

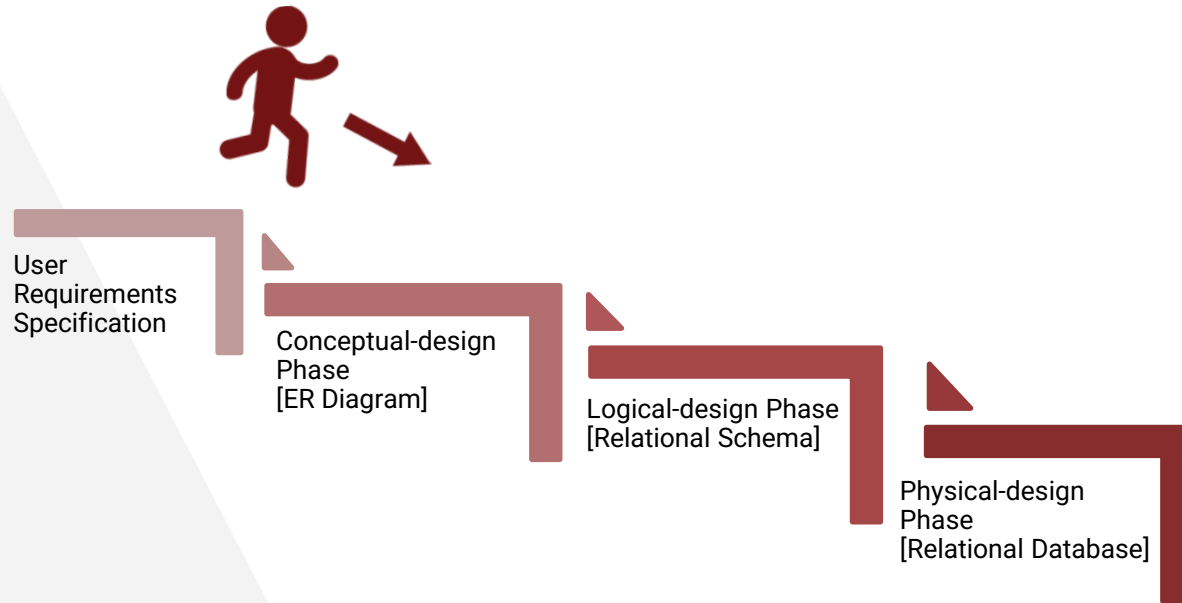


Database Management System

E-R Data Model

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Design Phases



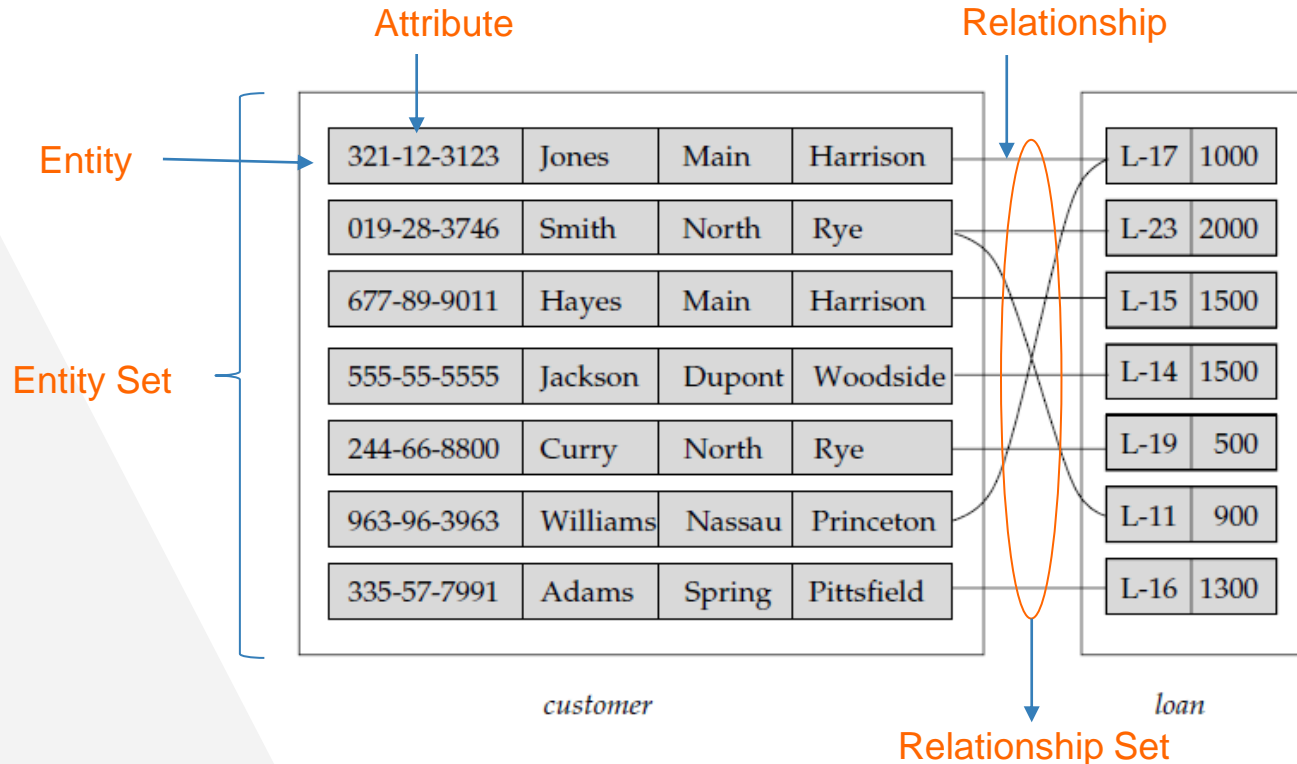
Conceptual Design >> E-R Data Model

- ▶ Entity-relationship(E-R) data model is used to represent the conceptual design. It maps the meanings and interactions of real-world enterprises onto a conceptual schema.
- ▶ The E-R data model perceives the real world as consisting of basic objects, called **entities**, and **relationships** among these objects.
- ▶ The E-R model has an associated diagrammatic representation, the **E-R diagram**. E-R diagram can express the overall logical structure of a database graphically.
- ▶ Three principal concepts:
 - Entity sets
 - Attributes
 - Relationship sets
- ▶ We will consider *Chen Model Notations* for our E-R Diagram.

E-R Diagram >> Components

- ▶ **Entity:** It is a **real-world object** about which we collect data. In other words, it is a definable thing that can have data stored about it.
- ▶ **Entity Set:** An entity set is a **set of entities** of the same type that share the same properties or attributes.
- ▶ **Attributes:** Attributes are descriptive **properties** of the entities in the entity set. Each entity has its own value for each attribute.
- ▶ **Relationship:** It is an **association** among several entities.
- ▶ **Relationship Set:** It is a **set of relationships** of the same type.

E-R Diagram >> Components

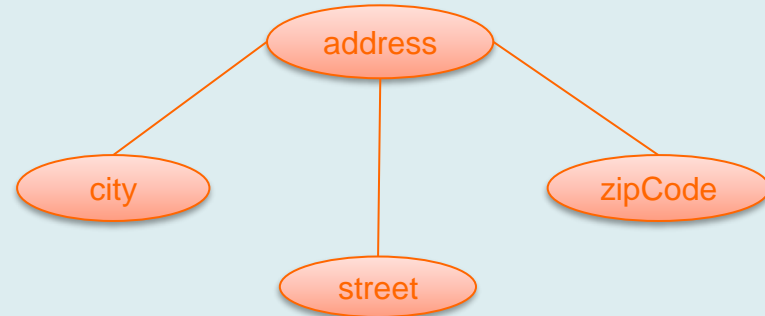


E-R Diagram >> Attributes

Simple – Attribute value is atomic and can't be divided into subparts.



Composite – Attributes that can be divided into subparts i.e. other attributes.



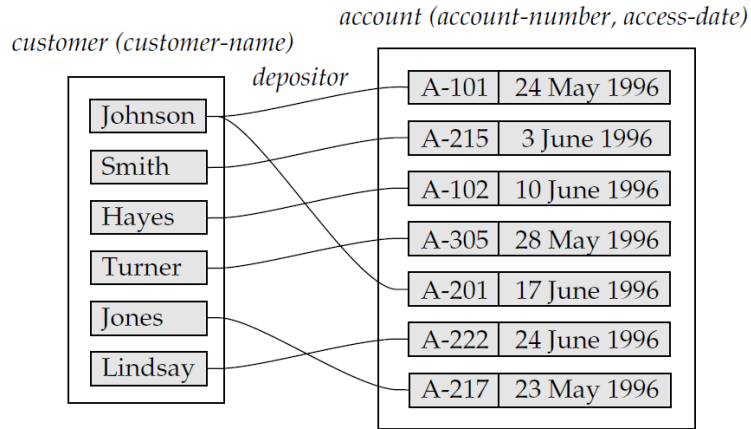
Derived – Attributes that can be calculated from other related attributes.



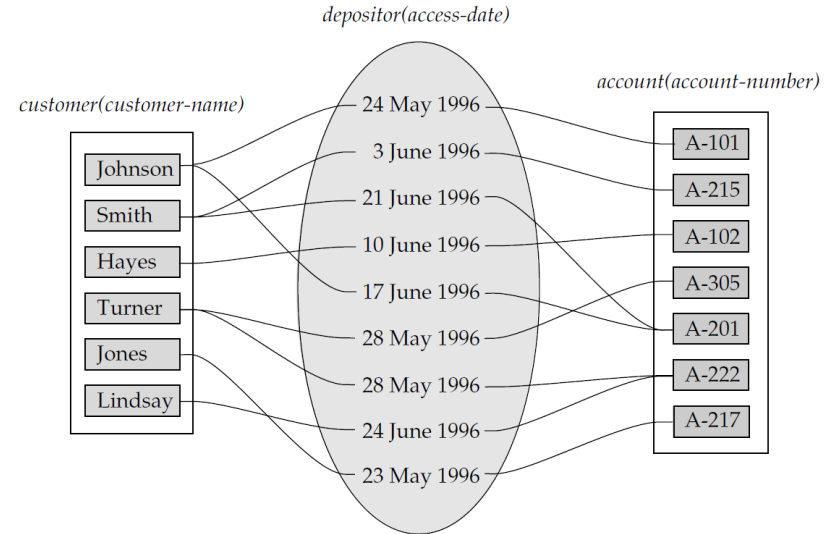
Multivalued – Attributes having more than one values (a set of values) for a specific entity.



E-R Diagram >> Relationship Attributes



One-to-Many Relationship Set

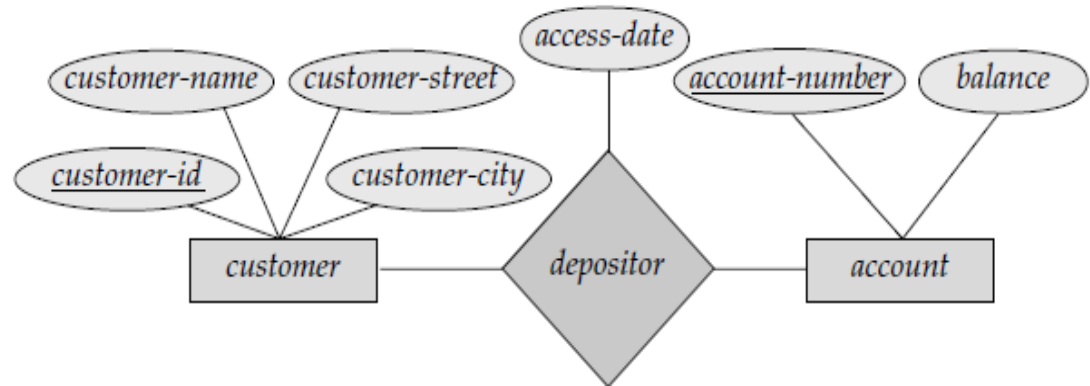


Many-to-Many Relationship Set

E-R Diagram >> Relationship Attributes

Descriptive Attribute – Properties/characteristics of a relationship.

This type of attributes can't be associated with any entity sets that the relationship set links.



E-R Diagram >> Keys

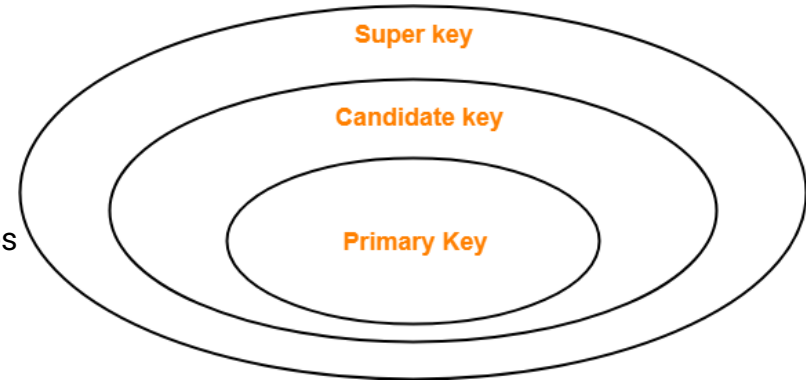
Superkey – A set of one or more attributes that, taken collectively, allow us to identify uniquely an entity in the entity set.

Candidate key – A minimal (irreducible) superkey such that no proper subset of its attributes is also a superkey.

Primary key – The candidate key chosen to be used for identifying entities and accessing records.

Key attribute – An attribute that is part of a (primary) key.

Partial key/Discriminator – an attribute that when combined with the key attribute of the owner entity, provides identification for the weak entity.

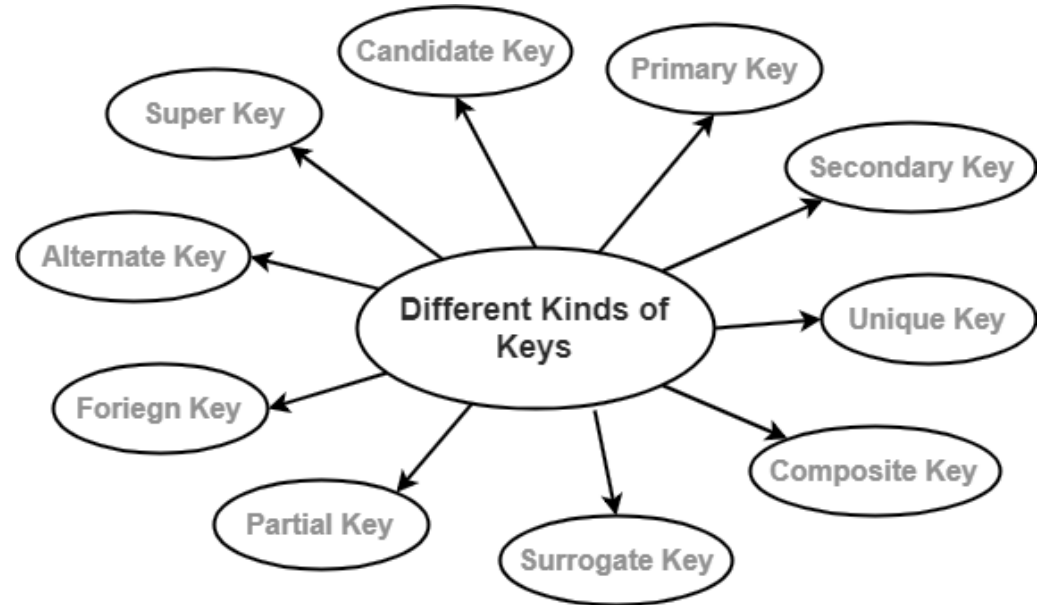


Relational Database Keys

Composite key – A key that is composed of more than one attribute.

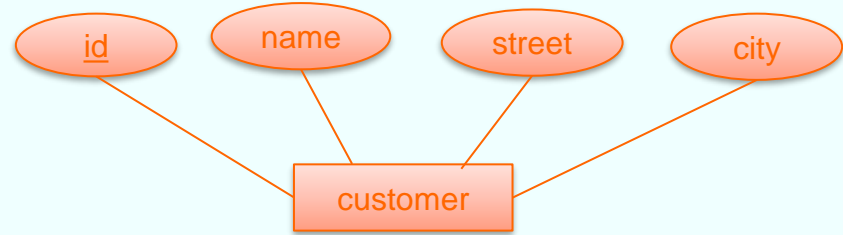
Foreign key – An attribute or combination of attributes in one table whose values must either match the primary key in another table or be null.

Foreign keys are used to ensure referential integrity, the condition in which every foreign key entry must either be null or a valid value in the primary key of the related table.



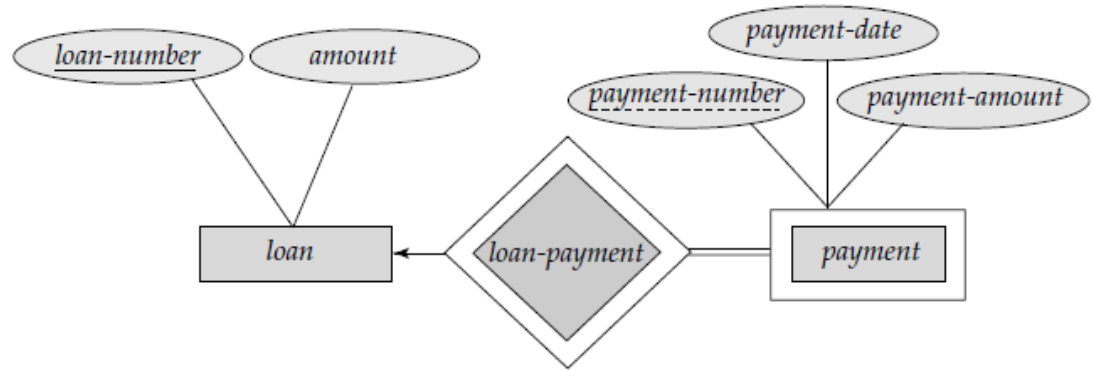
E-R Diagram >> Entity Sets

Strong Entity Set – has enough attributes to uniquely identify each entity.



Weak Entity Set – It is one whose existence is dependent on another (identifying) entity set.

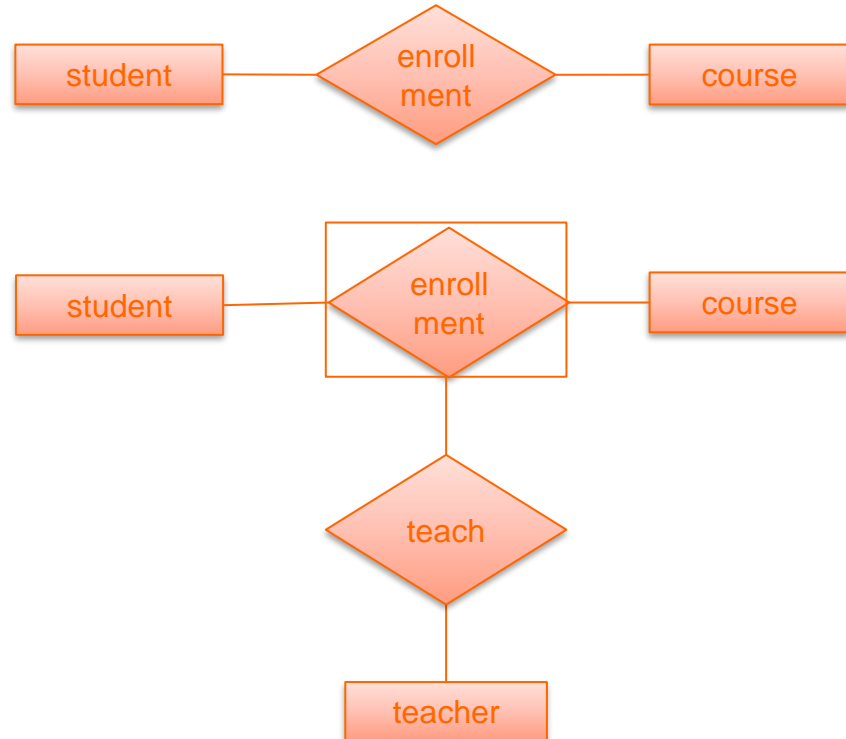
The primary key attributes of the identifying entity set, along with the discriminator (partial key) attributes of its own are used to uniquely identify each weak entity.



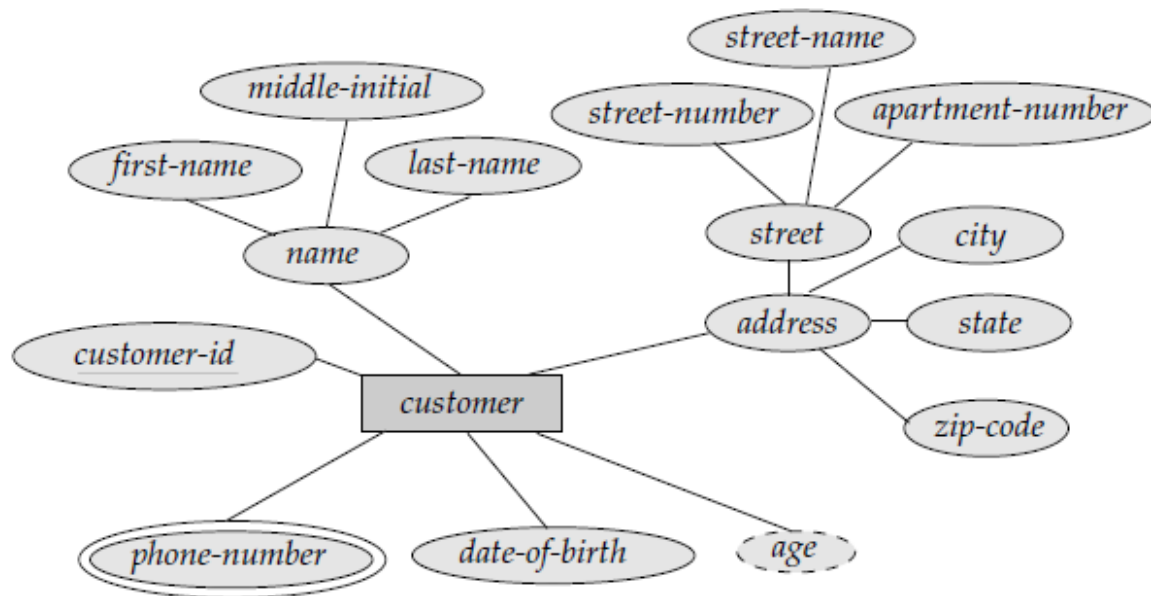
E-R Diagram >> Entity Sets

Associative Entity Set – This type of entity set is used in a many-to-many relationship.

When you need a relationship to be involved in a relationship then the former relationship is converted to an associative entity.



E-R Diagram >> Example



E-R Diagram >> Relationship Sets

Non-Identifying Relationship Set – A relationship where child entity is existence-independent of parent entity, and primary key of child doesn't contain primary key component of parent entity.

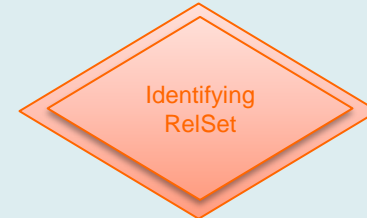
In terms of relationship strength, it is also known as weak relationship.



Identifying Relationship Set – A relationship where child entity is existence-dependent on parent (identifying) entity, and primary key of child entity contains primary key component of parent entity.

The identifying relationship set should not have any descriptive attributes, since any such attributes can instead be associated with the weak entity set.

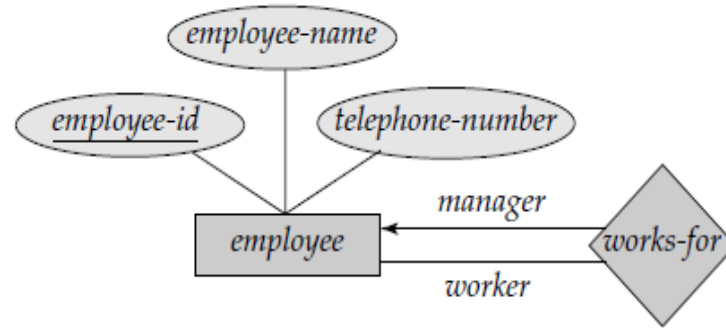
In terms of relationship strength, it is also known as strong relationship.



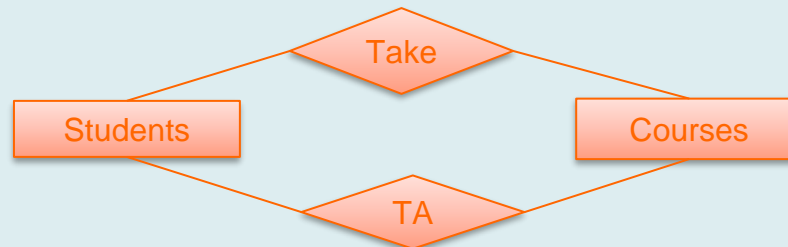
E-R Diagram >> Relationship Sets

Recursive Relationship Set – The same entity set participates more than once in the relationship.

- The function that an entity plays in a relationship is called that entity's **role**.
- Since entity sets participating in a relationship set are generally distinct, roles are implicit and are not usually specified.
- However, they are useful when the meaning of a relationship needs clarification.



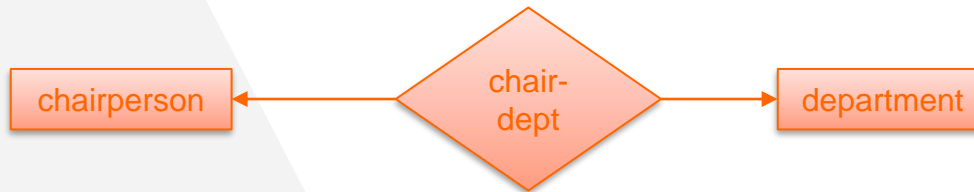
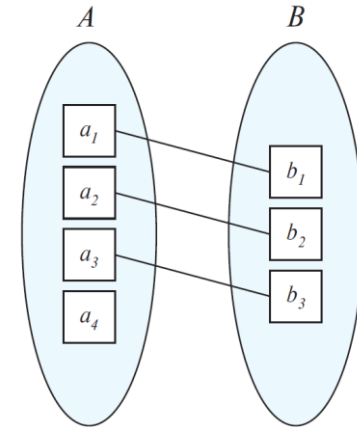
Parallel Relationship Set – more than one relationships between the same entity sets.



E-R Diagram >> Mapping Cardinalities

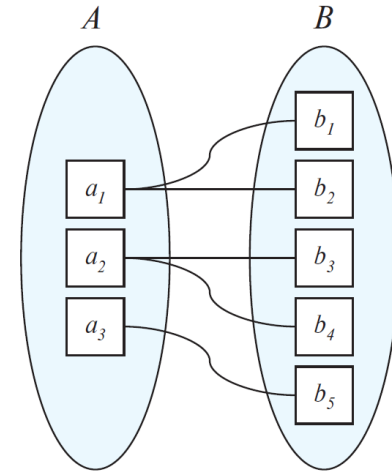
Mapping cardinalities, or Cardinality ratios, express the number of entities to which another entity can be associated via a relationship set.

One-to-one(1:1) – An entity in A is associated with at most one entity in B, and an entity in B is associated with at most one entity in A.



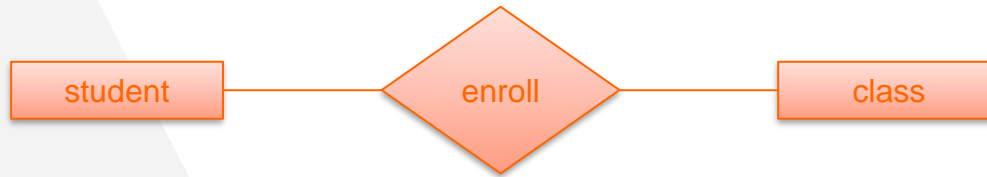
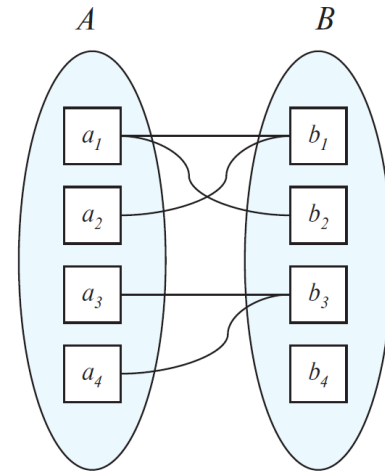
E-R Diagram >> Mapping Cardinalities

One-to-many (1:N) – An entity in A is associated with any number of entities in B. An entity in B, however, can be associated with at most one entity in A.



E-R Diagram >> Mapping Cardinalities

Many-to-many (M:N) – An entity in A is associated with any number of entities in B, and an entity in B is associated with any number of entities in A.



E-R Diagram >> Participation Constraints

Total participation – Every member of the entity set must participate in the relationship

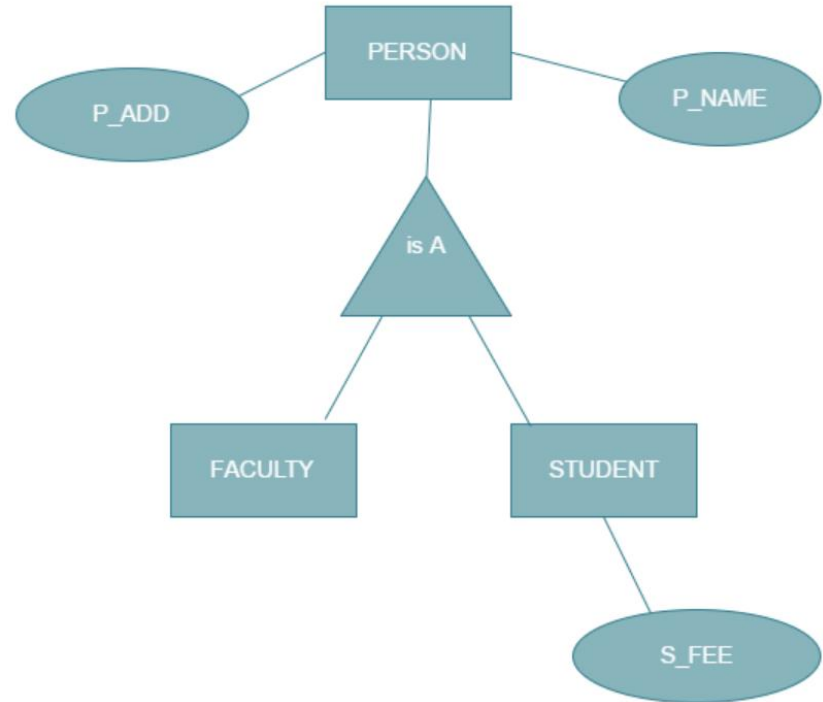
Partial participation – Not all entities in the set are involved in the relationship. In the previous example not every professor guides student.



Extended E-R Diagram >> Generalization

Generalization – It is the process of extracting common properties from a set of entities and create a generalized entity from it.

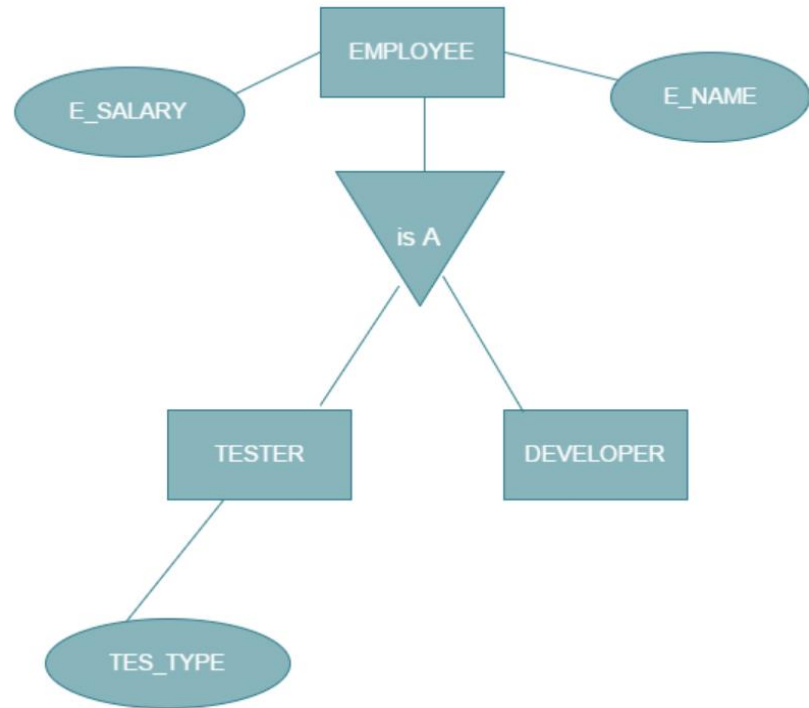
It is a bottom-up approach in which two or more entities can be generalized to a higher level entity if they have some attributes in common.



Extended E-R Diagram >> Specialization

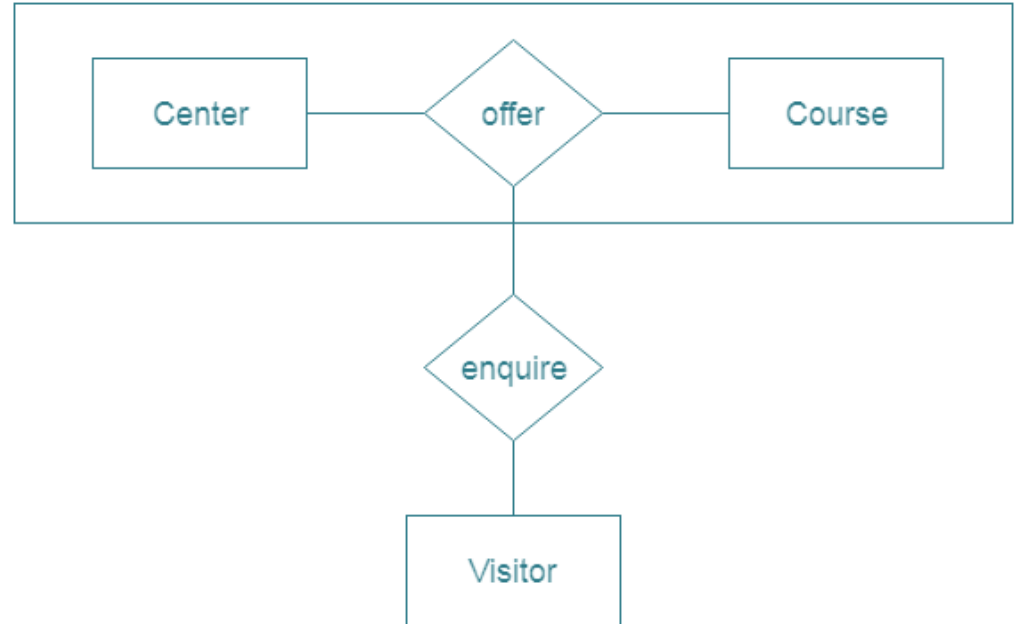
Specialization – an entity is divided into sub-entities based on their characteristics.

It is a top-down approach where higher level entity is specialized into two or more lower level entities.



Extended E-R Diagram >> Aggregation

Aggregation – an ER diagram is not capable of representing relationship between an entity and a relationship which may be required in some scenarios. In those cases, a relationship with its corresponding entities is aggregated into higher level entity.



E-R Diagram >> Practice 1 (Banking Enterprise)

- ▶ The bank is organized into **branches**. Each branch is located in a particular **city** and is identified by **a unique name**. The bank monitors the **assets** of each branch.
- ▶ Bank **employees** are identified by their **employee-id** values. The bank administration stores the **name** and **telephone number** of each employee, the names of the **employee's dependents**, and **the employee-id number of the employee's manager**. The bank also keeps track of the employee's **start date** and, thus, **length of employment**.
- ▶ Bank **customers** are identified by their **customer-id** values. The bank stores each **customer's name**, and the **street** and **city** where the customer lives. **Customers may have accounts and can take out loans. A customer may be associated with a particular banker**, who may act as a **loan officer or personal banker** for that customer.
- ▶ **Accounts** can be **held by more than one customer, and a customer can have more than one account**. Each account is assigned a **unique account number**. The bank maintains a record of each **account's balance**, and the most **recent date on which the account was accessed** by each customer holding the account.
- ▶ A **loan originates at a particular branch and can be held by one or more customers**. A loan is identified by **a unique loan number**. For each loan, the bank keeps track of the **loan amount** and the **loan payments**. Although a loan **payment number** does not uniquely identify a particular payment among those for all the bank's loans, a payment number does identify a particular payment for a specific loan. The **date** and **amount** are recorded for each payment.

Construct an E-R Diagram for the bank enterprise.

E-R Diagram >> Practice 2 (Company Database)

- ▶ The company is organized into **departments**. Each department has a **unique name**, a **unique number**, and a **particular employee who manages the department**. We keep track of the **start date** when that employee began managing the department. A department may have several **locations**.
- ▶ A **department controls a number** of **projects**, each of which has a **unique name**, a **unique number**, and a **single location**.
- ▶ We store each **employee's name**, **social security number**, **address**, **salary**, **gender**, and **birth date**. An employee is assigned to one department but may work on several projects, which are not necessarily controlled by the same department. We keep track of the **number of hours** per week that an employee works on each project. We also **keep track of the direct supervisor of each employee**.
- ▶ We want to keep track of the **dependents** of each employee for insurance purposes. We keep each dependent's **first name**, **gender**, **birth date**, and **relationship** to the employee.

Draw the E-R Diagram.

E-R Diagram >> Practice 3 (Online Book Store Database)

- ▶ Every **book** has a **title, isbn, year and price**. The **store also keeps the author and publisher for any book**.
- ▶ For **authors**, the database keeps the **name, address and the url** of their homepage.
- ▶ For **publishers**, the database keeps the **name, address, phone number and the url** of their website.
- ▶ The store has several **warehouses**, each of which has **a code, address and phone number**. The **warehouse stocks several books**. **A book may be stocked at multiple warehouses**. (In previous sentence, we are not referring to a particular copy of the book. Consider for example “the complete book” for our course. This book may be stocked at multiple warehouses.) The database records the **number of copies** of a book stocked at various warehouses.
- ▶ The bookstore keeps the **name, address, email-id, and phone number** of its **customers**.
- ▶ A **customer owns several shopping basket**. A shopping basket is identified by **a basketID** and **contains several books**. **Some shopping baskets may contain more than one copy of same book**. The database records the **number of copies** of each book in any shopping basket.

Design an ER diagram for such a bookstore.

E-R Diagram >> Practice 4 (Blog Management System)

Construct an ER diagram according to the details provided below:

- ▶ The blog management system maintains each blog writer's unique email, name, encoded password, gender, date of birth, join date, length of employment and address. The address field consists of three components: postal code, city and street name. Every blog writer is hired by only one blog writer as his employer. The visitors may follow more than one blog writer.
- ▶ Each of the blogs has blog id, details, date, time and category. One blog may fall under several categories. Here blog id cannot uniquely identify a specific blog but blog id together with blog writer email can uniquely identify a specific blog. A blog writer may publish several blogs.
- ▶ The visitors can see all the blogs published by writers. Each visitor can comment more than one time in each blog and the system maintains the date, time, content of that blog comment. Visitors can also hit reactions (like/dislike) in more than one blogs. The system maintains unique visitor email, visitor name and encrypted password for each visitor.

E-R Diagram >> Practice 5 (League of Villains)

Consider the following Scenario:

The League of Villains is getting more and more prominent. To reduce the dominance of the villains, hero society is thinking of positioning heroes in regions. However they first need to design a database with the following conditions:

- ▶ Heroes have a unique name, a power, strength level and a rank. Villains also have properties similar to heroes. Also, each villain may have a boss who is also a villain himself.
- ▶ A hero is responsible for a certain region. A region has latitude, longitude, and population. A region can be terrorized by multiple villains. However, one villain does not terrorize more than a region.
- ▶ Heroes and villains often fight. Hero society needs to keep track of the dates and results of these fights. A hero and a villain may fight multiple times.

Design an ERD for the scenario.

E-R Diagram >> Practice 6 (Course Mgmt. System)

Consider the following scenario for Course Management System:

- ▶ The university stores all the student information that includes a unique student id, name, date of birth, address. Address is stored in the following three sections: street name, postal code and city.
- ▶ Each course is identified by its unique course code, trimester, course name and course content. One course is conducted by several faculties and a student can choose several courses in a single trimester.
- ▶ The university identifies each faculty through their unique employee id. Each faculty also has a particular room no, name, contact no, email and join date. Each faculty is associated with anonymous reviews of students. Each review consists of a review id, review details and datetime. The review id can't identify a particular review among all the reviews but the review id for a specific faculty can identify a particular review. Each student is also assigned to a specific faculty for advising purpose.

Design an ER Diagram for the scenario that satisfies all the given requirements.

E-R Diagram >> Practice 7 (Job Portal System)

Consider the following scenario for a Job portal:

- ▶ The job portal manages each user's profile where each user is represented by his or her name, unique email, address, date of birth, educational qualifications, job position and job experience. Both recruiters and job seekers are user and one recruiter can recruit more than one job seeker.
- ▶ The recruiters can post job openings to the job portal. The job portal keeps track of each posts date, time, contents, no of viewers. The system also keeps track of which job seeker is interested in which job posts.
- ▶ Each of the offices is maintained by their unique office id, name, address and contact no. Every user belongs to some offices as a recruiter or, an employee or, a follower. Each person can provide his or her anonymous review of offices. Each of the review contains review id, date, time, review details. The review id cannot uniquely identify a particular review but a review id together with an office id can uniquely identify a particular review.

Design and ER Diagram for the scenario that satisfies all the given requirements.

THANKS!

Any questions?

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References:

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