

CSC355-Database Systems
Week-3 Lecture 1 & 2

Spring 2021

Semester

Previous Lecture



Chapter 2-Database Environment



Three Level Architecture



Mapping



Data Independence

Database Language (DDL)

Data Definition Language (DDL)

- ▶ Allows the DBA or user to describe or name entities, attributes, and relationships required for the application
- ▶ Plus, any associated integrity and security constraints.

Database Language (DML)

- ▶ **Data Manipulation Language (DML)**
 - ▶ Provides basic data manipulation operations on data held in the database.
- ▶ **Procedural DML**
 - ▶ Allows user to tell system exactly how to manipulate data.
- ▶ **Non-Procedural DML**
 - ▶ Allows user to state what data is needed rather than how it is to be retrieved.

```
try{  
    Statement st = connection.createStatement();  
    ResultSet rs = st.executeQuery("SELECT * FROM students");  
    while(rs.next){  
        String s = rs.getString(1);  
        //dst...  
    }  
} catch(SQLException e){}
```

```
INSERT INTO Employee (Id, LastName, FirstName)  
VALUES (7, 'Muhammad', 'Faizan')
```

DDL**V E R S U S****DML****DDL**

A type of SQL command that helps to define database schemas

Stands for Data Definition Language

Create, drop, alter are some DDL commands

Commands affect the entire database or the table

DML

A type of SQL command that helps to retrieve and manage data in relational databases

Stands for Data Manipulation Language

Insert, update, delete and select are some commands

Commands affect one or more records in a table

DDL vs. DML

Database Language (DML)

Fourth Generation Languages (4GLs)

- ▶ **Forms generators:** A forms generator is an interactive facility for rapidly creating data input and display layouts for screen forms.
- ▶ **Report generators:** A **report generator** is a facility for creating reports from data stored in the database.
- ▶ **Graphics generators:** A **graphics generator** is a facility to retrieve data from the database and display the data as a graph showing trends and relationships in the data.
- ▶ **Application generators:** An **application generator** is a facility for producing a program that interfaces with the database.

Data Model

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

Data Model comprises:

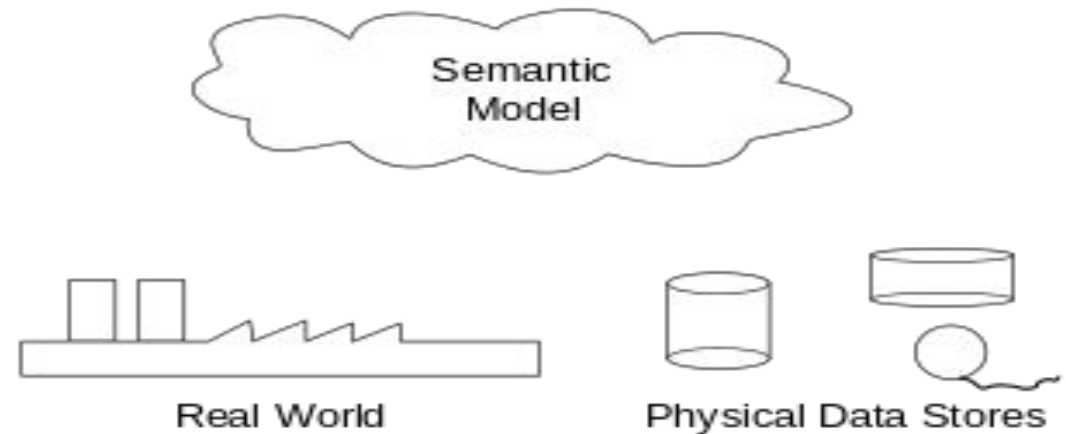
- ▶ A structural part consisting of a set of rules according to which databases can be constructed;
- ▶ A manipulative part defining the types of operation that are allowed on the data (this includes the operations that are used for updating or retrieving data from the database and for changing the structure of the database);
- ▶ Possibly a set of integrity rules which ensures that the data is accurate.

Data Model

- ▶ Purpose
 - ▶ To represent data in an understandable way.
- ▶ Categories of data models include:
 - ▶ Object-based
 - ▶ Record-based
 - ▶ Physical.

Data Models

- ▶ Object-Based Data Models
 - ▶ Entity-Relationship
 - ▶ Semantic
 - ▶ Functional
 - ▶ Object-Oriented.
- ▶ Record-Based Data Models
 - ▶ Relational Data Model
 - ▶ Network Data Model
 - ▶ Hierarchical Data Model.
- ▶ Physical Data Models



Relational Data Model

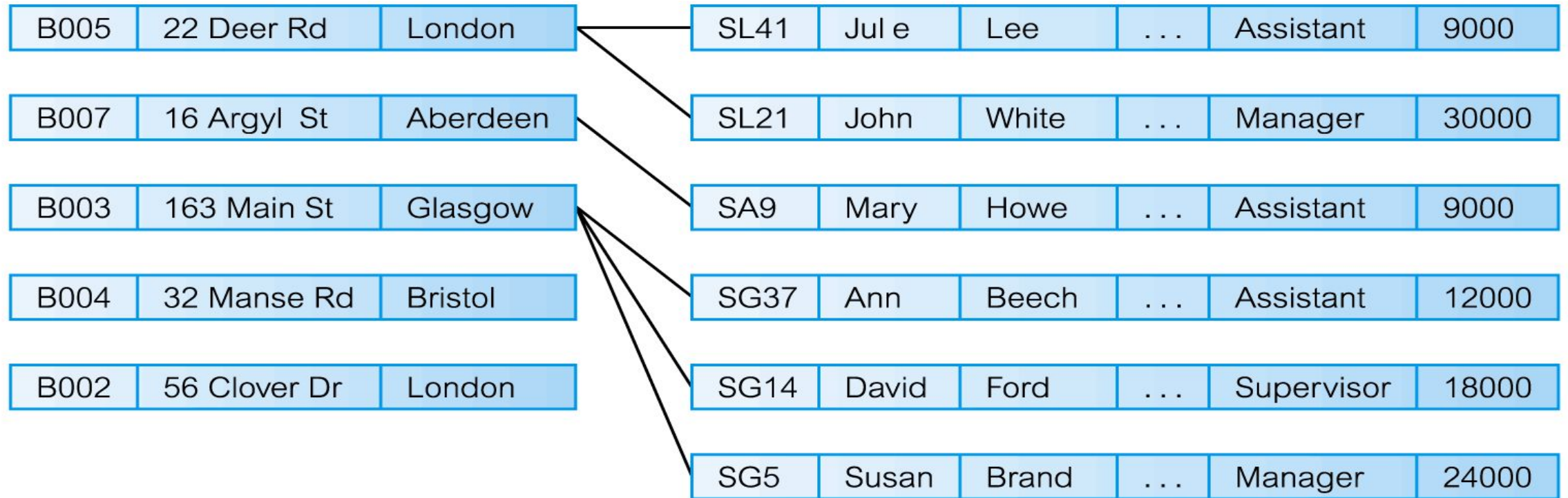
Branch

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

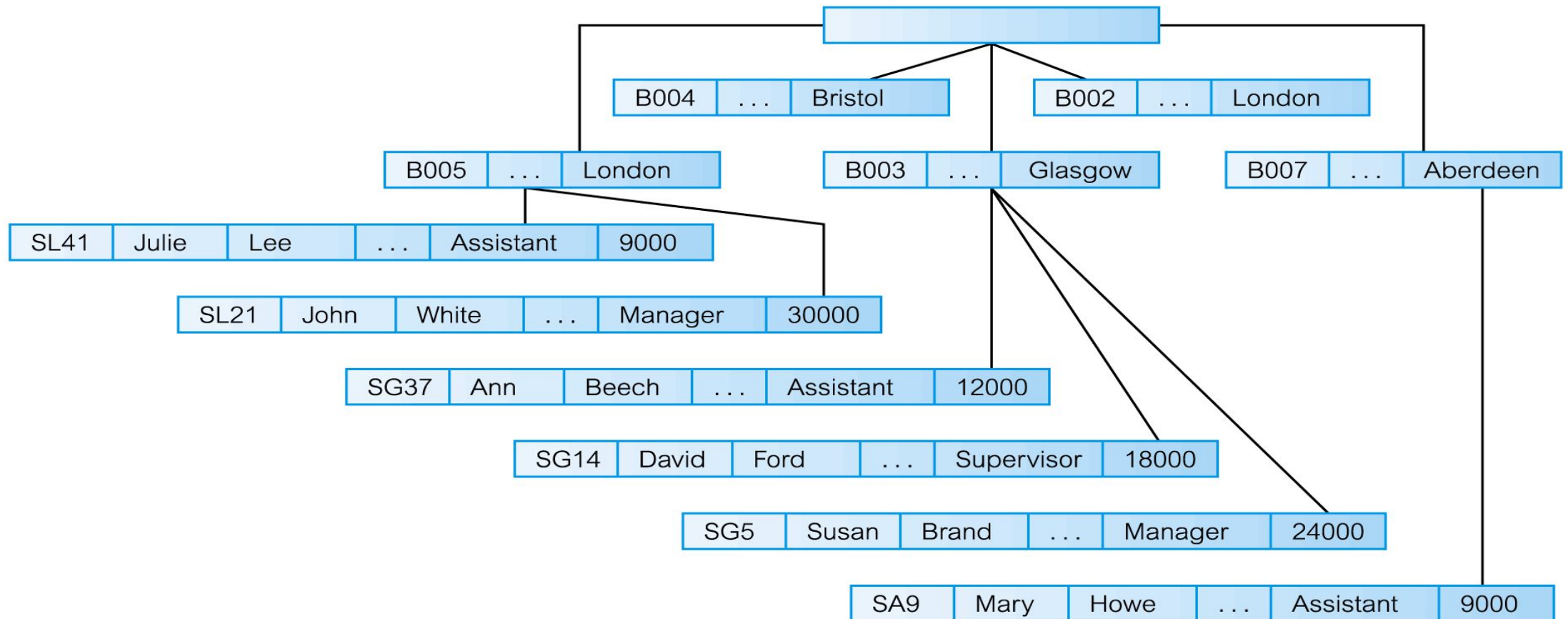
Staff

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

Network Data Model



Hierarchical Data Model



Conceptual Modelling

- ▶ Conceptual schema is the core of a system supporting all user views.
- ▶ Should be complete and accurate representation of an organization's data requirements.
- ▶ Conceptual modelling is process of developing a model of information usage, that is independent of implementation details.
- ▶ Result is a conceptual data model.

Functions of a DBMS

1. Data storage, retrieval, and update: A DBMS must furnish users with the ability to store, retrieve, and update data in the database.

2. A user-accessible catalog: A DBMS must furnish a catalog in which descriptions of data items are stored and which is accessible to users. The amount of information and the way the information is used vary with the DBMS. Typically, the system catalog stores:

- I. names, types, and sizes of data items;
- II. names of relationships;
- III. integrity constraints on the data;
- IV. names of authorized users who have access to the data and many more.

Functions of a DBMS

3. Transaction support: A DBMS must furnish a mechanism which will ensure either that all the updates corresponding to a given transaction are made or that none of them is made.

A more complicated example might be to delete a member of staff from the database *and* to reassign the properties that he or she managed to another member of staff. In this case, there is more than one change to be made to the database.

If the transaction fails during execution, perhaps because of a computer crash, the database will be in an **inconsistent** state: some changes will have been made and others not.

Functions of a DBMS

4. Concurrency control services: A DBMS must furnish a mechanism to ensure that the database is updated correctly when multiple users are updating the database concurrently.

Concurrent access is relatively easy if all users are only reading data, as there is no way that they can interfere with one another. However, when two or more users are accessing the database simultaneously and at least one of them is updating data, there may be interference that can result in inconsistencies.

Time	T ₁	T ₂	bal _x
t ₁		read(bal _x)	100
t ₂	read(bal _x)	bal _x = bal _x + 100	100
t ₃	bal _x = bal _x - 10	write(bal _x)	200
t ₄	write(bal _x)		90
t ₅			90

Functions of a DBMS

5. Recovery services: A DBMS must furnish a mechanism for recovering the database if the database is damaged in any way.

6. Authorization services: A DBMS must furnish a mechanism to ensure that only authorized users can access the database.

For example, we may want only branch managers to see salary-related information for staff and prevent all other users from seeing this data. Additionally, we may want to protect the database from unauthorized access.

The term **security** refers to the protection of the database against unauthorized access, either intentional or accidental.

Functions of a DBMS

7. Support for data communication: A DBMS must be capable of integrating with communication software.

8. Integrity services: Database integrity refers to the correctness and consistency of stored data: it can be considered as another type of database protection. While integrity is related to security, it has wider implications: integrity is concerned with the quality of data itself.

Integrity is usually expressed in terms of *constraints*, which are consistency rules that the database is not permitted to violate. For example, we may want to specify a constraint that no member of staff can manage more than 100 properties at any one time.

Functions of a DBMS

9. Services to promote data independence: A DBMS must include facilities to support the independence of programs from the actual structure of the database. Data independence is normally achieved through a view or subschema mechanism.

10. Utility services: Utility programs help the DBA to administer the database effectively.

- ▶ Import facilities, to load the database from flat files, and export facilities, to unload the database to flat files;
- ▶ Monitoring facilities, to monitor database usage and operation;
- ▶ Statistical analysis programs, to examine performance or usage statistics;
- ▶ Index reorganization facilities, to reorganize indexes and their overflows;
- ▶ Garbage collection and reallocation, to remove deleted records physically from the storage devices, to consolidate the space released, and to reallocate it where it is needed.

Next lecture

- ▶ **Components of a DBMS**
- ▶ **Multi-User DBMS Architectures**