DATABASE MODELS

- Definition: collection of logical constructs used to represent data structure and relationships within the database
  - **Conceptual models:** logical nature of data representation; it emphasizes on what entity is presented; it is used for database design as blueprint
  - **Implementation models:** emphasis on how the data are represented in the database

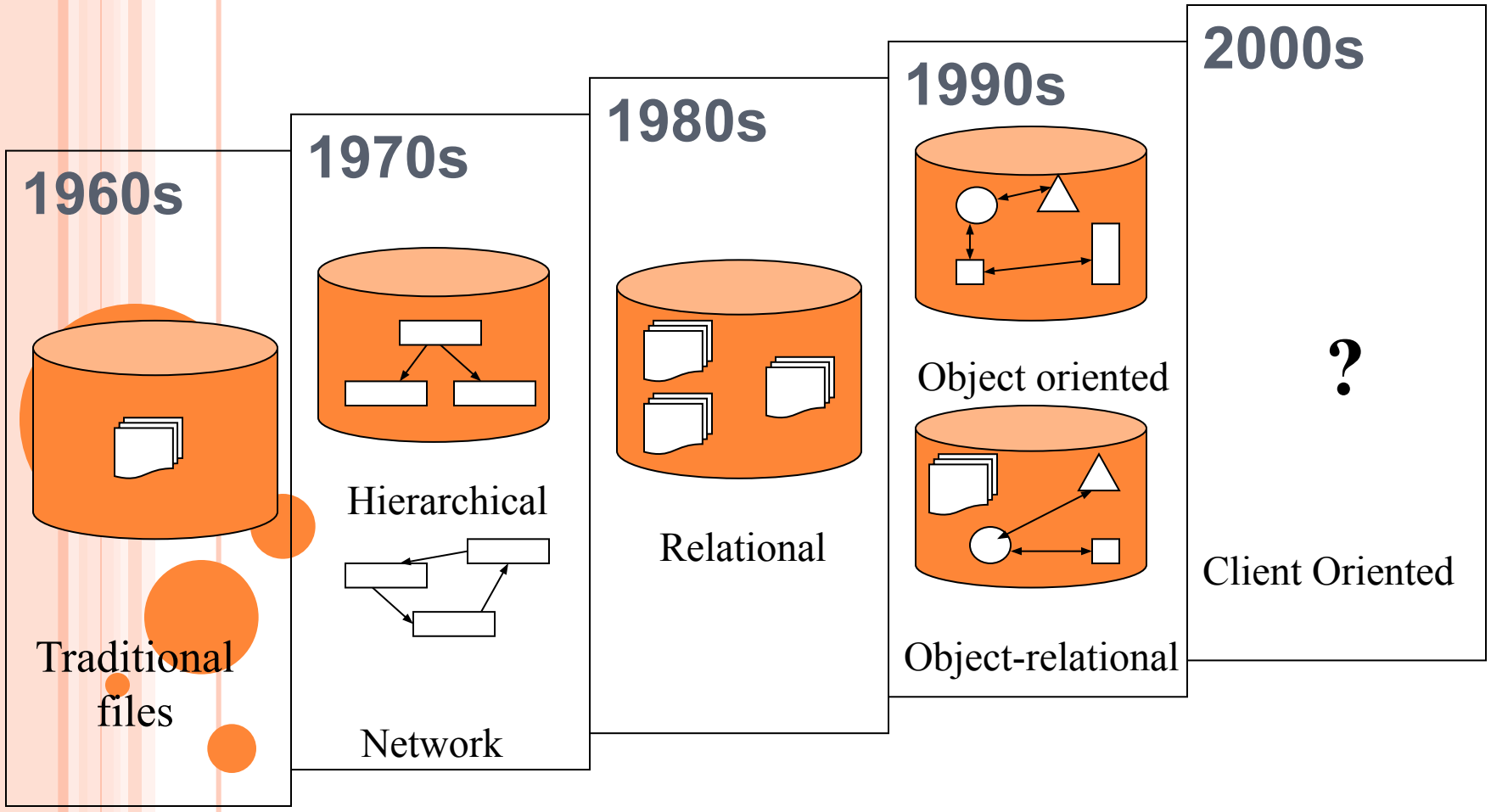
DATABASE MODELS

- **Conceptual models include**
  - Entity-relationship database model (ERDBD)
  - Object-oriented model (OODBM)
- **Implementation models include**
  - Hierarchical database model (HDBM)
  - Network database model (NDBM)
  - Relational database model (RDBM)
  - Object-oriented database model (ODBM)

DATABASE MODELS (CON'T.)

- **Relationships in Conceptual Models**
  - One-to-one (1:1)
  - One-to-many (1:M)
  - Many-to-many (M:N)
- **Implementation Database Models**
  - Hierarchical
  - Network
  - Relational
  - Object-Oriented

EVOLUTION OF DATABASE MODALS

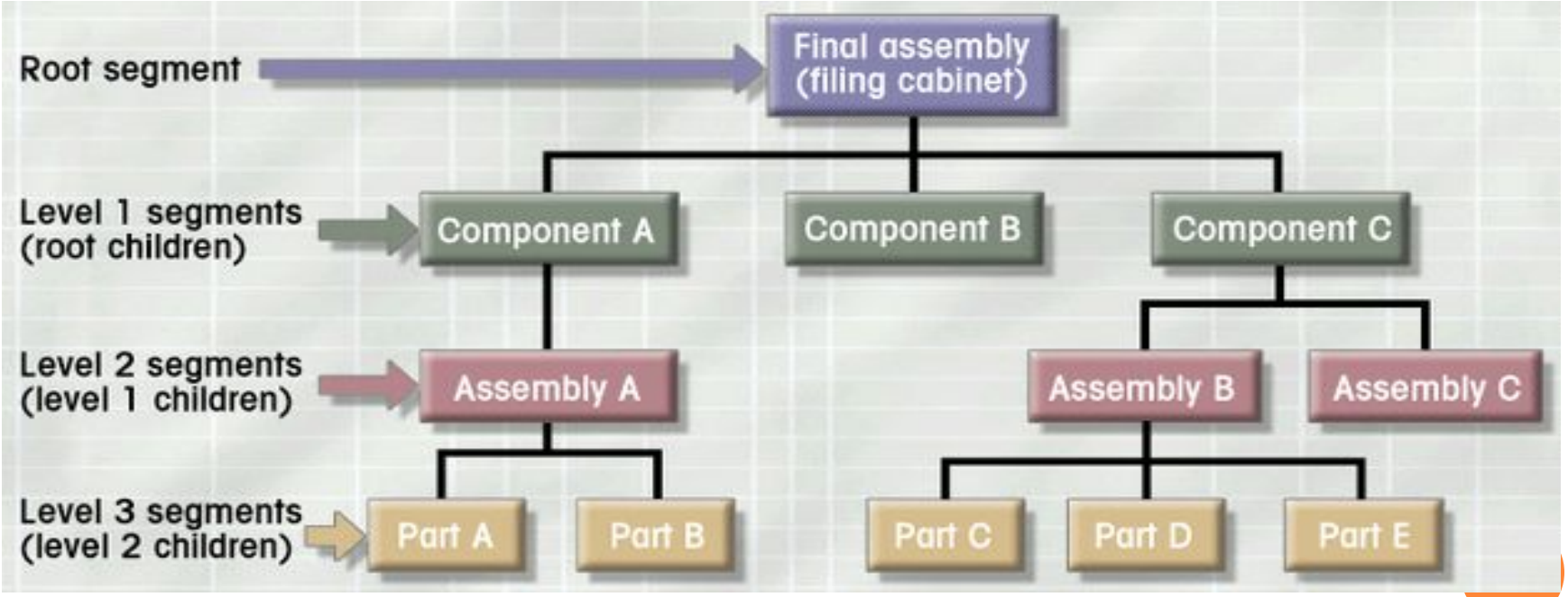


HIERARCHICAL DATABASE MODEL (HDBM)

- Logically represented by an upside down tree
  - Each parent can have many children (segment linkage)
  - Each child has only one parent
  - A single table acts as the **"root"** of the database from which other tables **"branch"** out.
  - **Relationships** in such a system are **children and parents.**
  - Parents and children are tied together by **links** called **"pointers**

HIERARCHICAL DATABASE MODEL

- Logically represented by an upside down tree
  - 1:M relationship



HIERARCHICAL DATABASE MODEL

- Hierarchical path (beginning from left)
- Left-list hierarchical path, or preorder traversal, or hierarchical sequence

Final assembly->Component A->Assembly A-> -> Part A ->Part B -> Component B -> Component C –Assembly B -> Part C ->Part D

- Re-list sequence, if the segment is frequently accessed
- Bank systems commonly use HD model

HIERARCHICAL DATABASE MODEL

- Bank systems commonly use the HDBM
  - customer account can be subject to many transactions (1:M relationship)
  - Relationship is fixed (debiting and crediting)
  - Frequently access large amount of transactions

HIERARCHICAL DATABASE MODEL

- Advantages
  - Conceptual simplicity: relationship between layers is logically simple; design process is simple
  - Database security: enforced uniformly through the system
  - Data integrity
  - Data independence
  - Efficiency in 1:M relationships and when uses require large numbers of transactions
  - Dominant in 1970s , when we used mainframe system with large databases

HIERARCHICAL DATABASE MODEL

- Disadvantages
  - Complex implementation: physical data storage characteristics; database design is complicated
  - Difficult to manage and lack of standards
  - Lacks structural independence
  - Applications programming and use complexity (pointer based)
  - Implementation limitations, i.e. especially it only handle 1:M type of model

NETWORK DATABASE MODEL (NDBM)

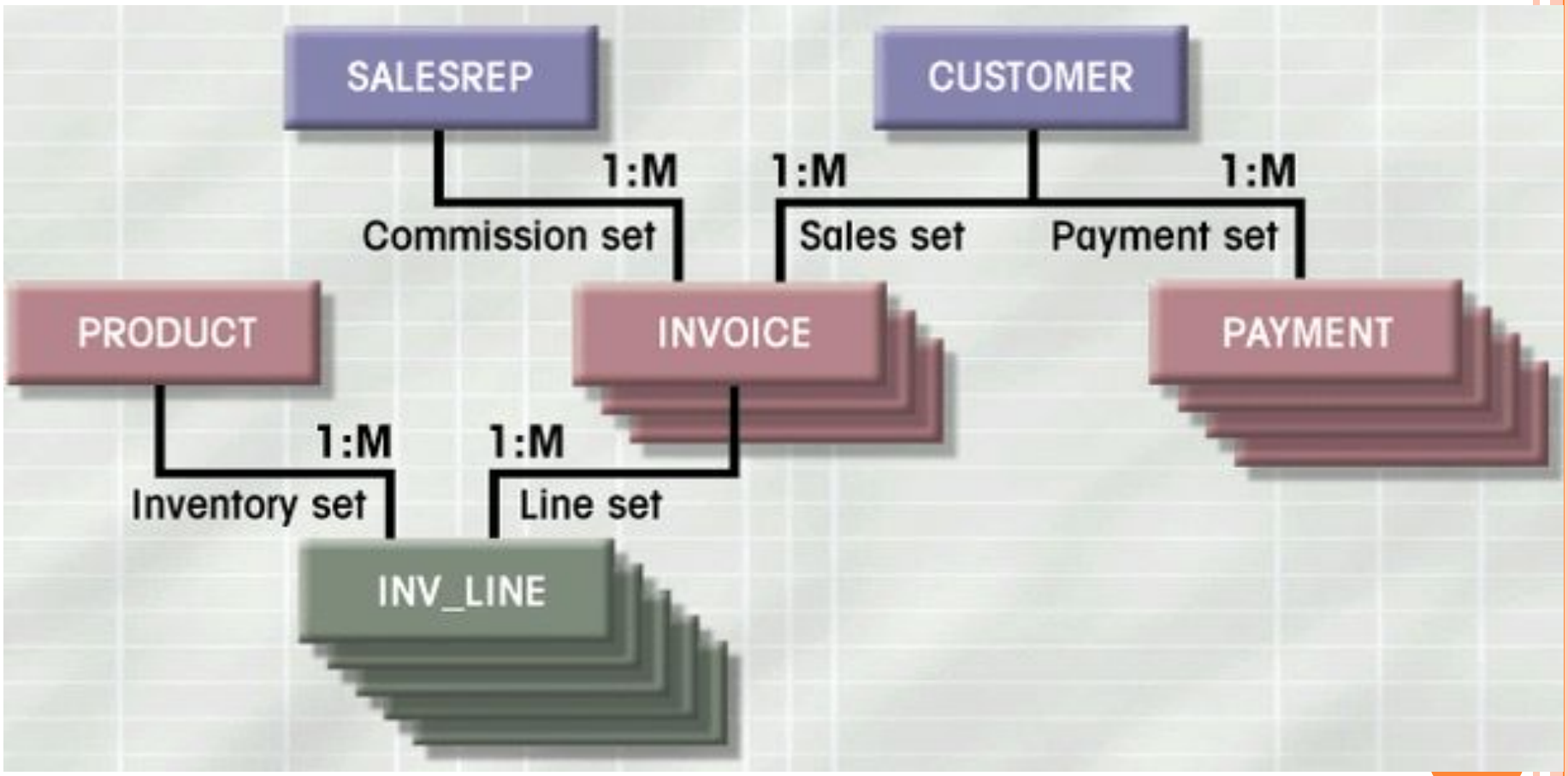
- Each record can have multiple parents
  - Called by Database Task Group (DBTG) to define standards
  - Three crucial database components
    - Network schema: conceptual organization of the entire database
    - Subschema: portion of database as information for application programs
    - Database management language: defining data characteristics and data structure
      - Schema Data definition language (DDL): define schema components
      - Subschema Data definition language
      - Data manipulating language: manipulate data content

NETWORK DATABASE MODEL

- Each record can have multiple parents
- Introduce set to describe relationship
- Each set has owner record and member record, parallel to parent and child in HDM
  - Member may have several owners
  - One-ownership
- Hierarchical model is a subset of the network model.
- The network model uses **set theory** to provide a **tree-like hierarchy.**

NETWORK DATABASE MODEL

- Member may have several owners



NETWORK DATABASE MODEL

- Advantages
  - Conceptual simplicity, just lime HDM
  - Handles more relationship types (but all 1:M relationship)
  - Data access flexibility
  - Promotes database integrity
  - Data independence
  - Conformance to standards

NETWORK DATABASE MODEL

- Disadvantages
  - System complexity

    (Develop by the Computer programmers for the Computer Programmers rather than user)
  - Lack of structural independence

RELATIONAL DATABASE MODEL (RDBM)

- Let's user or database designer to operate human logical environment
- Perceived by user as a collection of tables for data storage, while let RDBMS handles the physical details.
- Tables are a series of row/column intersections
- Tables related by sharing common entity characteristics
- It allows 1:1, 1:M, M:N relationships

RELATIONAL DATABASE MODEL

Table name: AGENT

AGENT_CODE	AGENT_LNAME	AGENT_FNAME	AGENT_INITIAL	AGENT_AREACODE	AGENT_PHONE
501	Alby	Alex	B	713	228-1249
502	Hahn	Leah	F	615	882-1244
503	Okon	John	T	615	123-5589

Link through AGENT code

Table name: CUSTOMER

CUS_CODE	CUS_LNAME	CUS_FNAME	CUS_INITIAL	CUS_AREACODE	CUS_PHONE	CUS_RENEW_DATE	AGENT_CODE
10010	Ramas	Alfred	A	615	844-2573	05-Apr-2002	502
10011	Dunne	Leona	K	713	894-1238	16-Jun-2002	501
10012	Smith	Kathy	W	615	894-2285	29-Jan-2001	502
10013	Olowski	Paul	F	615	894-2180	14-Oct-2002	502
10014	Orlando	Myron		615	222-1672	28-Dec-2002	501
10015	O'Brian	Amy	B	713	442-3381	22-Sep-2002	503
10016	Brown	James	G	615	297-1228	25-Mar-2002	502
10017	Williams	George		615	290-2556	17-Jul-2002	503
10018	Farriss	Anne	G	713	382-7185	03-Dec-2002	501
10019	Smith	Olette	K	615	297-3809	14-Mar-2002	503

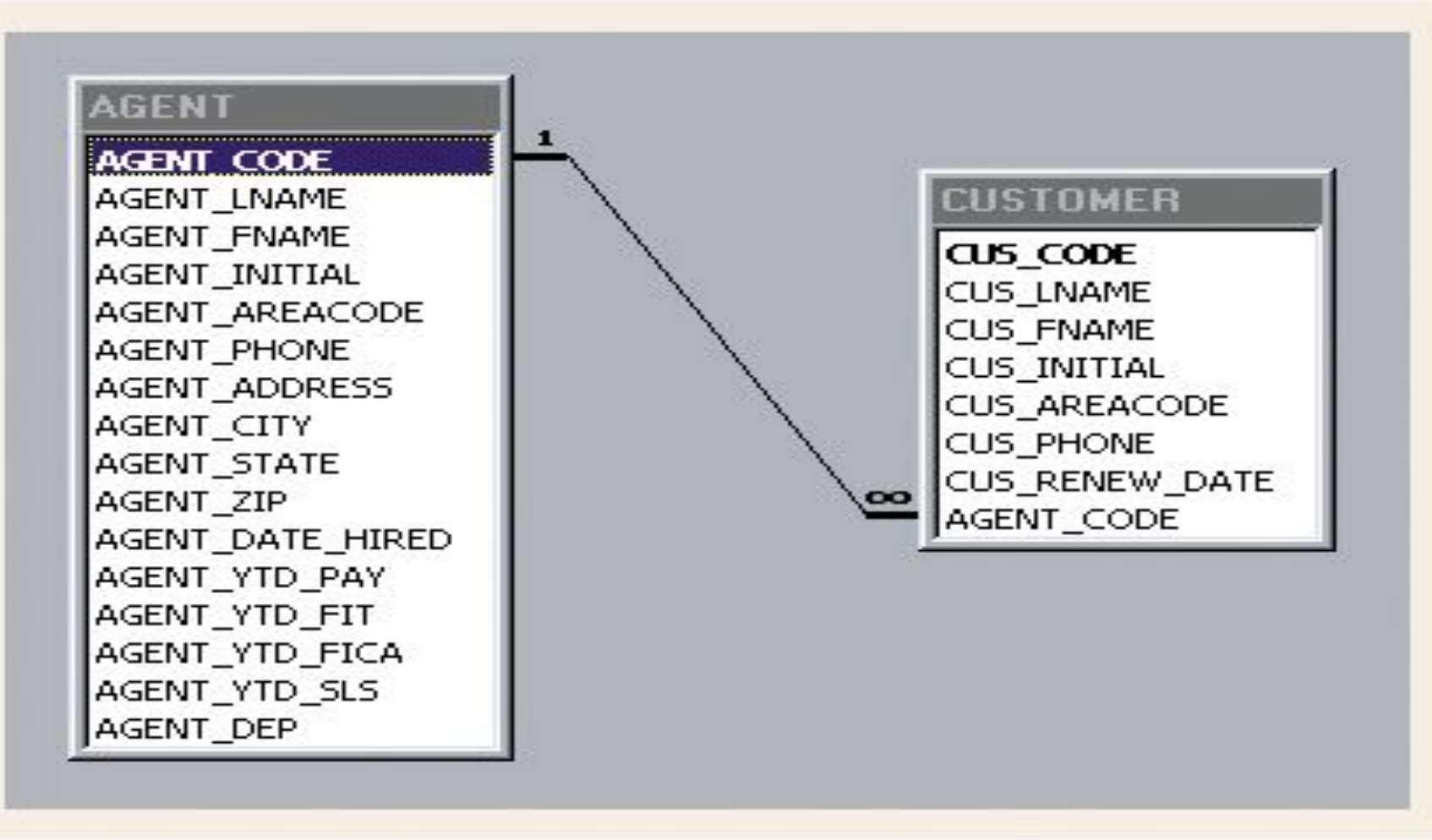


FIGURE 1.12 A RELATIONAL SCHEMA

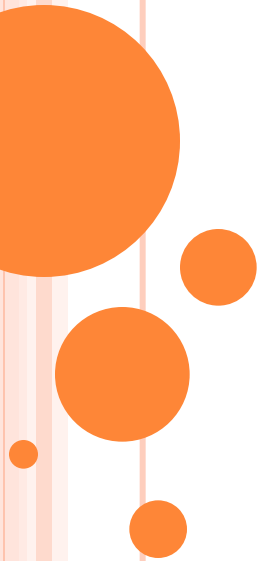
RELATIONAL DATABASE MODEL

- Advantages
  - Structural independence: data access path is is irrelevant to database design; change structure will not affect the database
  - Improved conceptual simplicity
  - Easier database design, implementation, management, and use
  - Ad hoc query capability with SQL (4GL is added)
  - Powerful database management system

RELATIONAL DATABASE MODEL

- Disadvantages
  - Substantial hardware and system software overhead
  - Poor design and implementation is made easy
  - May promote “islands of information” problems

CHAPTER:



The Relational Database Model

IN THIS CHAPTER, YOU WILL LEARN:

- That the relational database model's basic components are entities and their attributes, and relationships among entities
- How entities and their attributes are organized into tables
- About relational database operators, the data dictionary, and the system catalog

LOGICAL VIEW OF DATA

- Relational Database
  - Designer focuses on logical representation rather than physical
  - Use of table advantageous
    - Structural and data independence
    - Related records stored in independent tables
    - Logical simplicity
  - Allows for more effective design strategies

LOGICAL VIEW OF DATA (CON'T.)

- Entities and Attributes
  - Entity is a person, place, event, or thing about which data is collected
  - Attributes are characteristics of the entity
- Tables
  - Holds related entities or entity set
  - Also called relations
  - Comprised of rows and columns

TABLE CHARACTERISTICS (CON'T.)

- Column values all have same data format
  - Data types:
    - Number
    - Character
    - Date
    - Logical
- Each column has range of values called attribute domain
- Order of the rows and columns is immaterial to the DBMS

Entity set

Column (attribute)

value

Row entity

Database name: CH2_COLLEGE

Table name: STUDENT

STU_NUM	STU_LNAME	STU_FNAME	STU_INIT	STU_DOB	STU_HRS	STU_CLASS
321452	Bowser	William	C	Saturday, February 12, 1972	42	So
324257	Smithson	Anne	K	Tuesday, November 15, 1977	81	Jr
324258	Brewer	Juliette		Tuesday, August 23, 1966	36	So
324269	Oblonski	Walter	H	Sunday, September 16, 1973	66	Jr
324273	Smith	John	D	Friday, December 30, 1955	102	Sr
324274	Katinga	Raphael	P	Thursday, October 21, 1976	114	Sr
324291	Robertson	Gerald	T	Wednesday, April 08, 1970	120	Sr
324299	Smith	John	B	Wednesday, November 30, 1983	15	Fr

STUDENT table, cont.

STU_GPA	STU_TRANSFER	DEPT_CODE	STU_PHONE	PROF_NUM
2.84	No	BIOL	2134	205
3.27	Yes	CIS	2256	222
2.26	Yes	ACCT	2256	228
3.09	No	CIS	2114	222
2.11	Yes	ENGL	2231	199
3.15	No	ACCT	2267	228
3.87	No	EDU	2267	311
2.92	No	ACCT	2315	230

STU_HRS = Credit hours earned
STU_CLASS = Student classification
STU_DOB = Student date of birth

STU_GPA = Grade point average
STU_PHONE = 4-digit campus phone extension
PROF_NUM = Professor number of the professor who is the student's advisor

TABLE 2.3 RELATIONAL DATABASE KEYS

KEY TYPE	DEFINITION
Superkey	An attribute (or combination of attributes) that uniquely identifies each entity in a table.
Candidate key	A minimal superkey. A superkey that does not contain a subset of attributes that is itself a superkey.
Primary key	A candidate key selected to uniquely identify all other attribute values in any given row. Cannot contain null entries.
Secondary key	An attribute (or combination of attributes) used strictly for data retrieval purposes.
Foreign key	An attribute (or combination of attributes) in one table whose values must either match the primary key in another table or be null.

Foreign key:

R1: EMP(EmpNo, EName,…,DeptNo)

R2: DEPT(DeptNo, DName)