database:** A database stored on multiple machines
 - DBMS will mask this organizational detail from its users
- ❑ **Data independence:** The ability to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

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Database Fundamentals

Database Models

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



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Relational Database Model

□ **Relation:** A rectangular table

■ **Attribute:** A column in the table

■ **Tuple:** A row in the table

	Empl Id	Name	Address	SSN
EMPLOYEE relation	25X15	Joe E. Baker	33 Nowhere St.	111223333
	24Y70	Cheryl H. Clark	563 Downtown Ave.	999009999
	23Y34	G. Jerry Smith	1555 Circle Dr.	111005555

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Relational Database Model

A relation containing employee info (Fig 9.3)

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
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.	.	.	.

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Relational Database Model

Relational Design

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

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Relational Database Model

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

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Relational Database Model

A relation containing redundancy (Fig 9.4)

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	*
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.
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Relational Database Model

An employee database consisting of three relations (Fig 9.5)**EMPLOYEE relation**

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

JOB relation

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

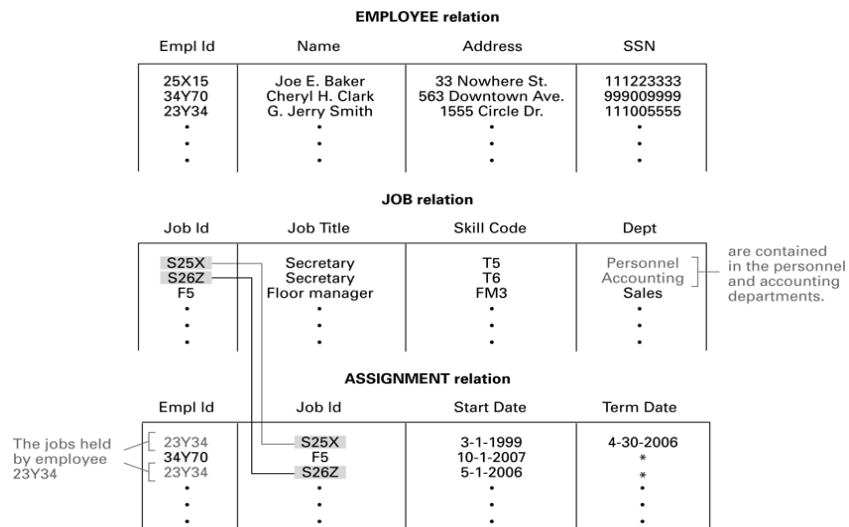
ASSIGNMENT relation

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

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Relational Database Model

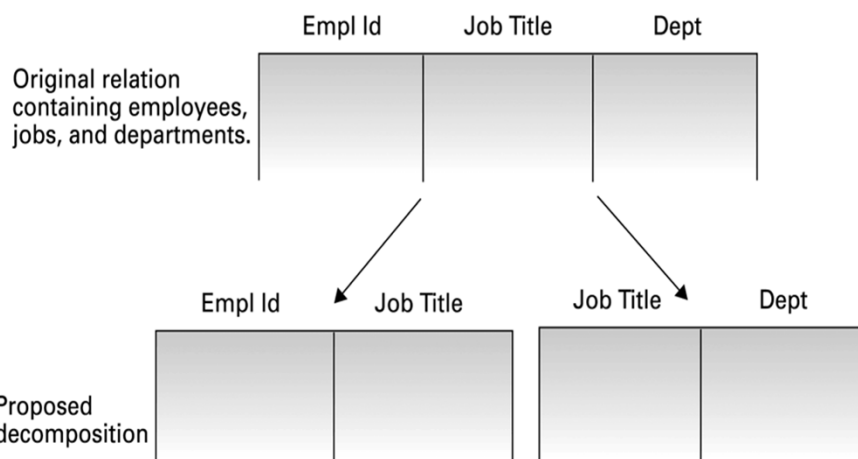
Finding the departments in which employee 23Y34 has worked (Fig 9.6)



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Relational Database Model

A relation and a proposed decomposition (Fig 9.7)



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Relational Database Model

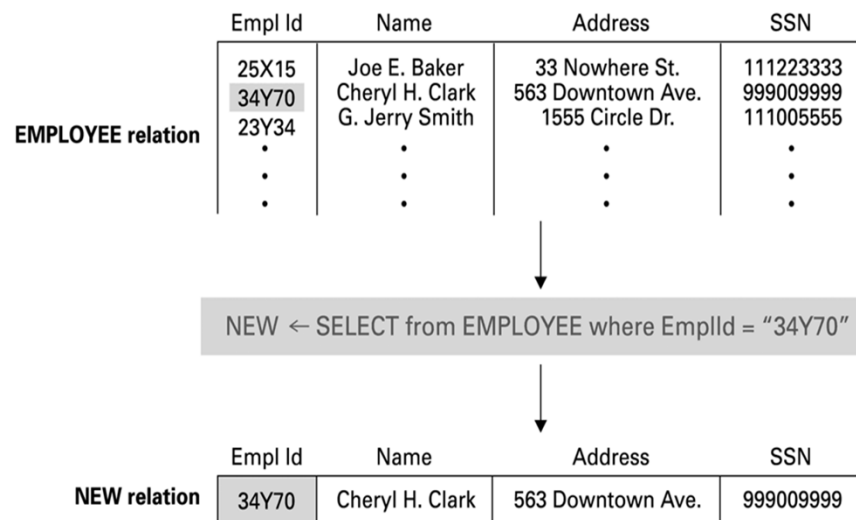
Relational Operations

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

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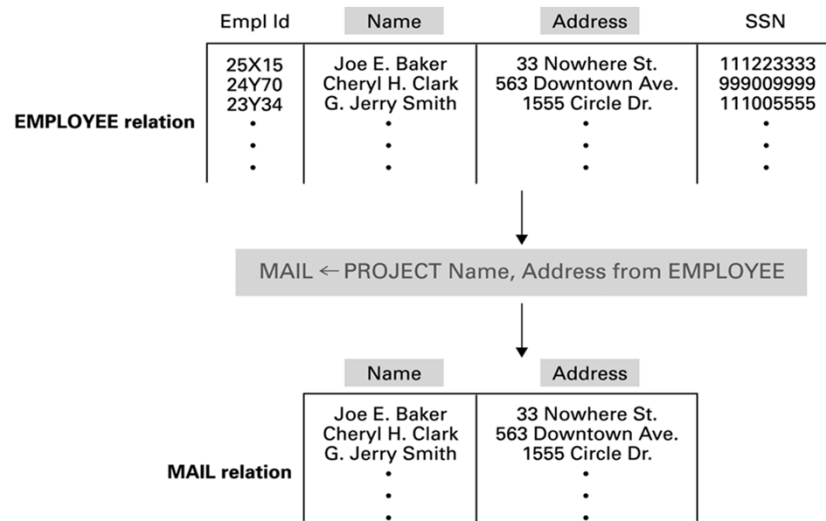
Relational Database Model

The SELECT operation (Fig 9.8)



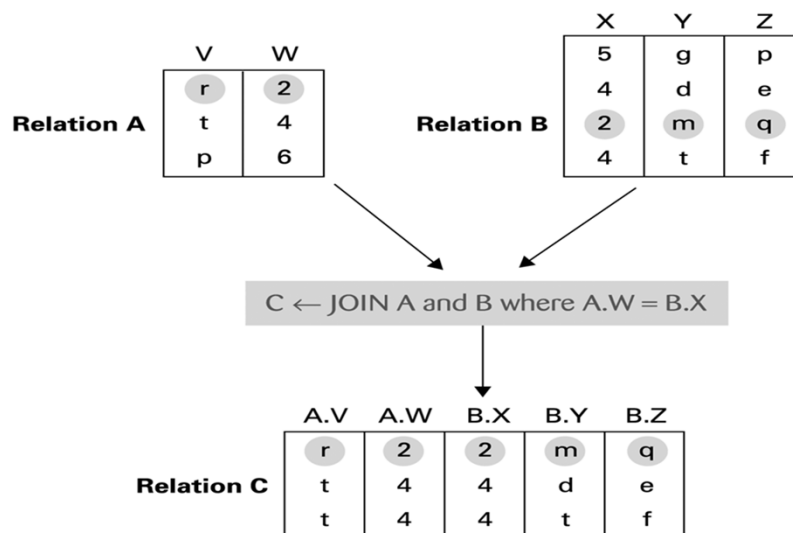
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Relational Database Model

The PROJECT operation (Fig 9.9)

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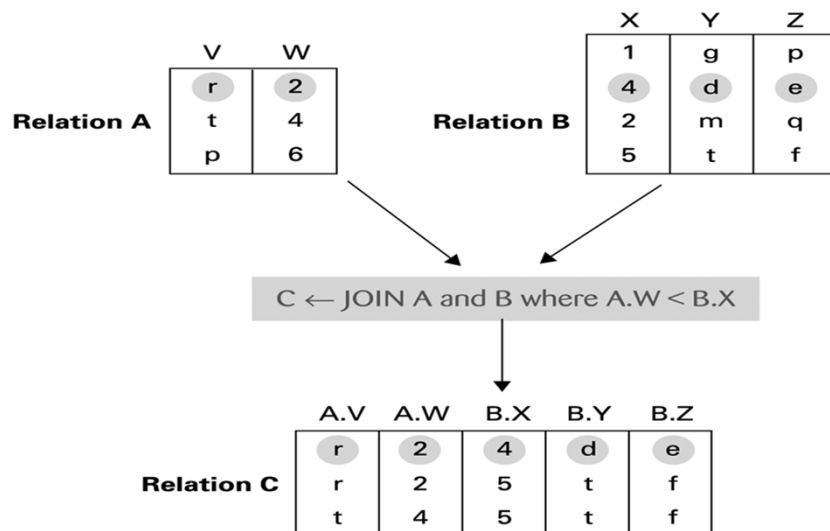
Relational Database Model

The JOIN operation (Fig 9.10)

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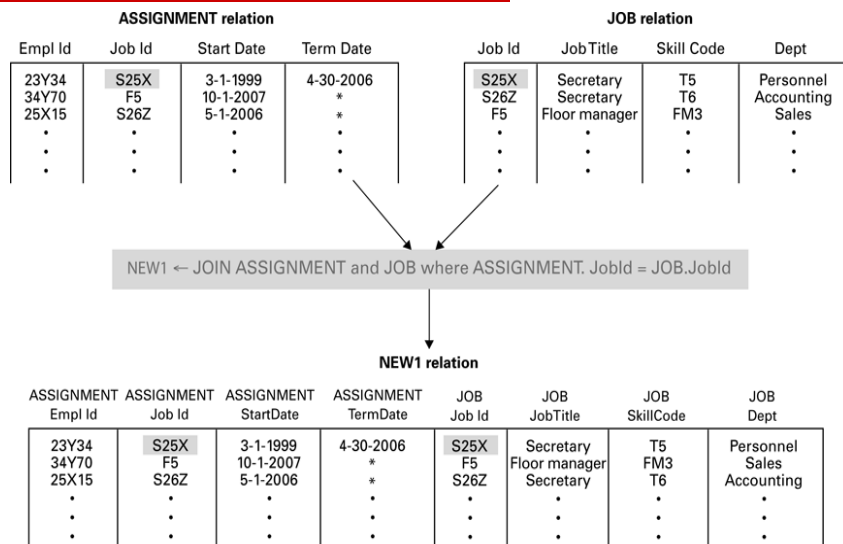
Another example of the JOIN operation (Fig 9.11)



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Relational Database Model

An application of the JOIN operation (Fig 9.12)



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Relational Database Model

Structured Query Language (SQL)

□ Operations to manipulate tuples

- select
- insert
- update
- delete

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Relational Database Model

SQL Examples

□ **select** EmplId, Dept
 from ASSIGNMENT, JOB
 where ASSIGNMENT.JobId = JOB.JobId
 and ASSIGNMENT.TermDate = "*" "

ASSIGNMENT relation

Empl Id	Job Id	Start Date	Term Date
23Y34	S25X	3-1-1999	4-30-2006
34Y70	F5	10-1-2007	*
25X15	S26Z	5-1-2006	*
.	.	.	.
.	.	.	.
.	.	.	.

JOB relation

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

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Relational Database Model

SQL Examples (continued)

❑ **insert** into EMPLOYEE
 values ('43212', 'Sue A. Burt',
 '33 Fair St.', '444661111')

❑ **update** EMPLOYEE
 set Address = '1812 Napoleon Ave.'
 where Name = 'Joe E. Baker'

❑ **delete** from EMPLOYEE
 where Name = 'G. Jerry Smith'

	Empl Id	Name	Address	SSN
EMPLOYEE relation	25X15	Joe E. Baker	33 Nowhere St.	111223333
	24Y70	Cheryl H. Clark	563 Downtown Ave.	999009999
	23Y34	G. Jerry Smith	1555 Circle Dr.	111005555

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