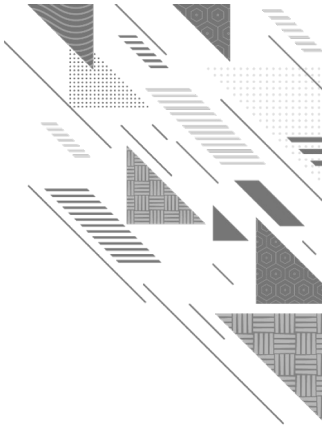
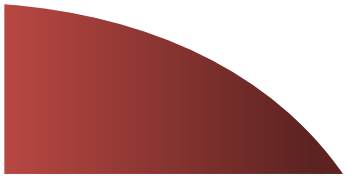
Database Analysis:
Data Models

Outline

- Basic concept of E-R diagram
- Types of Attributes
- Mapping Cardinality
- Weak Entity Sets
- Extended E-R features
- Generalization and Specialization
- Constraints on Specialization and Generalization
- Aggregation
- E-R diagram of Hospital Management System
- Reduction to E-R Database Schema
- Database Models
- Integrity Constraints



Basic concept of E-R diagram



Basic concepts

- What is Database Design?
  - Database Design is a collection of processes that facilitate the **designing**, **development**, **implementation** and **maintenance** of enterprise database management systems.
- What is E-R diagram?
  - E-R diagram: (Entity-Relationship diagram)
  - It is **graphical (pictorial) representation** of database.
  - It uses different types of symbols to represent different objects of database.

Entity

- An entity is a **person**, a **place** or an **object** that is distinguishable from other objects based on the values of the attributes it possess.
- An entity is represented by a **rectangle** which contains the name of an entity.
- Entities of a college database are:
  - Student
  - Professor/Faculty
  - Course
  - Department
  - Result
  - Class
  - Subject

Symbol

Exercise Write down the different entities of bank database.

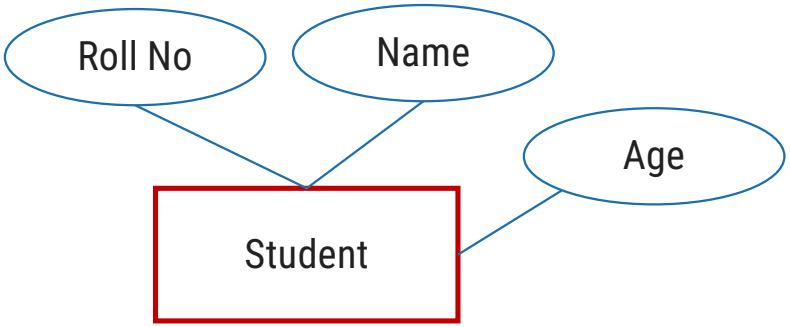
Exercise Write down the different entities of hospital database.

Entity Set or Entity Type

- It is a **set (group) of same type** of **entities**, i.e., that share same properties or same attributes
- Examples:
  - All persons having an account in a bank
  - All the students studying in a college
  - All the professors working in a college
  - Set of all accounts in a bank
- Entity can be represented in an relational model by row/tuple/record.
- Entity set is represented by table in relational model.

ER Model

- Entity can not be represented in the ER Diagram as it is an instance/data.
- Entity set is represented by rectangle in ER Diagram



Relational Model

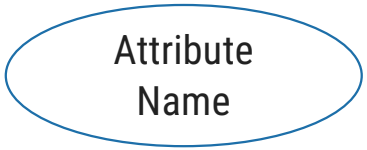
- Entity can be represented in relational model by row/tuple/record.
- Entity set is represented by table in relational model.

Entity Set → Student

Attributes → Roll No	Name	Age
Entity → 1	A	19
Entity → 2	B	18
3	C	18
..	..	..

Attributes

- Attribute is **properties** or details about an entity.
- An attribute is represented by an **oval** containing name of an attribute.
- Attributes of Student are:
  - Roll No
  - Student Name
  - Branch
  - Semester
  - Address
  - Mobile No
  - Age
  - SPI
  - Backlogs



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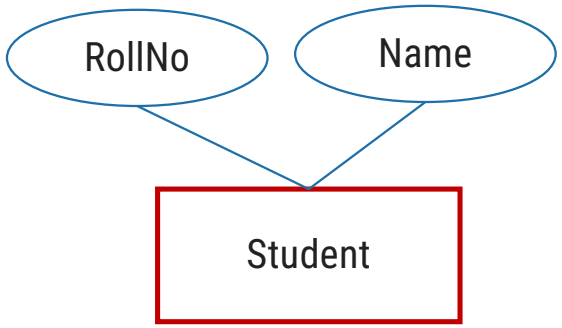
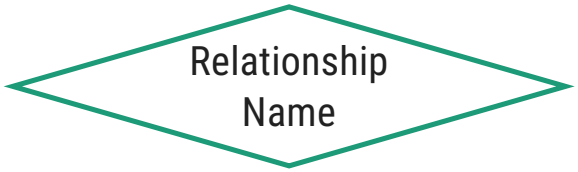


Exercise Write down the different attributes of Faculty entity.

Exercise Write down the different attributes of Account entity.

Relationship

- Relationship is an **association** (connection) between several entities.
- It should be placed between two entities and a line connecting it to an entity.
- A relationship is represented by a **diamond** containing relationship's name.



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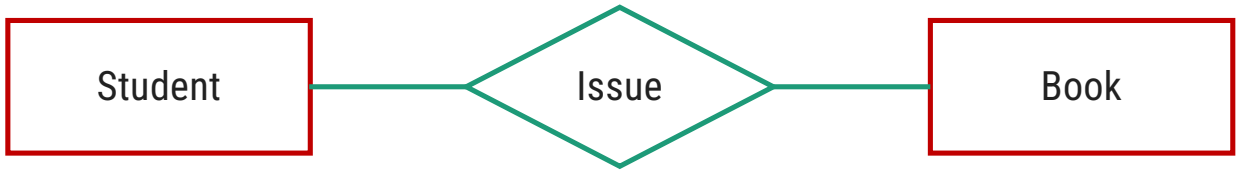
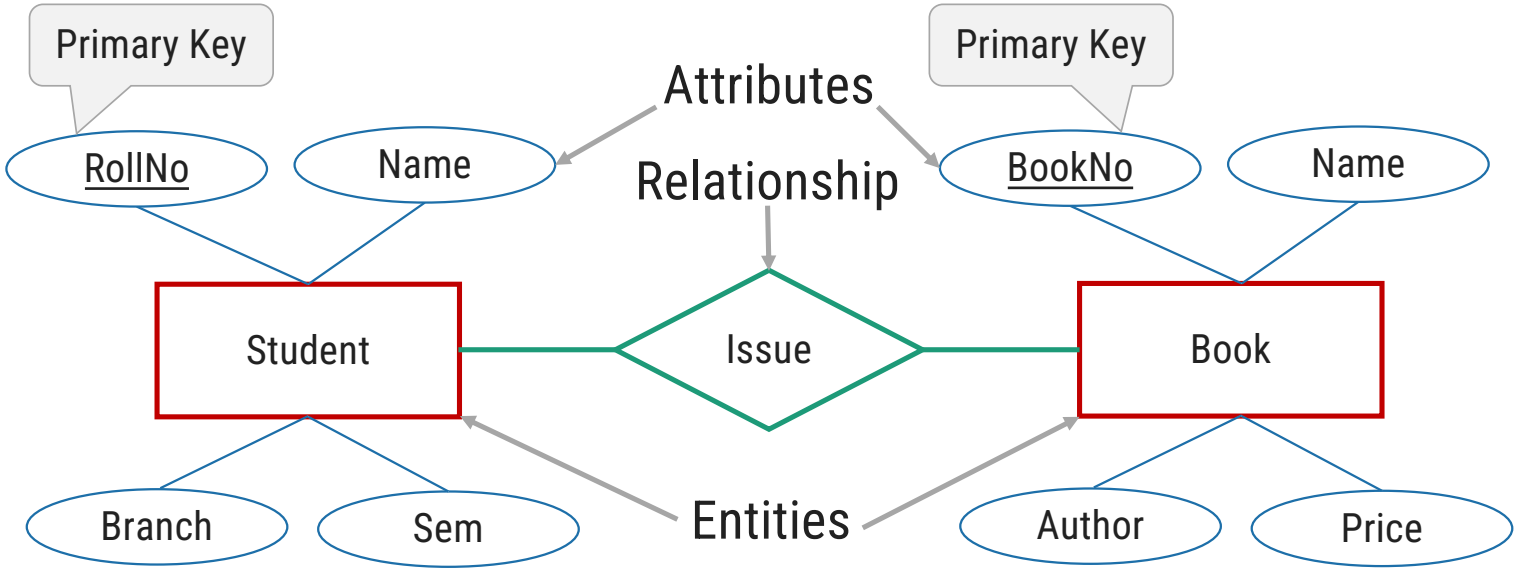
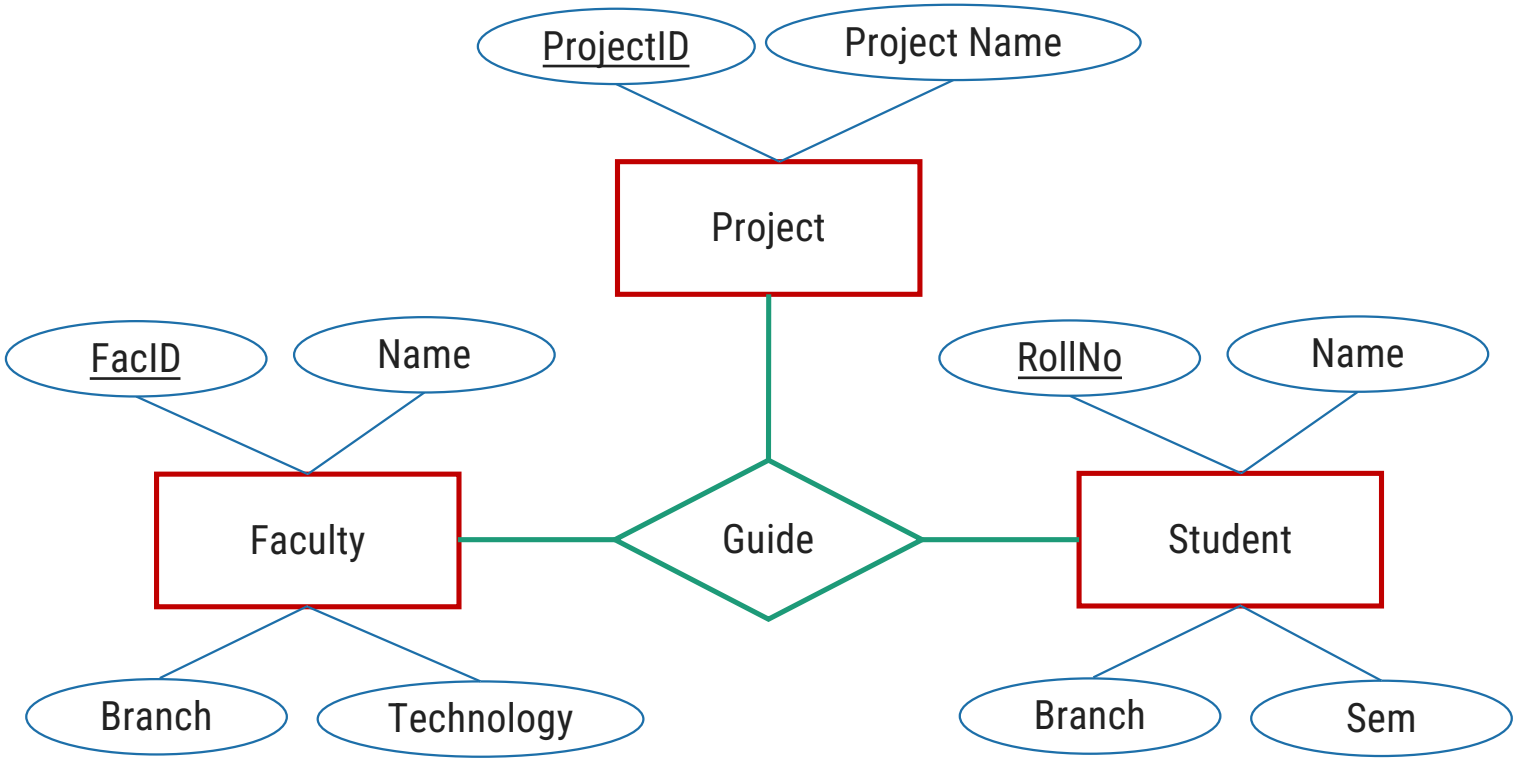


E-R Diagram of a Library System



Each and every entity must have one primary key attribute.
Relationship between 2 entities is called binary relationship.

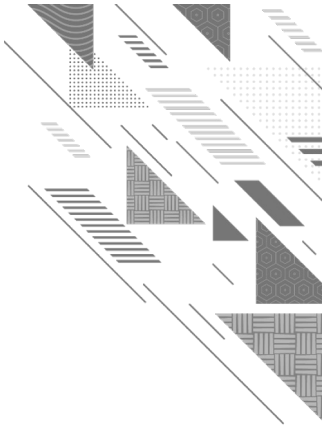
Ternary Relationship



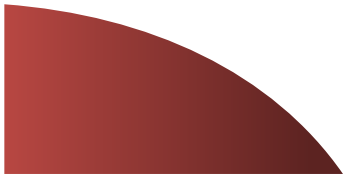
- Relationship between 3 entities is called ternary relationship.
- Number of entities participated in a relationship is called degree of relationship

Exercise

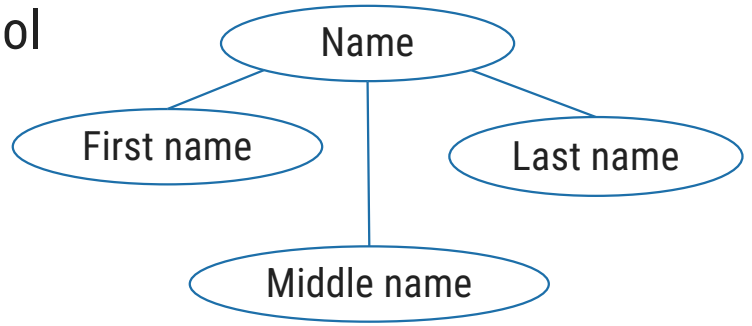
- Draw an E-R diagram of following pair of entities
  - Customer & Account
  - Customer & Loan
  - Doctor & Patient
  - Student & Project
  - Student & Teacher
    - Note: Take four attributes per entity with one primary key attribute.
      Keep proper relationship between two entities.



Types of Attributes



Types of Attributes

Simple Attribute	Composite Attribute
Cannot be divided into subparts	Can be divided into subparts
E.g. RollNo, CPI	E.g. Name (first name, middle name, last name) Address (street, road, city)
Symbol 	Symbol 

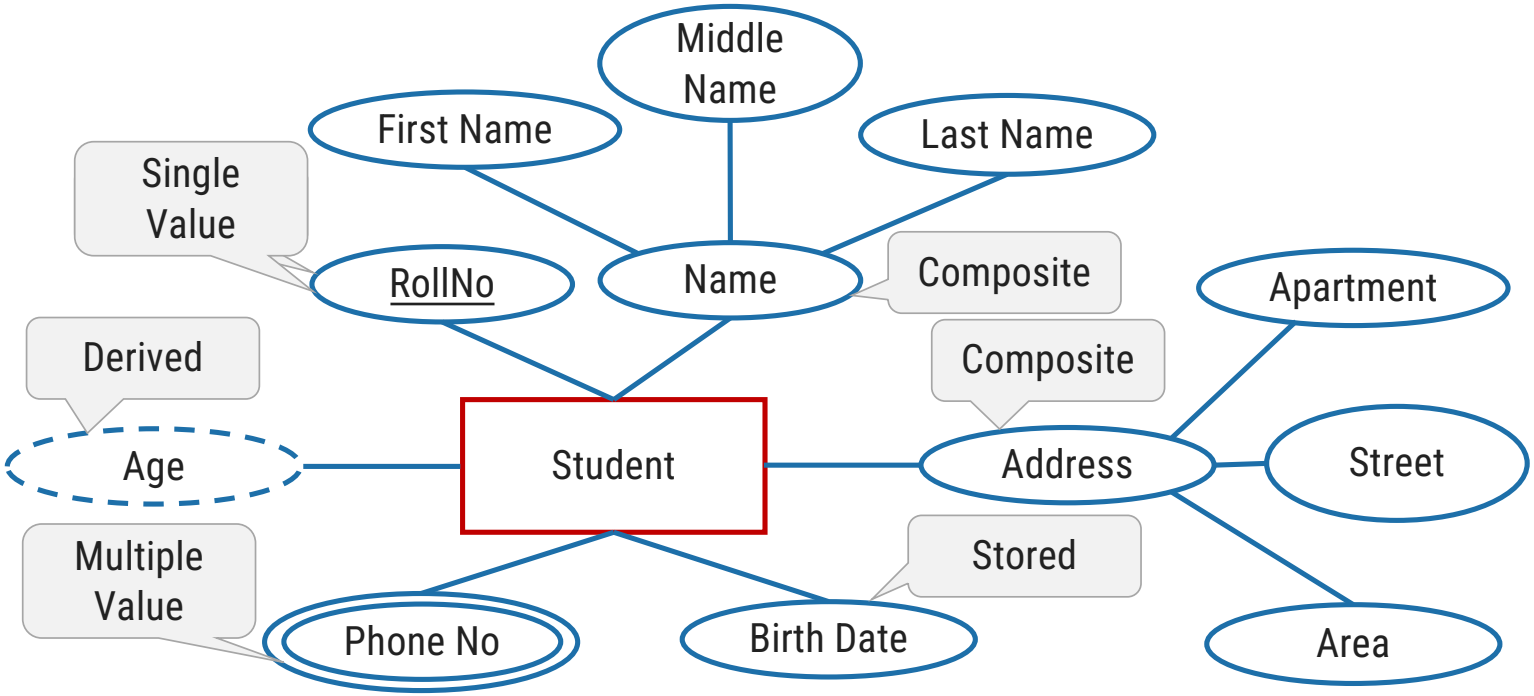
Types of Attributes

Single-valued Attribute	Multi-valued Attribute
Has single value	Has multiple (more than one) value
E.g. RollNo, CPI	E.g. PhoneNo (person may have multiple phone nos) EmailID (person may have multiple emails)
Symbol 	Symbol 

Types of Attributes

Stored Attribute	Derived Attribute
It’s value is stored manually in database	It’s value is derived or calculated from other attributes
E.g. Birthdate	E.g. Age (can be calculated using current date and birthdate)
Symbol 	Symbol 

Entity with all types of Attributes

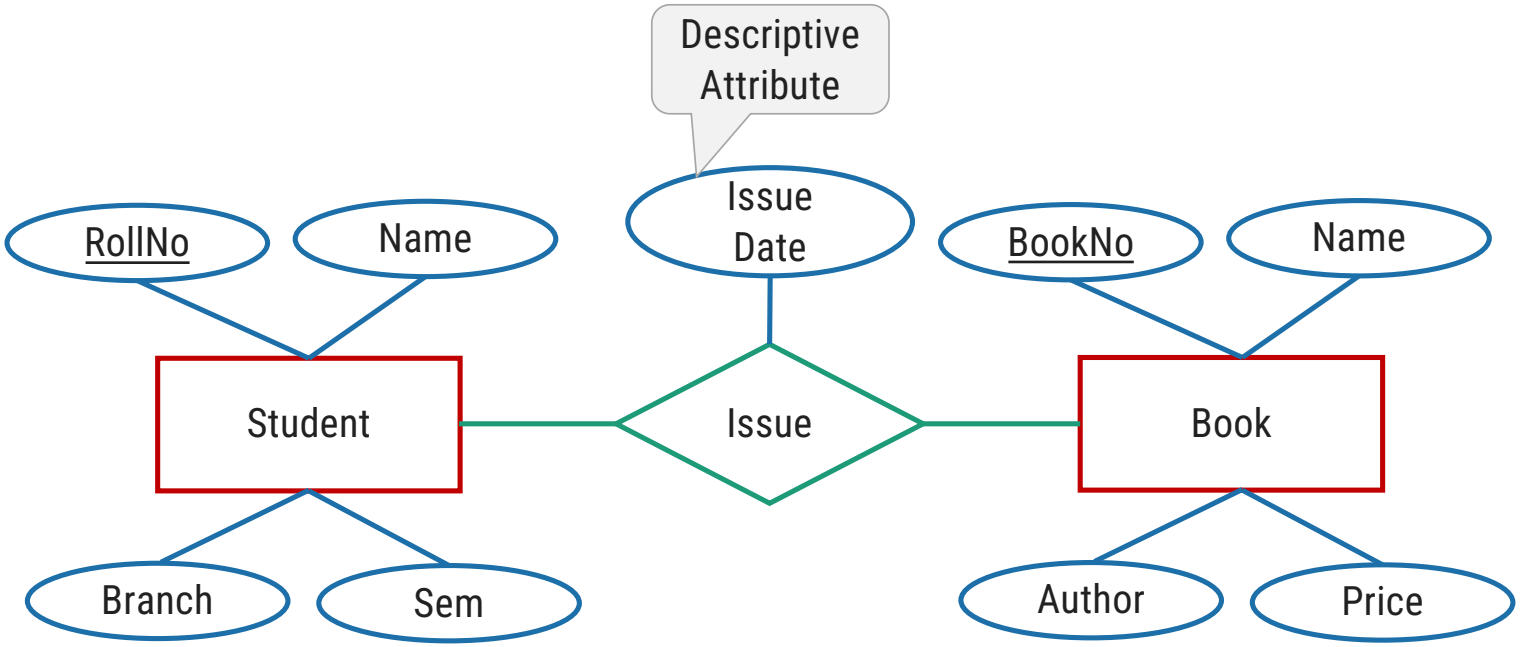


Exercise

- Draw an E-R diagram of Banking Management System.
- Draw an E-R diagram of Hospital Management System.
- Draw an E-R diagram of College Management System.
  - Take only 2 entities
  - Keep proper relationship between two entities
  - Use all types of attributes

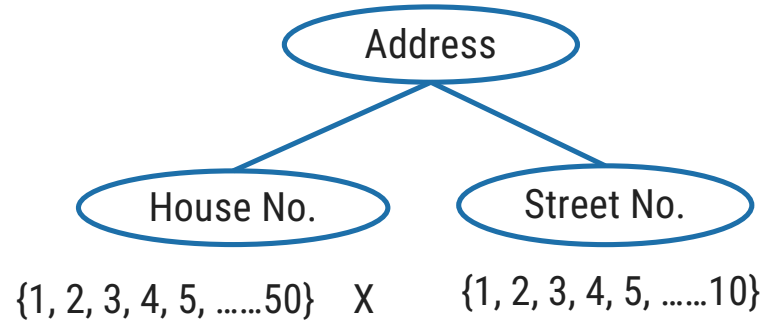
Descriptive Attribute

- **Attribute of the relationship** is called descriptive attribute.



Domain

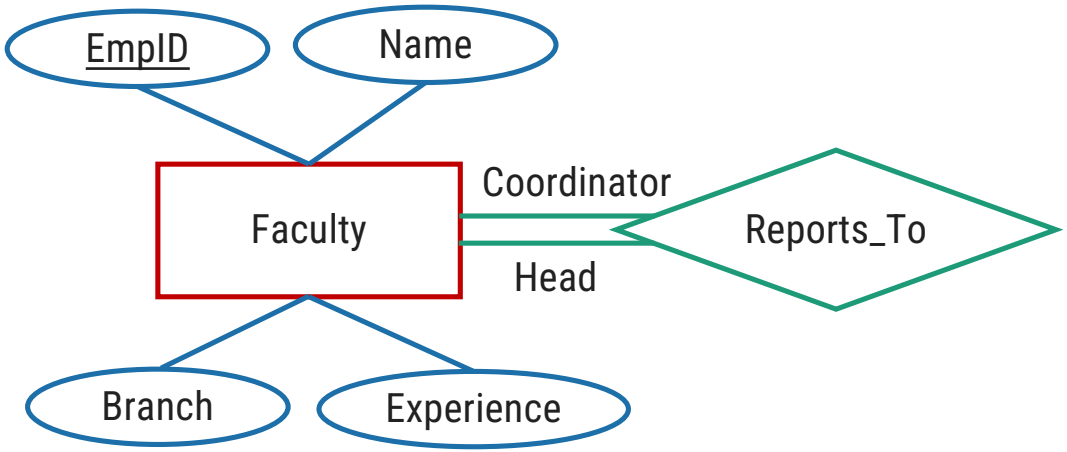
- **All possible values of any attribute** is called domain of attribute.
- **Domain of multi-valued attribute** is the subset of value from the basic domain.
- **Domain of composite attribute** is the Cartesian product of domain of component of composite attribute.



- **Null Attribute:** In some cases a particular entity may not have some applicable value for an attribute.

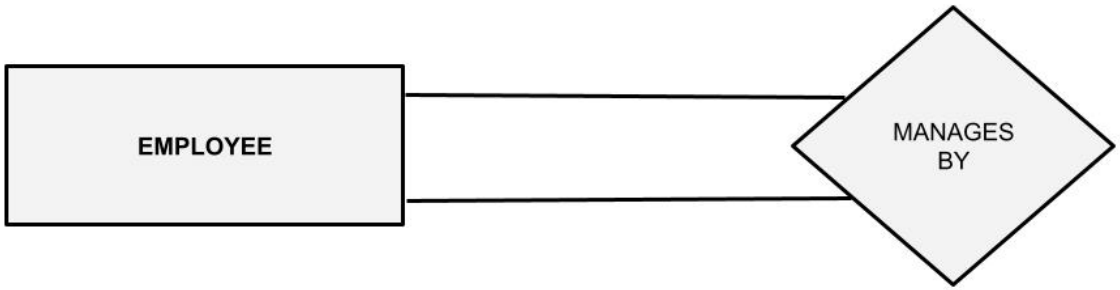
Role

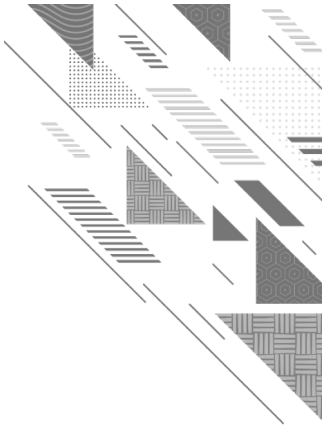
- Roles are indicated by labeling the lines that connect diamonds (relationship) to rectangles (entity).
- The labels “Coordinator” and “Head” are called roles; they specify Faculty entities interact with whom via Reports_To relationship set.
- Role labels are optional, and are used to clarify semantics (meaning) of the relationship.



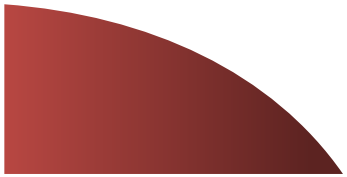
Recursive Relationship

- An Entity set related to itself is called recursive relationship.
- The same **entity participates in a relationship set more than once** then it is called recursive relationship set.





Mapping Cardinality



Mapping Cardinality/Cardinality Ratio

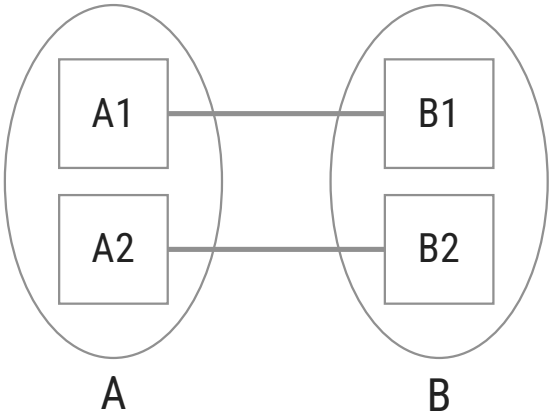
- Mapping cardinality is the maximum number of relationship instances in which an entity can participate.

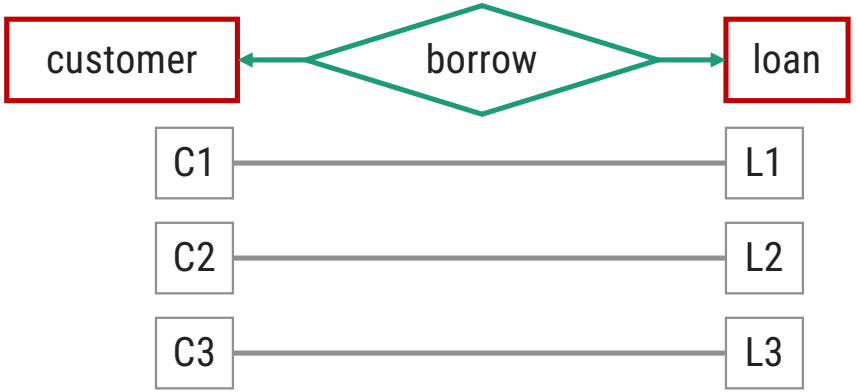
- It is most **useful in describing binary relationship sets**.

- For a binary relationship set, the mapping cardinality are of the following types:
  - One to One
  - One to Many
  - Many to One
  - Many to Many

One-to-One relationship (1 – 1)

- An entity in **A is associated with only one entity in B** and an entity in **B is associated with only one entity in A**.

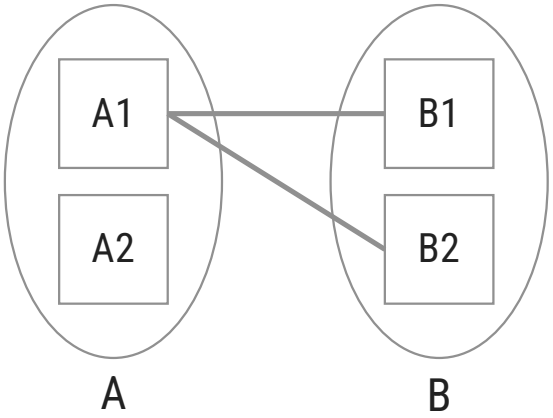


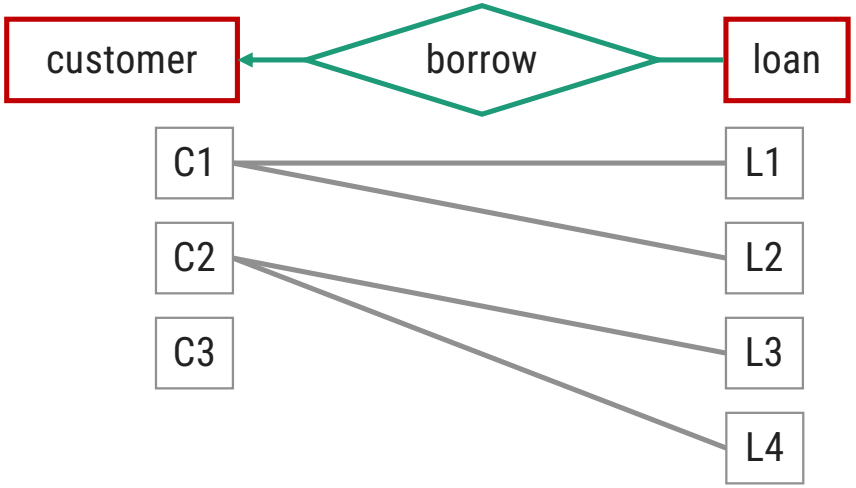


- Example: A **customer is connected with only one loan** using the relationship borrower and a **loan is connected with only one customer** using borrower.

One-to-Many relationship (1 – N)

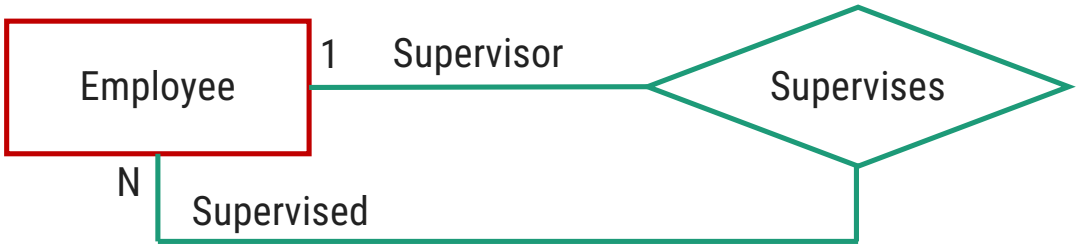
- An entity in **A is associated with more than one entities in B** and an entity in **B is associated with only one entity in A**.





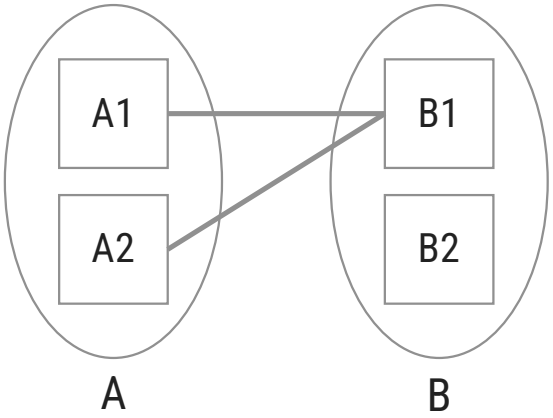
- Example: A **loan is connected with only one customer** using borrower and a **customer is connected with more than one loans using borrower**.

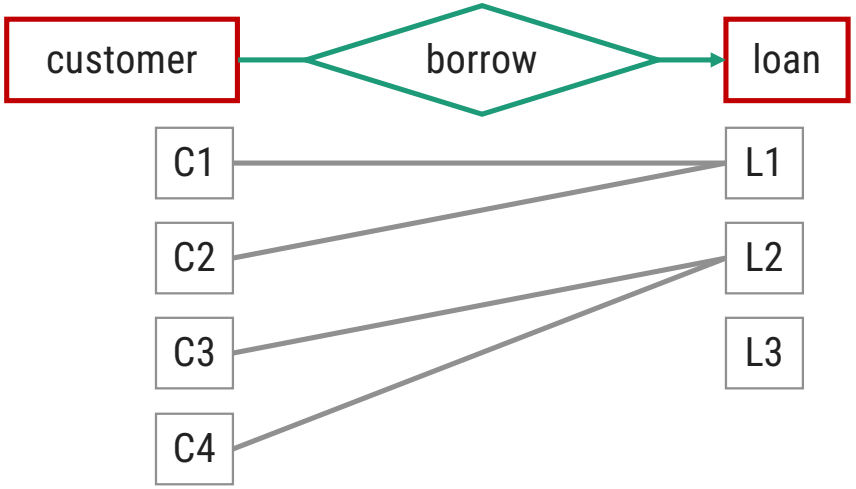
One-to-Many Recursive Relationship



Many-to-One relationship (N – 1)

- An entity in **A is associated with only one entity in B** and an entity in **B is associated with more than one entities in A**.

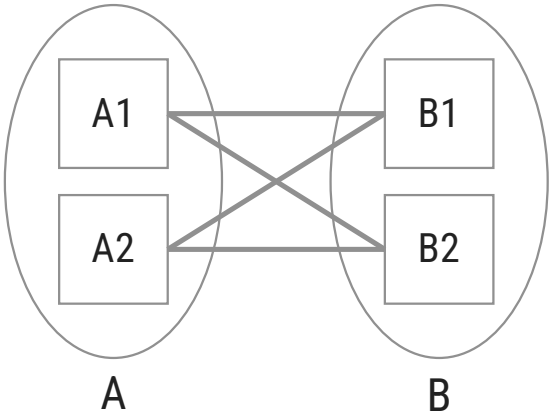


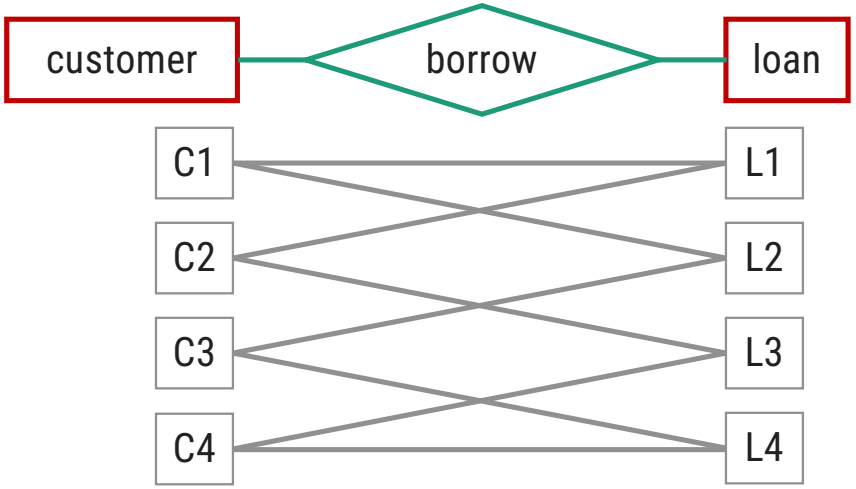


- Example: A **loan is connected with more than one customer** using borrower and a **customer is connected with only one loan** using borrower.

Many-to-Many relationship (M – N)

- An entity in **A is associated with more than one entities in B** and an entity in **B is associated with more than one entities in A**.





- Example: A **customer is connected with more than one loan** using borrower and a **loan is connected with more than one customer** using borrower.

Mapping Cardinality (Cardinality Constraints) [Exercise]

- Draw an E-R diagram and specify which type of mapping cardinality will be there in the following examples:
  - Each customer has only one account in the bank and each account is held by only one customer. [single account]
  - Each customer has only one account in the bank but an account can be held by more than one customer. [joint account]
  - A customer may have more than one account in the bank but each account is held by only one customer. [multiple accounts]
  - A customer may have more than one account in the bank and each account is held by more than one customer. [join account as well as multiple accounts]
  - A student can work in more than one project and a project can be done by more than one student.
  - A student can issue more than one book but a book is issued to only one student.
  - A subject is taught by more than one faculty and a faculty can teach more than one subject.