

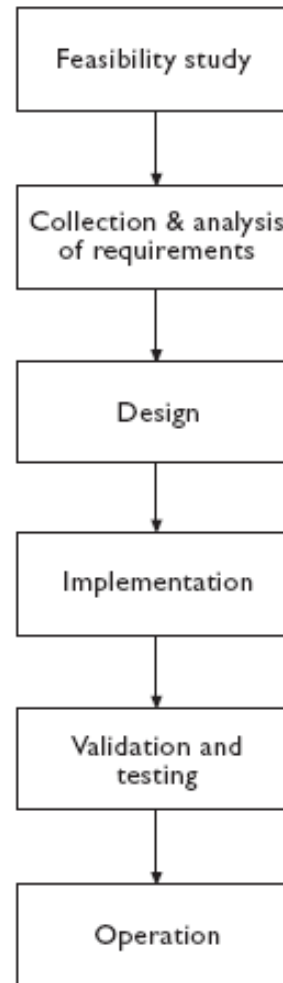
Database Management Systems

Database Design (1)

Topics

- Information Systems Life Cycle
- Data Base Design
 - Logical Design
 - Physical Design
- Entity Relationship (ER) Model
 - Entity
 - Relationship
 - Attributes
 - Cardinality of Relationships

Information System Life Cycle



Database Design

- Database design is the process of producing a detailed data model of a database.
- Database design includes:
 - Determining data to be stored
 - Determining main entities and their attributes
 - Determining relationships between entities
 - Designing a suitable model to store them

Logical and Physical Design

- Logical design is about gathering requirements and converting those requirements into a model.
- Logical design includes the activities and the relationships between units.
- Physical design is the process of converting the logical model into database tables.

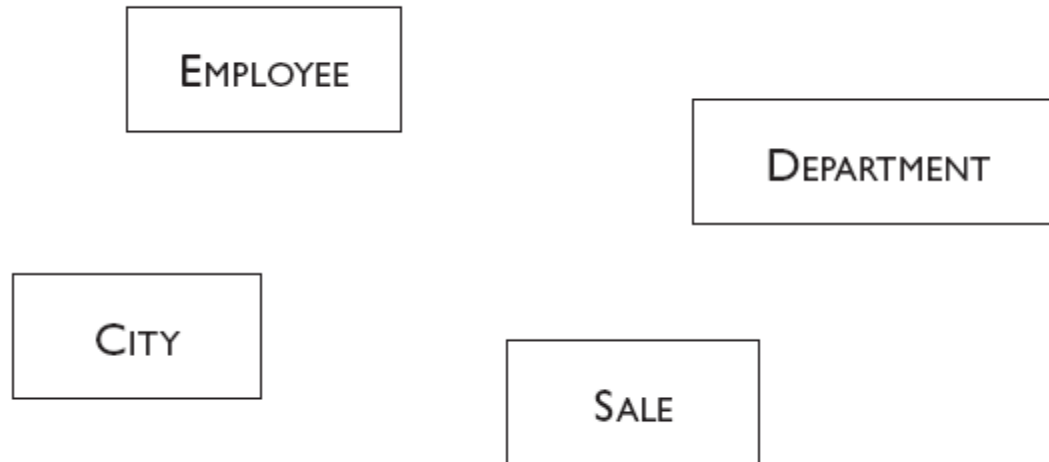
The Entity Relationship Model

- The **E-R** (entity-relationship) data model views the real world as a set of basic **objects** (**entities**) and **relationships** among these objects.
- E-R is used for logical design of a database

Entities

- An **entity** is an object that exists and is distinguishable from other objects. For instance, John Harris with S.S.N. 890-12-3456 is an entity, as he can be uniquely identified as one person in the universe.
- An **entity** may be a physical object such as a house or a car, or a concept such as a customer transaction or order.

Graphical Model of Entities



Examples of Entities in the E-R Model

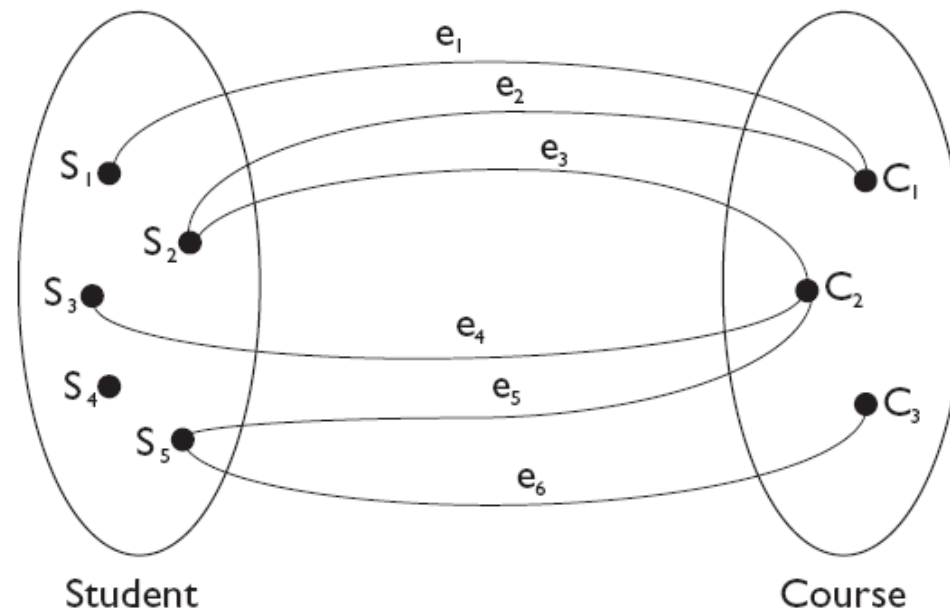
- CITY, DEPARTMENT, EMPLOYEE, PURCHASE and SALE are examples of entities in a commercial application
- STUDENT, COURSE, INSTRUCTOR are example entities of university application
- BOOK, MAGAZINE, EMPLOYEE, CLIENT are example entities of library application

Relationships

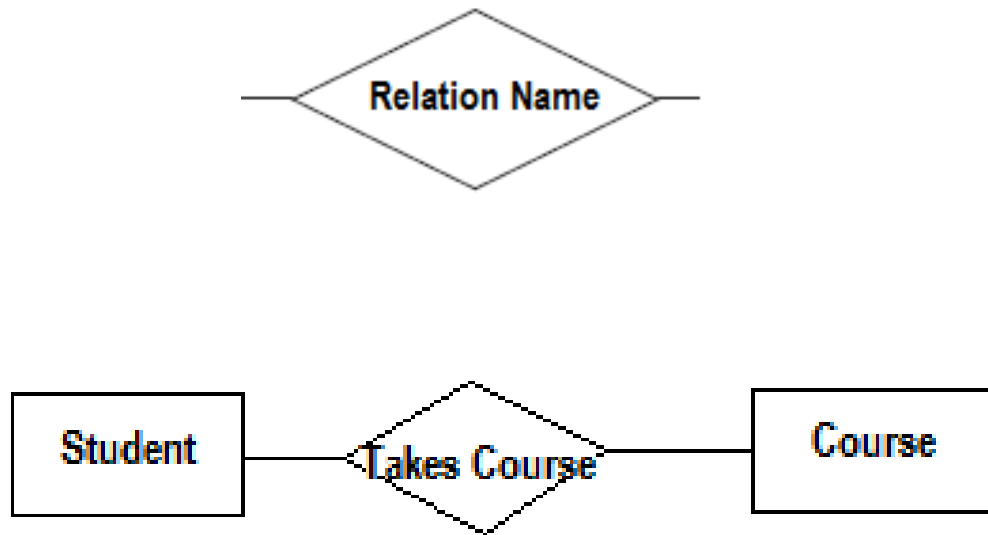
- A **relationship** is an association between several entities.
- For example, consider the two entity sets *customer* and *account*. The relationship *CustAcct* defines the relation between customers and their accounts.

Example Relationships

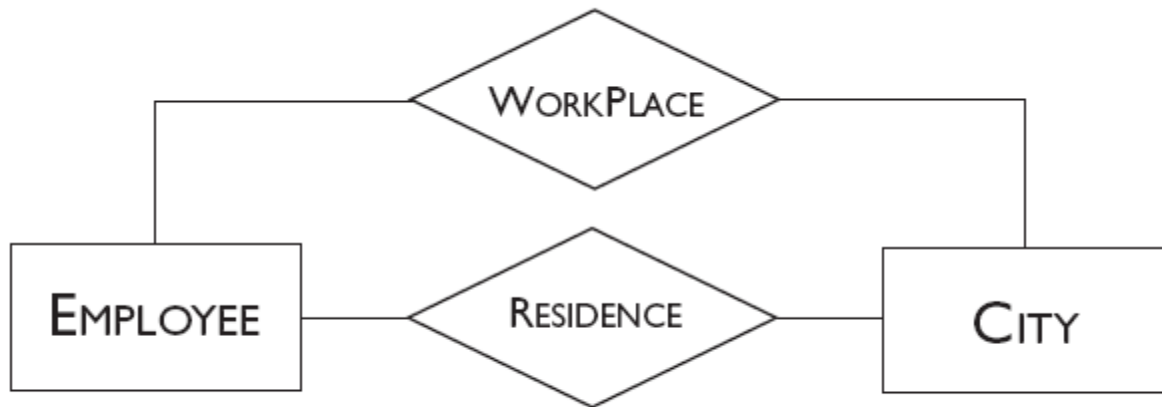
- Each student takes some courses each semester. Therefore **TakesCourse** is the relationship between student and course entities



Graphical Model of Relationships



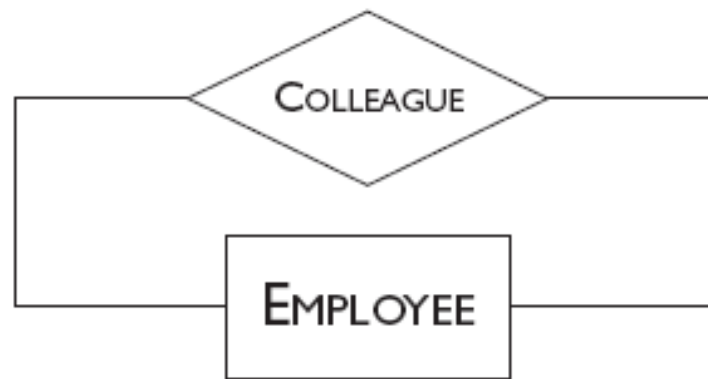
Example Entity-Relationships



Recursive Relationships

- If a relation connects an entity to itself, it is called recursive relationship.
- e.g. An Employee is a colleague for another employee
- A person can be the father of another person. Both father and child are from the same entity set.

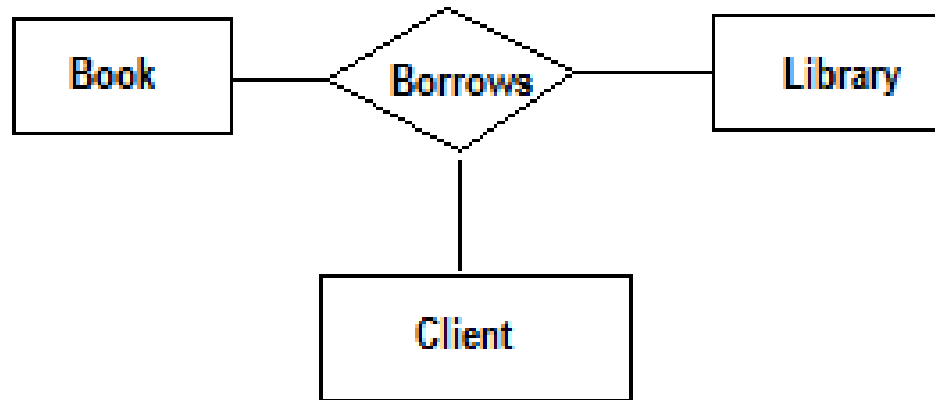
Example for Recursive Relationships



Ternary Relationships

- If a relation connects three entities to each other, it is called a ternary relationship.
- e.g. A client borrows a book from a library
entities are: Client, Book, Library
Book belongs to **Library**
Client borrows the **Book**

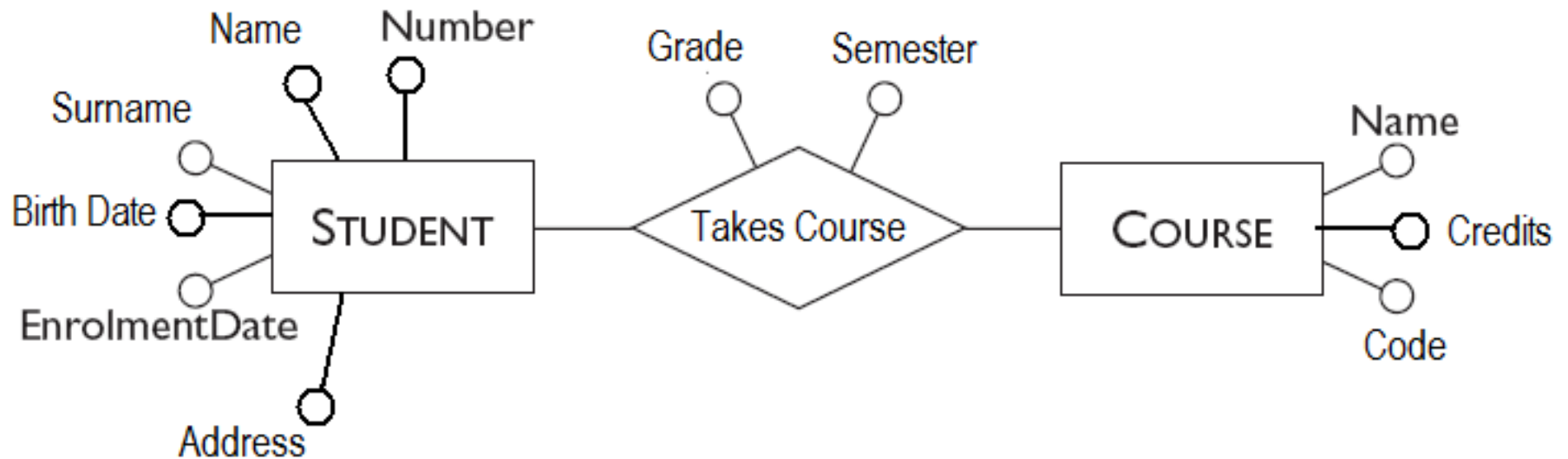
Ternary Relationship



Attributes

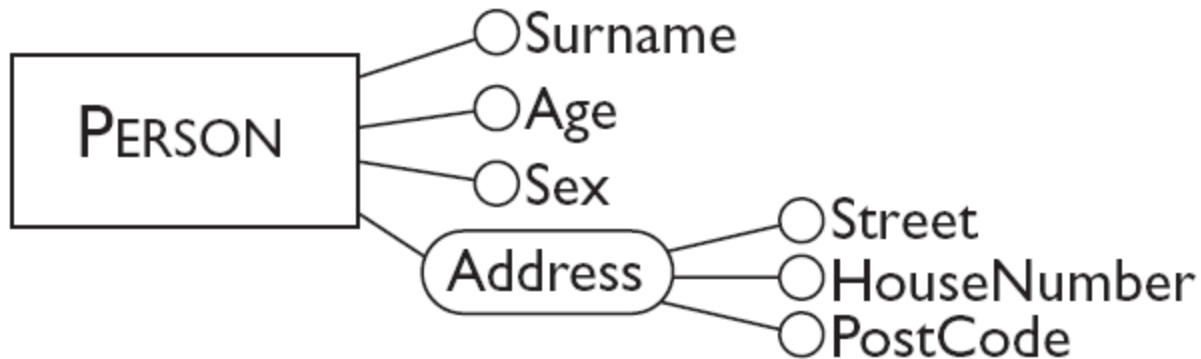
- Attributes describe the properties of entities or relationships.
- e.g. Surname, Salary and Age are possible attributes of the EMPLOYEE entity.
- Semester, Grade are attributes of relationship **Takes Course**

Example

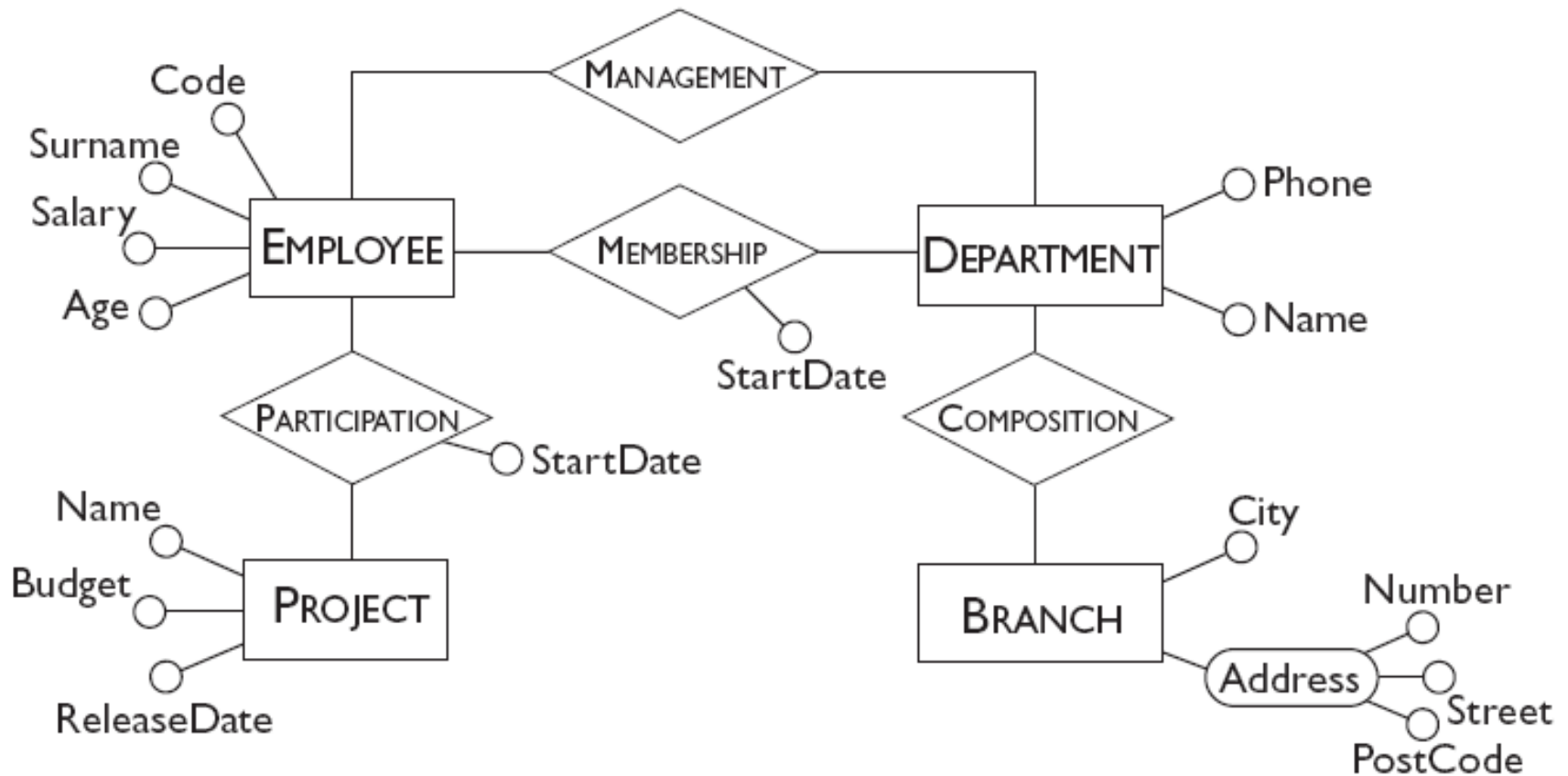


Composite Attributes

- If an attribute contains many sub-parts it is called a composite attribute
- E.g. An address is made of Street, House Number, Post Code, ...



An Entity-Relationship Schema



Cardinality of Relationship

- Cardinality shows how many entities participate in a relationship.
- Example 1. : many students are taking ceng 356
- A student may also take many courses

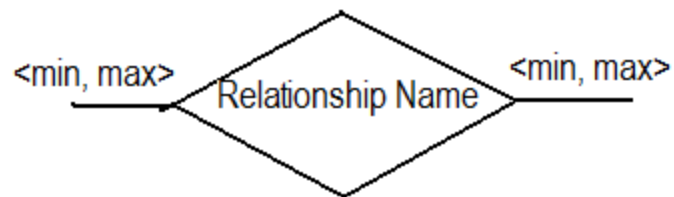
- Example 2. : each student number is given to only one student, each student has only one number

Relationship Cardinality Types

- A relationship can be:
 - One-to-one (Student → Number)
 - One-to-many (Department → Student)
 - Many-to-many (Student → Course)

Optional Relationships

- Some members of an entity set may have no relationship with other entity members.
- e.g. A library client may borrow zero or many books but a book can be borrowed by only one client.
- Optional relationship is shown as follows:

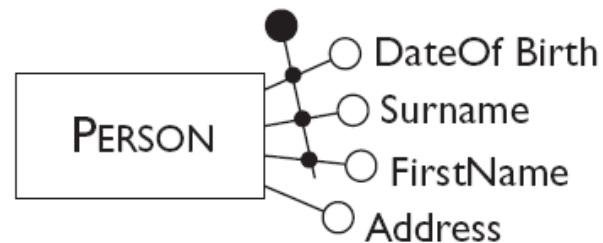
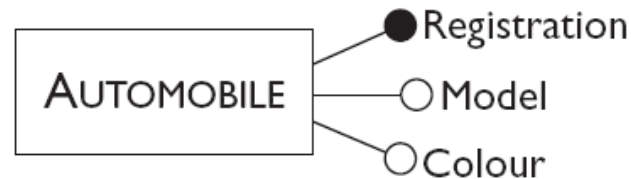


Cardinality of Relationship Example


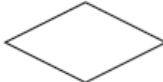


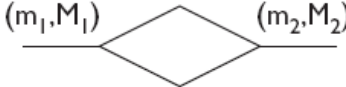
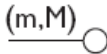



Identifier

- Identifiers are attributes that help us to uniquely identify an entity.
- Identifiers are given with filled in circles.



Graphical Symbols for E-R Constructs

Construct	Graphical representation
Entity	
Relationship	
Simple attribute	
Composite attribute	
Cardinality of a Relationship	
Cardinality of an attribute	
Identifier	

Summary

- Database design is the process of modeling data in an information system.
- E-R model is a method for database design.
- E-R model is based on finding entities in a system and the relationships between them.
- E-R model is converted into tables in physical design.

Questions?