Nadar Saraswathi College of Engineering & Technology

NSCET E-LEARNING PRESENTATION

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COMPUTER SCIENCE AND ENGINEERING

II YEAR / IV SEMESTER

CS8492 – DATABASE MANAGEMENT SYSTEMS

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UNIT- I I

DATABASE DESIGN

CONTENTS

- Entity
- Relationship model
- E-R Diagrams
- Enhanced-ER Model
- ER-to-Relational Mapping
- Functional Dependencies
- Non-loss Decomposition
- First, Second, Third Normal Forms, Dependency Preservation
- Boyce/Codd Normal Form
- Multi-valued Dependencies and Fourth Normal Form
- Join Dependencies and Fifth Normal Form

ENTITY RELATIONSHIP MODEL

The entity relationship (ER) data model was developed to facilitate database design by allowing specification of an enterprise schema that represents the overall logical structure of a database.

The ERDs represent three main components entities, attributes and relationships.

ENTITY RELATIONSHIP MODEL

Entity sets:

An entity is a thing or object in the real world that is distinguishable from all other objects.

Relationship sets:

A relationship is an association among several entities.

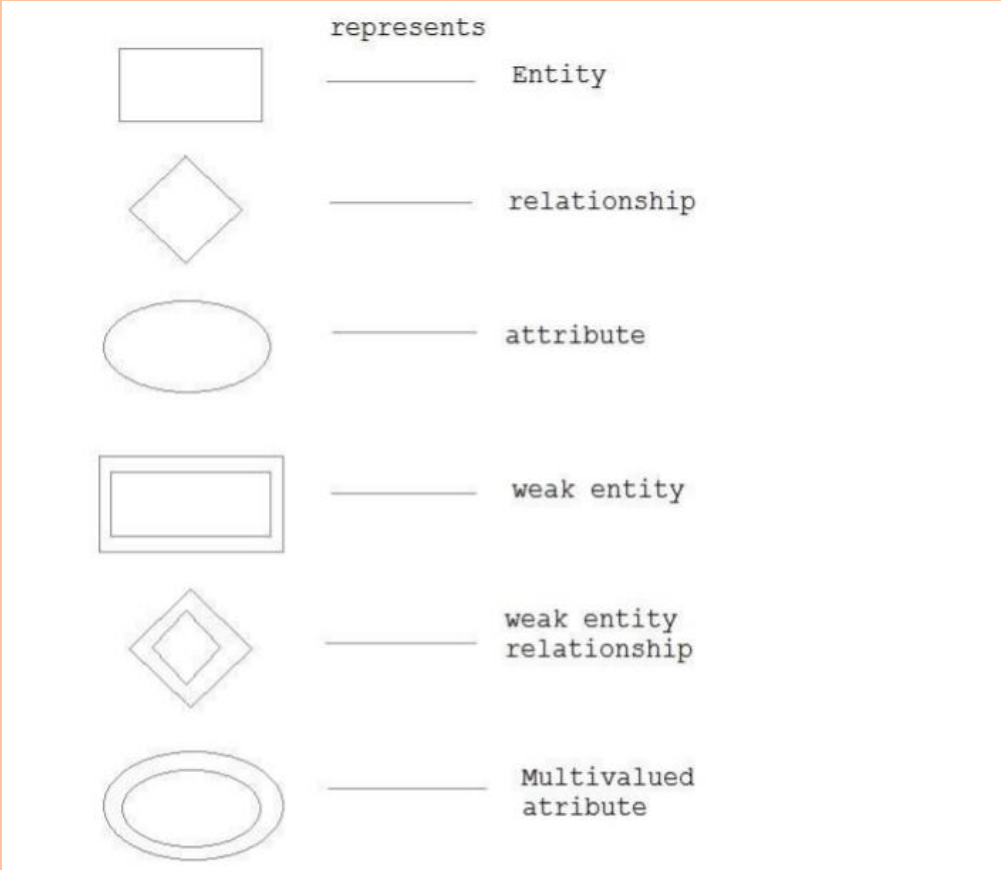
ENTITY RELATIONSHIP MODEL

Attributes:

For each attribute, there is a set of permitted values, called the domain, or value set, of that attribute.

- Simple and composite attributes.
- Single valued and multi valued attributes.
- Derived attribute.

E-R DIAGRAM REPRESENTATIONS



E-R DIAGRAM COMPONENTS

- Rectangles represent entity sets.
- Ellipses represent attributes.
- Diamonds represent relationship sets.
- Lines link attributes to entity sets and entity sets to
- relationship sets.
- Double ellipses represent multivalued attributes.
- Dashed ellipses denote derived attributes.
- Primary key attributes are underlined

ENHANCED ER MODEL

Specialization:

This is a Top-down design process designate sub groupings within an entity set that are distinctive from other entities in the set.

These sub groupings become lower-level entity sets that have attributes or participate in relationships that do not apply to the higher-level entity set.

Depicted by a triangle component labeled ISA (i.e., savings-account “is an”account)

ENHANCED ER MODEL

Generalization:

- A bottom-up design process
- combine a number of entity sets that share the same features into a higher-level entity set.
- Specialization and generalization are simple inversions of each other; they are represented in an E-R diagram in the same way.

ER-TO-RELATIONAL MAPPING

- ER Model, when conceptualized into diagrams, gives a good overview of entity-relationship, which is easier to understand.
- ER diagrams can be mapped to relational schema, that is, it is possible to create relational schema using ER diagram.
- We cannot import all the ER constraints into relational model, but an approximate schema can be generated.

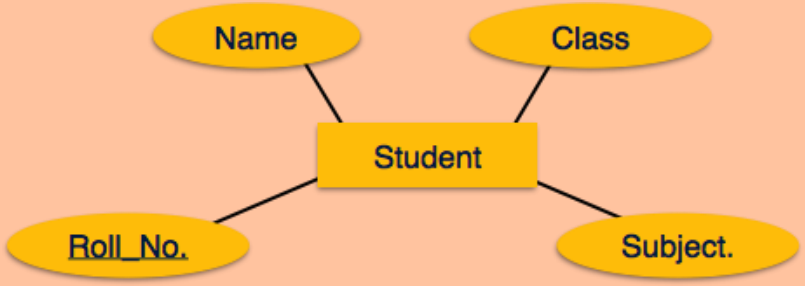
ER diagrams mainly comprise of −

- Entity and its attributes
- Relationship, which is association among entities.

ER-TO-RELATIONAL MAPPING

Mapping Entity

An entity is a real-world object with some attributes.



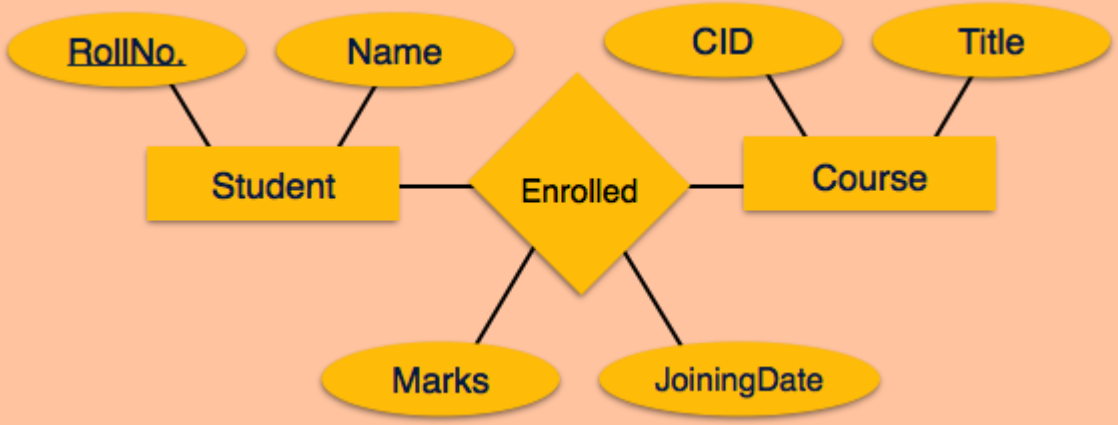
Mapping Process (Algorithm)

- Create table for each entity.
- Entity's attributes should become fields of tables with their respective data types.
- Declare primary key.

ER-TO-RELATIONAL MAPPING

Mapping Relationship:

A relationship is an association among entities.



ER-TO-RELATIONAL MAPPING

Mapping Process:

- Create table for a relationship.
- Add the primary keys of all participating Entities as fields of table with their respective data types.
- If relationship has any attribute, add each attribute as field of table.
- Declare a primary key composing all the primary keys of participating entities.
- Declare all foreign key constraints

ER-TO-RELATIONAL MAPPING

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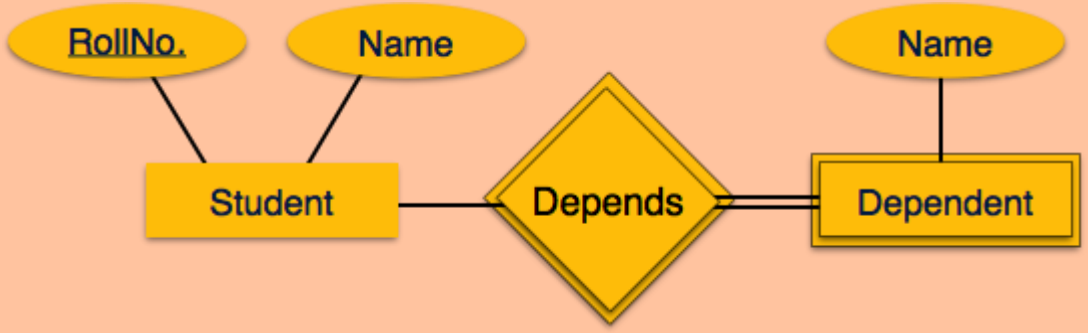
Mapping Weak Entity Sets:

A weak entity set is one which does not have any primary key associated with it.



ER-TO-RELATIONAL MAPPING

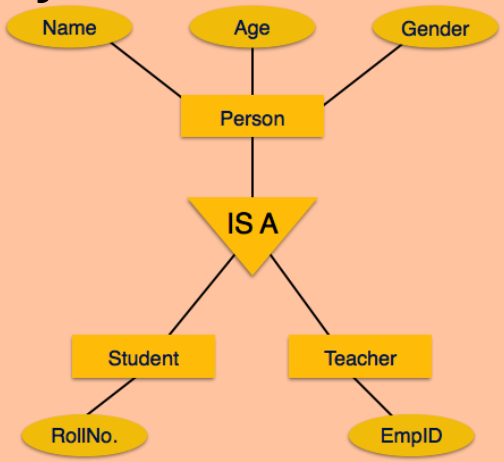
Mapping Process

- Create table for weak entity set.
- Add all its attributes to table as field.
- Add the primary key of identifying entity set.
- Declare all foreign key constraints

ER-TO-RELATIONAL MAPPING

Mapping Hierarchical Entities

ER specialization or generalization comes in the form of hierarchical entity sets.



ER-TO-RELATIONAL MAPPING

Mapping Process

- Create tables for all higher-level entities.
- Create tables for lower-level entities.
- Add primary keys of higher-level entities in the table of lower-level entities.
- In lower-level tables, add all other attributes of lower-level entities.
- Declare primary key of higher-level table and the primary key for lower-level table.
- Declare foreign key constraints.

FUNCTIONAL DEPENDENCY

A functional dependency is defined as a constraint between two sets of attributes in a relation from a database.

Given a relation R, a set of attributes X in R is said to functionally determine another attribute Y, also in R.

(written X → Y) if and only if each X value is associated with at most one Y value.

X is the determinant set and Y is the dependent attribute.

AXIOMS

1. **Reflexivity Rule :**If X is a set of attributes and Y is a subset of X, then X ? Y holds. each subset of X is functionally dependent on X.
2. **Augmentation Rule:**If X -> Y holds and W is a set of attributes, then WX -> WY holds.
3. **Transitivity Rule:**If X -> Y and Y -> Z holds, then X -> Z holds.

AXIOMS

4. **Union Rule:** If X -> Y and X -> Z holds, then X -> YZ holds.
5. **Decomposition Rule :** If X -> YZ holds, then so do X -> Y and X -> Z.
6. **Pseudotransitivity Rule:** If X -> Y and WY -> Z hold then so does WX -> Z.

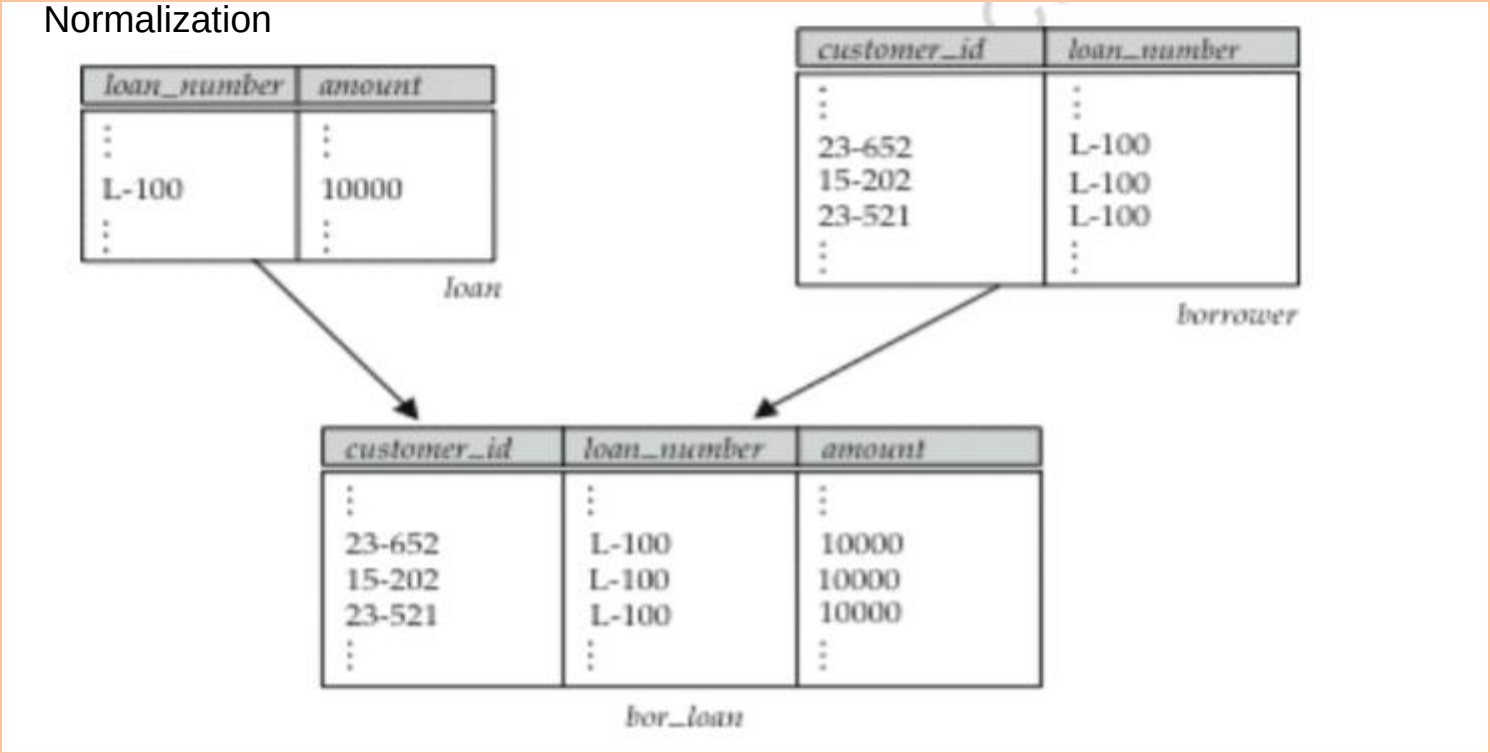
NORMALIZATION

Initially Codd (1972) presented three normal forms (1NF, 2NF and 3NF) all based on functional dependencies among the attributes of a relation.

The fourth and fifth normal forms are based on multi-value and join dependencies and were proposed later

NORMALIZATION

- Normalization



FIRST NORMAL FORM

A relational schema R is in first normal form if the domains of all attributes of R are atomic Non-Atomic values complicate storage and encourage redundant (repeated) storage of data.

Example: Set of accounts stored with each customer, and set of owners stored with each account.

SECOND NORMAL FORM

A functional dependency, denoted by X —>Y, between two sets of attributes X and Y that are subsets of R specifies a constraint on the possible tuples that can form a relation state r of R.

SECOND NORMAL FORM

Example:

{SSN, PNumber} ->Hours.

A functional dependency X —> Y is a partial dependency if some attribute A £ X can be removed from X and the dependency still holds.

{SSN, PNumber} —> EName is partial because SSN —>EName holds.

THIRD NORMAL FORM

A functional dependency X —> Y in a relation schema R is a transitive dependency if there is a set of attributes Z that is neither a candidate key nor a subset of any key of R, and both X->Z and Z —>Y hold.

Example: Consider the relation EMP_Dept

ENAME	SSN	BDATE	ADDRESS	DNO	DNAME	DMGRSSN

BOYCE CODD NORMAL FORM

A database table is in BCNF if and only if there are no non-trivial functional dependencies of attributes on anything other than a superset of a candidate key.

MULTIVALUED DEPENDENCIES AND FOURTH NORMAL FORM

Multi-valued dependency(MVD) represents a dependency between attributes (for example, A, B,and C) in a relation.

such that for each value of A there is a set of values for B and asset of values for C However, the set of values for B and C are independent of each other.

MVD is represented as A->>B,A->>C.

FOURTH NORMAL FORM

A relation that is in Boyce-codd normal form and contains no nontrivial multivalued dependencies is in Fourth Normal Form.

The normalization of BCNF relations to 4NF involves the removal of the MVD from the relation by placing the attributes in a new relation along with a copy of the determinant(s).

JOIN DEPENDENCIES AND FIFTH NORMAL FORM

Whenever we decompose a relation into two relations the resulting relations have the lossless join property.

This property refers to the fact that we can rejoin the resulting relations to produce the original Relation.

FIFTH NORMAL FORM

A relation that has no join dependency is in Fifth Normal Form.

THANK YOU