



BITS Pilani
Hyderabad Campus

Database Design & Applications (SS ZG 518)

Dr.R.Gururaj
CS&IS Dept.

Conceptual Database Design (ER Modeling) Ch. 3

Content

- ❑ *ER Model*
- ❑ *Steps in Database Design Process*
- ❑ *Entities, Attributes, and Associations*
- ❑ *ER Notations*

Major Steps in Database Design Process



Step 1: Requirement analysis

- Understanding the domain
- Identifying the data to be stored
- Identifying the constraints

Step 2: Conceptual Database design

E-R modeling/UML

Step 3: Logical Database Design

Designing tables and relationships

Step 4: Refinement of schema

Step 5: Physical database design

- ❑ Indexing
- ❑ Clustering
- ❑ Storage formats

ER Modeling

ER Model is a popular high-level (conceptual) data model.

It is an approach to designing Semantic Conceptual schema of a Database.

ER model allows us to describe the data involved in a real-world environment in terms of objects and their relationships, which are widely used in design of database.

ER model provides preliminary concepts or idea about the data representation which is later modified to achieve final detailed design.

ER Modeling



Important concepts/notions used in ER modeling are-

Entity is an object in real-world or some idea or concept which can be distinguished from other objects.

Ex.: person, school, class, department, weather, salary, temperature etc.

Entity has independent existence.

Each entity belongs to an *Entity type* that defines the structure.

Entity Set is a Collection of similar objects.

Concepts used in ER



Attribute: reflects a property of an object or entity. We have following types of attributes.

- > Simple attribute
- > Composite attribute
- > Single valued attribute
- > Multi-valued attribute
- > Derived attribute
- > Stored attribute

Candidate Key (simply called a key): Is an Attribute of an entity type whose value can uniquely identify an entity in a set.

Primary key: one of the candidate keys can become PK of an entity type.

Alternate keys: The candidate keys other than the PK, are known as alternate keys.



Concepts used in ER



Relationship: The association between entities is known as *relationship*.

Domain of an attribute: The set of possible values is known as domain of an attribute

Notations used in ER



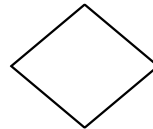
Notations used in ER modeling are shown below.



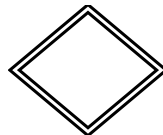
Entity Type



Weak Entity Type



Relationship Type

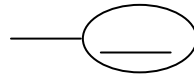


Identifying Relationship type

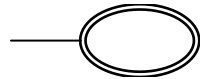


Attribute

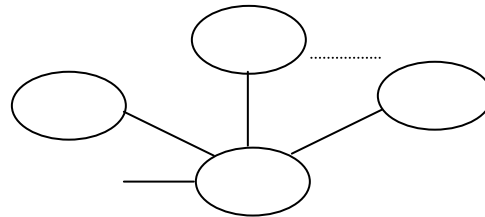
Notations used in ER



Key Attribute



Multivalued Attribute

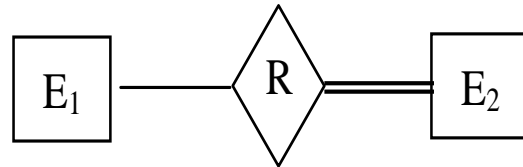


Composite Attribute

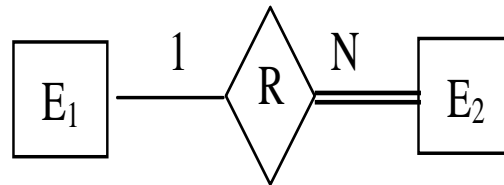


Derived Attribute

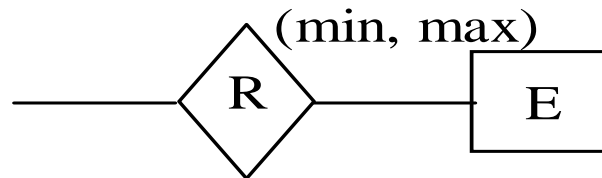
Notations used in ER



Total Participation of E_1 in R



Cardinality ratio 1; N for E_1 ; E_2 in R

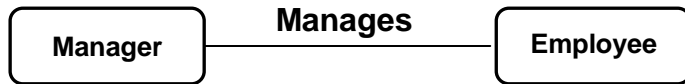


Structural Constraint (min, max) on Participation of E in R

Relationships in ER

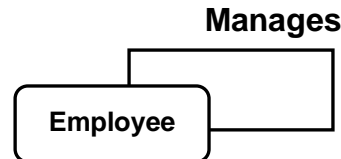
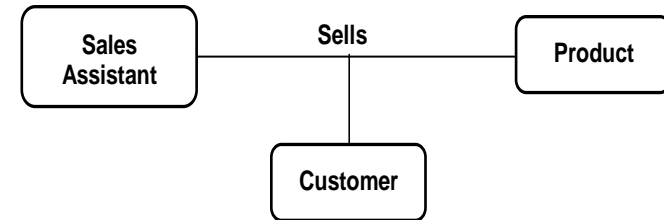


Relationships



Degree of a Relationship

- If there are two entity types involved it is a binary relationship type
- If there are three entity types involved it is a ternary relationship type
- Unary relationships are also known as a recursive relationship



- It is possible to have n-ary relationship (e.g. quaternary or unary)

Relationships in ER



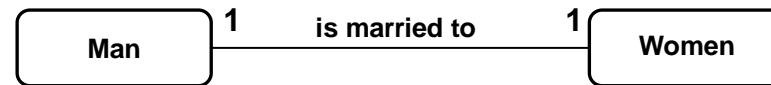
Cardinality of a relationship

Relationships are rarely one-to-one.

For example, a manager usually manages more than one employee.

This is described by the cardinality of the relationship, for which there are four possible categories.

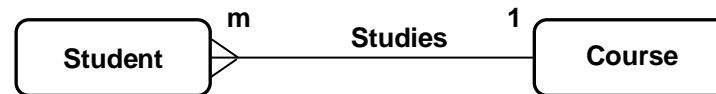
One to one (1:1) relationship



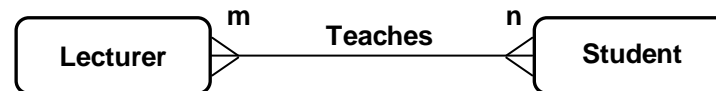
One to many (1:M) relationship



Many to one (M:1) relationship



Many to many (M:N) relationship





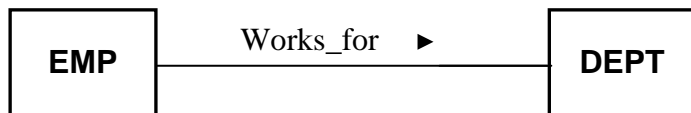
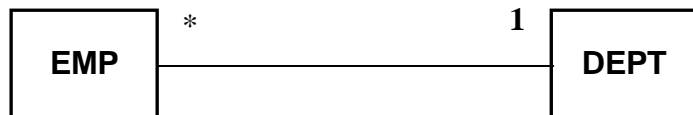
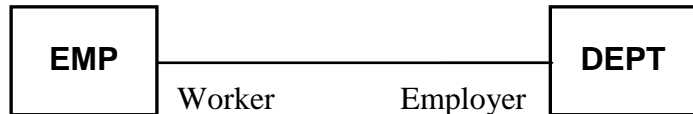
Relationships in ER



Participation Constraint

If all the entities of an entity type are involved in the relationship then that entity type's involvement is said to be total in that relationship. In the below relationship if each employee is associated with at least one dept. Then the participation of EMP is total. Here, EMP works for DEPT.

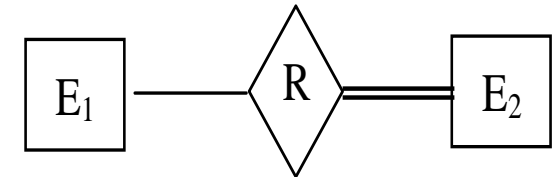
If, only few entities of the set are involved the participation is partial.



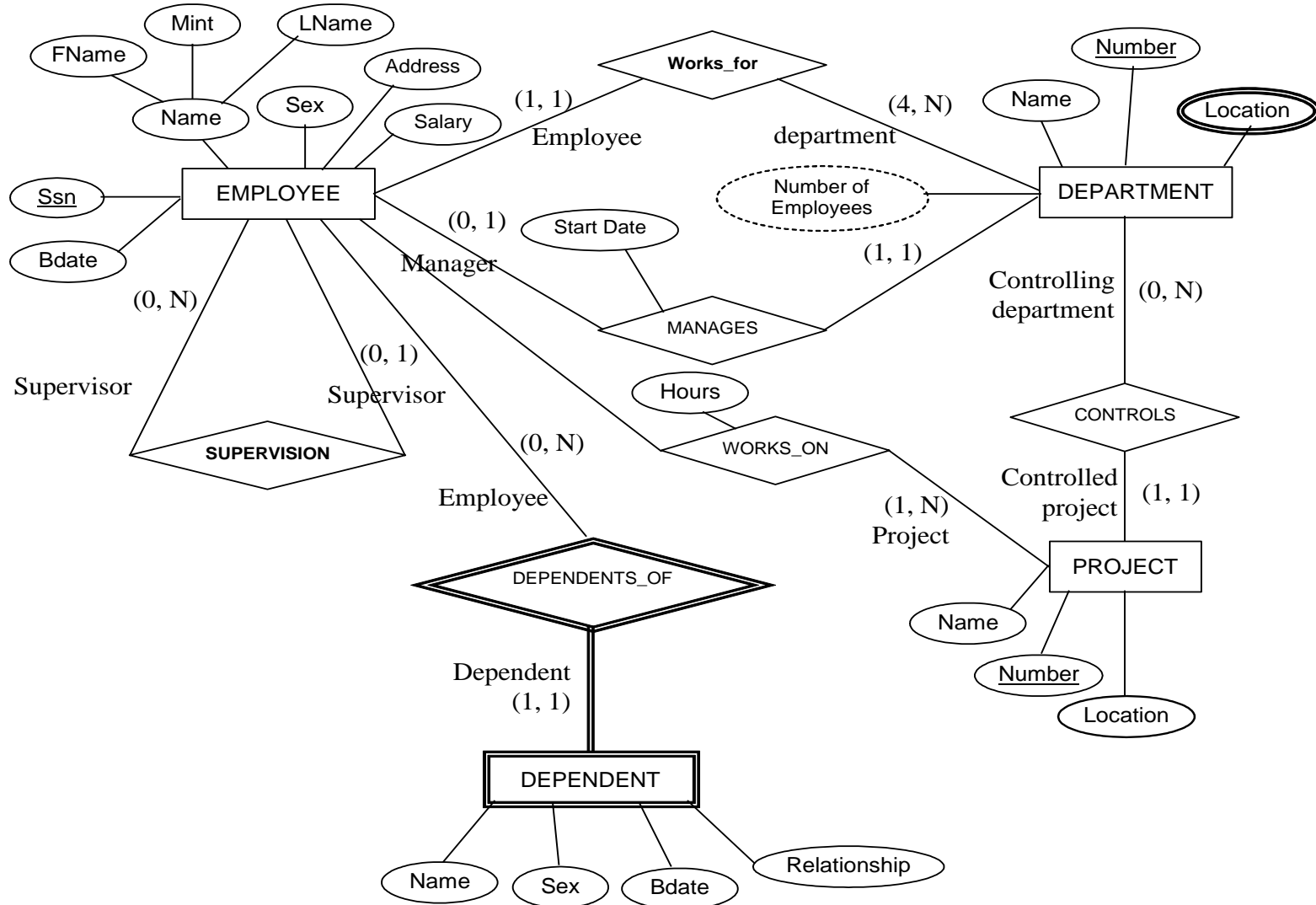
Association Role:

Multiplicity

Association Name & Direction:



ER Diagram for the Company DB schema, with all role names



Exercise



Assume that we need to capture the data about the **River systems** in our country.

Description is as follows.

- i) Capture the facts about rivers; like- name(unique), length, average flow, type.
- ii) Capture info about states- name(unique), area, capital, population, CM, cities with more than 10 lakhs population.
- iii) Projects details- name(unique), year, category, exp in Rs.Cr.
- iv) A river may be a tributary of other river. A river may have zero to many tributaries.
- v) A project will belong to only one state and is built on only one river.
- vi) A state may have zero to any number of projects.
- vii) A river can have zero to many projects.
- viii) A river flows through one or more states.
- ix) A state can have zero or more rivers.

Now draw an ER diagram for the above requirement. Assume necessary data which is missing in the question. The ER model should include- relationships, min-max, cardinality, participation conditions etc.



Summary

- ✓ *Various steps in Database Design Process*
- ✓ *What is ER Modeling*
- ✓ *Concepts and notations used in ER*
- ✓ *Representing Constraints in ER Modeling*
- ✓ *Exercise*