COMP S320F/3200SEF Database Management
COMP 8200SEF Database Systems

Lecture 1

INTRODUCTION TO DATABASES

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Introduction

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Lecture: 2 hours / week

Lab/tutorial: 1 hour / week

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Course Content

Introduction to Databases

The Relational Model

SQL: Data Definition

SQL: Data Manipulation

Advanced SQL

Entity-Relationship Modeling

Database Environment

Database Architectures

Intended Learning Outcomes

Upon completion of this course, students should be able to:

1. Describe essential principles and concepts of database management systems.
2. Perform data manipulation and extraction tasks effectively using SQL.
3. Utilize the relational model to solve data modelling problems.

Assessment

Overall Continuous Assessment Score OCAS (50%)

- 2 assignments for 8200SEF/3200SEF and 3 assignments for S320F (20%)
- 2 tests for 8200SEF/3200SEF/S320F (30%)

Overall Exam Score (OES) (50%)

- 2-hour written examination for 3200SEF/S320F
- Project for 8200SEF

To obtain a Pass Grade, normally you should obtain at least 40% in the 3 scores below:

- OCAS, OES and Course Score (CS)

Software

Oracle (www.oracle.com)

PostgreSQL (www.postgresql.org)

Textbook

Connolly, T and Begg, C, Database Systems: A practical Approach to Design, Implementation, and Management (6th ed.), Boston: Pearson Education.

Lecture 1 - Content

In this lecture, you will learn

- Traditional file-based systems
- Database Management System (DBMS)
- Major components of the DBMS environment

What is a database system?

Database

- A shared collection of logically related data, and a description of this data, designed to meet the information needs of an organization.
- E.g. Student and teacher records, course details

Database Management System (DBMS)

- Collection of programs accessing database through DBMS
- E.g. Oracle, PostgreSQL, MS SQL Server, MySQL and MS Access.

Examples of Database Applications

Studying at university

Purchases from the supermarket

Booking a holiday online

Using the library

Purchases using your credit card

…

File-Based System

Collection of application programs that perform services for the end users.

- E.g. a Java program to retrieve student records from a text file (*.txt)

Each program defines and manages its own data.

Why study it?

- Avoid its problems
- Help in converting it to DB system

Example: DreamHome (property agent)

Sales Department : selling and renting of properties

Contracts Department : handling the lease agreement associated with properties for rent

Sales Department forms:

Property for Rent Details form

Client Details form

Contracts Department form:

Lease Details form

DreamHome

Property for Rent Details

Property Number: PG21

Address 18 Dale Rd

City Glasgow

Postcode G12

Type House Rent 600

No. of Rooms 5

Allocated to Branch:

163 Main St, Glasgow

Branch No. B003

Staff Responsible

Ann Beech

Owner's Details

Name Carol Farrel

Address 6 Achray St

Glasgow G32 9DX

Tel. No. 0141-357-7419

Owner No. C087

Business Name

Address

Tel. No.

Owner No.

Contact Name

Business Type

DreamHome

Client Details

Client Number: CR74

First Name Mike Last Name Ritchie

Address 18 Tain St PA1G 1YQ

Tel. No. 01475-392178

Property Requirement Details

Preferred Property Type House Maximum Monthly Rent 750

General Comments Currently living at home with parents Getting married in August

Seen By Ann Beech Date 24-Mar-13

Branch No. B003 Branch City Glasgow

(b)

DreamHome

Lease Details

Lease Number: 10012

Client No. CR74

Full Name Mike Ritchie

Address (previous) 18 Tain St PA1G 1YQ

Tel. No. 01475-392178

Property No. PG21

Address 18 Dale Rd Glasgow G12

Payment Details

Monthly Rent 600

Payment Method Cheque

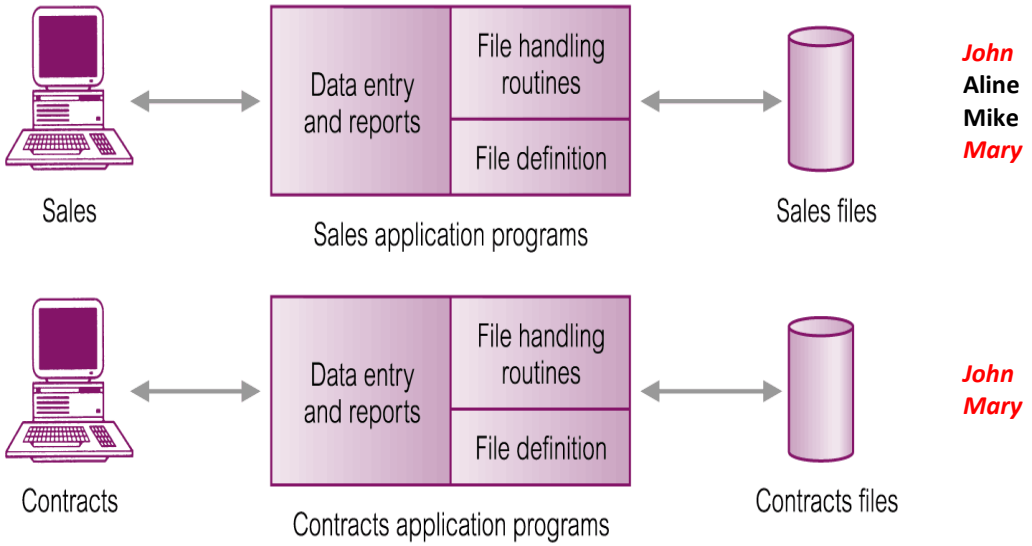
Deposit 1200 Paid (Y or N) Y

Rent Start Date 1-Jul-13

Rent Finish Date 30-Jun-14

Duration 1 Year

File-Based Processing



John
Aline
Mike
Mary

John
Mary

Figure 1.5 File-based processing.

Sales Files

PropertyForRent (propertyNo, street, city, postcode, type, rooms, rent, ownerNo)
PrivateOwner (ownerNo, fName, lName, address, telNo)
Client (clientNo, fName, lName, address, telNo, prefType, maxRent)

Contracts Files

Lease (leaseNo, propertyNo, clientNo, rent, paymentMethod, deposit, paid, rentStart, rentFinish, duration)
PropertyForRent (propertyNo, street, city, postcode, rent)
Client (clientNo, fName, lName, address, telNo)

Limitations

- *Data isolation*
  - *Sales and contracts files (i.e. text files) stored in different locations physically.*
- *Data duplication*
  - *i.e. John & Mary appeal in both files*
- *Data depending on program code*
  - *i.e. java files to access the text files*
- *Many programs to be maintained*
  - *Many java files needed to handle the data from storing, retrieving, updating, etc.*

Limitations of File-Based Approach

Separation and **isolation** of data

- Each program maintains its own set of data.
- Users of one program may be unaware of potentially useful data held by other programs.

Duplication of data

- Same data is held by different programs.
- Wasted space and potentially different values and/or different formats for the same item.

Limitations of File-Based Approach cont.

Data dependence

- File structure is defined in the program code.

Incompatible file formats

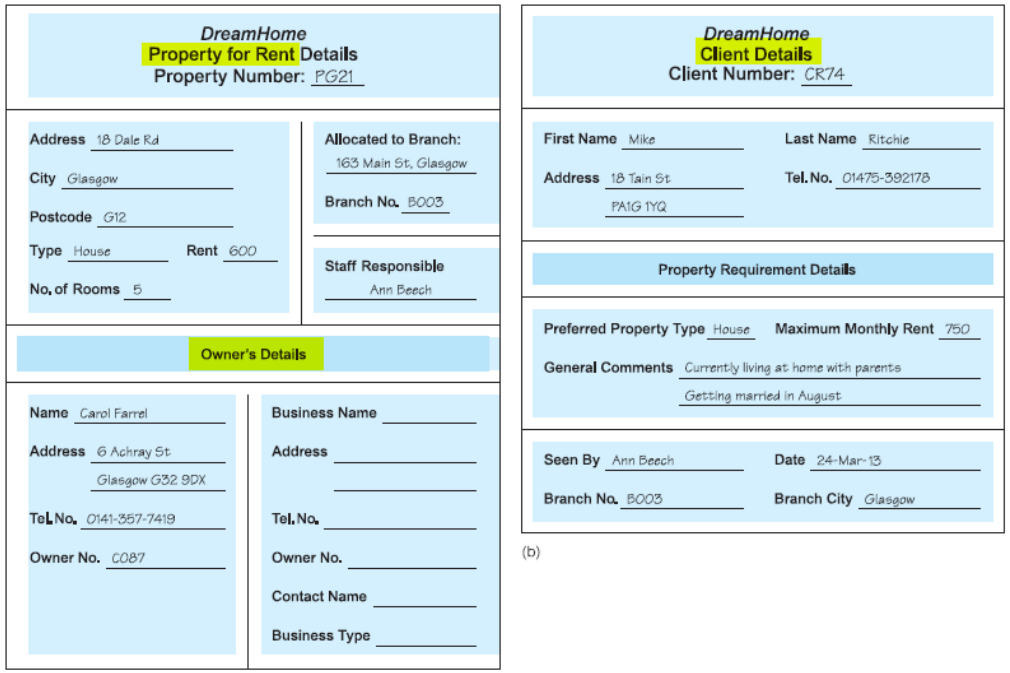
- Programs are written in different languages, and so cannot easily access each other's files.

Fixed Queries/Many application programs

- Programs are written to satisfy particular functions.
- Any new requirement needs a new program.

Database

1. Shared collection of logically related data (and a description of this data), designed to meet the information needs of an organization.



DreamHome
Property for Rent Details
Property Number: PG21

Address 18 Dale Rd
City Glasgow
Postcode G12
Type House Rent 600
No. of Rooms 5

Allocated to Branch:
163 Main St, Glasgow
Branch No. B003

Staff Responsible
Ann Beech

Owner's Details

Name Carol Farrel
Address 6 Achray St
Glasgow G32 9DX
Tel. No. 0141-357-7419
Owner No. CO87

Business Name
Address
Tel. No.
Owner No.
Contact Name
Business Type

DreamHome
Client Details
Client Number: CR74

First Name Mike Last Name Ritchie
Address 18 Tain St
PA1G 1YQ
Tel. No. 01475-392178

Property Requirement Details

Preferred Property Type House Maximum Monthly Rent 750
General Comments Currently living at home with parents
Getting married in August

Seen By Ann Beech Date 24-Mar-13
Branch No. B003 Branch City Glasgow

(b)

PropertyForRent

propertyNo	street	city	postcode	type	rooms	rent	ownerNo
PA14	16 Holhead Rd	Aberdeen	AB7 5SU	House	6	650	CO46
PL94	6 Argyll St	London	NW2	Flat	4	400	CO87
PG4	6 Lawrence St	Glasgow	G11 9QX	Flat	3	350	CO40
PG36	2 Manor Rd	Glasgow	G32 4QX	Flat	3	375	CO93
PG21	18 Dale Rd	Glasgow	G12	House	5	600	CO87
PG16	5 Novar Dr	Glasgow	G12 9AX	Flat	4	450	CO93

PrivateOwner

ownerNo	fName	lName	address	telNo
CO46	Joe	Keogh	2 Fergus Dr, Aberdeen AB2 7SX	01224-861212
CO87	Carol	Farrel	6 Achray St, Glasgow G32 9DX	0141-357-7419
CO40	Tina	Murphy	63 Well St, Glasgow G42	0141-943-1728
CO93	Tony	Shaw	12 Park Pl, Glasgow G4 0QR	0141-225-7025

Client

clientNo	fName	lName	address	telNo	prefType	maxRent
CR76	John	Kay	56 High St, London SW1 4EH	0207-774-5632	Flat	425
CR56	Aline	Stewart	64 Fern Dr, Glasgow G42 0BL	0141-848-1825	Flat	350
CR74	Mike	Ritchie	18 Tain St, PA1G 1YQ	01475-392178	House	750
CR62	Mary	Tregear	5 Tarbot Rd, Aberdeen AB9 3ST	01224-196720	Flat	600

Database

Branch

branchNo	street	city	postcode
B005	22 Deer Rd	London	SW1 4EH
B007	16 Argyll St	Aberdeen	AB2 3SU
B003	163 Main St	Glasgow	G11 9QX
B004	32 Manse Rd	Bristol	BS99 1NZ
B002	56 Clover Dr	London	NW10 6EU

Staff

staffNo	fName	lName	position	sex	DOB	salary	branchNo
SL21	John	White	Manager	M	1-Oct-45	30000	B005
SG37	Ann	Beech	Assistant	F	10-Nov-60	12000	B003
SG14	David	Ford	Supervisor	M	24-Mar-58	18000	B003
SA9	Mary	Howe	Assistant	F	19-Feb-70	9000	B007
SG5	Susan	Brand	Manager	F	3-Jun-40	24000	B003
SL41	Julie	Lee	Assistant	F	13-Jun-65	9000	B005

PropertyForRent

propertyNo	street	city	postcode	type	rooms	rent	ownerNo	staffNo	branchNo
PA14	16 Holhead	Aberdeen	AB7 5SU	House	6	650	CO46	SA9	B007
PL94	6 Argyll St	London	NW2	Flat	4	400	CO87	SL41	B005
PG4	6 Lawrence St	Glasgow	G11 9QX	Flat	3	350	CO40		B003
PG36	2 Manor Rd	Glasgow	G32 4QX	Flat	3	375	CO93	SG37	B003
PG21	18 Dale Rd	Glasgow	G12	House	5	600	CO87	SG37	B003
PG16	5 Novar Dr	Glasgow	G12 9AX	Flat	4	450	CO93	SG14	B003

Lease

leaseNo	propertyNo	clientNo	rent	payment Method	deposit	paid	rentStart	rentFinish	duration
10024	PA14	CR62	650	Visa	1300	Y	1-Jun-13	31-May-14	12
10075	PL94	CR76	400	Cash	800	N	1-Aug-13	31-Jan-14	6

Client

clientNo	fName	lName	telNo	prefType	maxRent	eMail
CR76	John	Kay	0207-774-5632	Flat	425	john.kay@gmail.com
CR56	Aline	Stewart	0141-848-1825	Flat	350	astewart@hotmail.com
CR74	Mike	Ritchie	01475-392178	House	750	mritchie01@yahoo.co.uk
CR62	Mary	Tregear	01224-196720	Flat	600	maryt@hotmail.co.uk

PrivateOwner

ownerNo	fName	lName	address	telNo	eMail	password
CO46	Joe	Keogh	2 Fergus Dr, Aberdeen AB2 7SX	01224-861212	jkeogh@lhh.com	********
CO87	Carol	Farrel	6 Achray St, Glasgow G32 9DX	0141-357-7419	cfarrel@gmail.com	********
CO40	Tina	Murphy	63 Well St, Glasgow G42	0141-943-1728	tinam@hotmail.com	********
CO93	Tony	Shaw	12 Park Pl, Glasgow G4 0QR	0141-225-7025	tony.shaw@ark.com	********

Viewing

clientNo	propertyNo	viewDate	comment
CR56	PA14	24-May-13	too small
CR76	PG4	20-Apr-13	too remote
CR56	PG4	26-May-13	
CR62	PA14	14-May-13	no dining room
CR56	PG36	28-Apr-13	

Registration

clientNo	branchNo	staffNo	dateJoined
CR76	B005	SL41	2-Jan-13
CR56	B003	SG37	11-Apr-12
CR74	B003	SG37	16-Nov-11
CR62	B007	SA9	7-Mar-12

Database

2. System **catalog** (**metadata**) provides description of data to enable program–data independence.

Entity name	*Description*	*Aliases*	*Occurrence*
Staff	General term describing all staff employed by *DreamHome*.	Employee	Each member of staff works at one particular branch.
PropertyForRent	General term describing all property for rent.	Property	Each property has a single owner and is available at one specific branch, where the property is managed by one member of staff. A property is viewed by many clients and rented by a single client, at any one time.

Figure 16.1 Extract from the data dictionary for the StaffClient user views of *DreamHome* showing a description of entities.

Database

3. Logically related data comprises **entities, attributes**, and **relationships** of an organization's information.

For part of the *DreamHome* case study, it consists of:

- six **entities** (the rectangles):
  - *Branch, Staff, PropertyForRent, Client, PrivateOwner, and Lease;*
- seven **relationships** (the names adjacent to the lines):
  - *Has, Offers, Oversees, Views, Owns, LeasedBy,* and *Holds*;
- six **attributes**, one for each entity:
  - *branchNo, staffNo, propertyNo, clientNo, ownerNo, and leaseNo.*

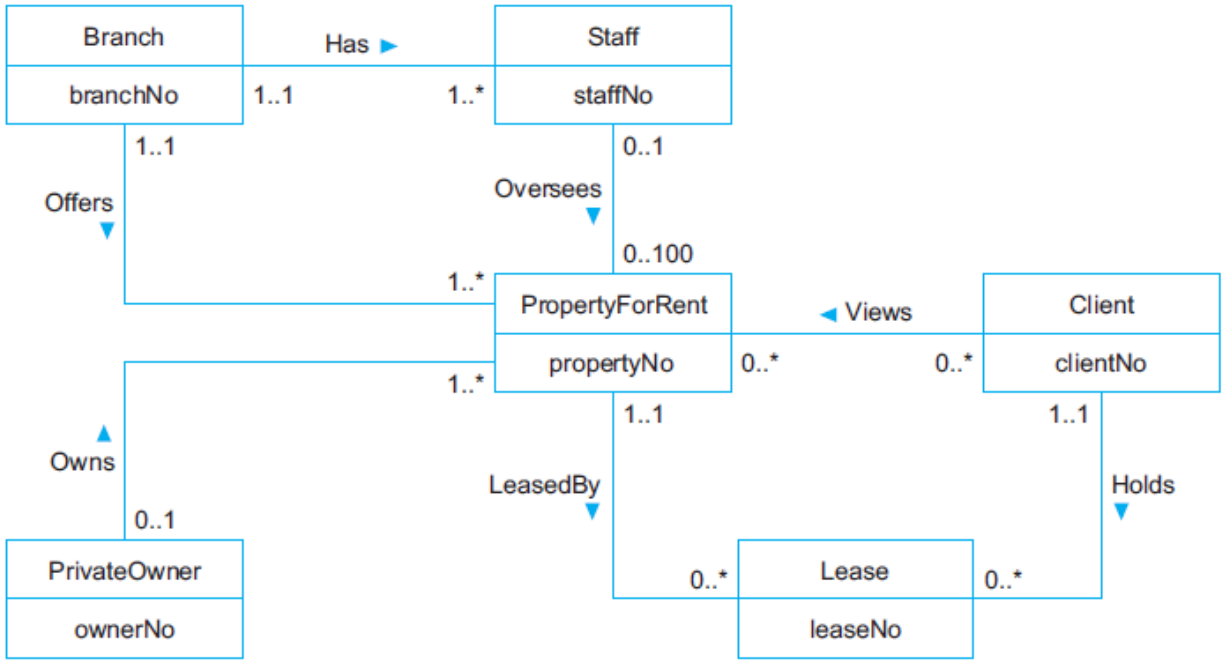


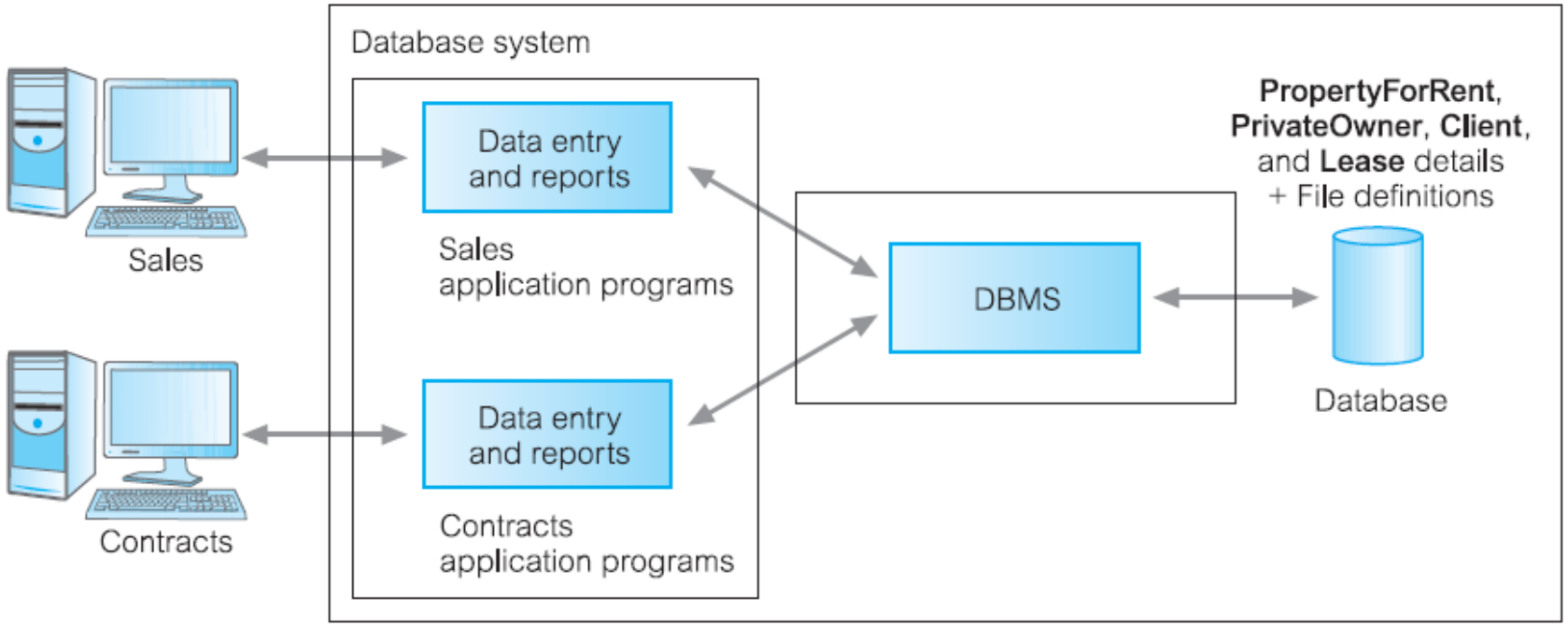
Figure 1.6 Example Entity–Relationship diagram.

Database Management System (DBMS)

A software system that enables users to define, create, maintain, and control access to the database.

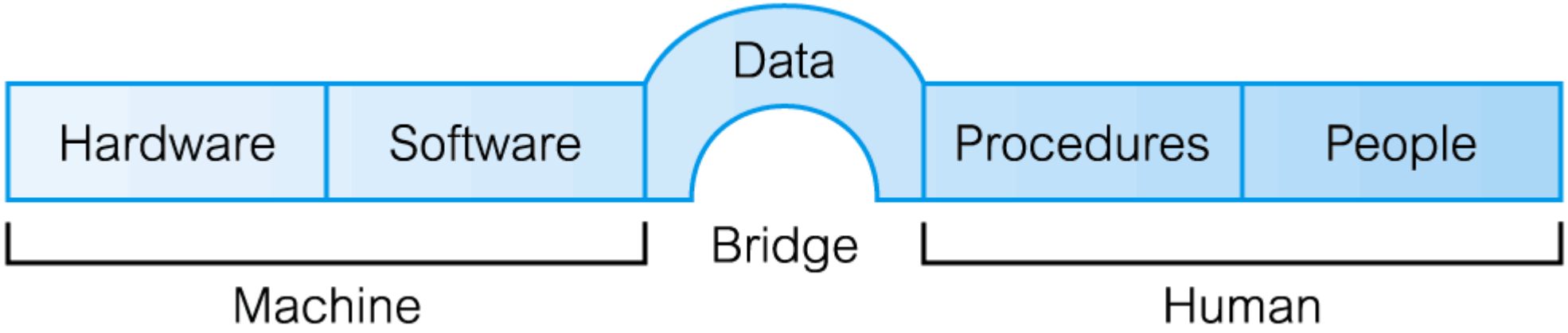
(Database) application program: a computer program that interacts with database by issuing an appropriate request (SQL statement) to the DBMS.

Database Management System (DBMS)



PropertyForRent (propertyNo, street, city, postcode, type, rooms, rent, ownerNo)
PrivateOwner (ownerNo, fName, lName, address, telNo)
Client (clientNo, fName, lName, address, telNo, prefType, maxRent)
Lease (leaseNo, propertyNo, clientNo, paymentMethod, deposit, paid, rentStart, rentFinish)

Components of DBMS Environment



Components of DBMS Environment

Hardware

- Can range from a PC to a network of computers.
- i.e., a client–server architecture:
  - the backend is the server and the frontends are the clients.

Software

- DBMS, operating system, network software (if necessary) and the application programs.

Data

- Used by the organization and a description of this data called the schema.

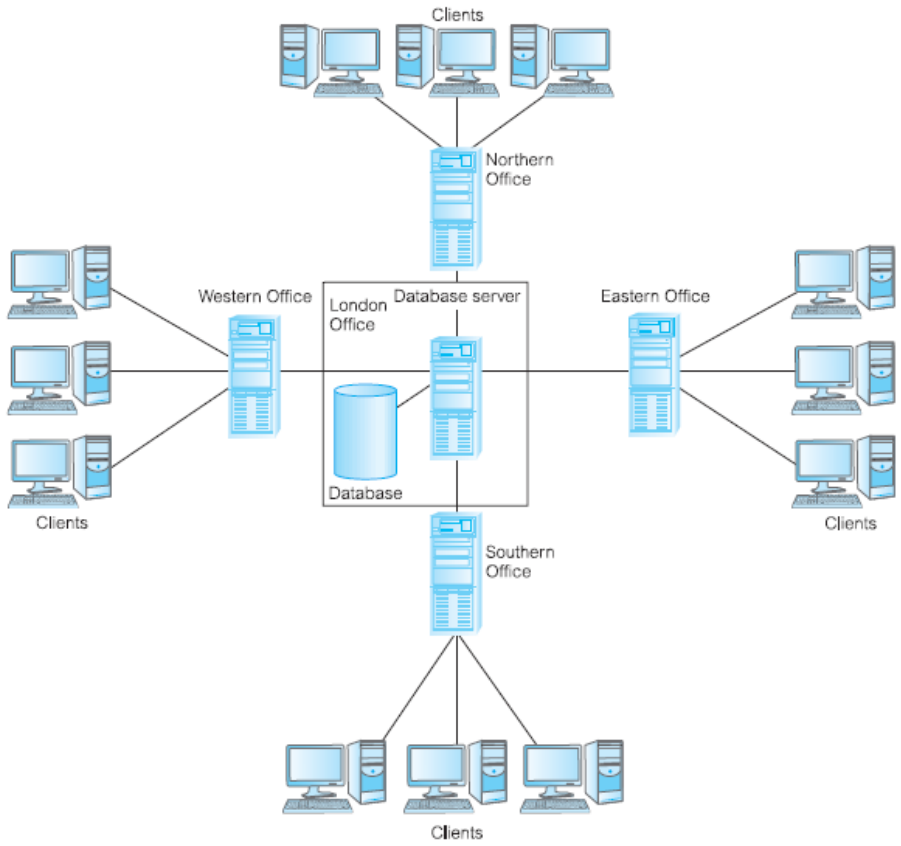


Figure 1.9 *DreamHome* hardware configuration.

Components of DBMS Environment

Procedures

- Instructions and rules that should be applied to the design and use of the database and DBMS, i.e., the instructions on how to:
  - Log on to the DBMS.
  - Use a particular DBMS facility or application program.
  - Start and stop the DBMS.
  - Make backup copies of the database.

People

- Discuss next…

Roles in the Database Environment

Notice the word roles, they can be the same person as:

- Data Administrator (DA) – higher level
  - responsible for the management of the data resource and database planning
- Database Administrator (DBA) – technical
  - responsible for maintenance of the operational system
- Database Designers
  - Logical - identify the data and the relationships between the data
  - Physical - decide how the logical database design is to be physically realized, i.e., mapping, storage structures, security measures, etc.

Roles in the Database Environment cont.

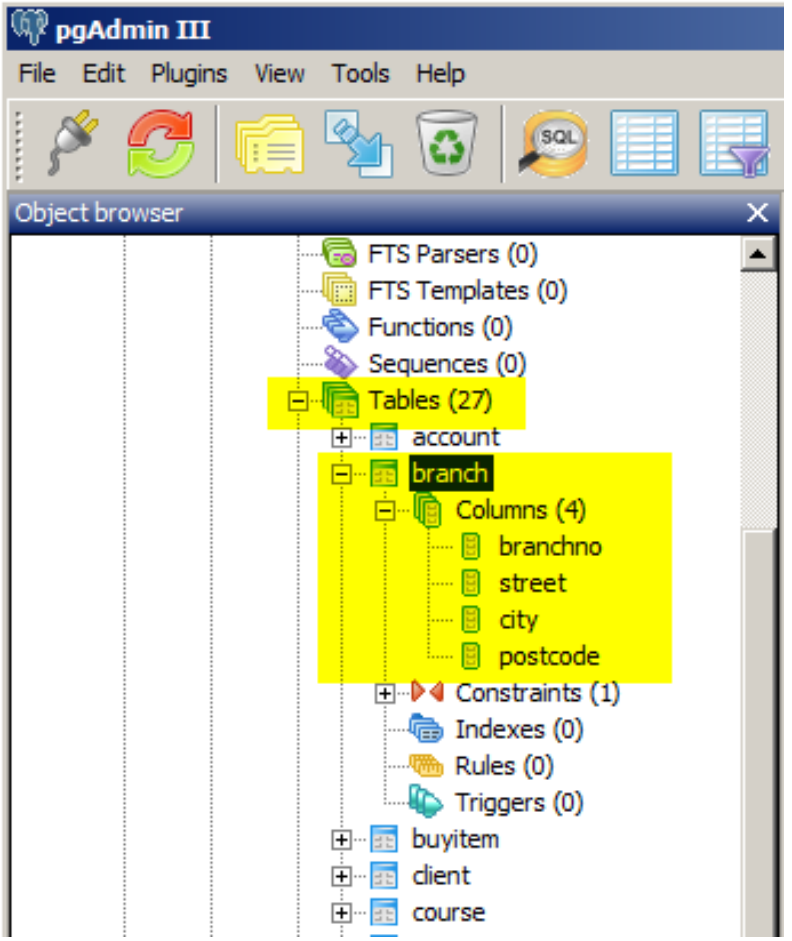
- Application Programmers
  - Implement the application programs that provide the required functionality for the end-users, i.e., retrieving data, inserting, updating, and deleting data.
- End Users ("clients" of the database)
  - Naive users
    - are typically unaware of the DBMS
    - invoke database operations by entering simple commands or choosing options from a menu
  - Sophisticated users
    - may use a high-level query language such as SQL to perform the required operations
    - may even write application programs for their own use

Database Languages

Data Definition Language (DDL)

- Allows the DBA or user to describe and name entities, attributes, and relationships required for the application.
- Enforces any associated integrity and security constraints.
- The result of the compilation of DDL statements is a set of tables stored in special files collectively called the system catalog.
- i.e., a SQL DDL for creating table branch

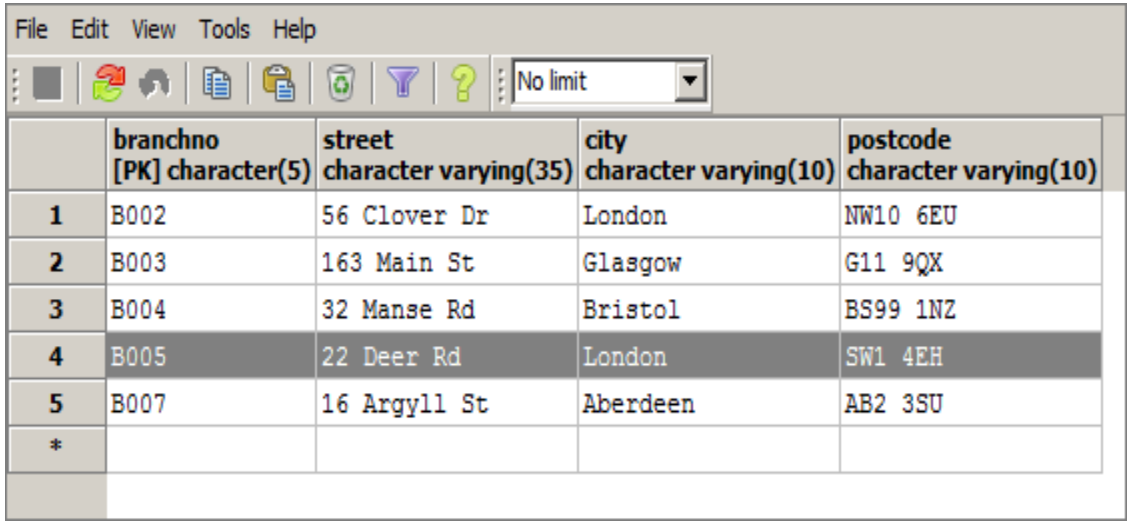
```
CREATE TABLE branch
(       branchNo char(5) PRIMARY KEY,
        street varchar(35),
        city varchar(10),
        postcode varchar(10)
);
```



Database Languages

Data Manipulation Language (DML)

- Provides basic data manipulation operations on data held in the database.
  - insertion of new data into the database;
  - modification of data stored in the database;
  - retrieval of data contained in the database;
  - deletion of data from the database.
- i.e., SQL DML of branch
  - INSERT INTO branch VALUES('B005','22 Deer Rd','London','SW1 4EH');
  - SELECT * from branch;



	branchno [PK] character(5)	street character varying(35)	city character varying(10)	postcode character varying(10)
1	B002	56 Clover Dr	London	NW10 6EU
2	B003	163 Main St	Glasgow	G11 9QX
3	B004	32 Manse Rd	Bristol	BS99 1NZ
4	B005	22 Deer Rd	London	SW1 4EH
5	B007	16 Argyll St	Aberdeen	AB2 3SU
*				

Data Model

An integrated collection of concepts for describing and manipulating data, relationships between data, and constraints on the data in an organization.

Provides the basic concepts and notations that will allow database designers and end-users to communicate unambiguously and accurately their understanding of the organizational data.

Record-based Model:

- Relational Data Model
- Network Data Model
- Hierarchical Data Model

Relational Data Model

Branch

branchNo	street	city	postCode
B005	22 Deer Rd	London	SW1 4EH
B007	16 Argyll St	Aberdeen	AB2 3SU
B003	163 Main St	Glasgow	G11 9QX
B004	32 Manse Rd	Bristol	BS99 1NZ
B002	56 Clover Dr	London	NW10 6EU

Staff

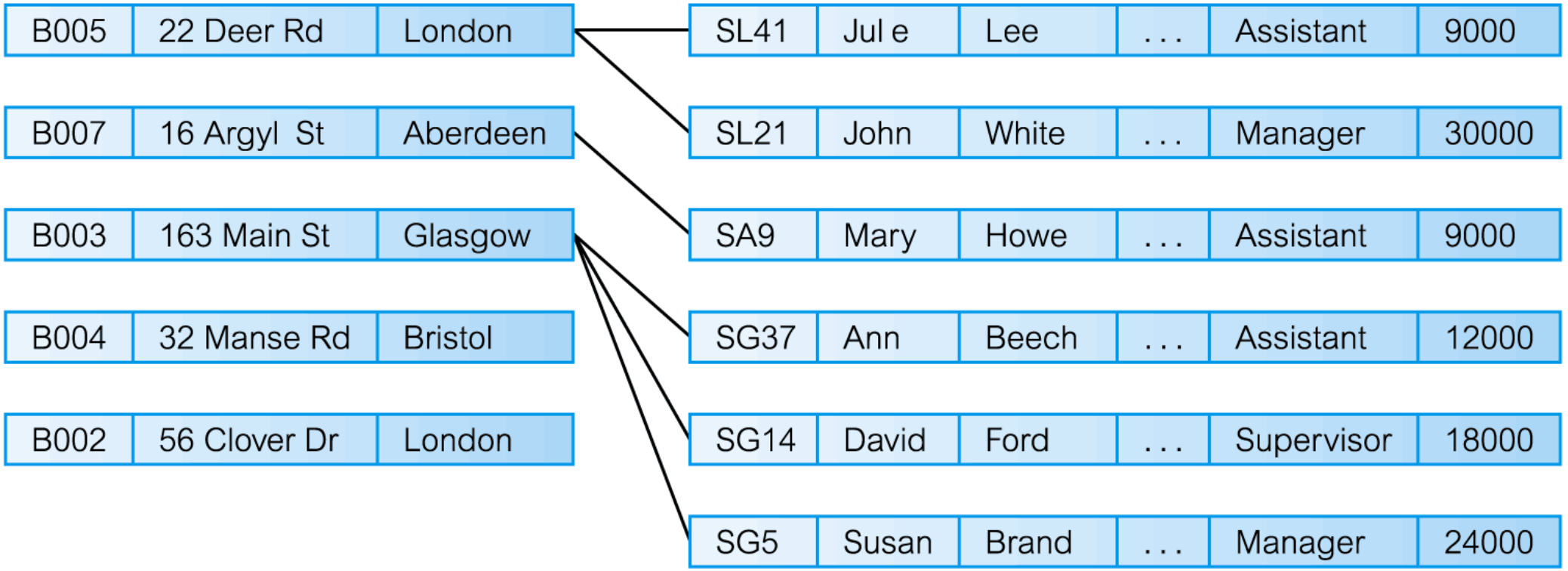
staffNo	fName	lName	position	sex	DOB	salary	branchNo
SL21	John	White	Manager	M	1-Oct-45	30000	B005
SG37	Ann	Beech	Assistant	F	10-Nov-60	12000	B003
SG14	David	Ford	Supervisor	M	24-Mar-58	18000	B003
SA9	Mary	Howe	Assistant	F	19-Feb-70	9000	B007
SG5	Susan	Brand	Manager	F	3-Jun-40	24000	B003
SL41	Julie	Lee	Assistant	F	13-Jun-65	9000	B005

branchNo is the primary key of Branch table (parent table)

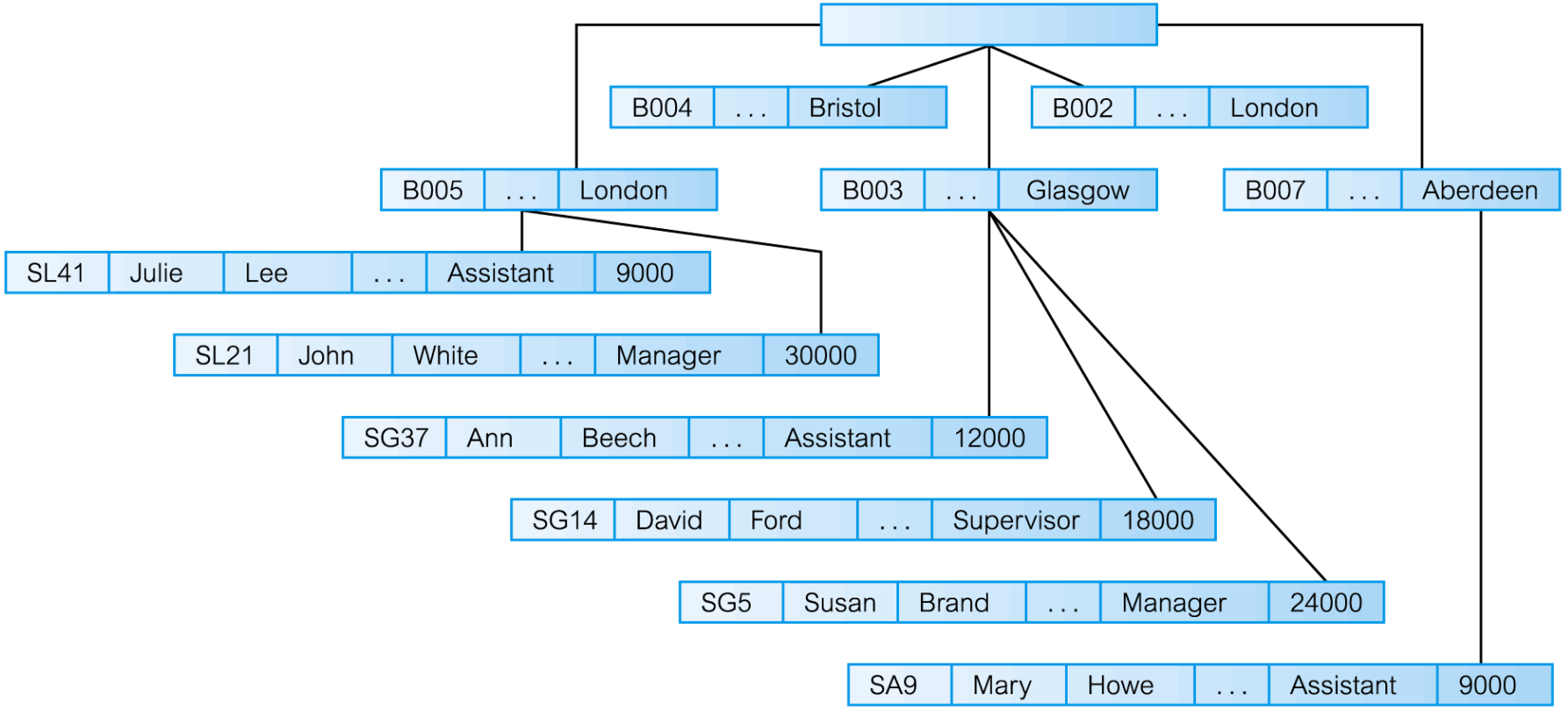
staffNo is the primary key of Staff table.

The *branchNo* in Staff table is the *foreign key* references Branch table.

Network Data Model



Hierarchical Data Model



Reference

Chapter 1 and 2 of Connolly, T and Begg, C, Database Systems: A practical Approach to Design, Implementation, and Management (6th ed.), Boston: Pearson Education.