

DATABASE SYSTEMS

Presented by Prof. Elisha T. O. Omulo

WEEK 6 AGENDA

- Enhanced entity-relationship (EER) model
- Use of supertype/subtype relationships in data modeling.
- Specialization and generalization techniques for defining supertype/subtype relationships.
- completeness constraints and disjointness constraints in modeling supertype/subtype relationships.
- Entity cluster to simplify presentation of an ER diagram.

Course Textbook: Carlos Coronel, Steven Morris, Peter Rob and Keeley Crockett Database Principles: Fundamentals of Design, Implementation, and Management, 14th Edition, 2022, ISBN-13978-0357673034.

Enhanced entity-relationship (EER) model

Limitation of ER Model

- Basic concepts of ER modeling lack ability to represent the requirements of the newer, more complex applications.
- A need to develop additional 'semantic' modeling concepts developed.

The Enhanced ER (EER) model

- The Enhanced Entity–Relationship Model is the ER model supported with additional semantic concepts.
- Additional concepts: specialization/generalization, aggregation, and composition. Unified Modeling Language (UML) is used to diagrammatically represent the basic concepts of the ER model.
- **Also(Course text):** extended entity relationship model (EERM), sometimes referred to as the enhanced entity relationship model, is the result of adding more semantic constructs to the original entity relationship (ER) model.

Task: Discuss the notion of EER model.

Use of supertype/subtype relationships in data modeling.

ENTITY SUPERTYPES AND SUBTYPES

Entity supertype- a generic entity type that is related to one or more entity subtypes.

SUPERTYPE

Example: EMPLOYEE
STUDENT
PERSON

SUBTYPES

PILOT, ADMINISTRATOR, ENGINEER
FRESHER, SOMOPHORE, SENIOR
INFANT, YOUNG, MID-AGE, OLD

Tables in which the subtypes are not considered tend to have too many NULLS.

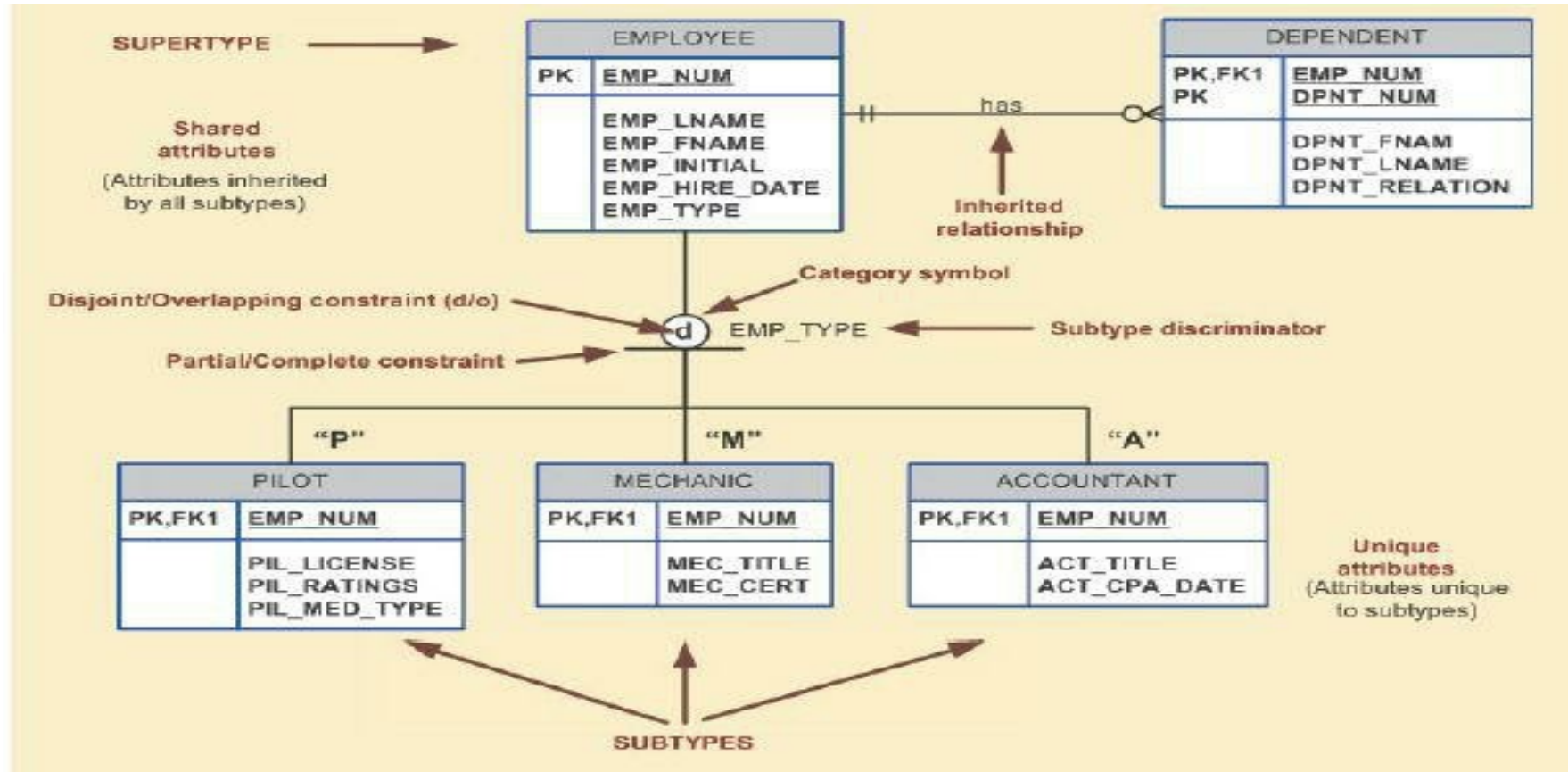
Determining supertypes and subtypes

- There must be different, identifiable kinds or types of the entity in the user's environment.
- The different kinds or types of instances should each have one or more attributes that are unique to that kind or type of instance.

Task: As at least 5 different examples of supertypes and subtypes.

Use of supertype/subtype relationships in data modeling.

ENTITY SUPERTYPES AND SUBTYPES



Task: As at least 5 different examples of supertypes and subtypes.

Use of supertype/subtype relationships in data modeling.

ENTITY SUPERTYPES AND SUBTYPES

- **Specialization-** Specialization hierarchies enable the data model to capture additional semantic content (meaning) into the ERD. A specialization hierarchy provides the means to:
- Support attribute inheritance.
- Define a special supertype attribute known as the subtype discriminator.
- Define disjoint/overlapping constraints and complete/partial constraints.
- Semantic “is-a” relationships is introduced in the specialization hierarchy.

Task: As at least 5 different examples of supertypes and subtypes.

Specialization and generalization techniques for defining supertype/subtype relationships.

Inheritance

- Allows entity subtype to inherit the attributes and relationships of the supertype.
- A supertype contains attributes that are common to all of its subtypes.
- However, subtypes contain only the attributes that are unique to the subtype.
- Example: pilots, mechanics, and accountants all inherit the employee attributes eg number, last name, firstname, middle initial, and hire date from the EMPLOYEE entity; but pilots have unique attributes; the same is true for mechanics and accountants.
- Note that inheritance enables all entity subtypes to inherit their primary key attribute from their supertype.

Task: discuss inheritance

Specialization and generalization techniques for defining supertype/subtype relationships.

Database name: Ch05_AirCo

Table name: EMPLOYEE

EMP_NUM	EMP_LNAME	EMP_FNAME	EMP_INITIAL	EMP_HIRE_DATE	EMP_TYPE
100	Kolmycz	Xavier	T	15-Mar-88	
101	Lewis	Marcos		25-Apr-89	P
102	Vandam	Jean		20-Dec-93	A
103	Jones	Victoria	R	28-Aug-03	
104	Lange	Edith		20-Oct-97	P
105	Williams	Gabriel	U	08-Nov-97	P
106	Duzak	Mario		05-Jan-04	P
107	Diante	Venite	L	02-Jul-97	M
108	Wiesenbach	Joni		18-Nov-95	M
109	Travis	Brett	T	14-Apr-01	P
110	Genkazi	Stan		01-Dec-03	A

Table name: PILOT

EMP_NUM	PIL_LICENSE	PIL_RATINGS	PIL_MED_TYPE
101	ATP	SEL/MEL/Instr/CFII	1
104	ATP	SEL/MEL/Instr	1
105	COM	SEL/MEL/Instr/CFI	2
106	COM	SEL/MEL/Instr	2
109	COM	SEL/MEL/SES/Instr/CFII	1

Task: How do supertypes and subtypes relate? Discuss.

Completeness constraints and disjointness constraints in modeling supertype/subtype relationships.

Subtype discriminator: is the attribute in the supertype entity that determines to which subtype the supertype occurrence is related.

Example: subtype discriminator in EMPLOYEE table is the employee type (EMP_TYPE).

Overlapping subtypes: subtypes that contain nonunique subsets of the supertype entity set; that is, each entity instance of the supertype may appear in more than one subtype, eg. in a university a person may be an employee, a student, or both. A an employee may be a professor as well as an administrator.

Task: Discuss where the subtype discriminator should be placed

Completeness constraints and disjointness constraints in modeling supertype/subtype relationships.

- **Disjoint subtypes:** also known as nonoverlapping subtypes, are subtypes that contain a unique subset of the supertype entity set; in other words, each entity instance of the supertype can appear in only one of the subtypes, eg. an employee (supertype) who is a pilot (subtype) appears only in the PILOT subtype, not in any of the other subtypes.



Completeness constraint: each entity supertype occurrence must also be a member of at least one subtype.

The completeness constraint can be partial or total.

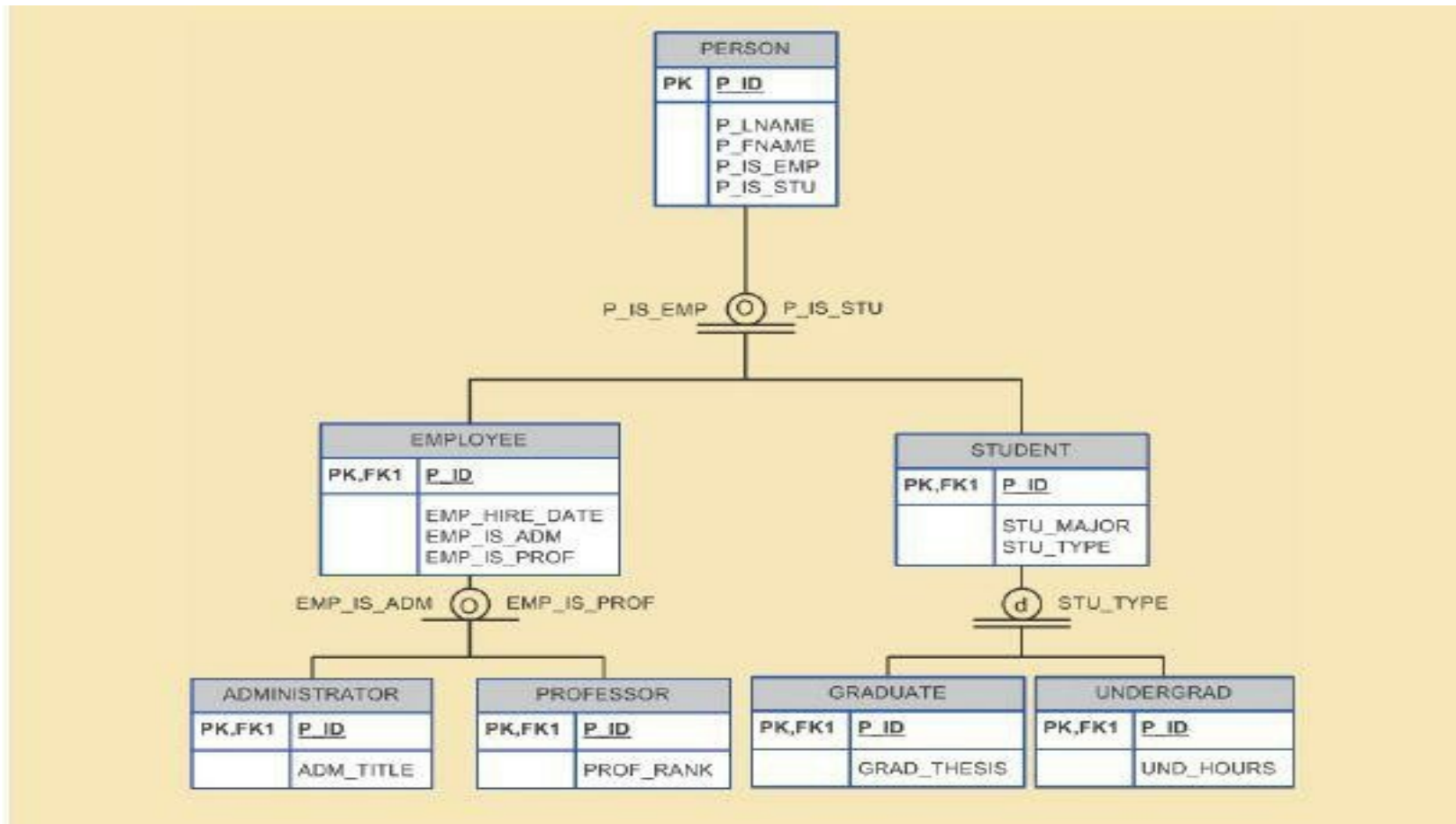
Partial completeness: not every supertype occurrence is a member of a subtype;

Total completeness: every supertype occurrence must be a member of at least one subtype.

Completeness constraints and disjointness constraints in modeling supertype/subtype relationships.

TYPE	DISJOINT CONSTRAINT	OVERLAPPING CONSTRAINT
Partial 	Supertype has optional subtypes. Subtype discriminator can be null. Subtype sets are unique.	Supertype has optional subtypes. Subtype discriminators can be null. Subtype sets are not unique.
Total 	Every supertype occurrence is a member of only one subtype. Subtype discriminator cannot be null. Subtype sets are unique.	Every supertype occurrence is a member of at least one subtype. Subtype discriminators cannot be null. Subtype sets are not unique.

Completeness constraints and disjointness constraints in modeling supertype/subtype relationships.



Task: Discuss disjoint and overlapping subtypes.

Entity cluster to simplify presentation of an ER diagram.

Specialization: top-down process of identifying lower-level, more specific entity subtypes from a higher-level entity supertype. Done by grouping the unique characteristics and relationships of the subtypes.

Generalization: bottom-up process of identifying a higher-level, more generic entity supertype from lower-level entity subtypes. Done by grouping the common characteristics and relationships of the subtypes.

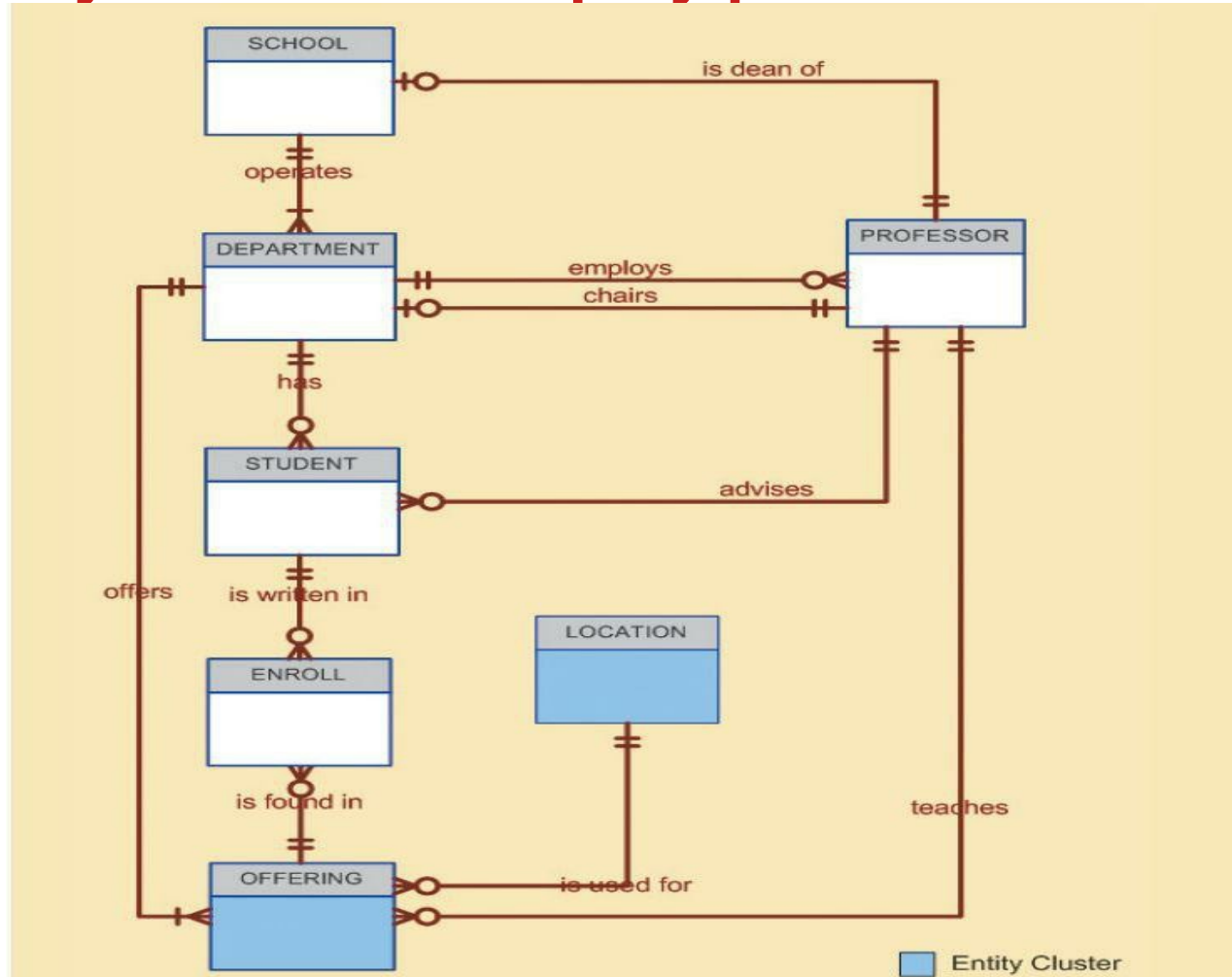
For example multiple types of musical instruments: piano, violin, and guitar can be generalized to “string instrument” entity supertype.

Entity cluster: “virtual” entity type used to represent multiple entities and relationships in the ERD.

- Formed by combining multiple interrelated entities into a single, abstract entity object. An entity cluster is considered “virtual” or “abstract” in the sense that it is not actually an entity in the final ERD.
- It is a temporary entity used to represent multiple entities and relationships, with the purpose of simplifying the ERD and thus enhancing its readability.

Task: describe entity clustering.

Entity cluster to simplify presentation of an ER diagram.



There are two entity clusters: **OFFERING**, which groups the **COURSE** and **CLASS** entities and relationships.

LOCATION, which groups the **ROOM** and **BUILDING** entities and relationships.

Week 6 exercises

- 1) Describe Enhanced entity-relationship (EER) model**
- 2) Recognize when to use supertype/subtype relationships in data modeling.**
- 3) Use both specialization and generalization as techniques for defining supertype/subtype relationships.**
- 4) Specify both completeness constraints and disjointness constraints in modeling supertype/subtype relationships.**
- 5) Develop an entity cluster to simplify presentation of an ER diagram.**

Week 6 Session References

- [Course Text] Carlos Coronel, Steven Morris, Peter Rob and Keeley Crockett Database Principles: Fundamentals of Design, Implementation, and Management, 14th Edition, 2022, ISBN-13978-0357673034.
- Thomas M. Connolly, Carolyn E. Begg (2021). Database Systems: A Practical Approach to Design, Implementation, and Management. Published by Pearson (July 14th 2021). ISBN-13: 9780137517053

Thank You

