Data Models

History of Database Systems

- First-generation
  - Hierarchical and Network
  - 1960's
- Second generation
  - Relational
  - 1970's
- Third generation
  - 1980's
  - Object-Relational
  - Object-Oriented

Data Model

- Def: Integrated collection of concepts for describing data, relationships between data, and constraints on the data in an organization.
- Purpose is to represent data in an understandable way
- Data Model comprises:
  - a structural part;
  - a manipulative part;
  - possibly a set of integrity rules
- Three levels of Data Models
  - External Data Model
  - Conceptual Data Model
  - Internal Data Model

Three Levels of Models

- External Data Model:
  - Represent each user's view of the organization
- Conceptual Data Model
  - Represent the logical (or community) view
  - It is DBMS independent;
- Internal data model
  - Represent the conceptual schema in such a way that it can be understood by the DBMS.

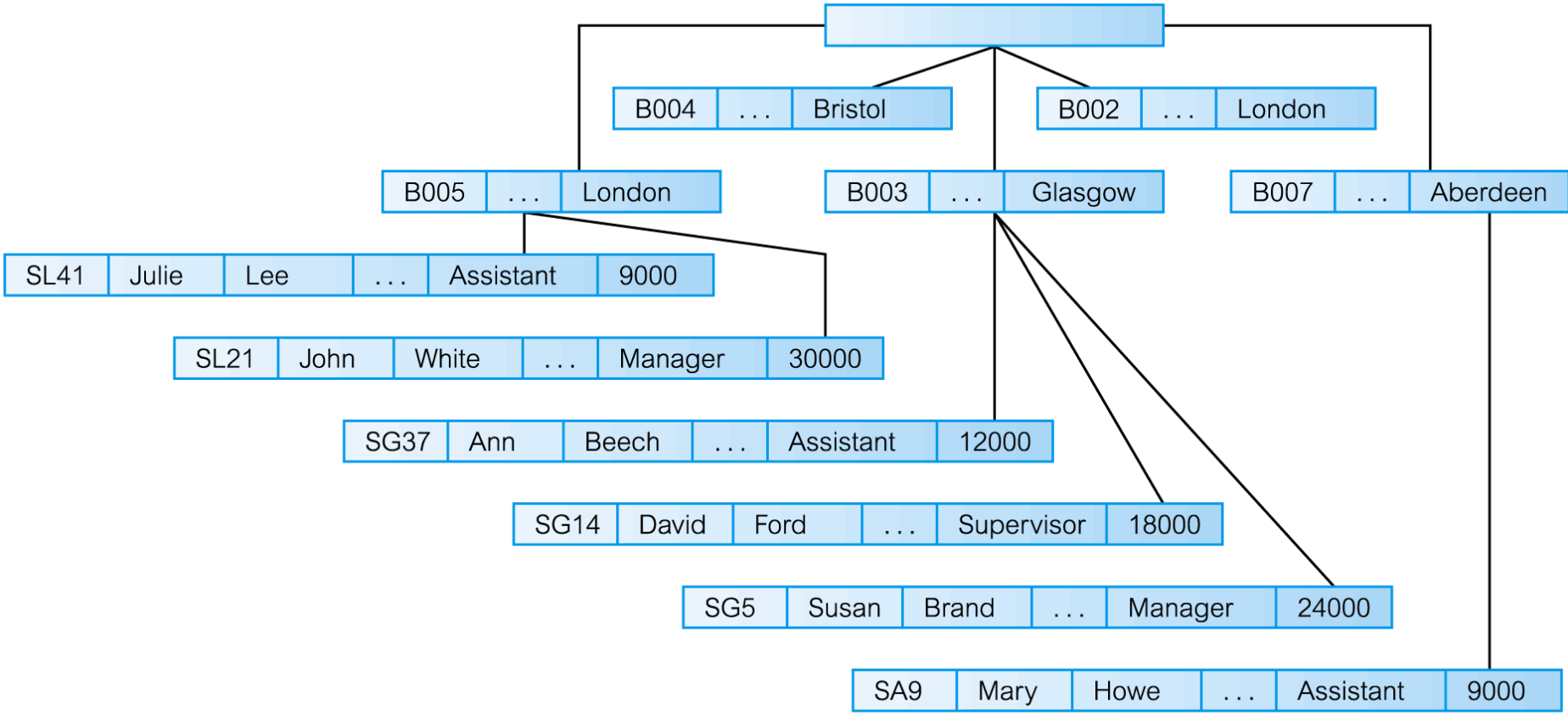
Types of Data Models

- Hierarchical Data Model
- Network Data Model
- Relational Data Model
- Object-Relational
- Object-Oriented

Hierarchical Data Model

- Record type is referred to as node
- The top node is the root node
- Nodes are arranged in a hierarchical structure
  - Like an inverted tree
- A parent node can have more than one child node
- A child node can only have one parent node
- The relationship between parent and child is one-to-many
- Relation is established by creating physical link between stored records (implemented as pointer)
- To add new record type or relationship, the database must be redefined and then stored in a new form.

Hierarchical Data Models (cont.)



Network Data Model

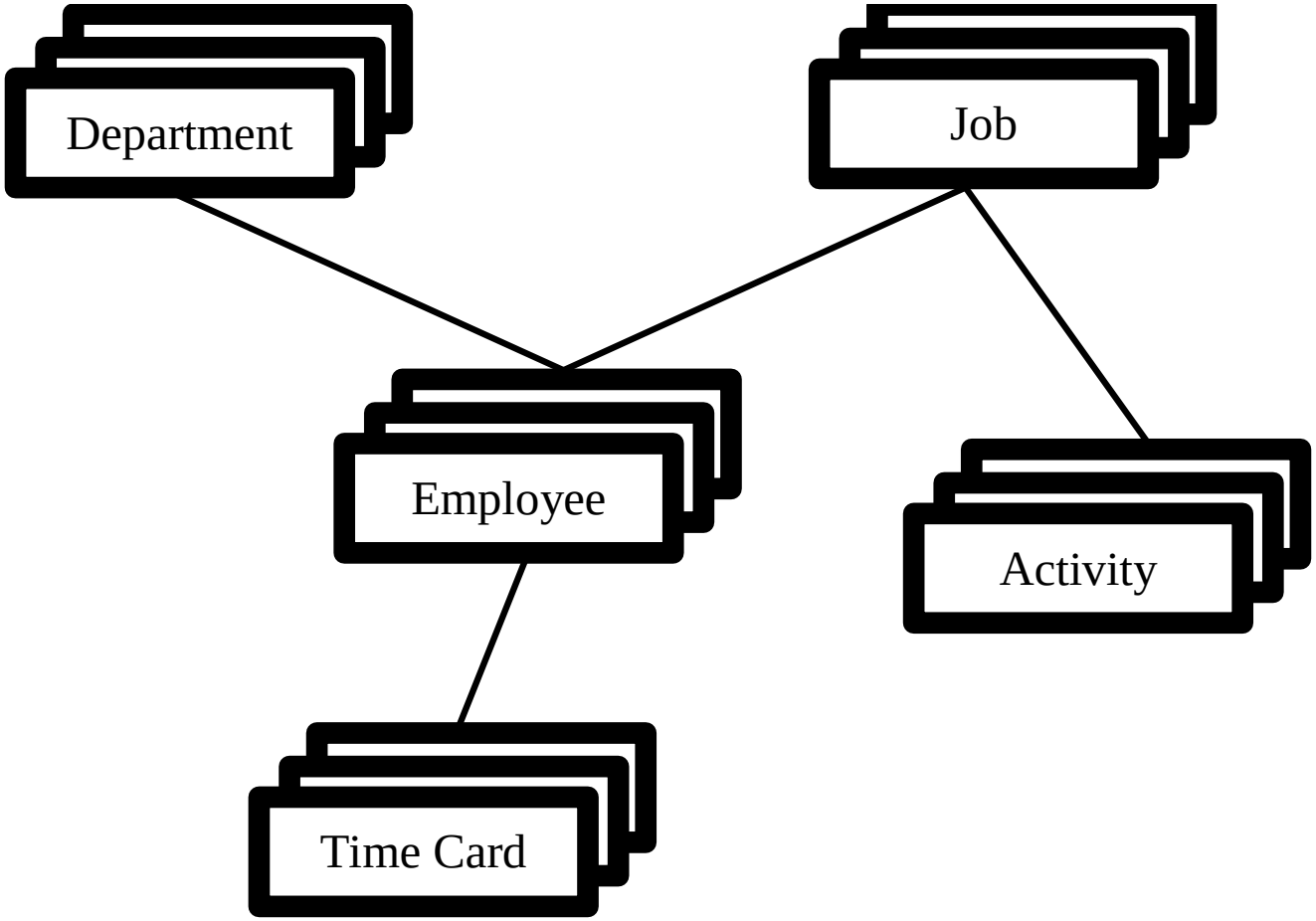
- Allows record types to have more than one parent
  - unlike hierarchical model
- A network data models sees records as set members
- Each set has an owner and one or more members
- Allows many to many relationship between entities
- Like hierarchical model network model is a collection of physically linked records.
- Allow member records to have more than one owner

Network Data Model (cont.)

B005	22 Deer Rd	London
B007	16 Argyl St	Aberdeen
B003	163 Main St	Glasgow
B004	32 Manse Rd	Bristol
B002	56 Clover Dr	London

SL41	Jul e	Lee	. . .	Assistant	9000
SL21	John	White	. . .	Manager	30000
SA9	Mary	Howe	. . .	Assistant	9000
SG37	Ann	Beech	. . .	Assistant	12000
SG14	David	Ford	. . .	Supervisor	18000
SG5	Susan	Brand	. . .	Manager	24000

Network Data Model (cont.)



1st Generation Data Models

- Hierarchical and Network Model
  - Navigational and procedural approach to data processing
  - Need to know the physical Database to access the data
  - Treat records as individual objects linked with pointers
    - i.e. cannot process in sets
- Both kinds of DBMSs were accessible from the programming language (usually Cobol) using a low-level interface
- Made the task of creating an application, maintaining the database as well as tuning and development controllable, but still complex and time-consuming.

2nd Generation Data Models

- Relational DBMS - 1970 Edgar F. Codd
- Data in a database could be represented as a tabular structure
  - Using tables with columns and rows
  - These tables were called relations
- These tables can be accessed using a high-level non-procedural (or declarative) language.
  - Instead of writing algorithms to access data
  - This approach only needed a predicate that identified the desired records or combination of records.
- In the beginning of the 1980s several Relational DBMS (RDBMS) products emerged
  - e.g. Oracle, Informix, Ingres and DB2

Relational Data Model

- Based on set theory and is based on the concept of Relation
- The database is seen as a collection of tables
  - Relation: Two dimensional table
- Stores data in the form of tables – rows and columns
- A row of the table is called tuple – equivalent to record
- Columns are called attribute – equivalent to fields
- Data value is the value of the Attribute
- Records are related by the data stored jointly in the fields of records in two tables.
- Uses Declarative (as Opposed to Procedural) approach to Database Processing
- Can Treats Records as a Group (Set)

Relational Data Model (cont.)

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

3rd Generation Data Models

- Object-Relational
  - Object-relational DBMS (ORDBMS)
  - Includes some object-oriented features and encapsulate these features into an RDBMS
  - extend the capabilities of an RDBMS to include support for richer object structures
- Object-Oriented
  - OODBMSs
  - Offer persistence to objects, including the object's associations and methods.