



Lecture 5

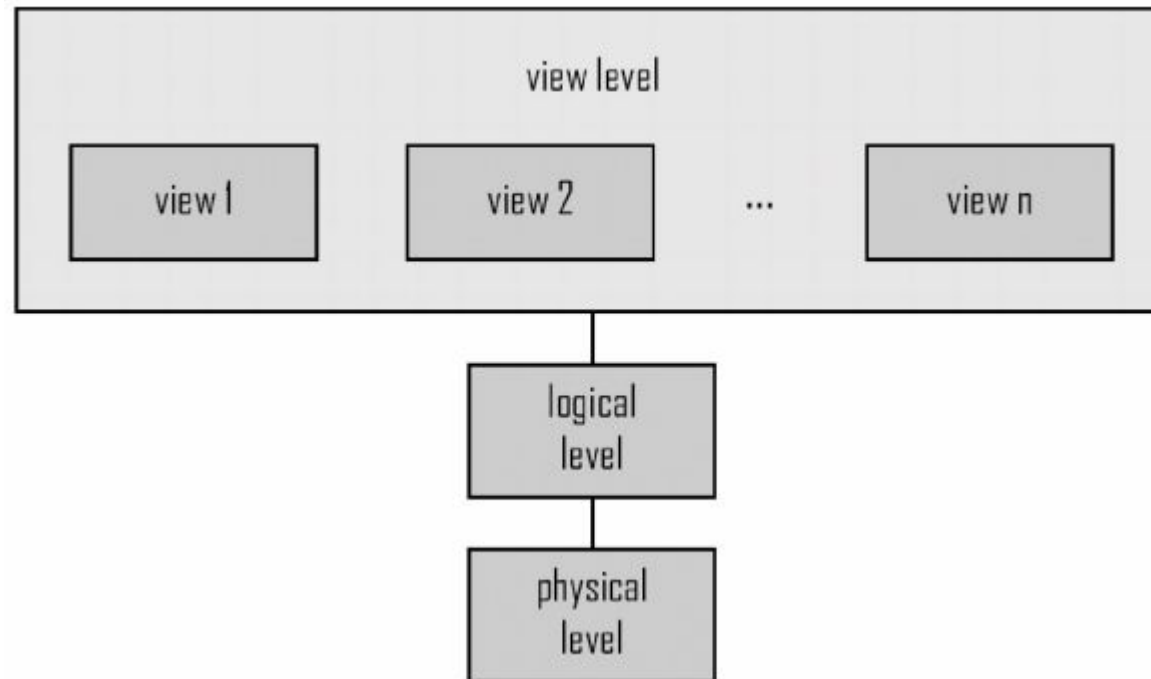
Database Management System

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Lesson 2: Data Model (6hrs)

1. **Different Data Model Concepts**
2. **E-R Model**
3. **Network/Hierarchical Model**
4. **Relational Model**
5. **Entities, Relationships and Attributes**
6. **E-R Diagrams, Keys**
7. **Generalization, Specialization and Aggregation**

Data Model Concept



Data Model Concept

- ◆ It refers to the collection of concepts that can be used to describe the structure of a database, describing data, data relations, semantics, etc.

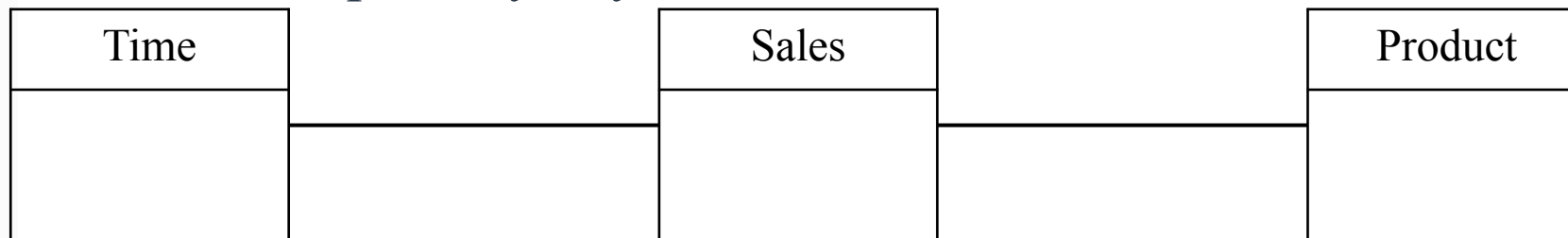
a) Conceptual Data Model

b) Logical Data Model

c) Physical Data Model

Data Model Concept: Conceptual Data Model

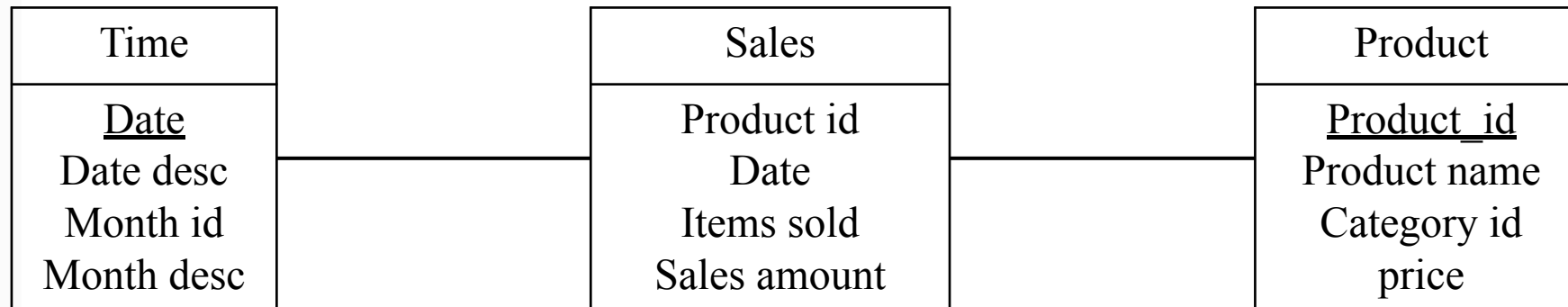
- ◆ Only sees entity (table).
- ◆ Eagle eye view concept.
- ◆ Identify the highest-level relationships between different entities.
- ◆ Includes important entities and relationships among them.
- ◆ No attributes and primary key are defined.



Data Model Concept: Logical Data Model

- ◆ Aka Implementation or Representation data model.
- ◆ Describes the data in as much detail as possible without regard to how they will be physically implemented in database.
- ◆ It includes all entities and relationships among them.
- ◆ All attributes are specified.
- ◆ Primary and foreign keys are specified.
- ◆ Normalization occurs at this level.

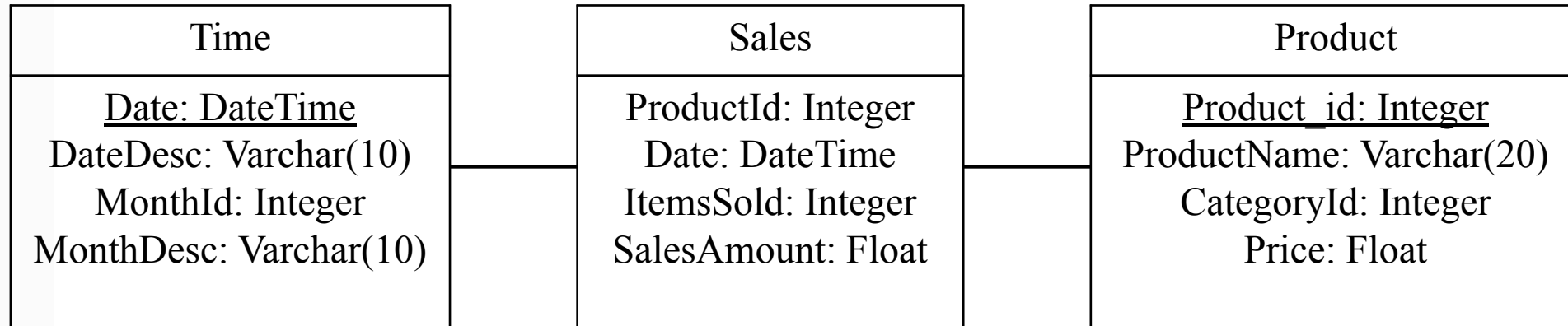
Data Model Concept: Logical Data Model



Data Model Concept: Physical Data Model

- ◆ Describes the details of how data are stored in the system.
- ◆ The concepts are generally for computer specialists.
- ◆ It shows all table structure including column name, column data type, column constraints, primary key, foreign key, relationships, etc.
- ◆ Denormalization may occur based on user requirements.

Data Model Concept: Physical Data Model



Data Model Concept

- ◆ Complexity increases from conceptual data model to logical data model to physical data model.

Data Model

- ◆ Data models describe the underlying structure of database.
- ◆ It is a conceptual tool for describing data, relationship among data, data semantics and consistency constraints.
- ◆ There are several data models which can be group into three categories.
 - a) **Object-based Logical Models.**
 - b) **Record-based Logical Models.**
 - c) **Physical Data Models.**

Object-based Logical Models

- ◆ Object based logical model describe data at the logical and view levels.
- ◆ It has flexible structuring capabilities.
- ◆ It allows to specify data constraints explicitly.
- ◆ Under object-based logical model there are sever data models
 - ◆ **Entity-relationship model**
 - ◆ **Object-oriented model**
- ◆ Object-based models focus on representing real-world entities and the relationships between them.

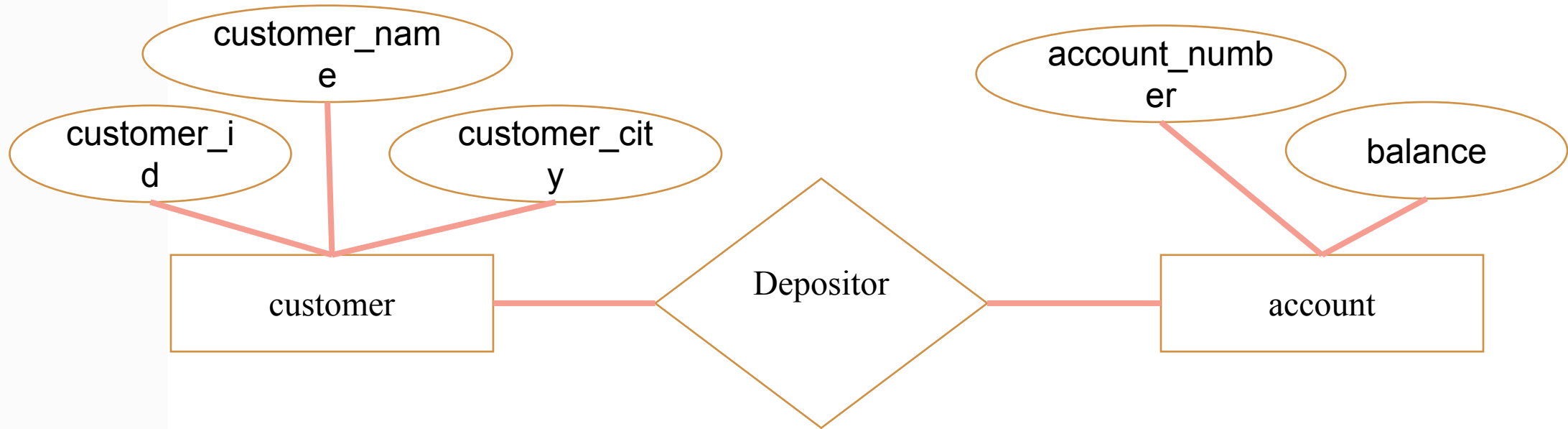
Entity-relationship model

- ◆ E-R model describes the design of database in terms of entities and relationship among them.
- ◆ An entity is a “thing” or “object” in real world that are distinguishable from other objects.
- ◆ An entity is described by a set of attributes. For example
 - ◆ Attributes `account_number` and `balance` may describe entity “account”.
 - ◆ Attributes `customer_id`, `customer_name`, `customer_city` may describe entity “customer”.
- ◆ E-R model graphically express overall logical structure of a database by an E-R diagram.

Entity-relationship model

- ◆ A relationship is an association among several entities. For example, a depositor relationship associates a customer with each account he or she has.
- ◆ The set of all entities of same type called entity set and similarly set of all relationship of the same type called relationship set.
- ◆ Components of E-R diagram are as follows:
 - ◆ rectangles: represent entity sets
 - ◆ ellipses: represent attributes
 - ◆ diamonds: represent relationships among entity sets
 - ◆ lines: link attributes to entity sets and entity sets to relationships

Entity-relationship model



Object-oriented model

- ◆ Object oriented data model is extension to E-R model with the notion of encapsulation, methods (functions) and object identity.
- ◆ It is based on collection of objects, like the E-R model.
- ◆ An object contains values stored in instance variables within the object.
- ◆ These values are themselves objects. That is, objects can contain objects to an arbitrarily deep level of nesting.
- ◆ The only way in which one object can access the data of another object is by invoking the method of that other object. This is called sending a message to the object.

Record-based Logical Models

- ◆ Record-based logical model also describes data at logical and view level.
- ◆ It describes logical structure of database in more detail for implementation point of view.
- ◆ It describes database structure in terms of fixed-format records of different types.
- ◆ Each table contains records of a particular type.
- ◆ And each record type defines fixed number of fields or attributes.
- ◆ Each field is usually of a fixed length.
- ◆ **Record-based models emphasize the organization of data in records and tables.**

Record-based Logical Models

- ◆ The three most widely-accepted models under record-based logical models are:
 - ◆ **Relational model**
 - ◆ **Network model**
 - ◆ **Hierarchical**

Relational model

- ◆ Relational model describes database design by a collection of tables (relations).
- ◆ It represents both data and their relationships among those data.
- ◆ Each table consist number of columns (attributes) with unique names.
- ◆ It is a most widely used data model.
- ◆ Relational model is lower-level abstraction than E-R model.
- ◆ Database model are often carried out in E-R model and then translated into relational mode.

Relational model

- Previous describe E-R model can be expressed in relational model as:

Customer_id	Customer_name	Customer_city
C01	X	A
C02	Y	B
C03	Z	A
C04	X	A

Account_number	balance
A1	200
A2	300
A3	500
A4	500

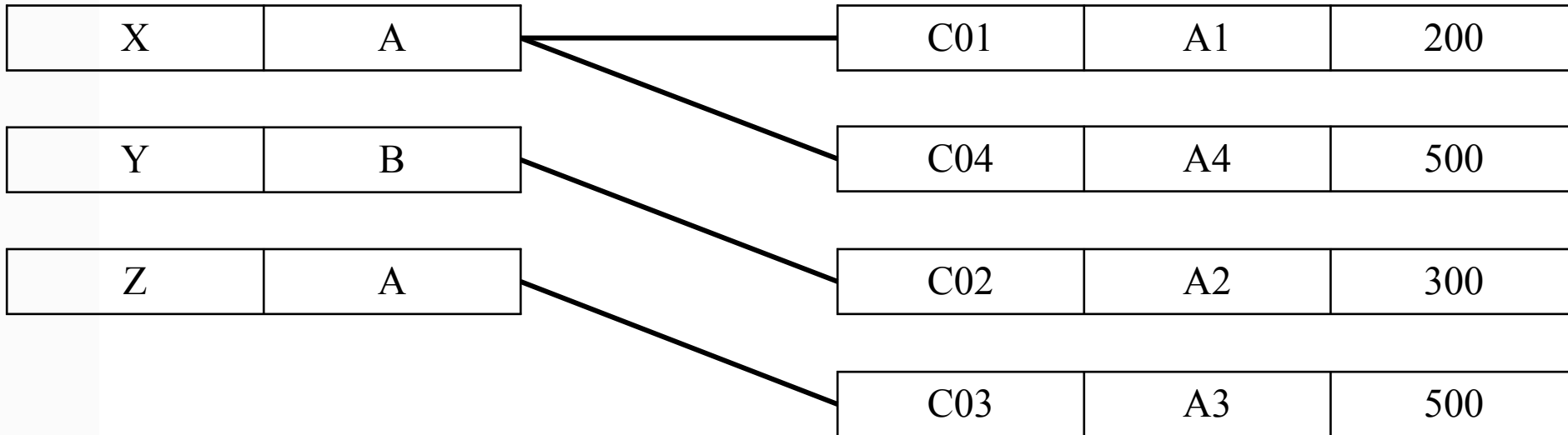
Customer_id	Account_number
C01	A1
C02	A2
C03	A3
C04	A4

Customer relation

account relation

Network model

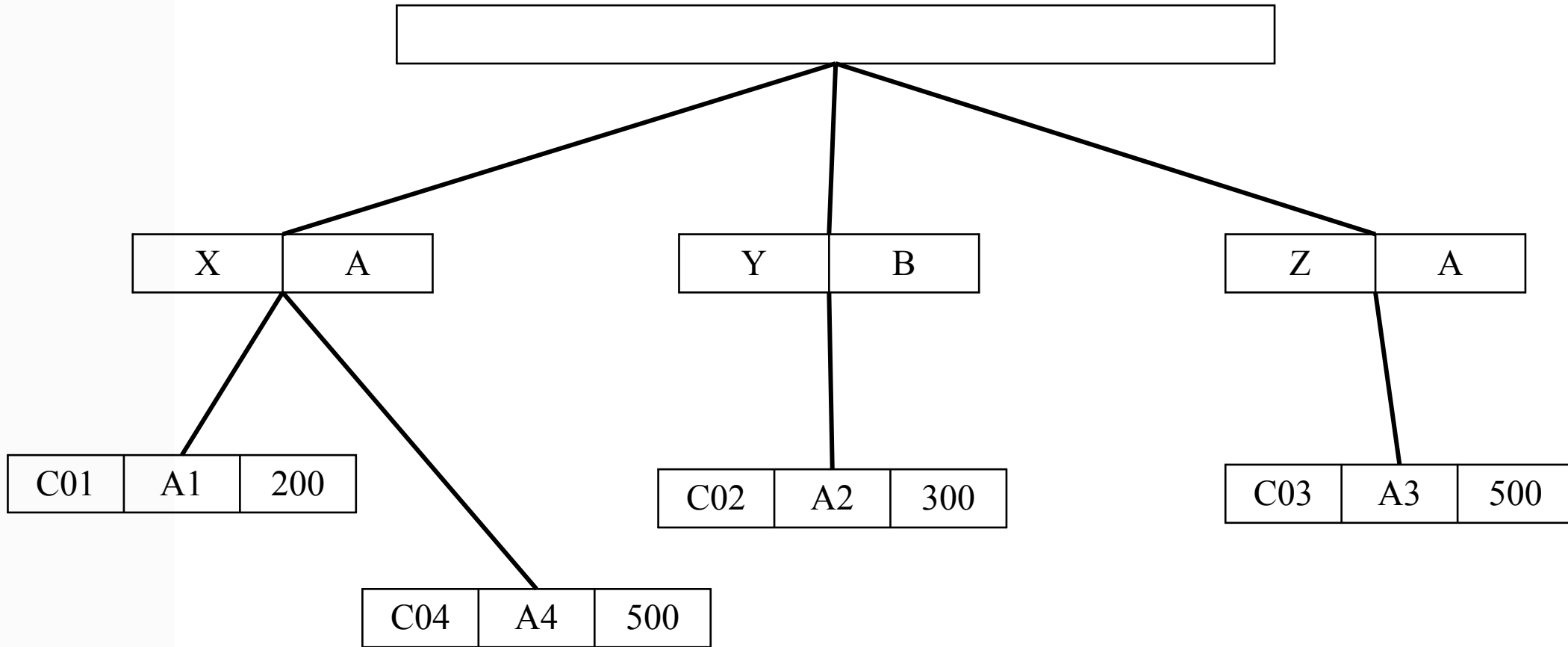
- ◆ In network model, data are represented by the set of records and
 - ◆ relationships among data are represented by links.



Hierarchical Models

- ◆ Hierarchical model also represents data by a set of records, but records are organized in hierarchical, or order structure and database is a collection of such disjoint trees.
- ◆ The nodes of the tree represent record types.
- ◆ Hierarchical tree consists one root record type along with zero or more occurrences of its dependent subtree and each dependent subtree is again hierarchical.
- ◆ In hierarchical model, no dependent record can occur without its parent record.
- ◆ Furthermore, no dependent record may be connected to more than one parent record.

Hierarchical Models



Physical Data Models

- ◆ Physical data models are used to describe data at the lowest level.
- ◆ Example: Indexed Sequential Access Method (ISAM) is a physical data model that defines how data is physically organized to optimize storage and retrieval.
- ◆ Physical data models describe how data is stored and accessed at the physical level.

END OF LECTURE 5

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PREVIEW FOR LECTURE 6

ENTITIES, RELATIONSHIPS AND ATTRIBUTES

E-R DIAGRAMS, KEYS

GENERALIZATION, SPECIALIZATION AND AGGREGATION