



BITS Pilani
Hyderabad Campus

Database Management Systems

Dr.R.Gururaj
CS&IS Dept.



Conceptual Database Design (ER Modeling)

Content

- ☐ *Steps in Database Design Process*
- ☐ *ER Concepts (Entities, Attributes, Associations etc.)*
- ☐ *ER Notations*
- ☐ *Class Hierarchies*
- ☐ *Conceptual modeling using UML*

Major Steps in Database Design Process



Requirement analysis

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

Conceptual Database design

E-R modeling/UML

Logical Database Design

Designing tables and relationships

Refinement of schema

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.

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

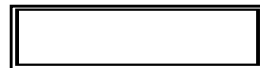
Notations used in ER



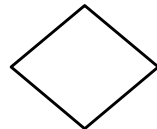
Notations used in ER modeling are shown below.



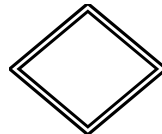
Entity Type



Weak Entity Type



Relationship Type

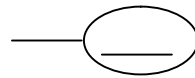


Identifying Relationship type

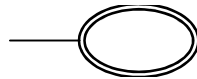


Attribute

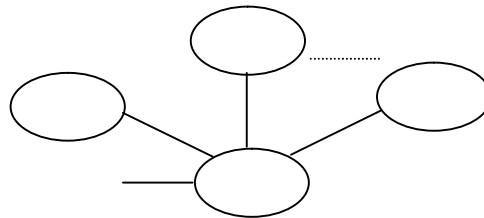
Notations used in ER



Key Attribute



Multivalued Attribute

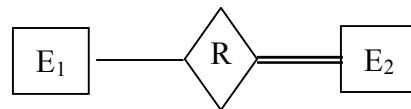


Composite Attribute

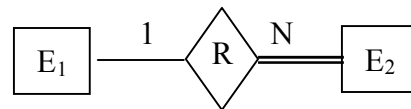


Derived Attribute

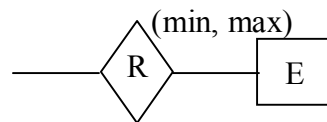
Notations used in ER



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**

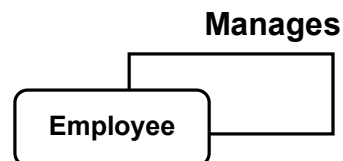
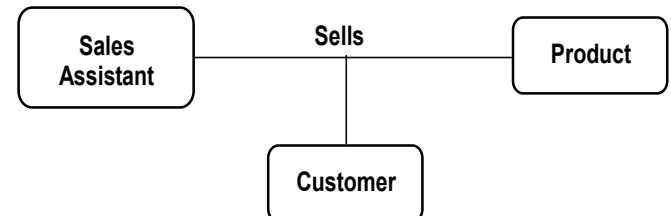
Relationships in ER

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



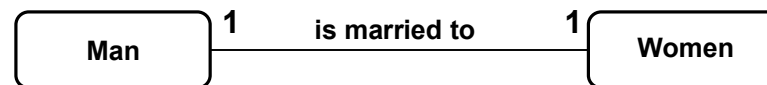
Cardinality of a relationship

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.

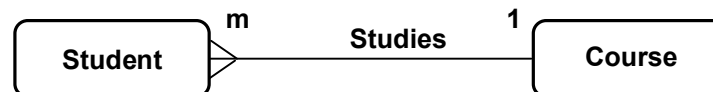
One to one (1:1) relationship



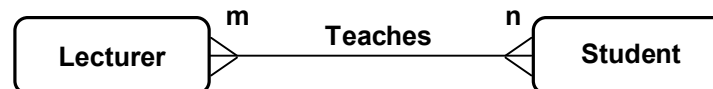
One to many (1:M) relationship



Many to one (M:1) relationship



Many to many (M:N) relationship

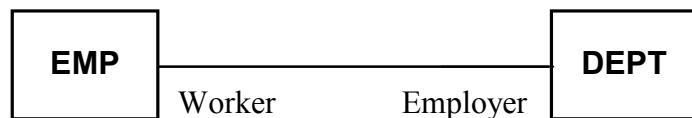
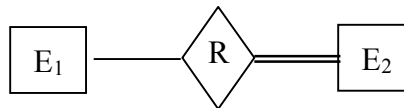


Relationships in ER

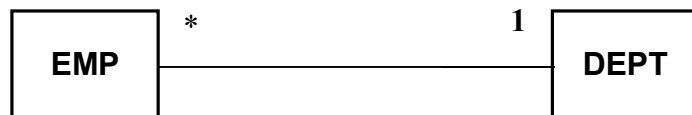
Participation Constraint

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.

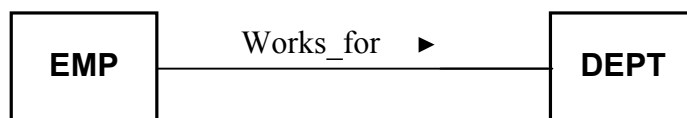
If, only few entities of the set are involved the participation is partial.



Association Role:

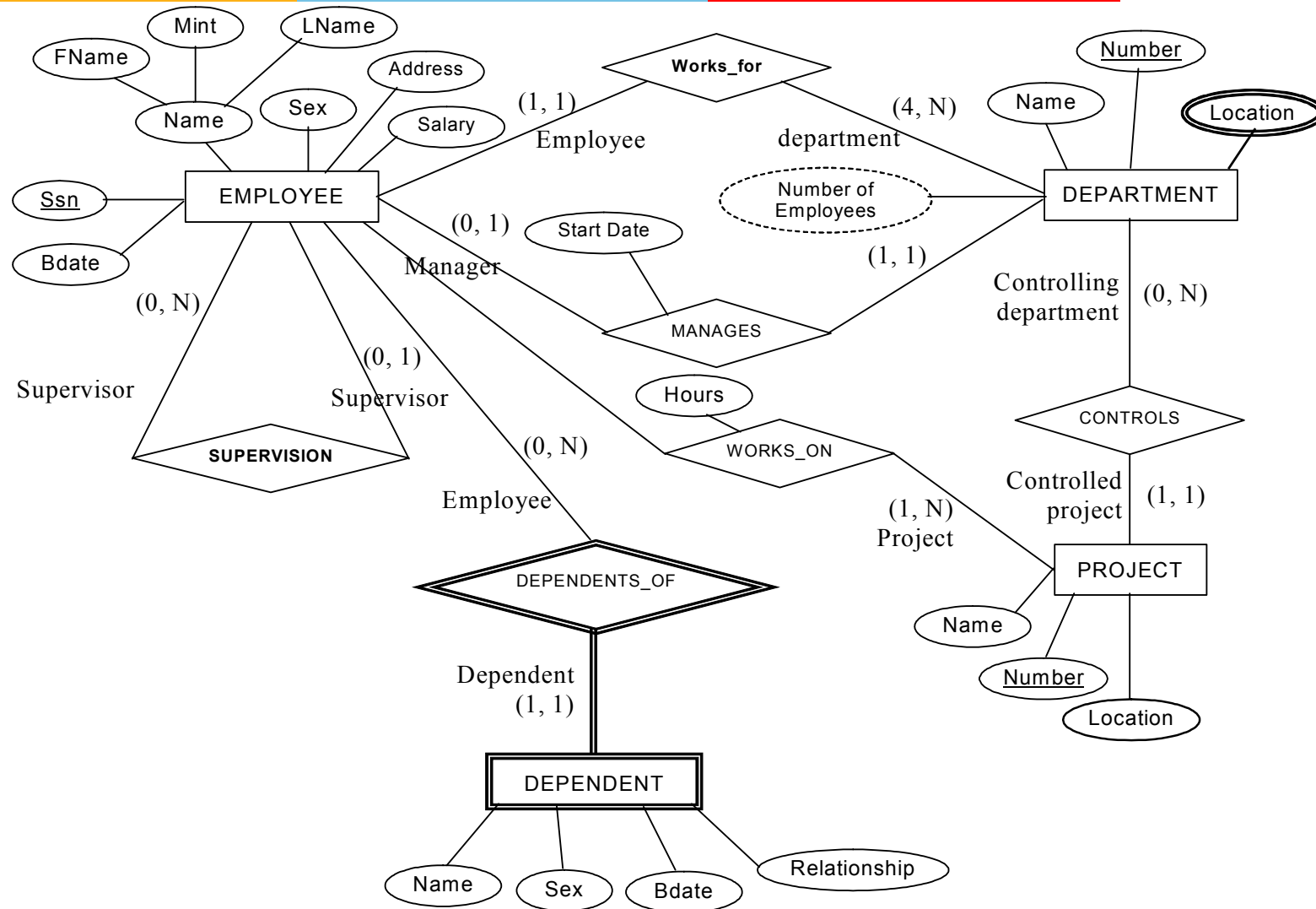


Multiplicity



Association Name & Direction:

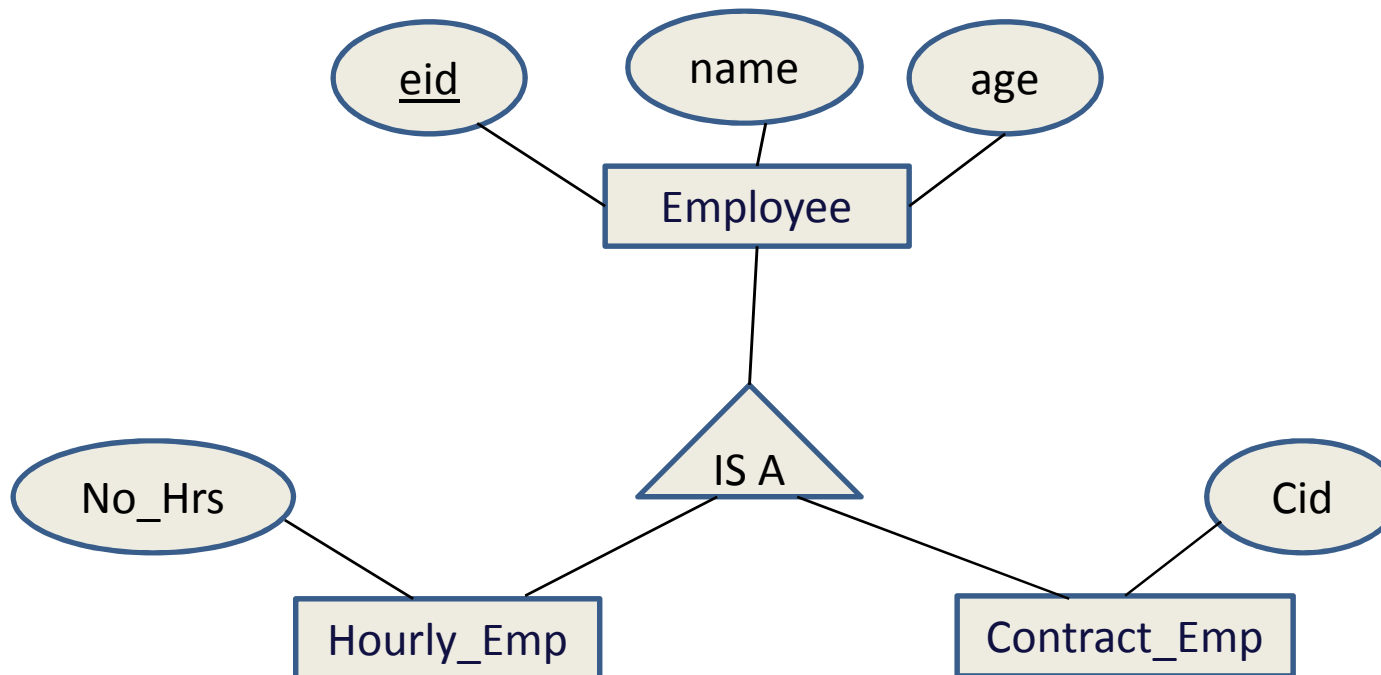
ER Diagram for the Company DB schema, with all role names



Class Hierarchies



Some times it is natural to classify entities in a set into subclasses.



Specialization : *Employee* is specialized into *Hourly_emp* and *Contract_emp*

Generalization: *Hourly_emp* and *Contract_emp* are generalized by *Employee*

UML for Conceptual data modeling



We can model a database at conceptual level using UML.

UML constructs can be drawn as diagrams.

It encompasses broader spectrum of software design process than ER modeling.

We can do:

- ☐ Business modeling (describe the business process involved in the SW)
- ☐ System modeling (specify requirements)
- ☐ Conceptual database modeling (like ER)
- ☐ Physical DB modeling (model indexes and table spaces)
- ☐ Hardware System modeling (describe hardware system configuration)

Class diagrams can be used to describe the database at conceptual level, like ER diagrams.



Summary

- ✓ *Various steps in database design process*
- ✓ *What is ER modeling*
- ✓ *Concepts and notations used in ER*
- ✓ *Class hierarchies in ER*
- ✓ *Use of UML for Conceptual database modeling*