Network Model and Hierarchy Model

Introduction

- In network model the data is stored in the form of graph In the hierarchy model data is stored in the form of Trees

Database Models

Network Model

Hierarchical Model

Relational Model

Object/Relational Model

Object-Oriented Model

Semi structured Model

Associative Model

Entity-Attribute-Value (EAV) data model

Context Model

Hierarchy Model

- The hierarchical data model organizes data in a tree structure. There is a hierarchy of parent and child data segments. This structure implies that a record can have repeating information, generally in the child data segments. Data in a series of records, which have a set of field values attached to it.

continue

- It collects all the instances of a specific record together as a record type. These record types are the equivalent of tables in the relational model, and with the individual records being the equivalent of rows.

Network Model

- Basic Concepts
- Data-Structure Diagrams
- The DBTG(database task group) CODASYL (multiuser compliance database mgmt system)Model
- DBTG Data-Retrieval Facility
- DBTG Update Facility
- DBTG Set-Processing Facility
- Mapping of Networks to Files

Basic Concepts

- Data are represented by collections of *records*.
  - similar to an entity in the E-R model
  - Records and their fields are represented as *record type*

```
type                    customer = record   type     account =
  record
    customer-name: string;                 account-number: integer;
    customer-street: string;               balance: integer;
    customer-city: string;
end                     end
```

- Relationships among data are represented by *links*
  - similar to a restricted (binary) form of an E-R relationship
  - restrictions on links depend on whether the relationship is many-many, many-to-one, or one-to-one.

Data-Structure Diagrams

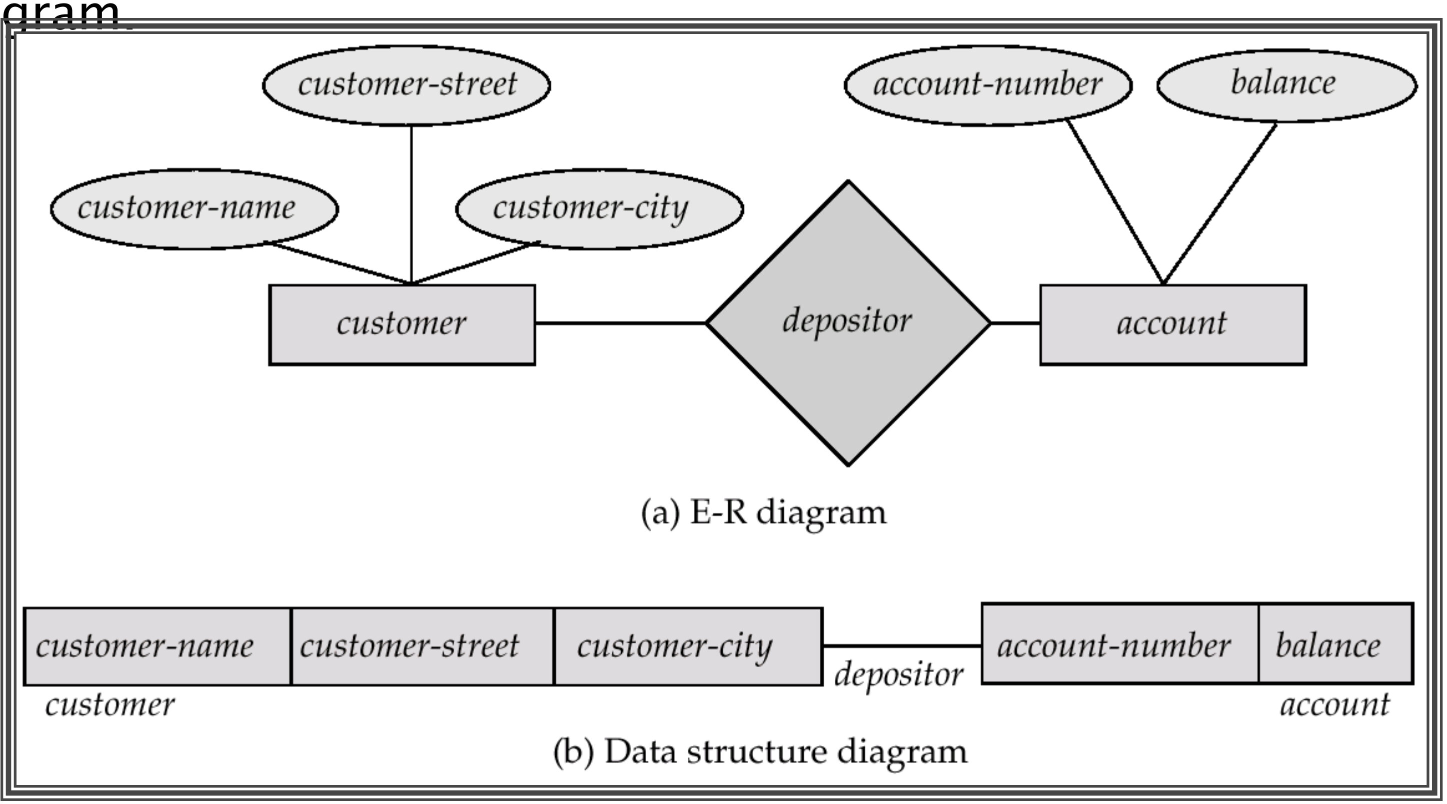
- Schema representing the design of a network database.

- A data-structure diagram consists of two basic components:
  - **Boxes**, which correspond to record types.
  - **Lines**, which correspond to links.

- Specifies the overall logical structure of the database.

Data-Structure Diagrams (Cont.)

- For every E-R diagram, there is a corresponding data-structure diagram.

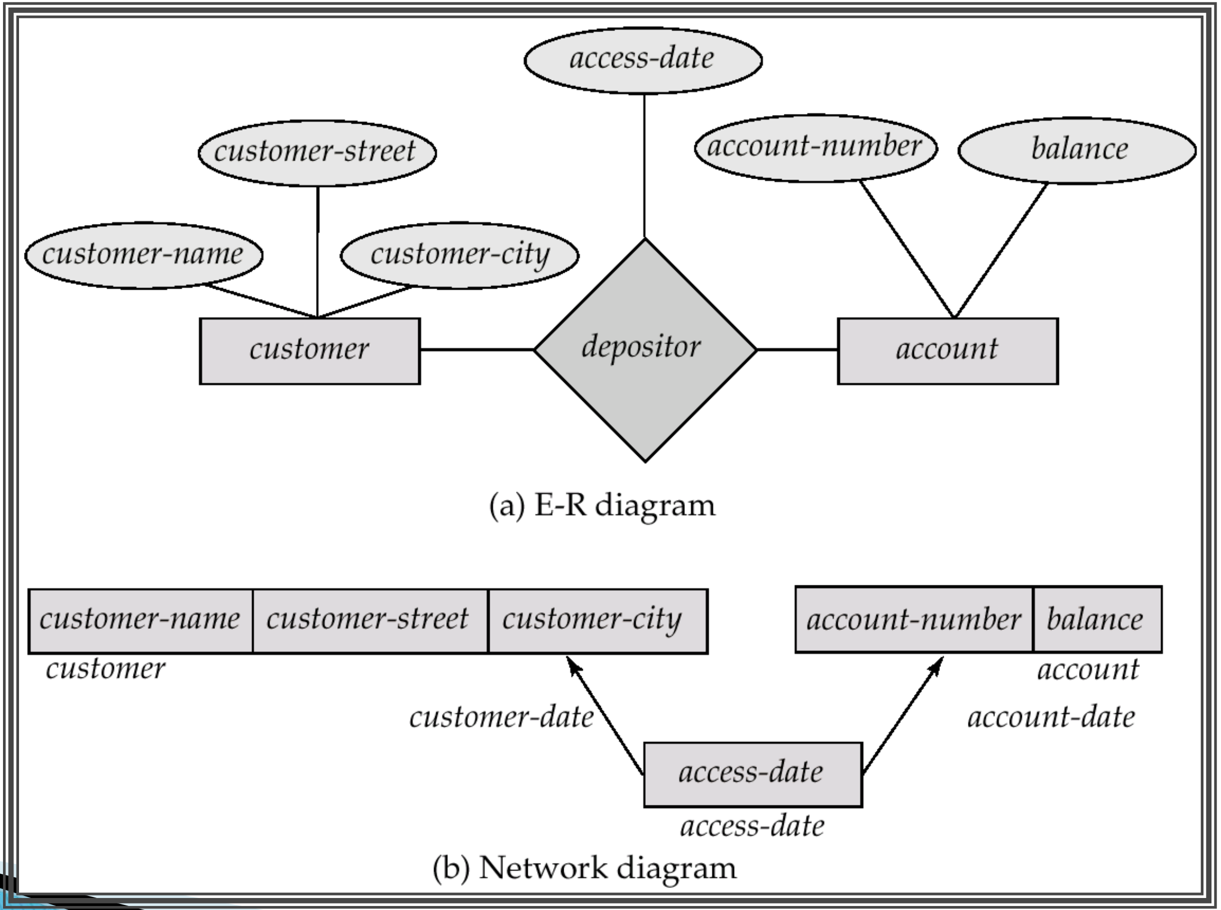


(a) E-R diagram

(b) Data structure diagram

Data-Structure Diagrams (Cont.)

- Since a link cannot contain any data value, represent an E-R relationship with attributes with a new record type and links.



(a) E-R diagram

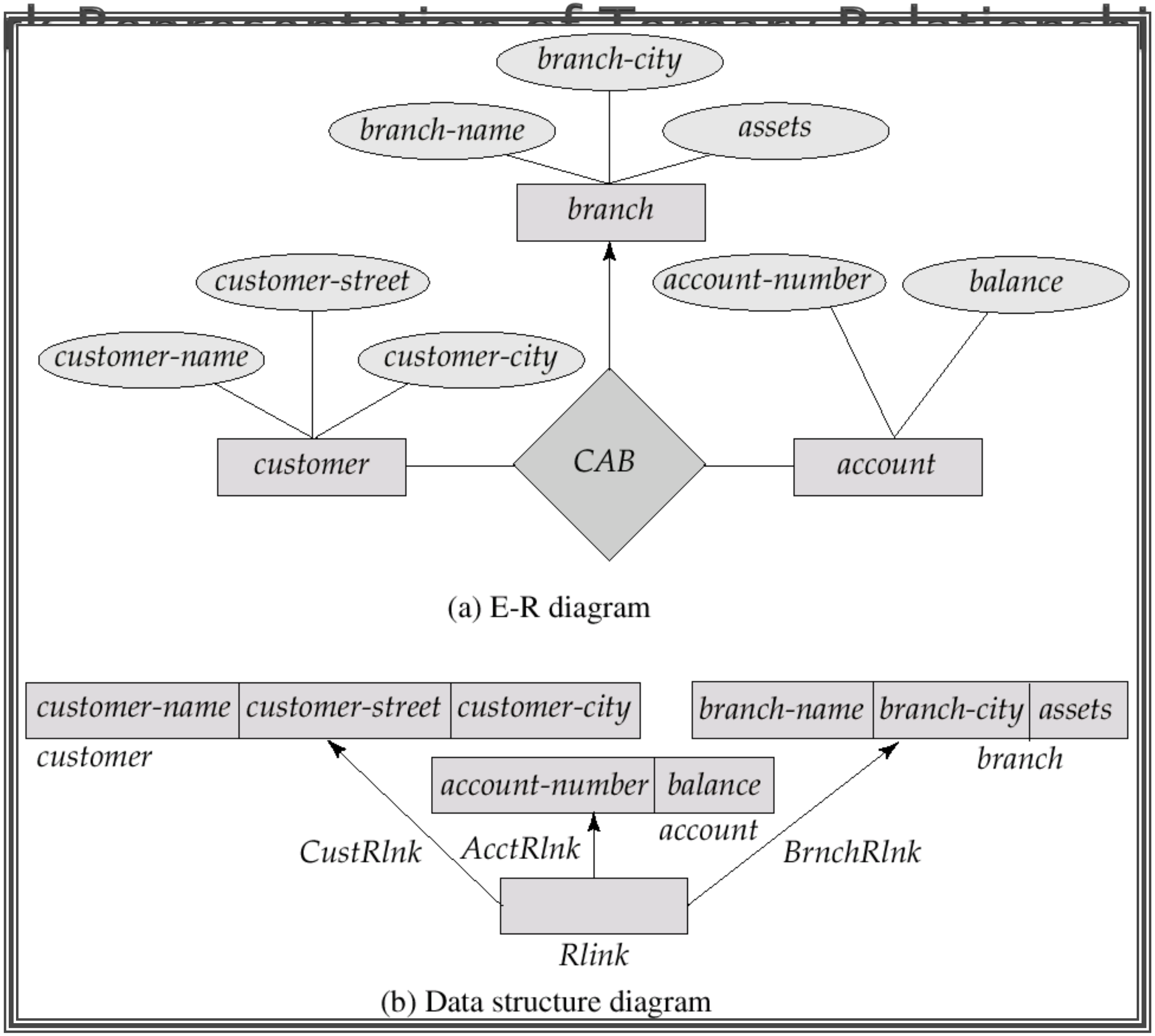
(b) Network diagram

General Relationships

- To represent an E-R relationship of degree 3 or higher, connect the participating record types through a new record type that is linked directly to each of the original record types.

1. Replace entity sets *account, customer,* and *branch* with record types *account, customer,* and *branch,* respectively.
2. Create a new record type *Rlink* (referred to as a *dummy* record type).
3. Create the following many-to-one links:
   - *CustRlink* from *Rlink* record type to *customer* record type
   - *AcctRlnk* from *Rlink* record type to *account* record type
   - *BrncRlnk* from *Rlink* record type to *branch* record type

Network Representation of Ternary Relationship

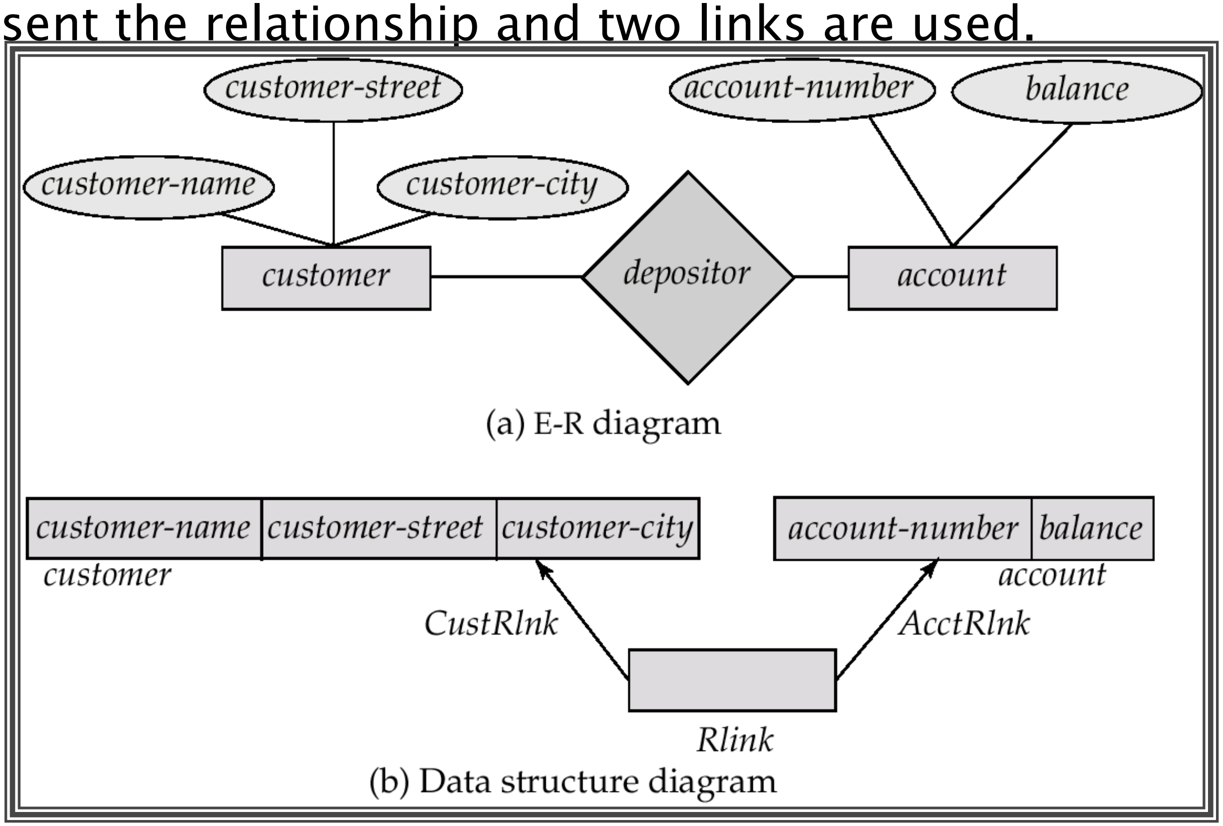


(a) E-R diagram

(b) Data structure diagram

The DBTG CODASYL Model

- All links are treated as many-to-one relationships.
- To model many-to-many relationships, a record type is defined to represent the relationship and two links are used.



(a) E-R diagram

(b) Data structure diagram

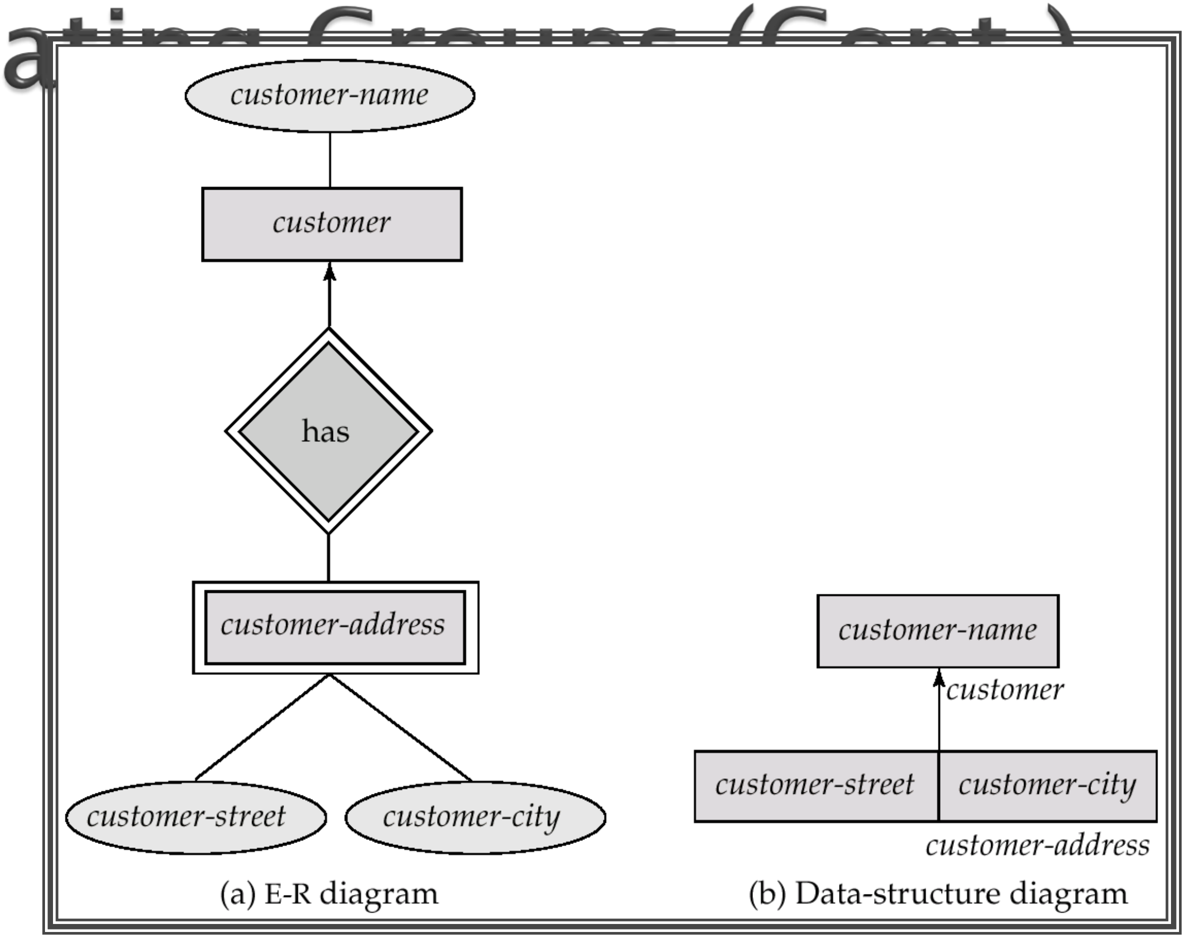
DBTG Sets

- The structure consisting of two record types that are linked together is referred to in the DBTG(database task group) model as a *DBTG set*
- In each DBTG set, one record type is designated as the *owner,* and the other is designated as the *member*, of the set.
- Each DBTG set can have any number of *set occurrences* (actual instances of linked records).
- Since many-to-many links are disallowed, each set occurrence has precisely one owner, and has zero or more member records.
- No member record of a set can participate in more than one occurrence of the set at any point.
- A member record can participate simultaneously in several set occurrences of *different* DBTG sets.

Repeating Groups

- Provide a mechanism for a field to have a set of values rather than a single value.
- Alternative representation of weak entities from the E-R model
- Example: Two sets.
  - *customer (customer-name)*
  - *customer-address (customer-street, customer-city)*
- The following diagrams represent these sets without the repeating-group construct.

Repeating Groups (Cont.)



(a) E-R diagram

(b) Data-structure diagram

- With the repeating-group construct, the data-structure diagram consists of the single record type *customer.*

DBTG Data-Retrieval Facility

- The DBTG data manipulation language consists of a number of commands that are embedded in a host language.

- *Run unit* — system application program consisting of a sequence of host language and DBTG command statements. Statements access and manipulate database items as well as locally declared variables.

- *Program work-area* (or *user work area*) — a buffer storage area the system maintains for each application program

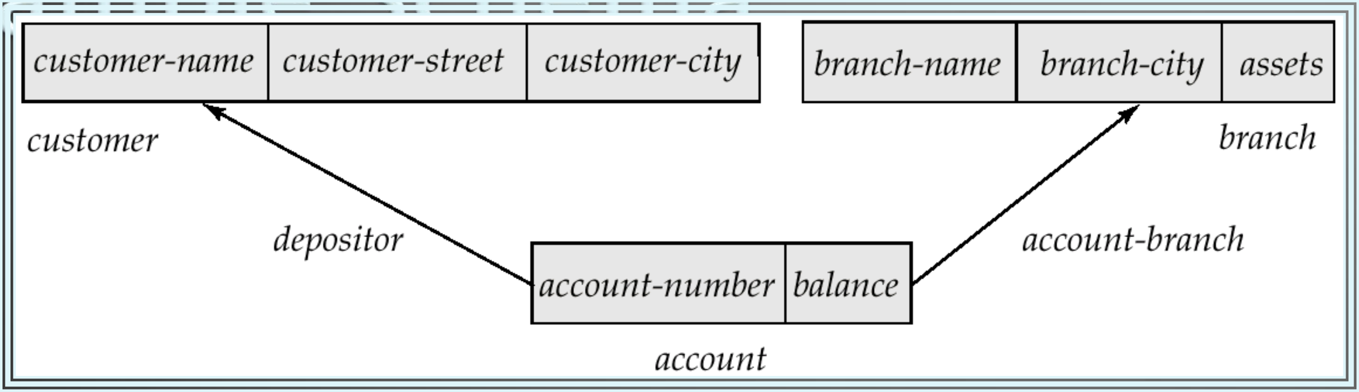
DBTG Variables

- Record Templates

- Currency pointers
  - Current of record type
  - Current of set type
  - Current of run unit

- Status flags
  - **DB-status** is most frequently used
  - Additional variables: **DB-set-name, DB-record-name,** and **DB-data-name**

Example Schema



customer-name | *customer-street* | *customer-city*

customer

branch-name | *branch-city* | *assets*

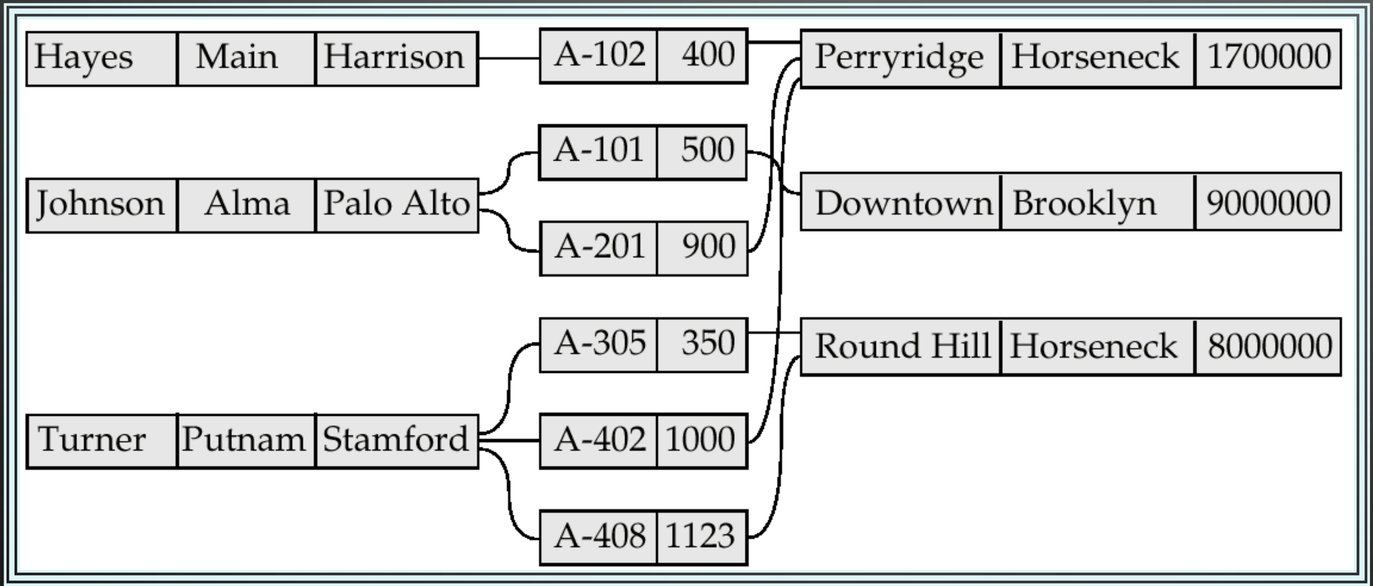
branch

depositor

account-branch

account-number | *balance*

account



Hayes | Main | Harrison

Johnson | Alma | Palo Alto

Turner | Putnam | Stamford

A-102 | 400

A-101 | 500

A-201 | 900

A-305 | 350

A-402 | 1000

A-408 | 1123

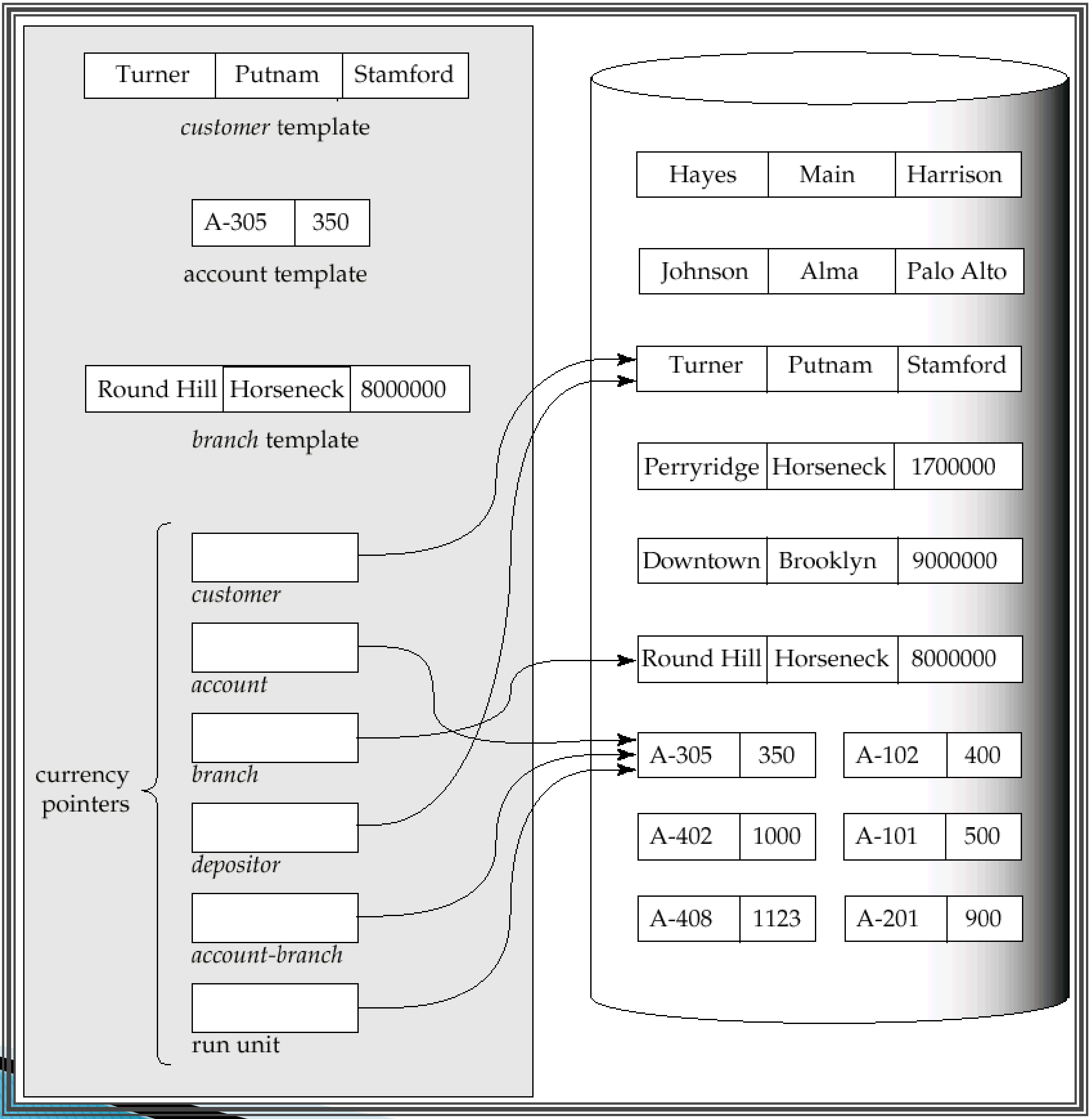
Perryridge | Horseneck | 1700000

Downtown | Brooklyn | 9000000

Round Hill | Horseneck | 8000000

Example Program Work Area

- Templates for three record types: *customer, account,* and *branch.*
- Six currency pointers
  - Three pointers for record types: one each tot he most recently accessed *customer, account,* and *branch* record
  - Two pointers for set types: one to the most recently accessed record in an occurrence of the set *depositor,* one to the most recently accessed record in an occurrence of the set *account-branch*
  - One run-unit pointer.
- Status flags: four variables defined previously
- Following diagram shows an example program work area state.



Turner Putnam Stamford

customer template

A-305 350

account template

Round Hill Horseneck 8000000

branch template

currency pointers

customer

account

branch

depositor

account-branch

run unit

Hayes Main Harrison

Johnson Alma Palo Alto

Turner Putnam Stamford

Perryridge Horseneck 1700000

Downtown Brooklyn 9000000

Round Hill Horseneck 8000000

A-305 350

A-102 400

A-402 1000

A-101 500

A-408 1123

A-201 900

The Find and Get Commands

- **find** locates a record in the database and sets the appropriate currency pointers
- **get** copies of the record to which the current of run-unit points from the database to the appropriate program work area template
- Example: Executing a **find** command to locate the customer record belonging to Johnson causes the following changes to occur in the state of the program work area.
  - The current of the record type *customer* now points to the record of Johnson.
  - The current of set type *depositor* now points to the set owned by Johnson
  - The current of run unit now points to *customer* record Johnson.

Access of Individual Records

- **find any** <record type> **using** <record-field>
  Locates a record of type <record type> whose <record-field> value is the same as the value of <record-field> in the <record type> template in the program work area.
- Once such a record is found, the following currency pointers are set to point to that record:
  - The current of run-unit pointer
  - The record-type currency pointer for <record type>
  - For each set in which that record belongs, the appropriate set currency pointer
- **find duplicate** <record type> **using** <record-field>
  Locates (according to a system-dependent ordering) the next record that matches the <record-field>

Access of Records Within a Set

- Other **find** commands locate records in the DBTG set that is pointed to by the <set-type> currency pointer.
- **find first** <record type> **within** <set-type>
  Locates the first database record of type <record type> belonging to the current <set-type>.
- To locate the other members of a set,k we use

  find next <record type> **within** <set-type>

  which finds the next element in the set <set-type>.
- **find owner within** <set-type>
  Locates the owner of a particular DBTG set

Predicates

- For queries in which a field value must be matched with a specified range of values, rather than to only one, we need to:

  - **get** the appropriate records into memory
  - examine each one separately for a match
  - determine whether each is the; target of our **find** statement

Example DBTG Query

- Print the total number of accounts in the Perryridge branch with a balance greater than $10,000.

```
count := 0;
branch.branch-name := “Perryridge”;
find any branch using  branch-name;
find first account within account-branch;
while DB-status = 0 do
    begin
        get account
        if account.balance > 10000 then count := count  + 1;
        find next account within  account-branch;
    end
print (count);
```

DBTG Update Facility

- DBTG mechanisms are available to update information in the database.
- To create a new record of type <record type>
  - insert the appropriate values in the corresponding <record type> template
  - add this new record to the database by executing

store <record type>

- Can create and add new records only one at a time

DBTG Update Facility (Cont.)

- To modify an existing record of type <record type>
  - find that record in the database
  - get that record into memory
  - change the desired fields in the template of <record type>
  - reflect the changes to the record to which the currency point of <record type> points by executing

modify <record type>

DBTG Update Facility (Cont.)

- To delete an existing record of type <record type>
  - make the currency pointer of that type point to the record in the database to be deleted
  - delete that record by executing

    erase <record type>

- Delete an entire set occurrence by finding the owner of the set and executing

  erase all <record type>

  - Deletes the owner of the set, as well as all the set's members.
  - If a member of the set is an owner of another set, the members of that second set also will be deleted.
  - **erase all** is recursive.

DBTG Set-Processing Facility

- Mechanisms are provided for inserting records into and removing records from a particular set occurrence
- Insert a new record into a set by executing the **connect** statement.

  connect <record type> **to** <set-type>

- Remove a record from a set by executing the **disconnect** statement.

  disconnect <record type> **from** <set-type>