Week 7, Lecture 14

Database Systems -

Introduction to Databases and Data Warehouses

CHAPTER 2 - Database Requirements and ER Modeling (Part I)

MAIN TOPICS

- Basic ER Modeling constructs
- Entity, Entity instance
- Attributes (Unique, Non-Unique)
- Relationship and its cardinality constraints
- Types of relationships (maximum cardinality wise)
- Relationship, Relationship instance
- Relationship attribute
- Examples of Database requirements and ERD

INTRODUCTION

- **Entity-relationship (ER) modeling** - conceptual database modeling technique
  - Enables the structuring and organizing of the requirements collection process
  - Provides a way to graphically represent the requirements
- **ER diagram (ERD)** - the result of ER modeling
  - Serves as a blueprint for the database

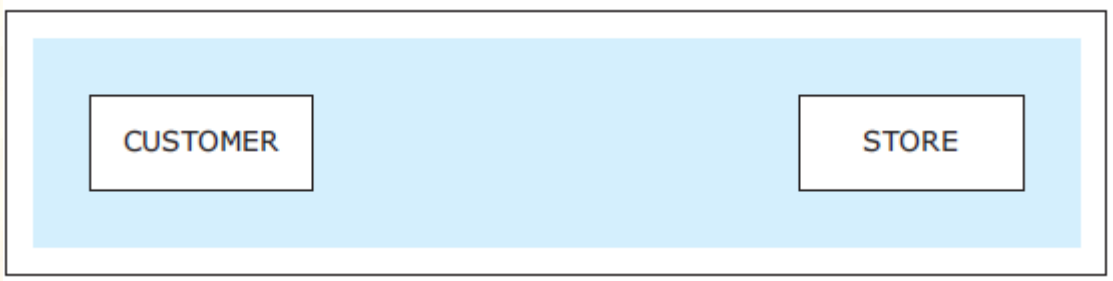
ENTITIES

- **Entities** - constructs that represent what the database keeps track of
  - The basic building blocks of an ER diagram
  - Represent various real world notions, such as people, places, objects, events, items, and other concepts
  - Within one ERD each entity must have a different name
  - Examples in a retail company's ERD
    - CUSTOMER, STORE, PRODUCT and SALES TRANSACTION

ENTITIES

Entities are denoted by rectangles with entity names inside.

Two entities:



ENTITIES

- **Entity instances (entity members)** – one or more occurrences of an entity
  - Example:
    - Entity CUSTOMER may contain entity instances (specific customers): customer Joe, customer Sue, and customer Pat.
  - Entities themselves are depicted in the ER diagrams while entity instances are not
  - Entity instances are eventually recorded in the database that is created based on the ER diagram

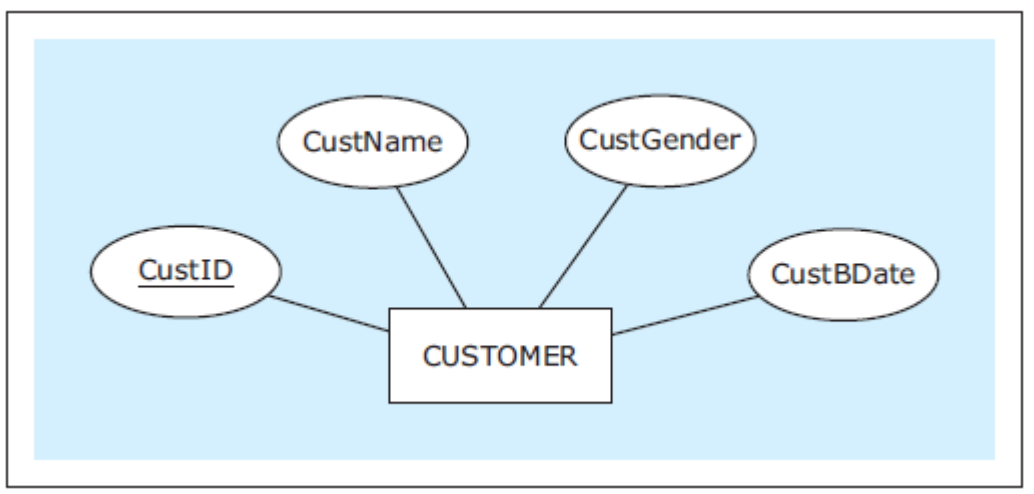
ATTRIBUTES

- **Attribute** - depiction of a characteristic of an entity
  - Represents the details that will be recorded for each entity instance
  - Within one entity, each attribute must have a different name
  - Example
    - entity CUSTOMER has attributes: customer ID, customer name
  - Denoted by ovals with attribute names inside
- **Unique Attribute** - attribute whose value is different for each entity instance
  - Example
    - customer ID of entity CUSTOMER
  - Are underlined in an ERD
  - Every regular entity must have at least one unique attribute

ATTRIBUTES

An entity CUSTOMER with 4 attributes:

- CustID is a unique attribute



RELATIONSHIPS

- **Relationship** - ER modeling construct depicting how entities are related
  - Denoted by diamonds with relationship names inside
  - Within an ER diagram, each entity must be related to at least one other entity via a relationship

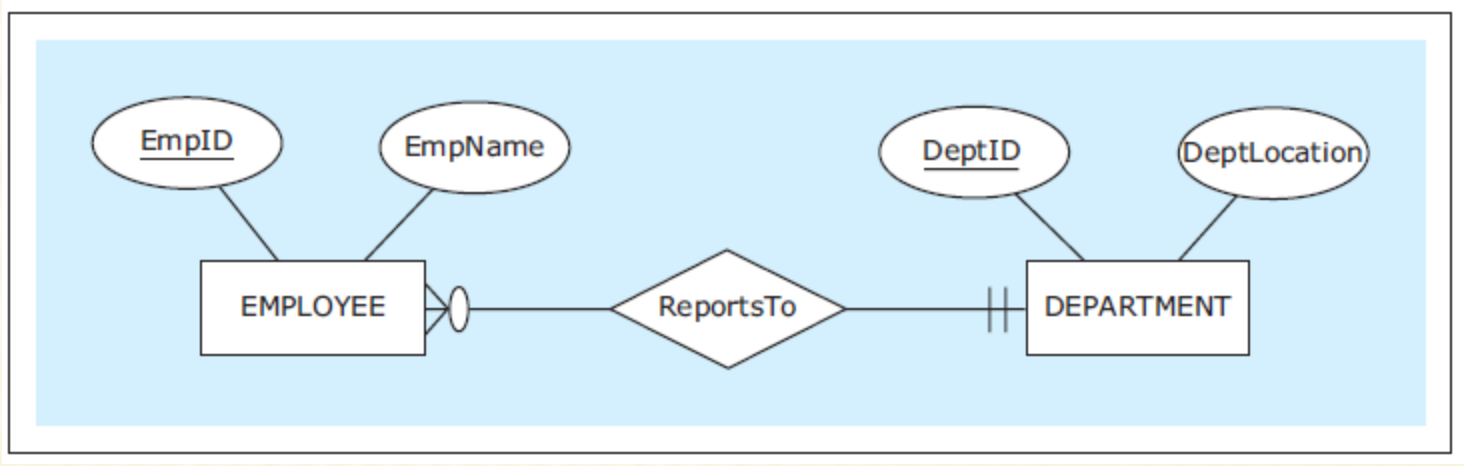
RELATIONSHIPS

- **Cardinality constraints** - depict how many instances of one entity can be associated with instances of another entity
  - **Maximum cardinality**
    - Denoted closer to the entity rectangle
    - Can be
      - **One** (represented by a straight bar: I)
      - **Many** (represented by a crow's foot symbol)
  - **Minimum cardinality (participation)**
    - Denoted farther away from the entity rectangle
    - Can be
      - **Optional** (represented by a circular symbol: O)
      - **Mandatory** (represented by a straight bar: I)

RELATIONSHIPS

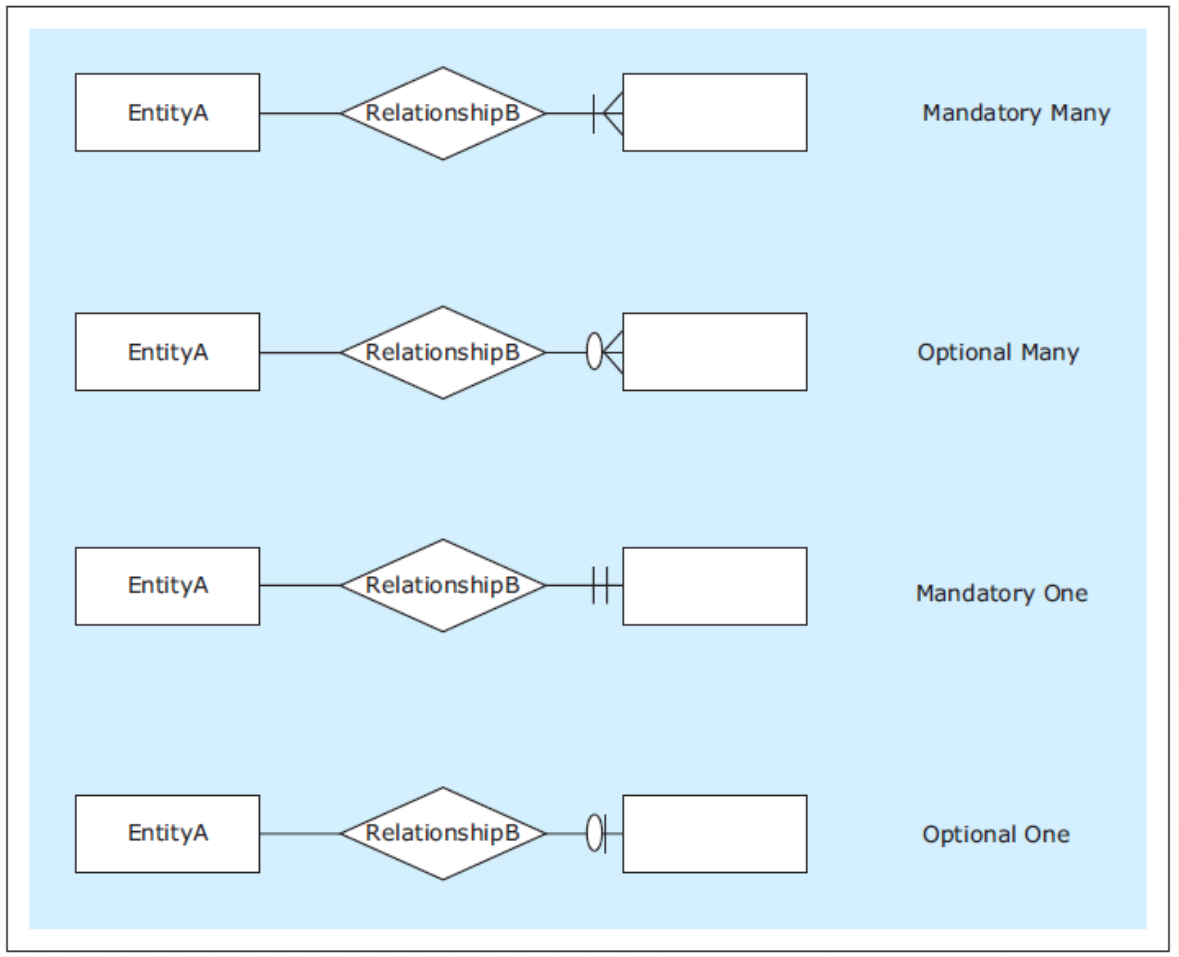
A relationship ReportsTo between two entities EMPLOYEE, DEPARTMENT

- An employee reports to exactly one department.
- A department may have many employees reporting to it, but does not have to have any.



RELATIONSHIPS

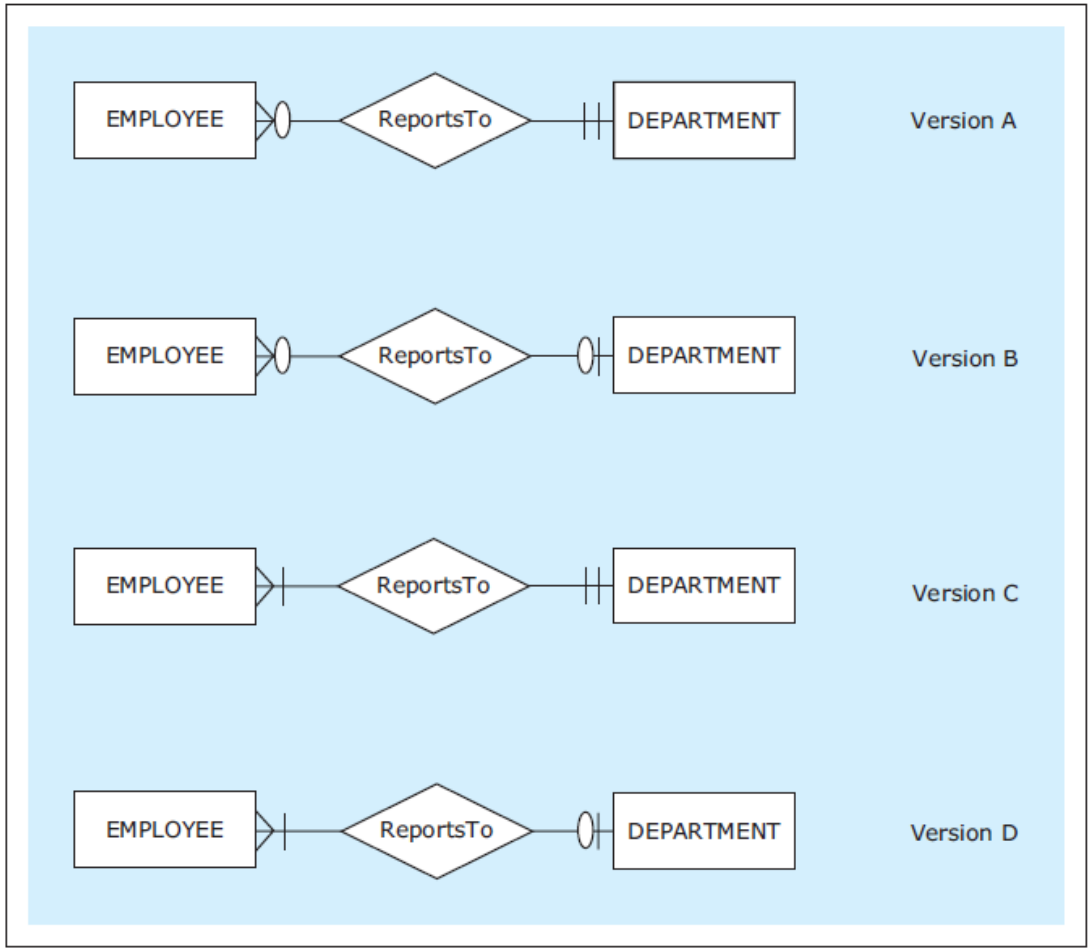
Four possible cardinality constraints



RELATIONSHIPS

Several possible versions of the relationship ReportsTo

See notes page for details.

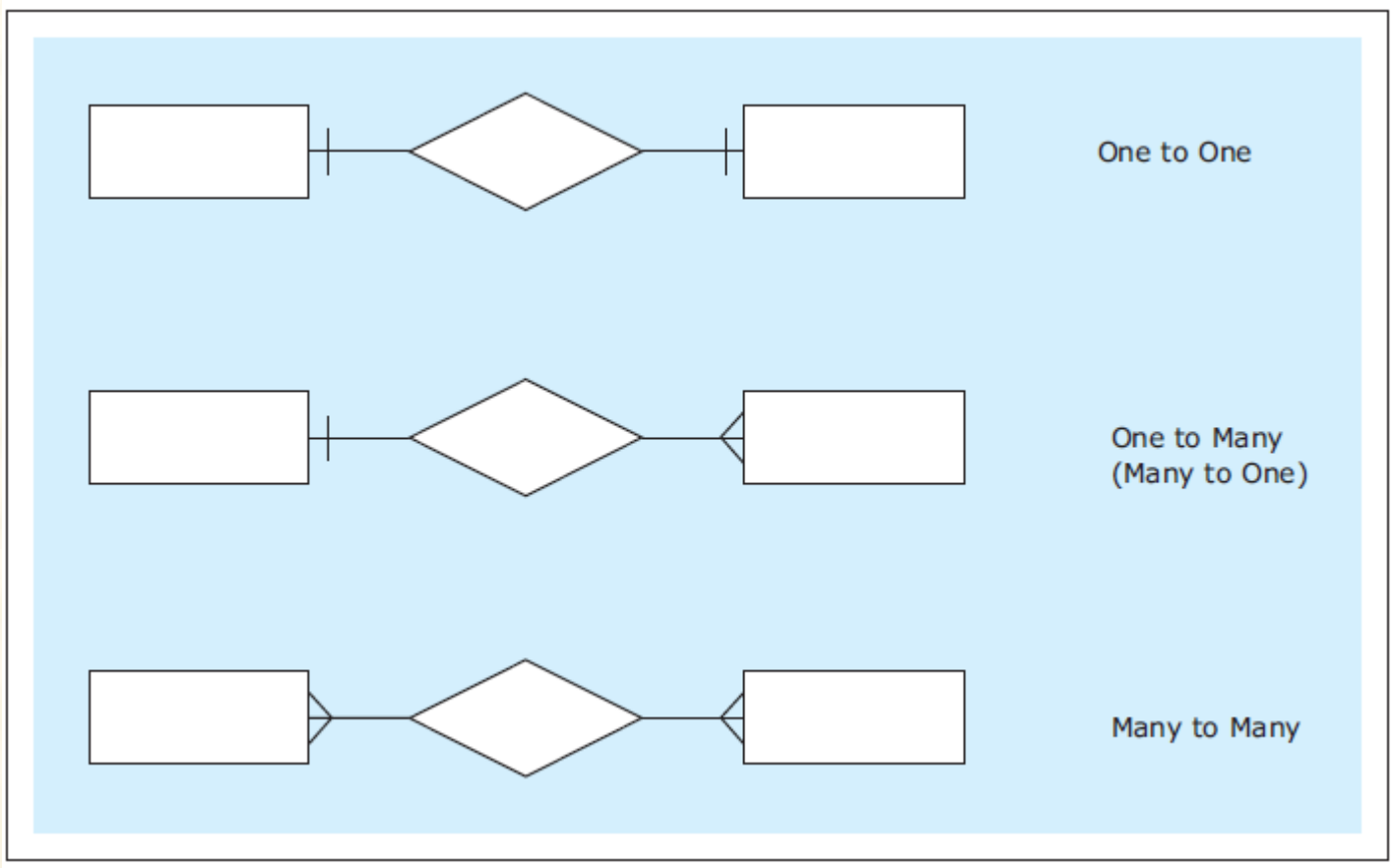


RELATIONSHIPS

- Types of Relationships (maximum cardinality-wise, omitting minimum cardinality)
  - One-to-one relationship (1:1)
  - One-to-many relationship (1:M)
  - Many-to-many relationship (M:N)
- The maximum cardinality on either side of the relationship can be either *one* or *many.*

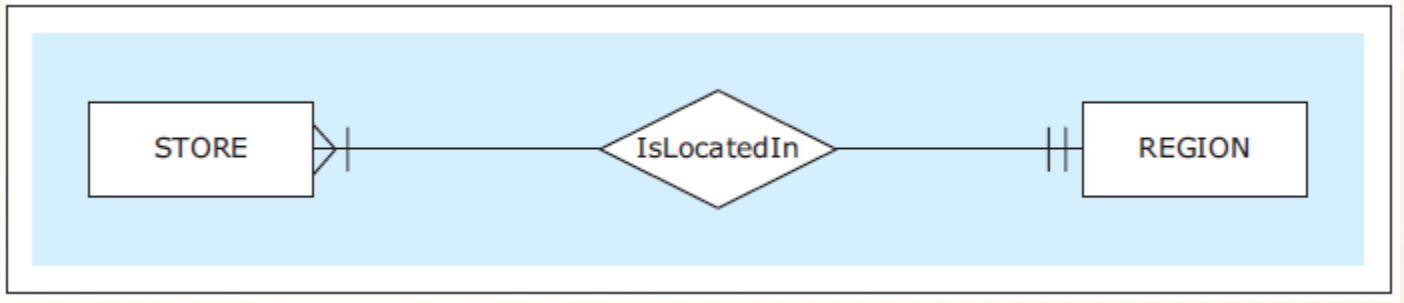
RELATIONSHIPS

Three types of relationships (maximum cardinality-wise)

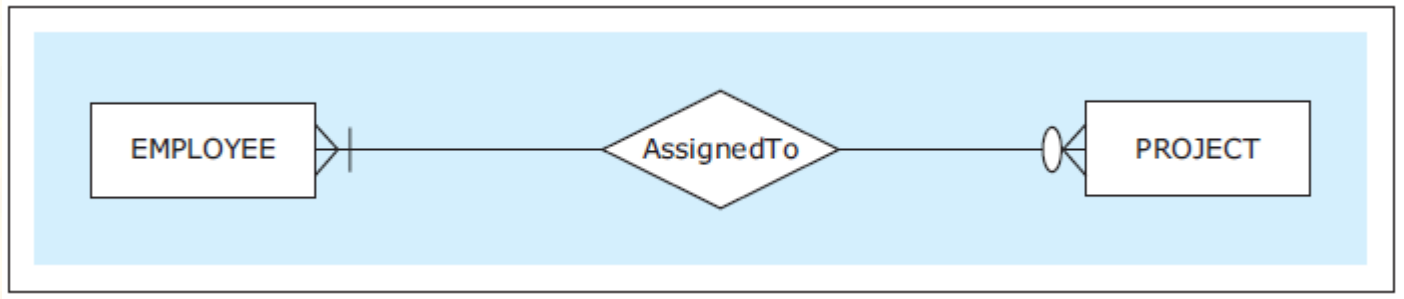


RELATIONSHIPS

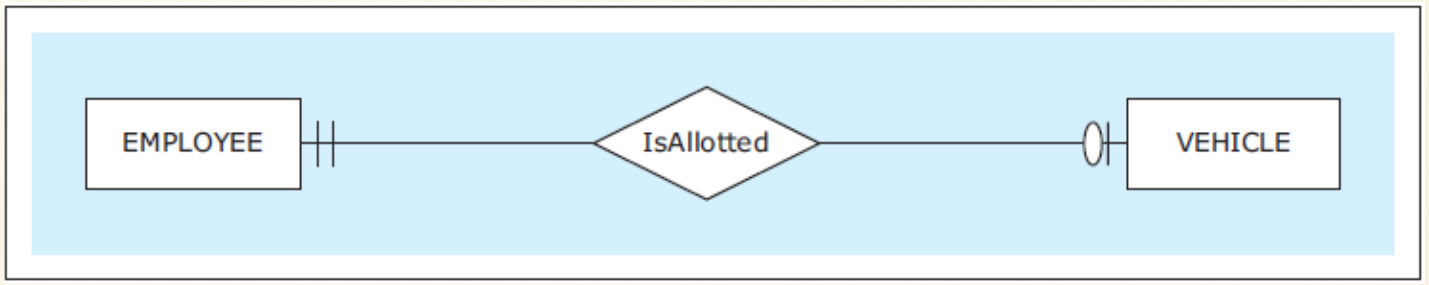
A 1:M Relationship



A M:N Relationship



A 1:1 Relationship

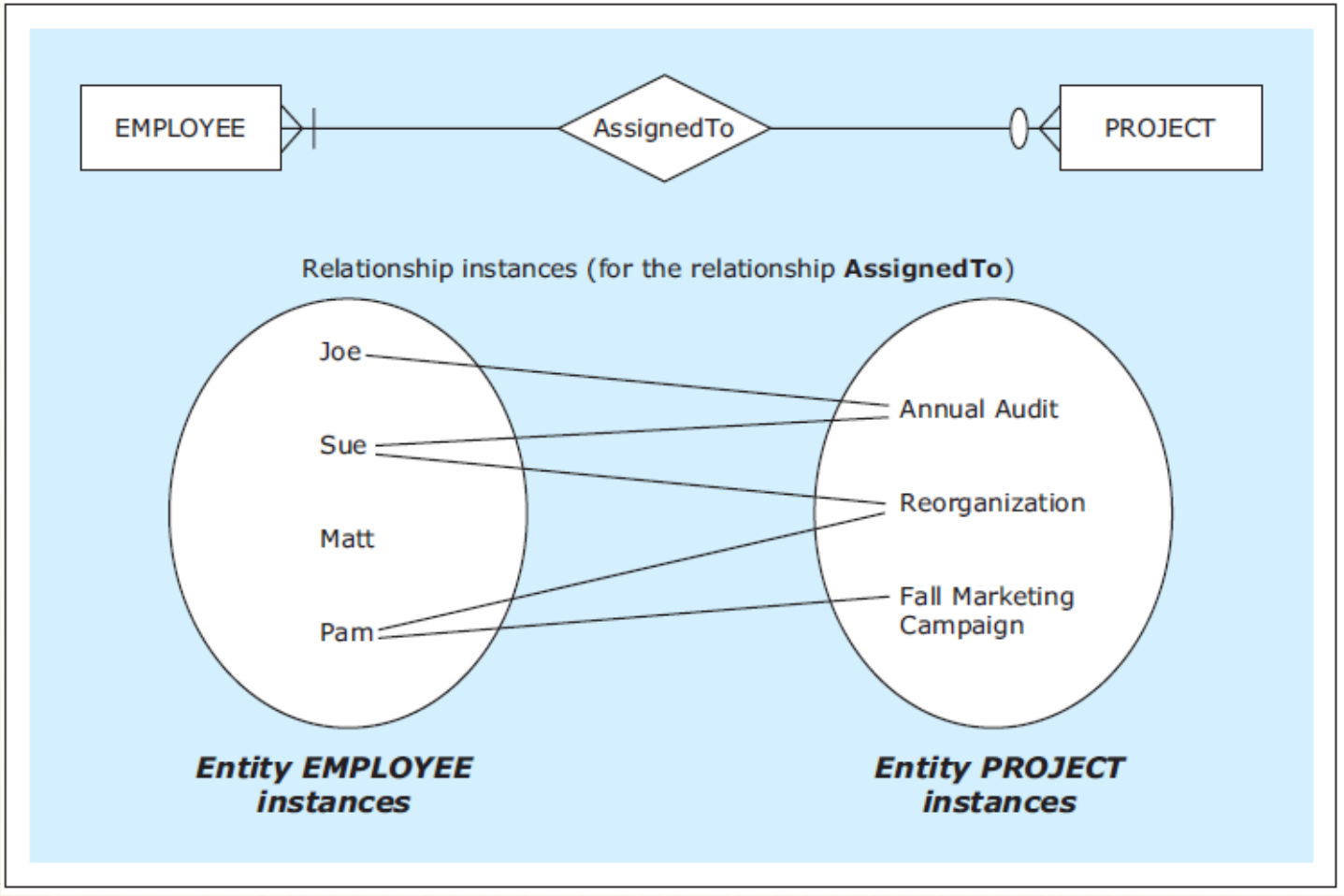


RELATIONSHIPS

- **Relationship instances** - occurrences of a relationship
  - Occur when an instance of one entity is related to an instance of another entity via a relationship
  - Relationship themselves are depicted in the ER diagrams while relationship instances are not
  - Relationship instances are eventually recorded in the database that is created based on the ER diagram

RELATIONSHIPS

A relationship and its instances (see notes page for details)

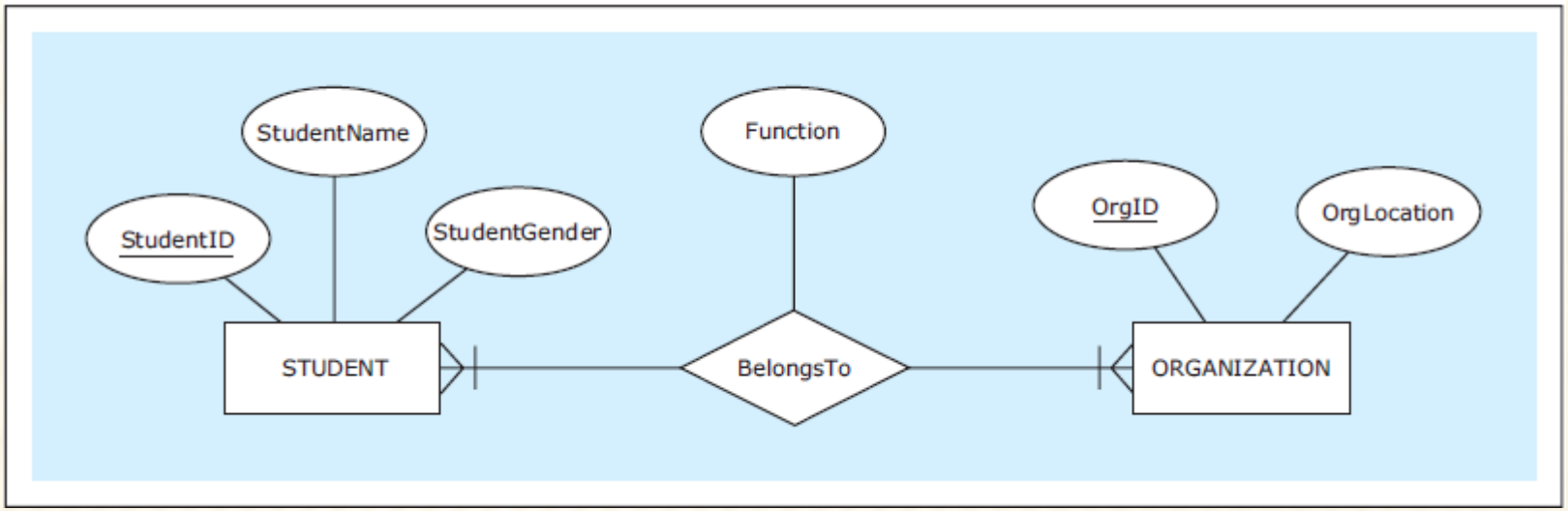


RELATIONSHIPS

- **Relationship attributes**
  - In some cases M:N relationships can actually have attributes of their own

RELATIONSHIPS

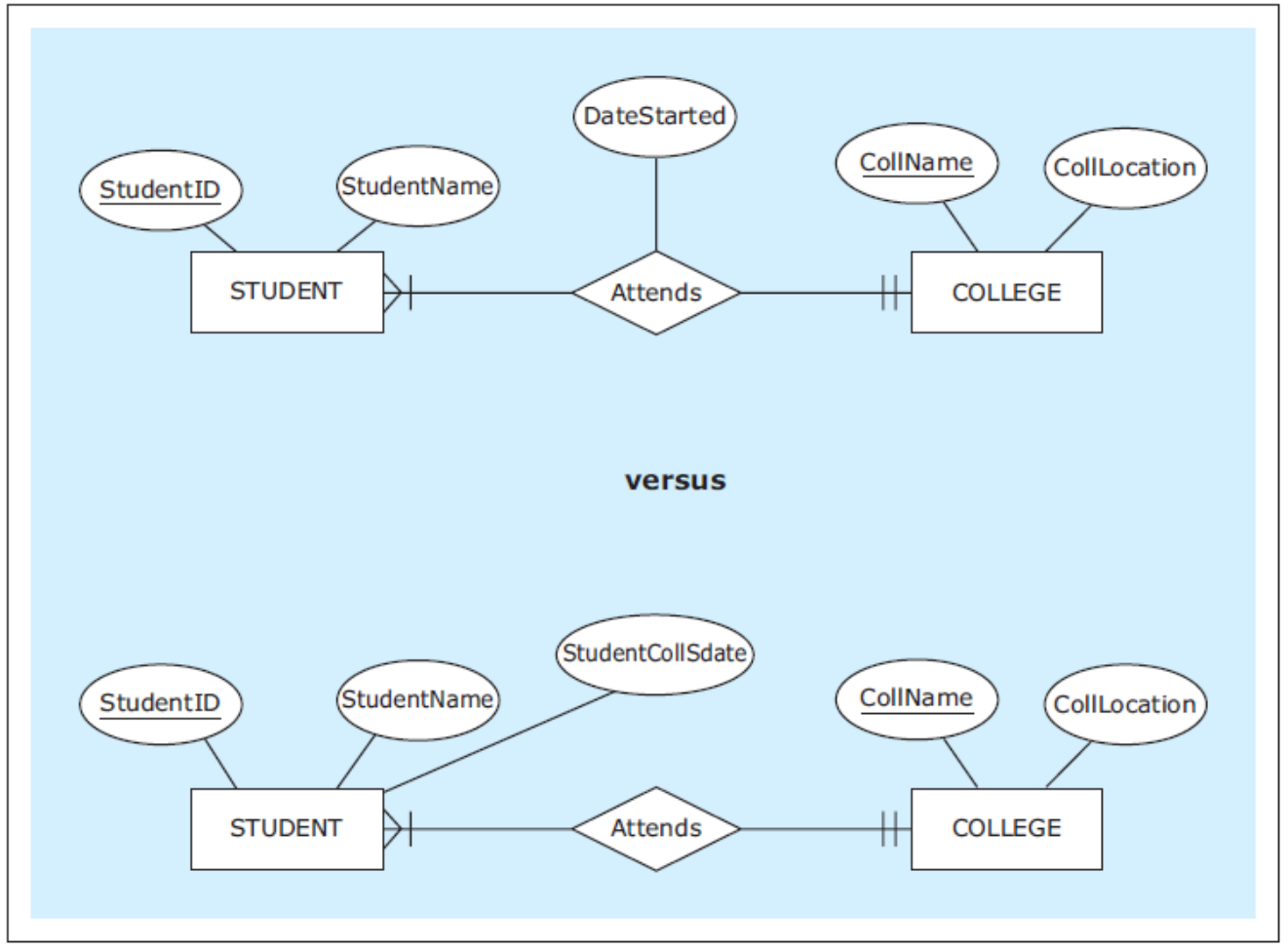
A M:N relationship with an attribute (See notes page for detail)



RELATIONSHIPS

A 1:M relationship with and without an attribute

(See notes page for detail)



MEMBERSHIP DB – REQUIREMENT IN TEXT

- The database will keep track of information about members, groups, and which members belong to which groups.
- For each member, the database keeps track of the unique ID, first name, last name, annual due.
- For each group, the database keeps track of the unique ID and group name.
- Each member may belong to zero or many groups.
- Each group may have zero or many members.
- The database keeps track of the date when a member joins a group.

MEMBERSHIP DB V2 – REQUIREMENT IN TEXT

- The database will keep track of information about members, groups, and which members belong to which groups.
- For each member, the database keeps track of the unique ID, first name, last name, annual due.
- For each group, the database keeps track of the unique ID and group name.
- Each member must belong to at least one group, but may long to many groups.
- Each group must have at least one member, but may have many members.
- The database keeps track of the date when a member joins a group.