SNS COLLEGE OF ENGINEERING

Kurumbapalayam (Po), Coimbatore – 641 107

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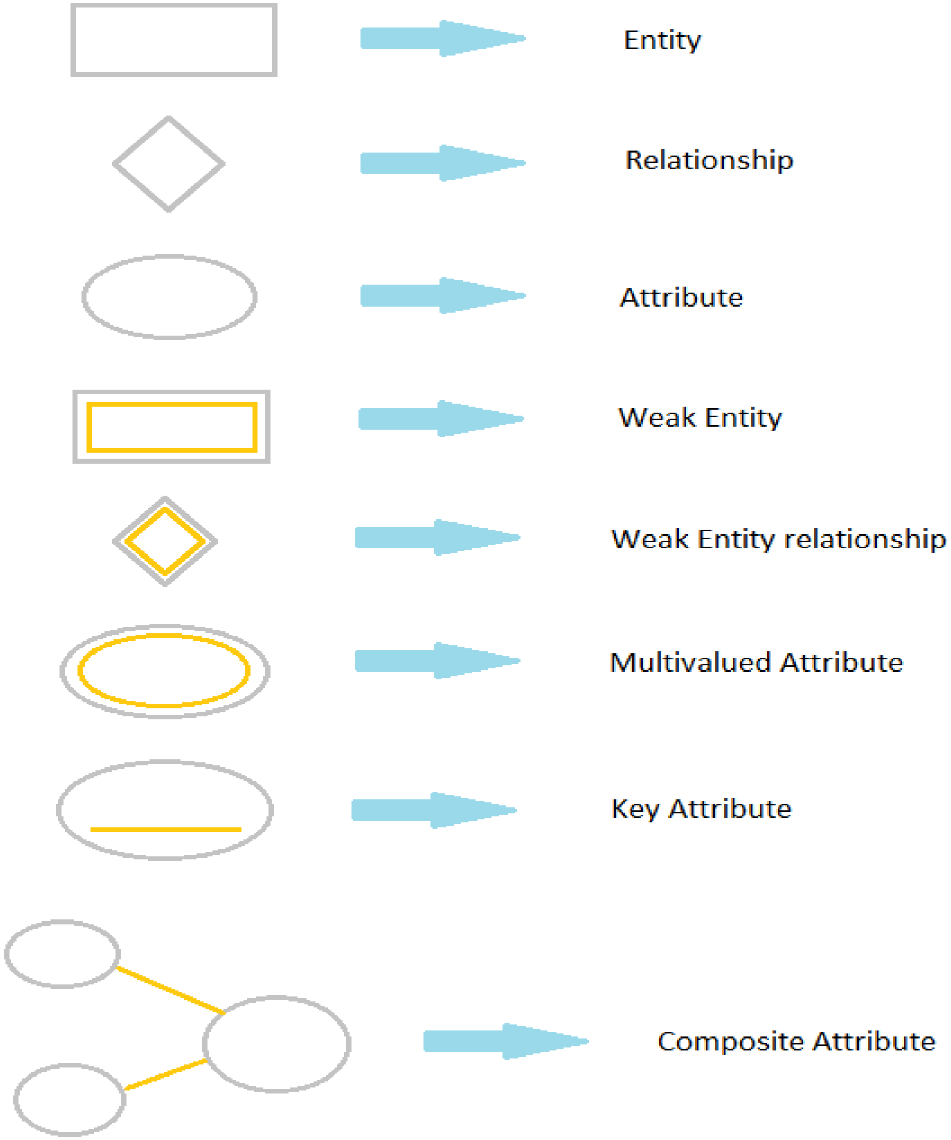
DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

COURSE NAME : 19CS402 - DATABASE MANAGEMENT SYSTEMS

II YEAR / III SEMESTER

Topic 1 : Entity Relationship Model

Components of ER Diagram



Entity

Relationship

Attribute

Weak Entity

Weak Entity relationship

Multivalued Attribute

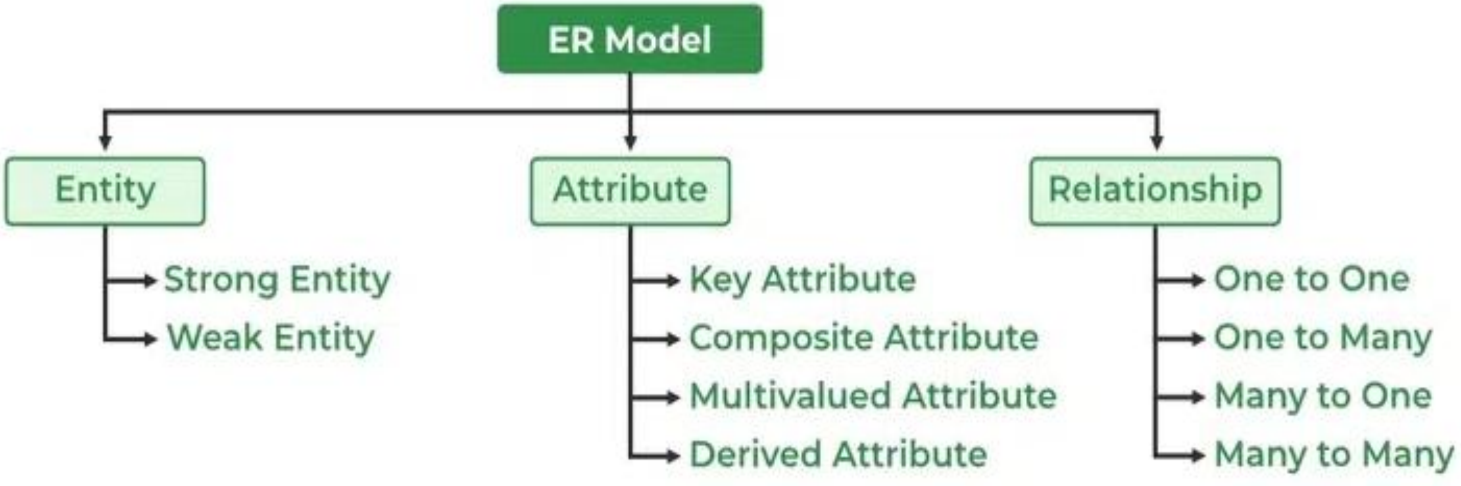
Key Attribute

Composite Attribute

Entity – Relationship Model

- The overall logical structure of a database can be expressed graphically using E-R diagrams.
- Features of E-R Model
  - This is used to give structure to the data.
  - Model can be evolved independent of any DBMS
  - It is an aid for database design.
  - It is easy to visualize and understand.

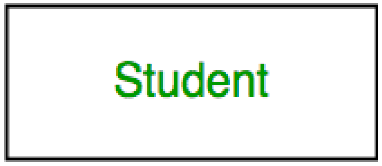
Entity – Relationship Model



ER Model

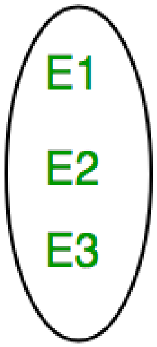
- Entity
  - Strong Entity
  - Weak Entity
- Attribute
  - Key Attribute
  - Composite Attribute
  - Multivalued Attribute
  - Derived Attribute
- Relationship
  - One to One
  - One to Many
  - Many to One
  - Many to Many

Basic Concepts



Entity Type

- Entity set
- Attributes
- Relational sets



Entity Set

- Entity set
  - An entity is a ‘thing’ or an ‘object’ in a real world.
  - An entity set is a collection of entities having the same properties
  - Example
    - Person, car, house, book, publisher etc..,

Attributes

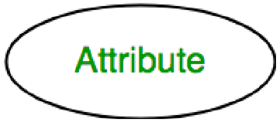
The properties that describe an entity are called attributes.

Example

- Customer (entity)
- Customer_id, Customer_name, city are called attributes.

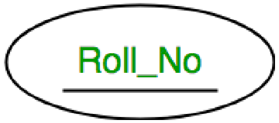
An attribute can be classified into various type

- Simple Attributes
- Composite attributes
- Single valued attributes
- Multi valued attributes
- Derived attribute



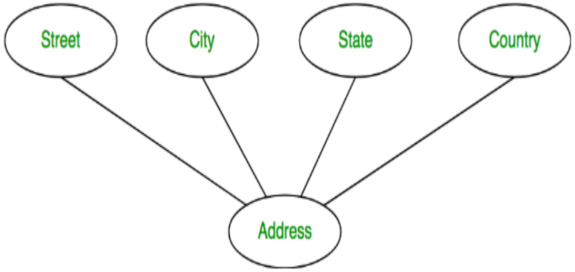
Simple attributes

- An attribute that cannot be divided into further subparts
- Example
  - Roll_no, Acc_no



• Composite attributes

- An attribute that can be divided into a set of subparts.
- Example
  - Customer_name divided
  - Firstname , Middlename, Lastna
  - Address
    - Street, City, Pincode



Composite Attribute

- Single valued Attribute
  - An attribute having only one value in a particular entity
  - Example
    - In a customer entity,
      - Name, id, street are single valued attribute
- Multi valued attribute
  - An attribute having more than one value for a particular entity
  - Example
    - Customer (entity) – (attribute) phone no
    - Student (entity) - (attribute) hobby (reading,music, painting etc.,)
- Derived attribute
  - An attribute that is derived from other related attributes or entities
  - Example
    - Age of a customer entity set is derived from the attribute date_of _birth of a customer.

Relationship set

- Relationship is an association among several entities.
- Example
  - Person and company relationship

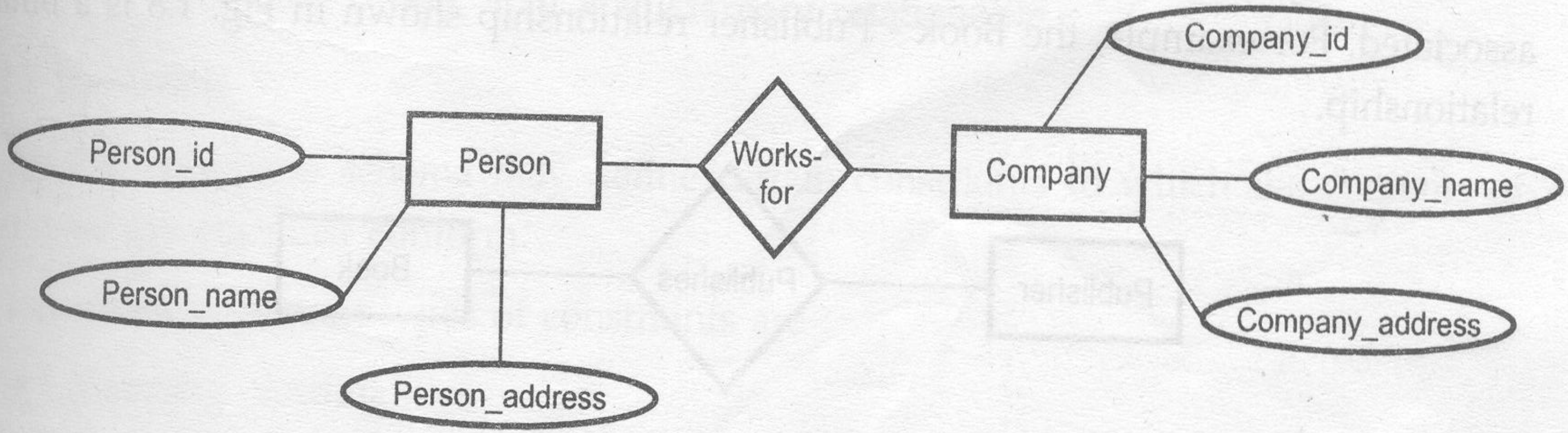
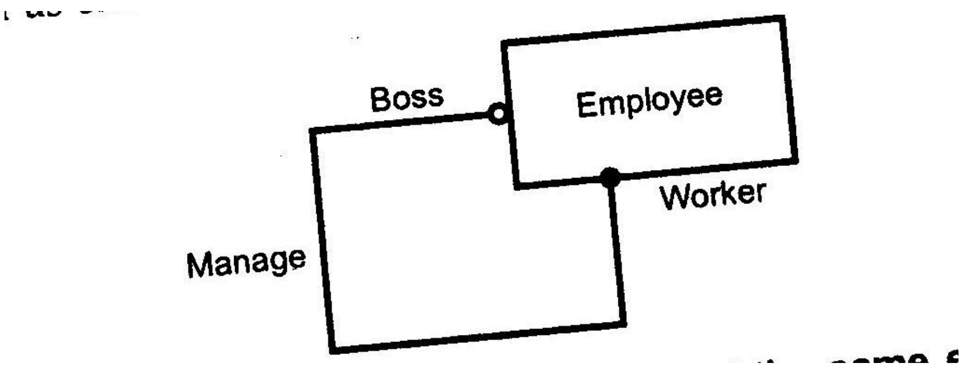


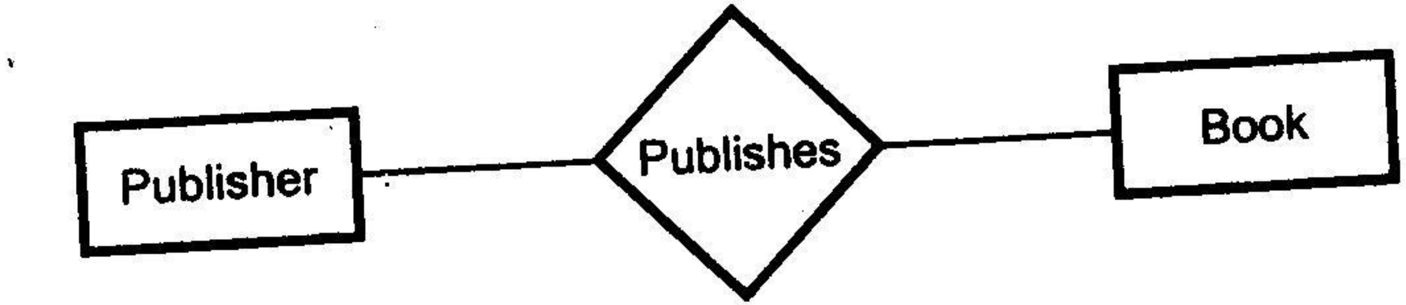
Fig. 1.5 An E-R diagram

Types of Relationships

- Unary relationship
  - An unary relationship exists when an association is maintained within a single entity.
  - Example
    - Boss and worker are two employees
    - Manage is association



- Binary relationship
  - – A binary relationship exists when two entities are associated.



- Ternary relationship
  - A binary relationship exists when three entities are associated.
  - Example

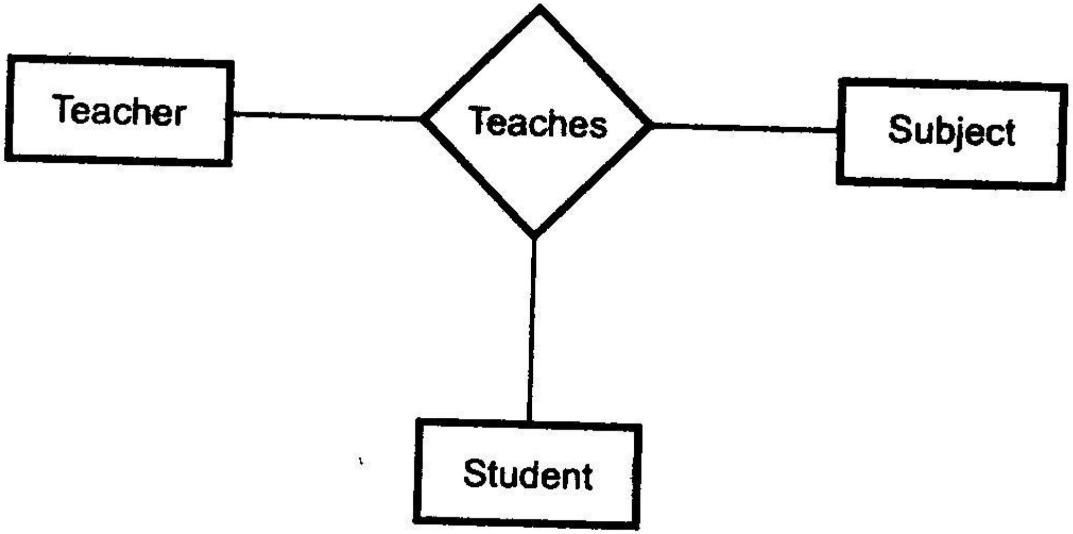


Fig. 1.9 Ternory relationship

Quaternary relationship

- A quaternary relationship exists when there are four entities associated.
- Example

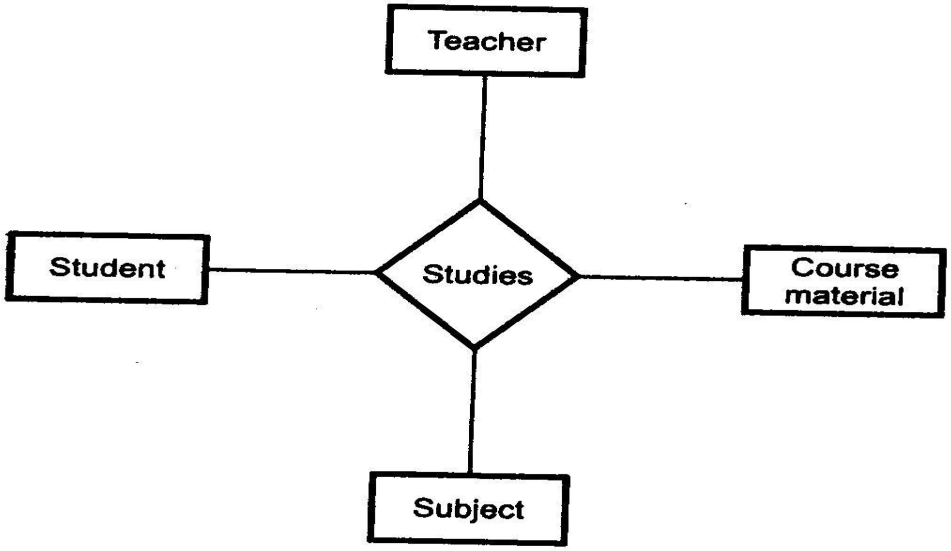


Fig. 1.10 A quaternary relationship

Constraints

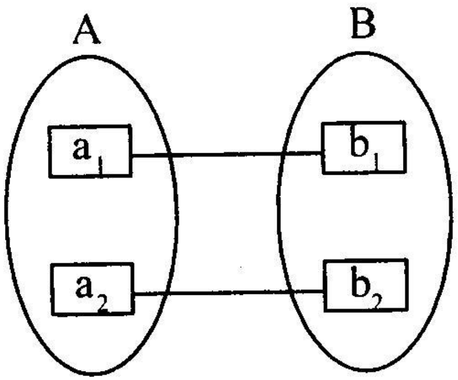
- Two main important types of constraints are:-
  - – Mapping cardinalities
  - – Participation constraints

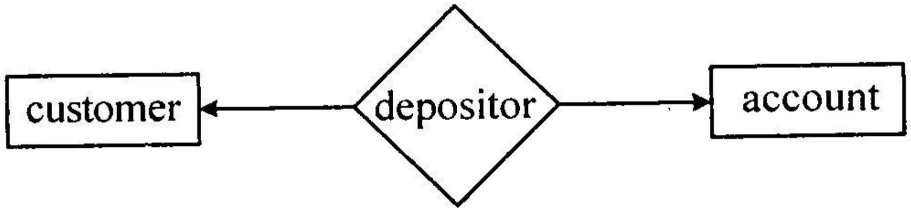
Mapping Cardinalities

- Mapping cardinalities or cardinality ratio express the number of entities to which another entity can be associated via relationship set.
- Types are
  - One to one
  - One to many
  - Many to one
  - Many to many

One to one

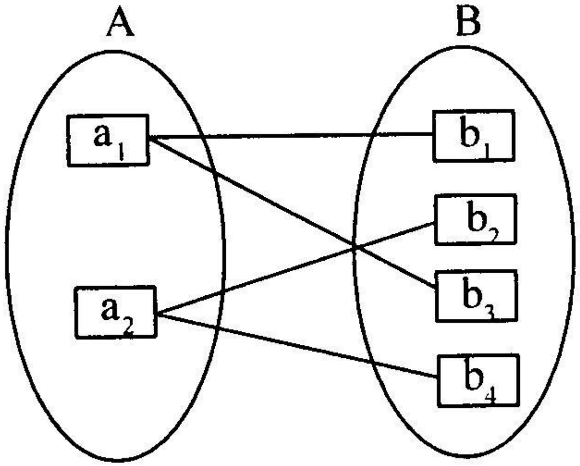
- An entity in A is associated with at most one entity in B.
- An entity in B is associated with at most one entity in A

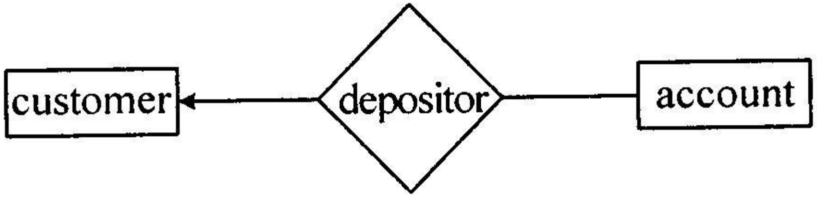




One to Many

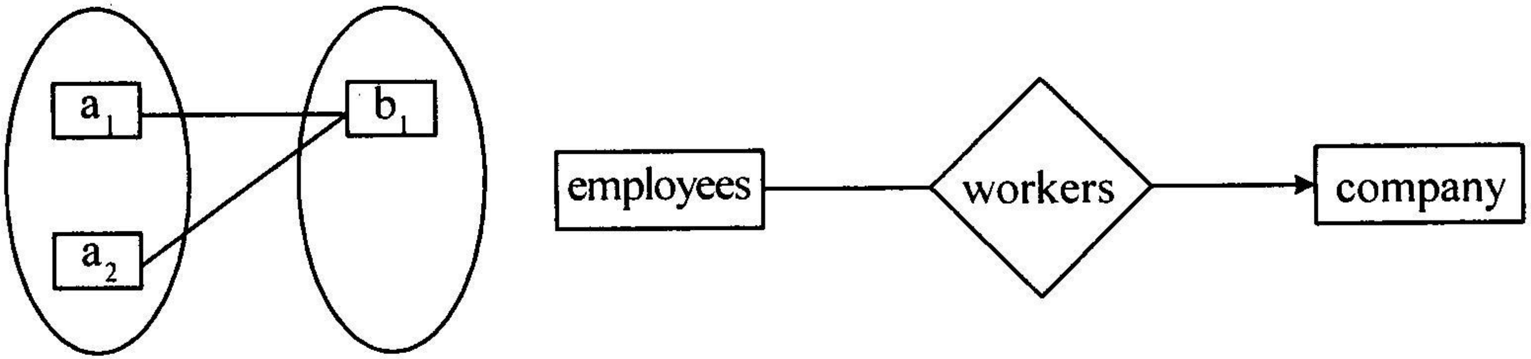
- An entity in A is associated with any number of (0 or more) entities in B.
- An entity in B is associated with at most one entity in A





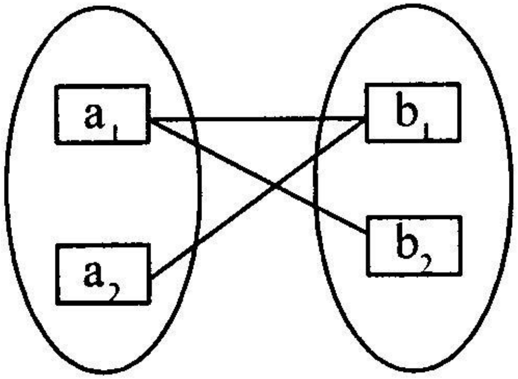
Many to one

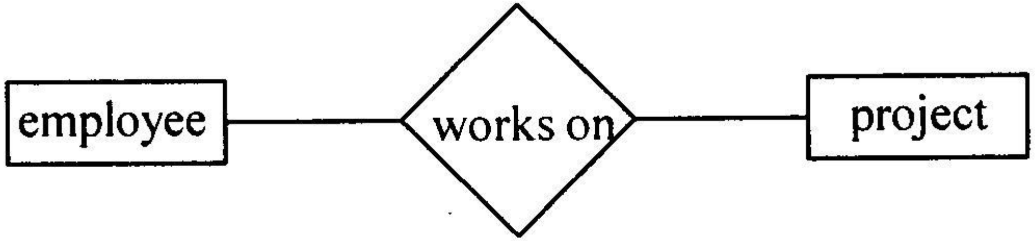
- An entity in A is associated with at most one entity in B.
- An entity in B is associated with Zero or more number of entities in A.



Many to Many

- An entity in A is associated with any number (0 or more) of entities in B and vice versa.





Participation Constraints

- Total participation
  - The participation of an entity set E in a relationship set R is said to be total if every entity in E participates in at least one relationship in R.
  - Example
    - Salary relationship employees
- Partial participation
  - If only some entities in E participate in relationships in R
    - Employees relationship commission

Keys

- A key allows to identify a set of attributes or relationship.
- Different types of keys are
  - Super key
  - Candidate key
  - Primary key
  - Foreign key

- Super key
  - A super key is a set of one or more attributes that allows us to identify uniquely an entity in the entity set,
  - Example
    - Roll_no attribute of the entity set 'student'.
- Candidate key
  - A candidate key is a minimal super key for which no proper subsets can be formed.
  - Example
    - {studnt_name, student_class}
- Primary key
  - Primary key is a key that has unique value
  - Example
    - Employee (eno, ename, salary, job, dno), eno is the primary key
- Foreign key
  - An attribute in one relation whose value matches the primary key in some other relation is called a foreign key.
  - Example
    - Employee (eno, ename, salary, job, dno)
    - Dept (dno,dname,dloc)

    Dno is primary key and eno is primary key

    So dno is foreign key

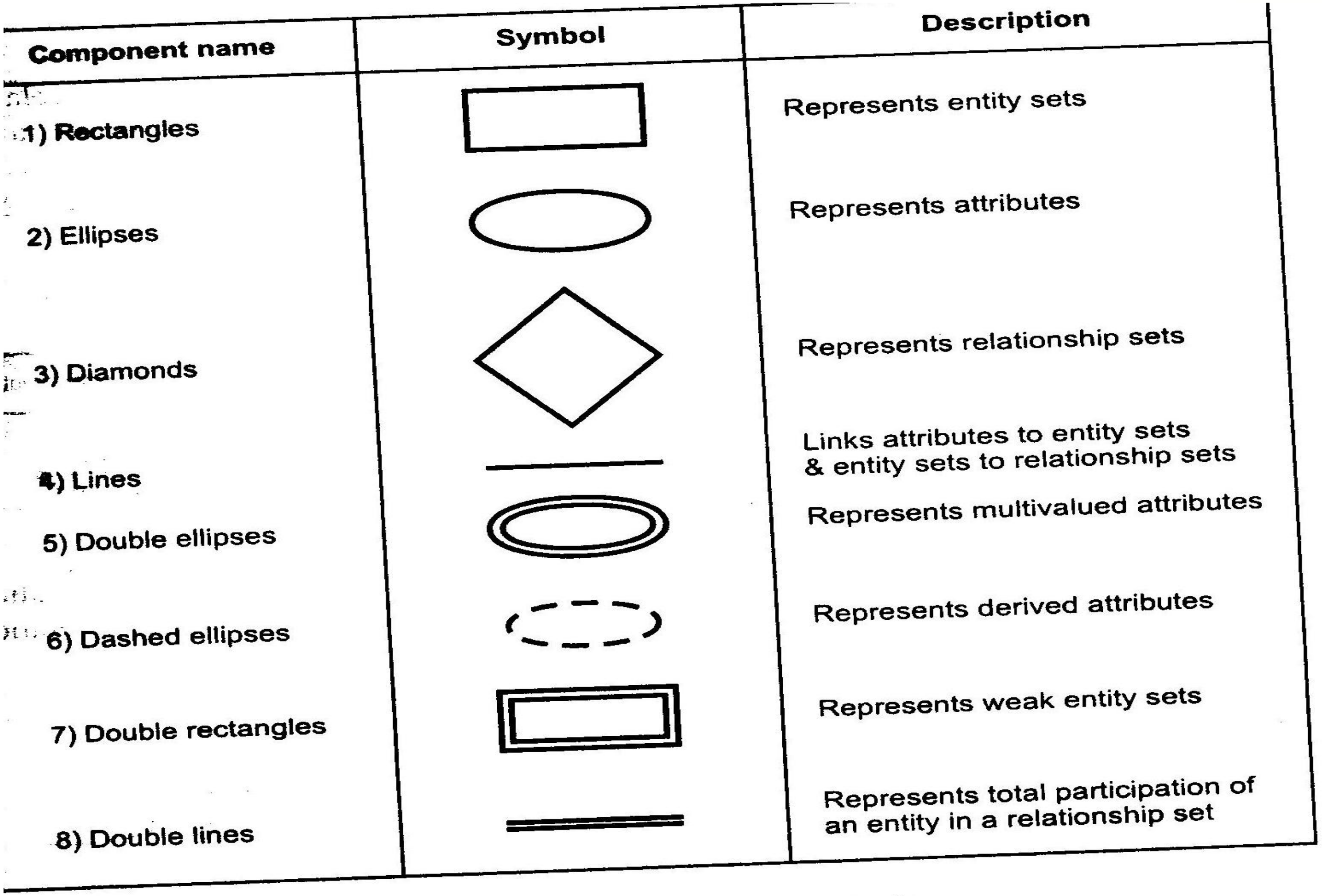
Weak Entity set

- An entity set may not have sufficient attributes to from a primary key. Such an entity set is termed as weak entity set.
- Example
  - Payment entity set with the attributes of payment_type, payment_amount and payment_date.

- ## Strong Entity set

  - An entity set that has a primary key is termed as a strong entity set.
  - Example
    - Loan entity set with the attributes of loan_id, loan_amount, loan_type

E-R diagram symbols



Component name	Symbol	Description
1) Rectangles	▭	Represents entity sets
2) Ellipses	⬭	Represents attributes
3) Diamonds	◇	Represents relationship sets
4) Lines	—	Links attributes to entity sets & entity sets to relationship sets
5) Double ellipses	◎	Represents multivalued attributes
6) Dashed ellipses	◌	Represents derived attributes
7) Double rectangles	⧈	Represents weak entity sets
8) Double lines	═	Represents total participation of an entity in a relationship set

Fig. 1.19 E-R diagram symbols

Alternative E-R Notations

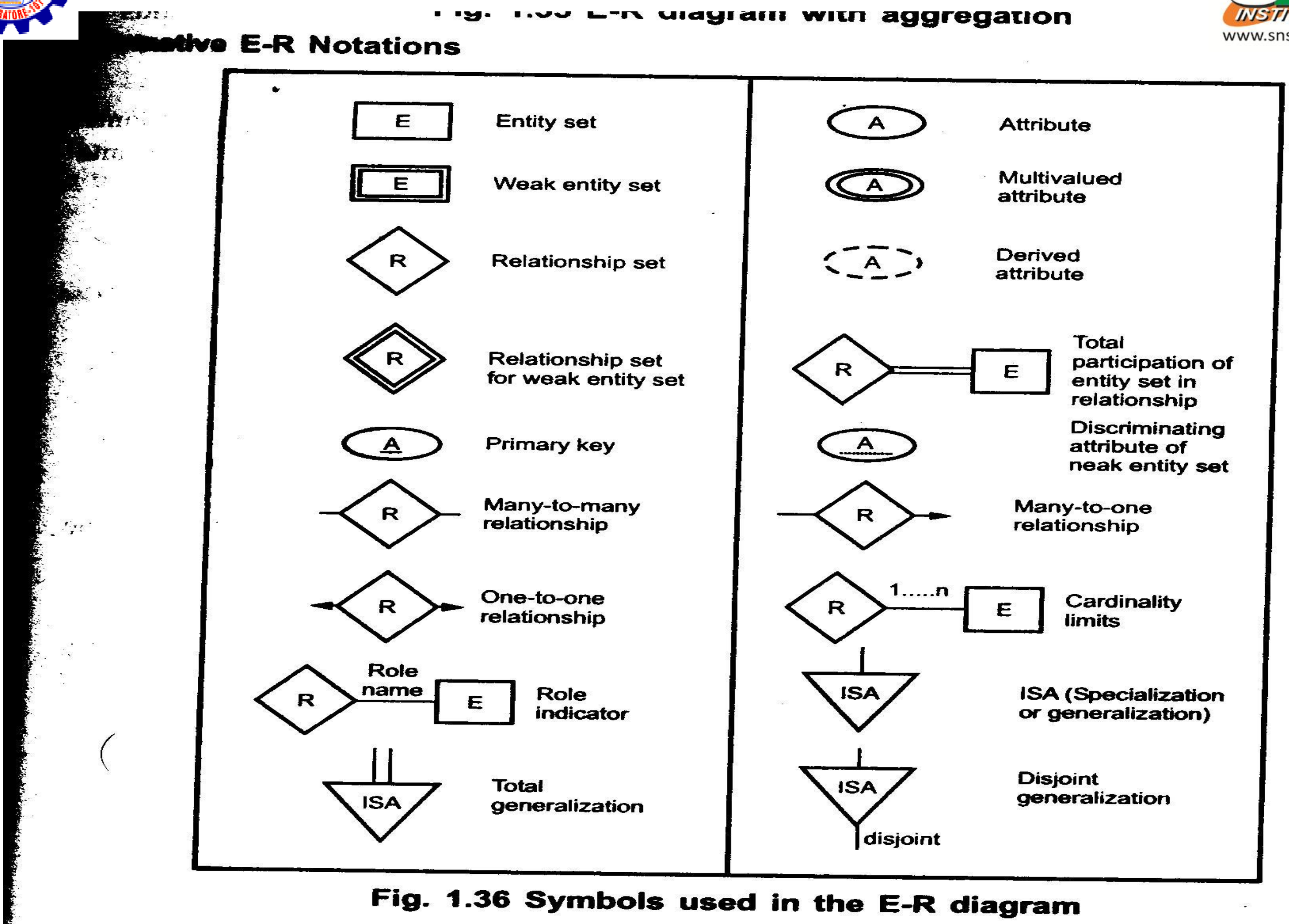
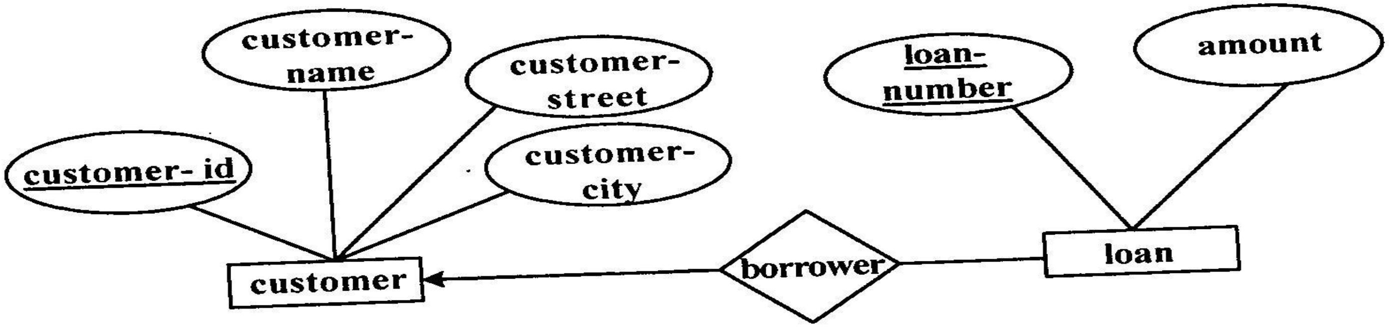


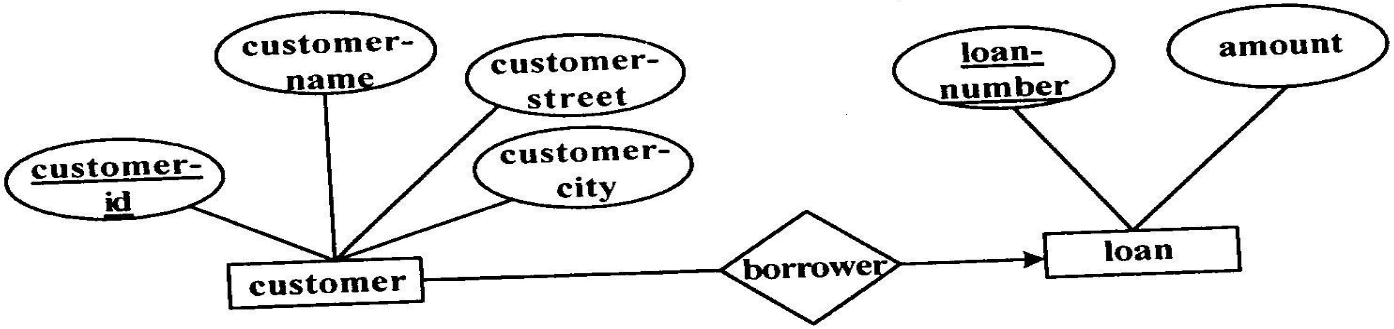
Fig. 1.36 Symbols used in the E-R diagram

E-R Diagram with relationships

1. One-to-Many:

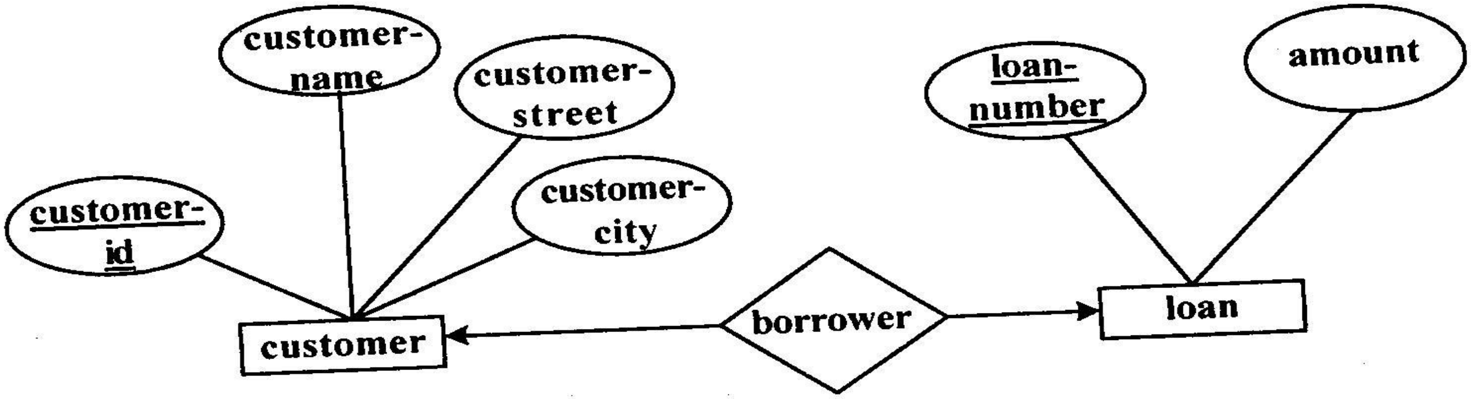


2. Many-to-One:

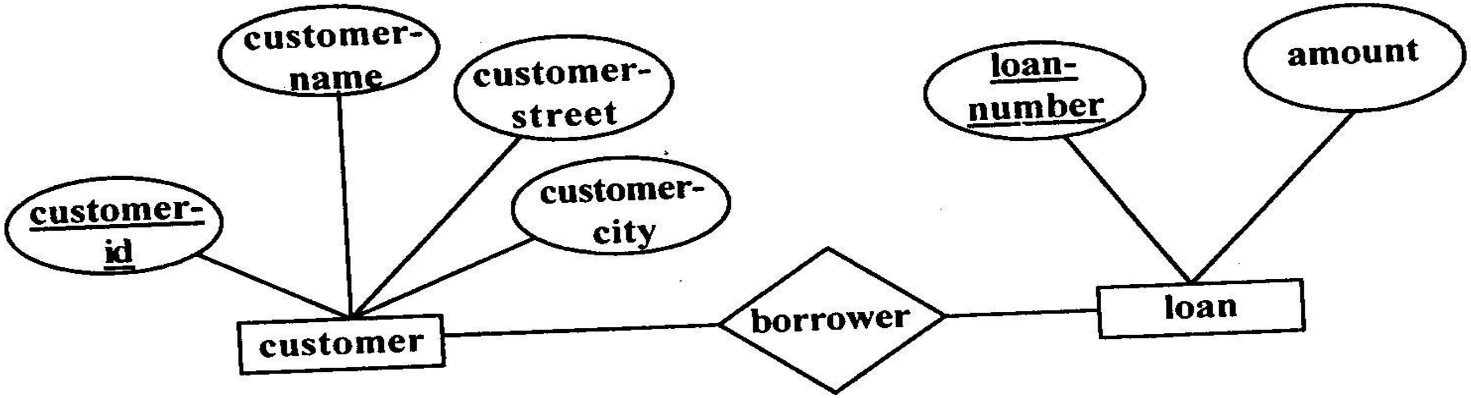


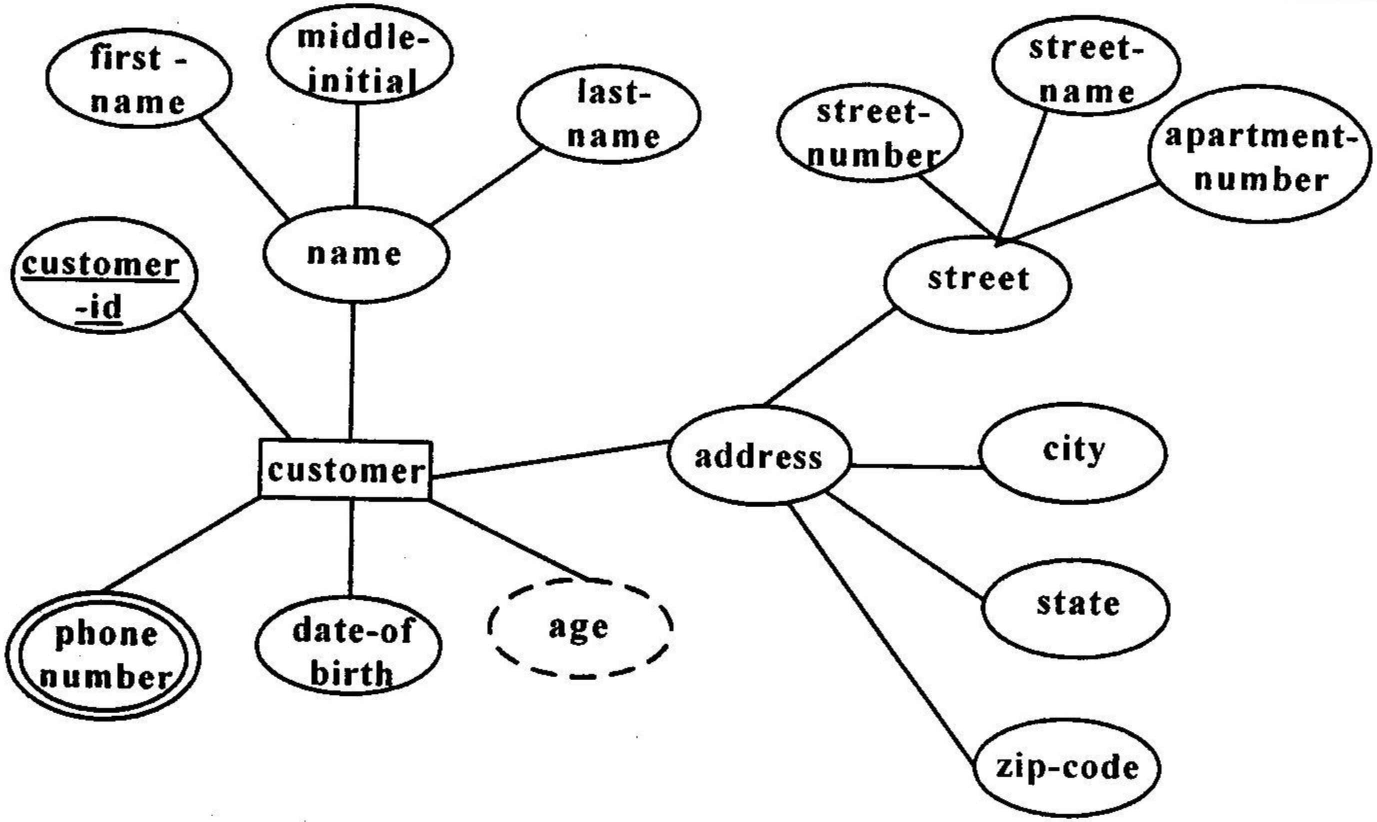
E-R Diagram with relationships cont…

3. One - to - One



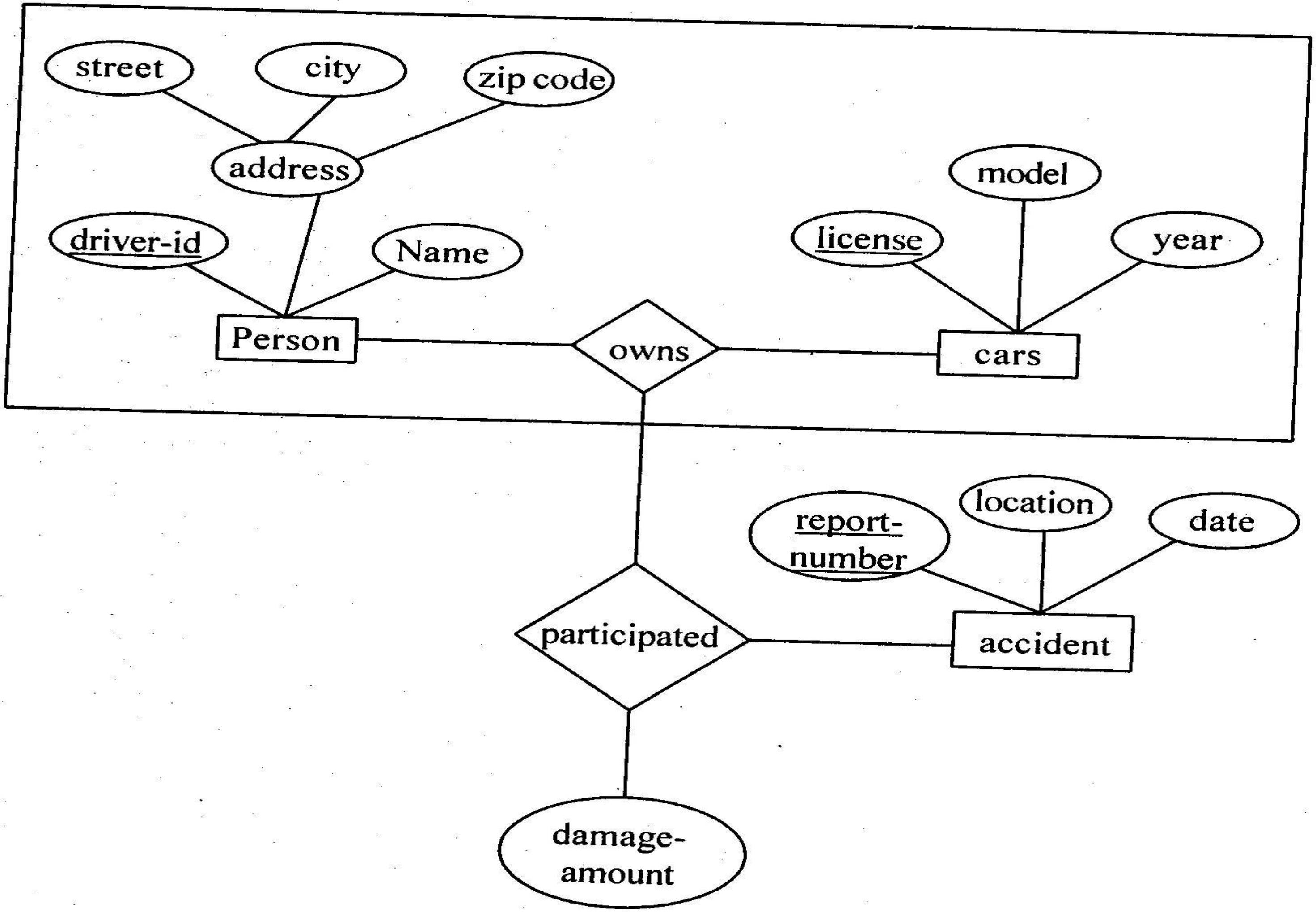
4. Many - to - Many



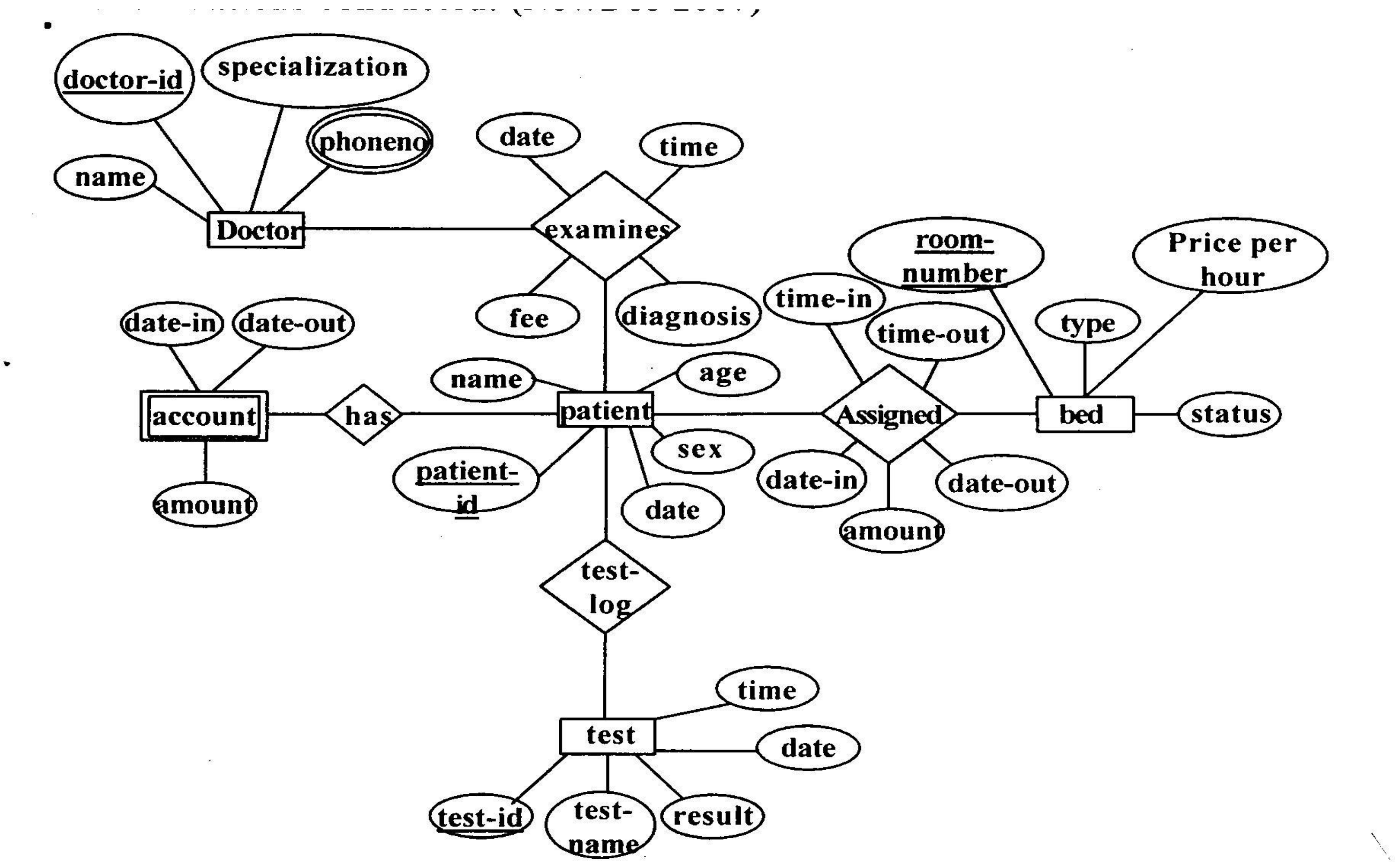


E-R diagram with composite, multivalue and derived attributes

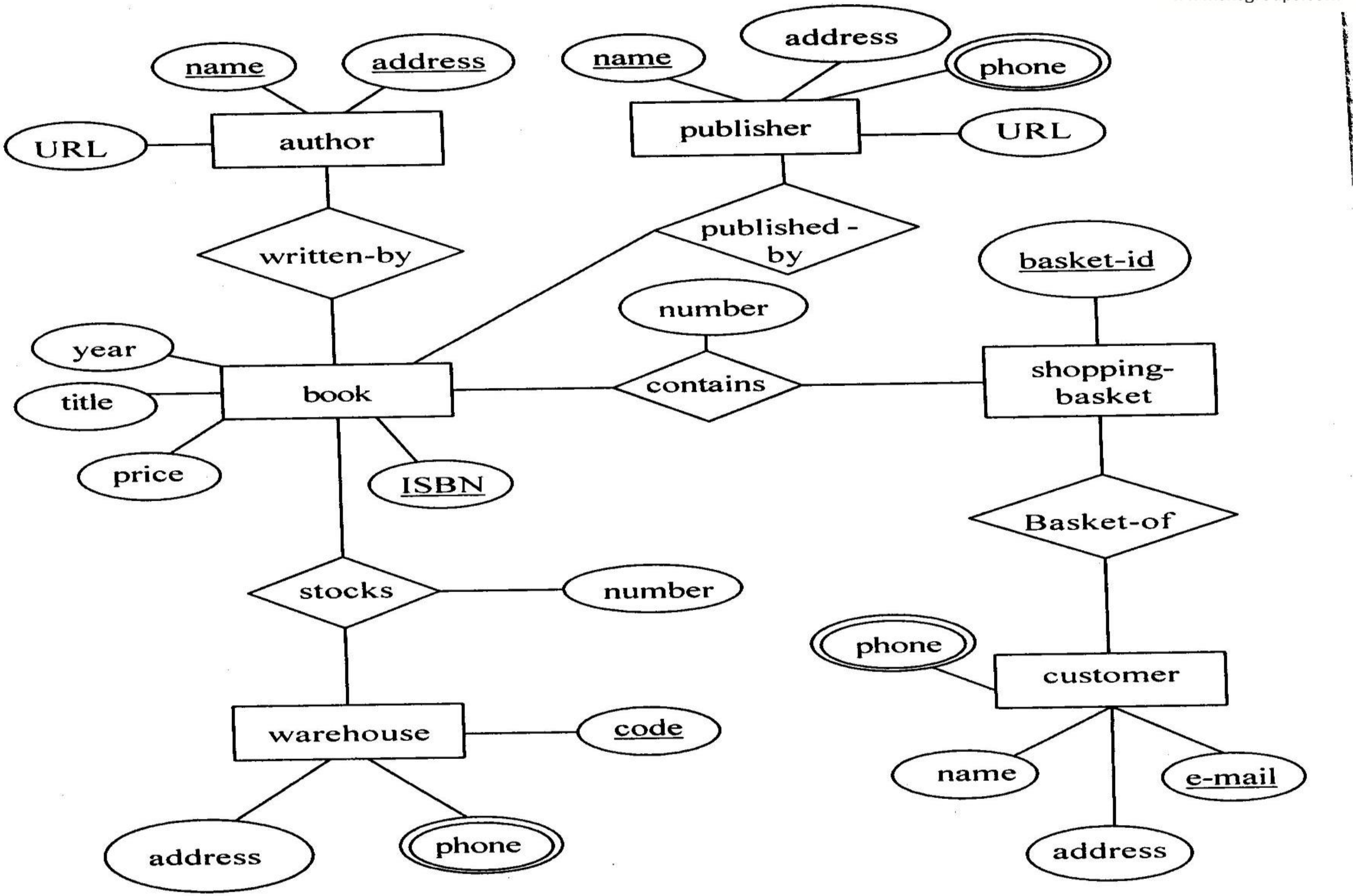
Construct an E-R diagram for a car insurance company whose customers own one or more cars each. Each car has associated with it zero to any number of recorded



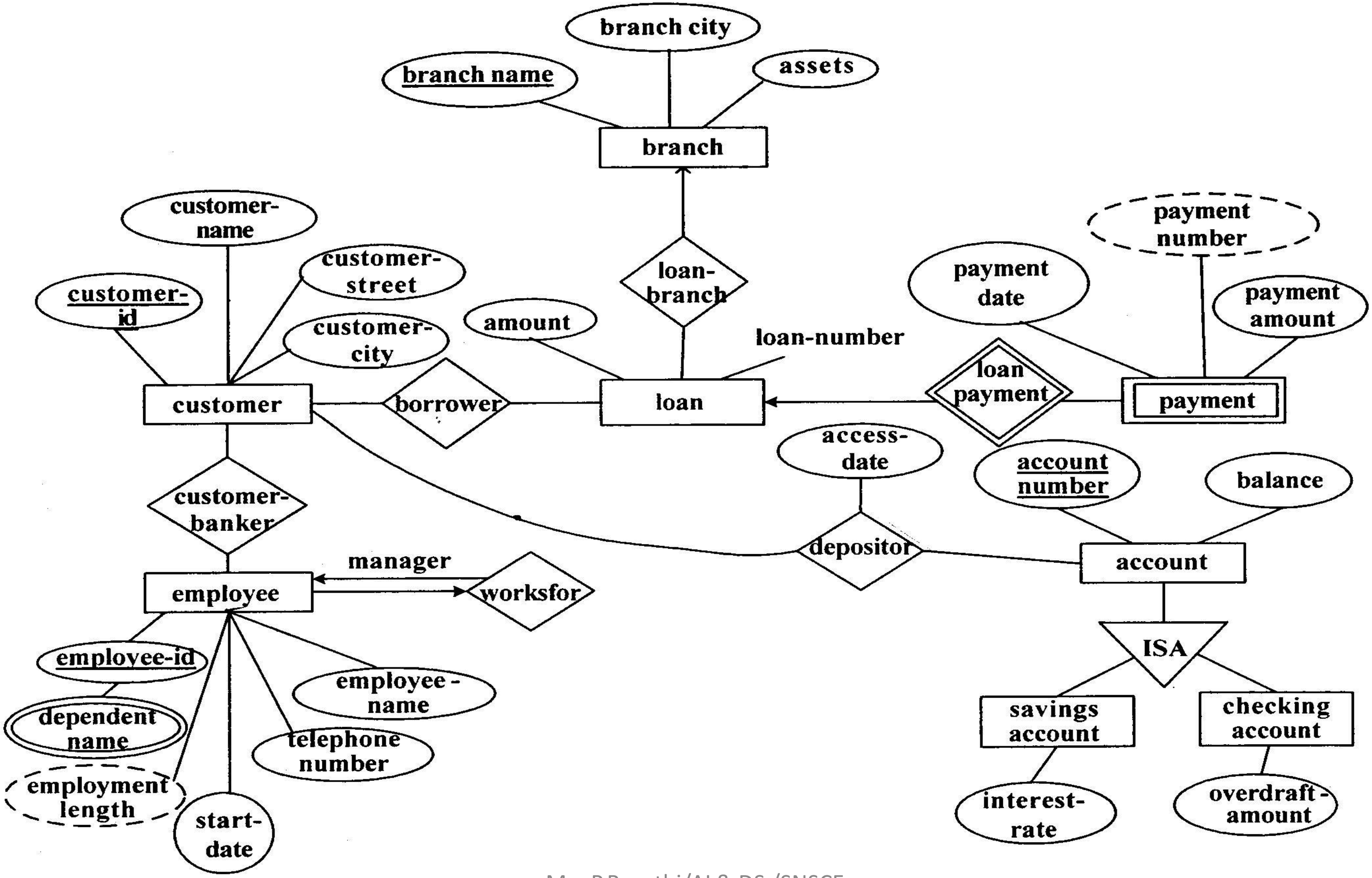
ıstruct an E-R diagram for a hospital with a set of patients and a set of medic
ociate with each patient a log of various tests and examinations conducted.



Construct an E-R diagram to model an online book store.



Construct an E-R diagram for a banking system



Entity Relationship Model

- Peter Chen’s Landmark Paper in 1976 – “The Relationship Model: Toward a Unified View of Data” – Graphical representation of entities and their relationships – Entity Relationship (ER) Model Based on Entity, Attributes & Relationships
- Entity is a thing about which data are to be collected and stored – e.g. EMPLOYEE
- Attributes are characteristics of the entity – e.g. SSN, last name, first name
- Relationships describe an associations between entities – i.e. 1:M, M:N, 1:1 – Complements the relational data model concepts
- Helps to visualize structure and content of data groups – entity is mapped to a relational table
- Tool for conceptual data modeling (higher level representation) Represented in an Entity Relationship Diagram (ERD)
- Entity relational model is a model for identify entities to be represented in the database and representation of how those entities are related

Database Design Process

Database design process can be divided into 6 major steps:

1.Requirements Analysis

2.Conceptual Database Design

3.Logical Database Design

4.Schema Refinement

5.Physical Database Design

6.Security Design

E-R Model: Pros & Cons

- Advantages Exceptional conceptual simplicity
- easily viewed and understood representation of database
- facilitates database design and management Integration with the relational database model
- enables better database design via conceptual modeling
- Disadvantages Incomplete model on its own
- Limited representational power – cannot model data constraints not tied to entity relationships » e.g. attribute constraints – cannot represent relationships between attributes within entities
- No data manipulation language (e.g. SQL) Loss of information content
- Hard to include attributes in ERD

Purpose of E/R Model

- The E/R model allows us to sketch database schema designs. – Includes some constraints, but not operations.
- Designs are pictures called entity-relationship diagrams.
- Later: convert E/R designs to relational DB designs.

Entity Sets

- Entity = “thing” or object.
- Entity set = collection of similar entities. – Similar to a class in object-oriented languages.
- Attribute = property of (the entities of) an entity set. – Attributes are simple values, e.g. integers or character strings, not structs, sets, etc.

Entity Sets

- Entity set car has two attributes, name and manf (manufacturer).
- Each car entity has values for these three attributes, e.g. (color and design , model)