**ER Modeling**

(Course Instructor: Bidur Devkota)

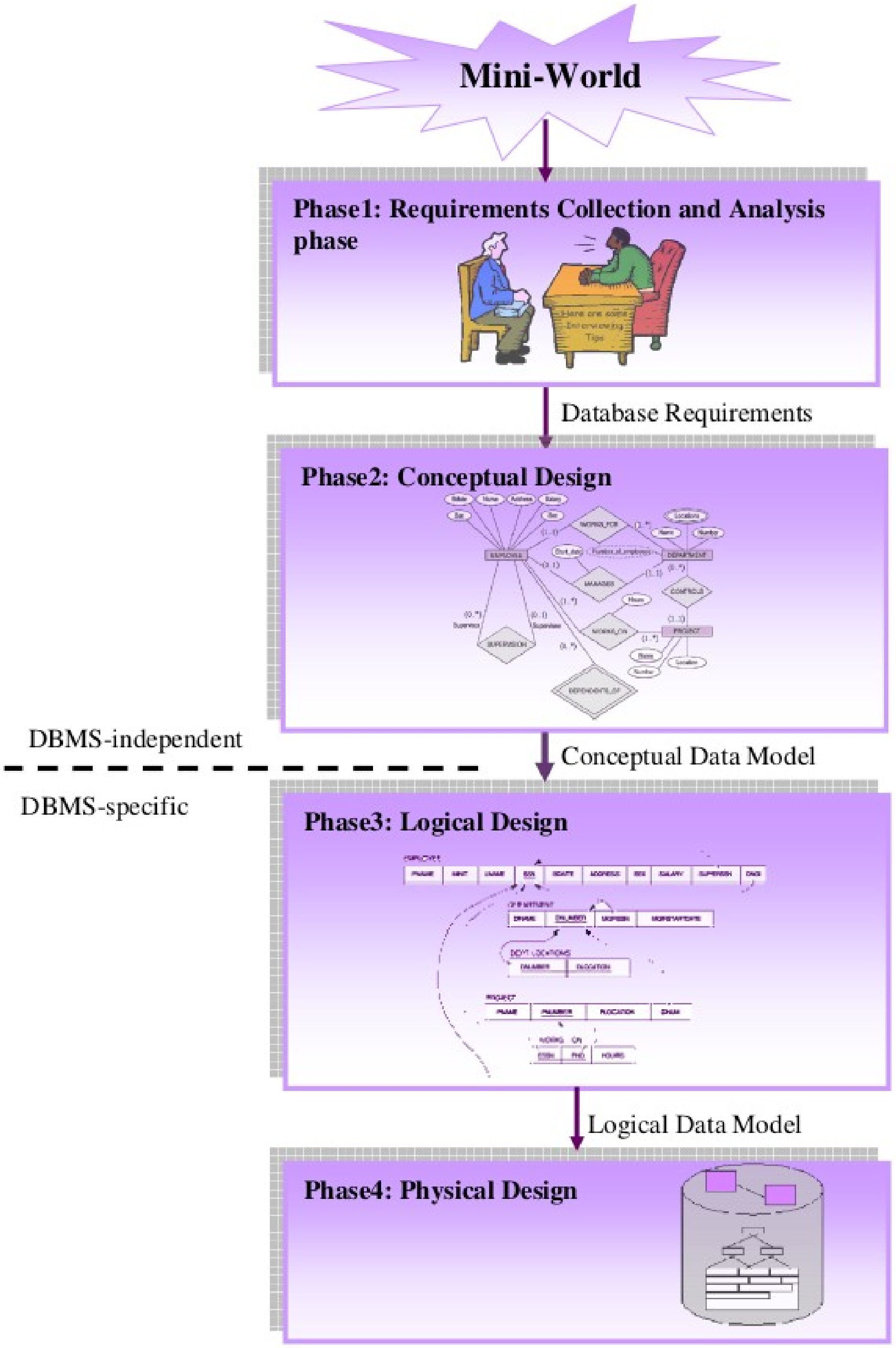


*Figure: Design Phase*

## 1. Databse Design Phases:

The main phases of database design are:

1. Phase 1: Requirements collection and analysis.
   - get a **description of the user requirements.**
   - **Interview** prospective database users to understand and document their data requirements
   - prepare **users' requirements** and **functional requirements** of the database application

2. Phase 2: Conceptual Design.
   - Develop conceptual schema for the database with High-Level Conceptual Data Model:
     - entity types,
     - relationship types,
     - constraints
   - do not include implementation details.
   - Act as a reference to ensure:
     - all data requirements are met
     - requirements do not include conflicts.

3. Phase 3: Logical design (data model mapping/Implementation)
   - Transform the high level conceptual schema into a lower- level implementation model.
   - Result of this phase is the schema as an implemented data model of the DBMS.

4. Phase 4: Physical design.
   - Decision about the internal storage structures, access paths and file organizations for the database files.

**Example:**

Design a database schema to fulfill the requirements for a company.

- Employees, departments, and projects
- Company is organized into departments
- Department controls several projects
- Employee: require each employee's name, Social Security number, address, salary, sex (gender), and birth date
- Keep track of the dependents of each employee

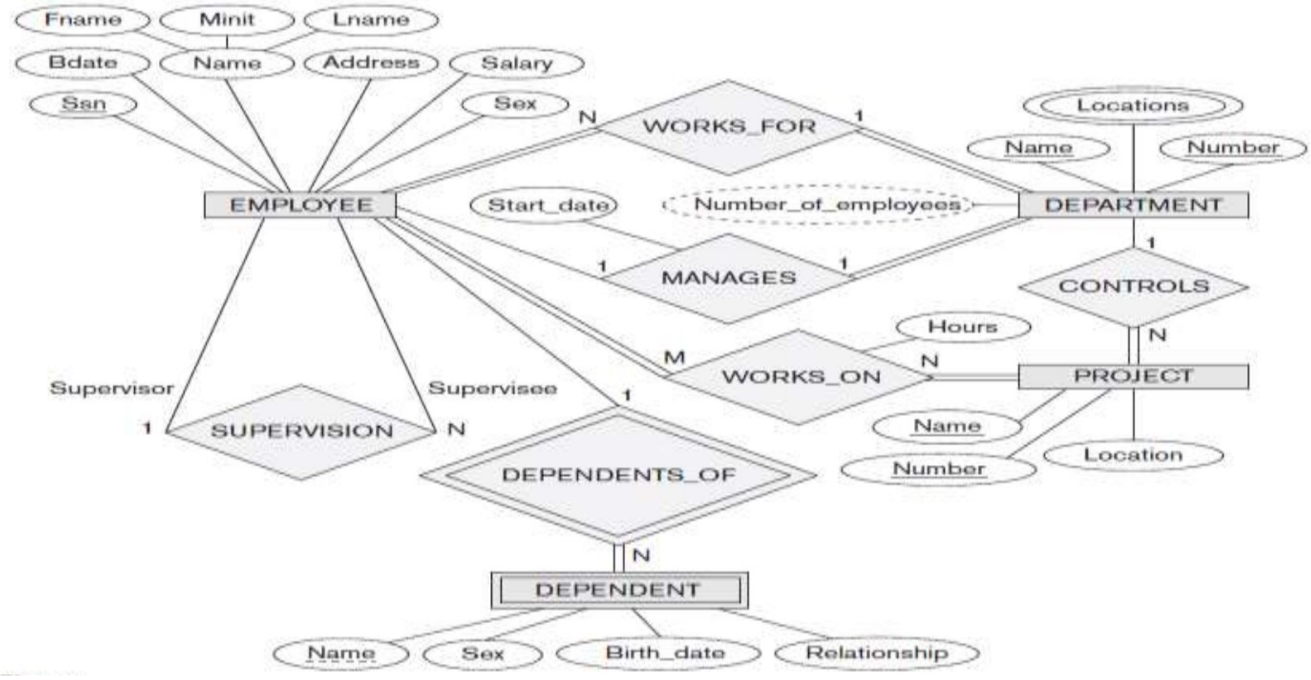
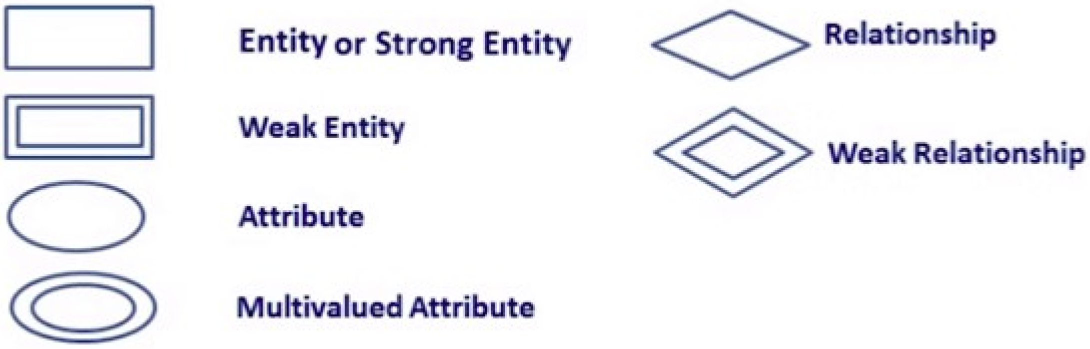


*Figure: ER diagram for a company*

**Notations:**

ER- Diagram is a visual representation of data that describe how data is related to each other.

Rectangles: This symbol represent entity types
Ellipses : Symbol represent attributes
Diamonds: This symbol represents relationship types
Lines: It links attributes to entity types and entity types with other relationship types
Primary key: attributes are underlined
Double Ellipses: Represent multi-valued attributes



2. **Entity-Relationship (ER) Model**

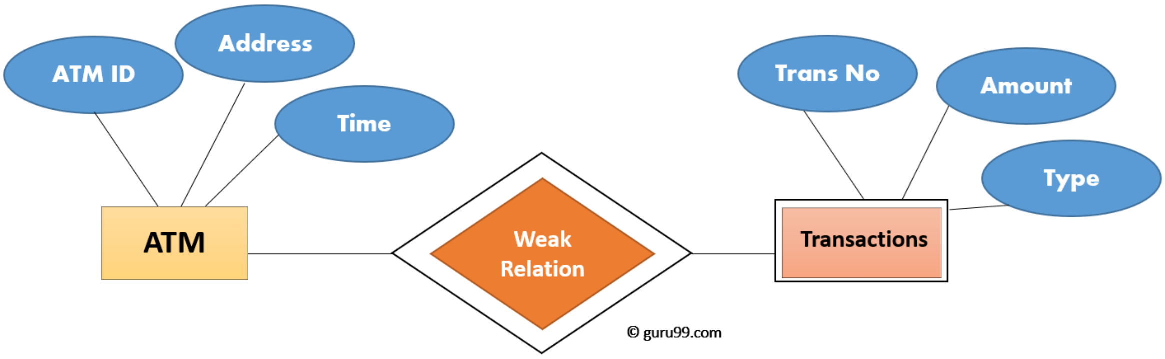
- a **high- level conceptual data model.**
- By Peter Chen in 1976
- **illustrates the real world situations** with concepts, used by general people.
- **Logically** describes a representation of the real world.
- Do **NOT** describe machine-related aspects.
- **grouping of data into entities**
- main concepts: **entity, attribute, and relationship.**

- **Entity:**
  - a "thing" ( an object or an event) in the real world:
  - distinguishable from other things.
  - Entity types represent sets of objects and are pictured by rectangular nodes.
  - **Examples of entities:**
    - **Person:** Employee, Student, Patient
    - **Place:** Store, Building
    - **Object:** Machine, product, and Car
    - **Event:** Sale, Registration, Renewal
    - **Concept:** Account, Course

- **Characteristic of Entity:**
  - Concrete physical Existence like:
    - Employee, Collage, Car, Book, Dog, etc.
  - Described by its attributes:
    - an EMPLOYEE entity may have a Name, Age, Address, DOB,etc.
  - Determined by particular value of its attributes:
    - An Employee Name= “Hari”, Age=21, Address=Pokhara, DOB:1998-08-09
    - **Another** Employee Name= “Sita”, Age=20, Address=Baglung, DOB:1999-08-12
- **Entity sets may not be disjoint.**
  - E.g, it is possible to define the entity set of all employees of a Supermarket (employee) and the entity set of all customers of the Supermarket (customer). A person entity may be an employee entity, a customer entity, both, or neither.
- An **entity type** defines a set of entities with same attribute:
  - Eg.  employee entity type and company entity type
- **An entity is an instance of an entity type**.
- An **entity set is the collection of all entities of a particular entity type in the database** at any point in time.

- **Relationship**
  - an **association** among two or more entities.
  - E.g. Ram **works** in the Chemistry department.
  - Entities take part in relationships.
  - Relationships: verbs or verb phrases.

- **Weak Entities**
    - doesn't have its key attribute.
    - It can be identified uniquely by considering the primary key of another entity.
    - For that, weak entity sets need to have participation.
    - E.g. "Trans No" is a discriminator within a group of transactions in an ATM.



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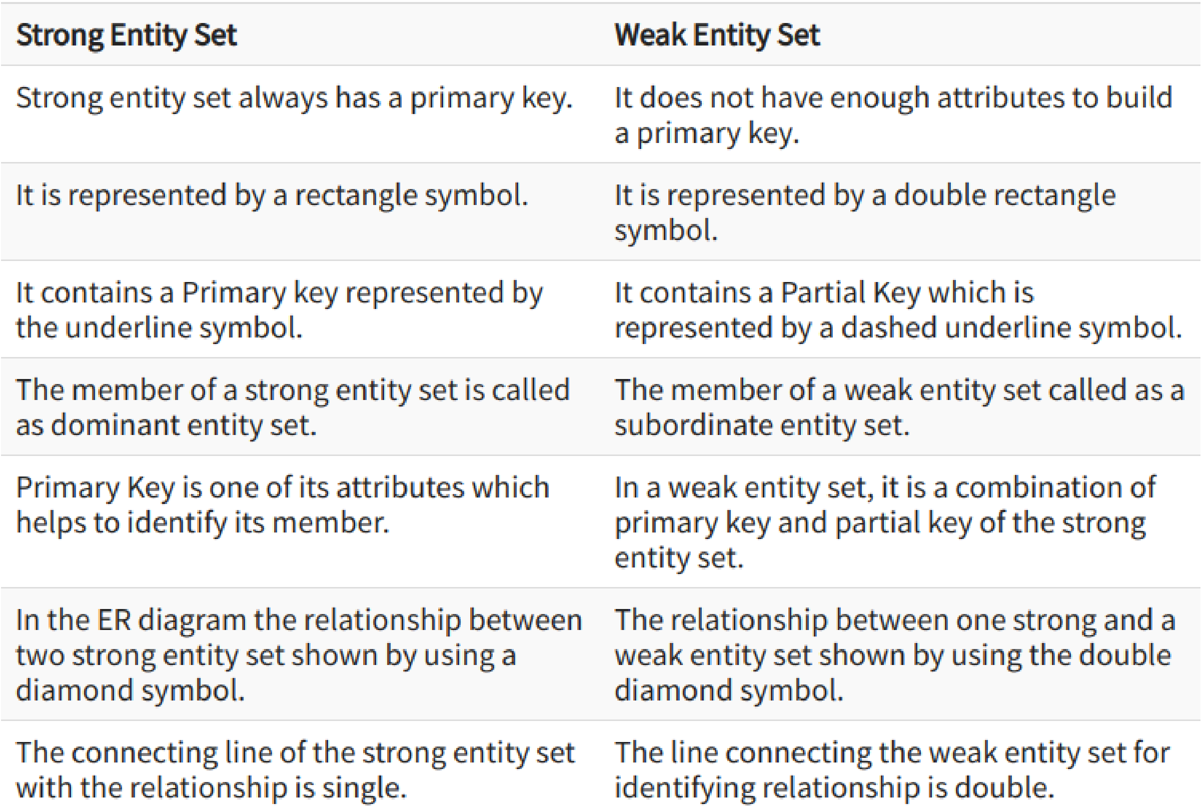
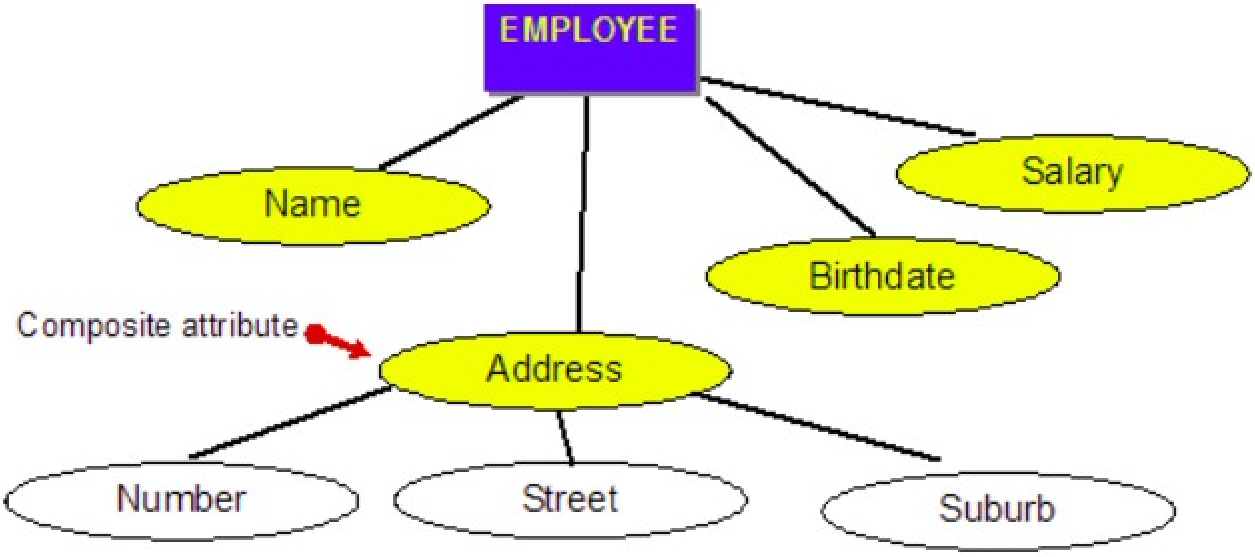


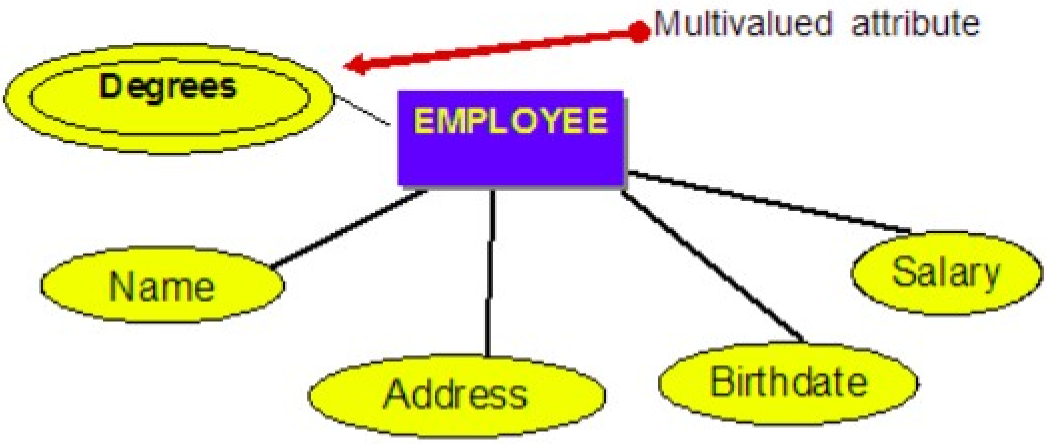
| Strong Entity Set | Weak Entity Set |
|---|---|
| Strong entity set always has a primary key. | It does not have enough attributes to build a primary key. |
| It is represented by a rectangle symbol. | It is represented by a double rectangle symbol. |
| It contains a Primary key represented by the underline symbol. | It contains a Partial Key which is represented by a dashed underline symbol. |
| The member of a strong entity set is called as dominant entity set. | The member of a weak entity set called as a subordinate entity set. |
| Primary Key is one of its attributes which helps to identify its member. | In a weak entity set, it is a combination of primary key and partial key of the strong entity set. |
| In the ER diagram the relationship between two strong entity set shown by using a diamond symbol. | The relationship between one strong and a weak entity set shown by using the double diamond symbol. |
| The connecting line of the strong entity set with the relationship is single. | The line connecting the weak entity set for identifying relationship is double. |

- **Attribute:**
    - **property** or **characteristic** of an entity type.
    - **Each attribute has a value drawn from some domain** (set of meaningful values).
    - Attributes name are written in an **ellipse** by **connecting it to its associated entity**
    - Attributes may also be associated with relationships
    - **An attribute is associated with exactly one entity or relationship.**
    - **Example:**
        - an employee entity may be described by the employee's name, age, address, dob, and job
        - An Employee Name= "Hari", Age=21, Address=Pokhara, DOB:1998-08-09, job: programmer

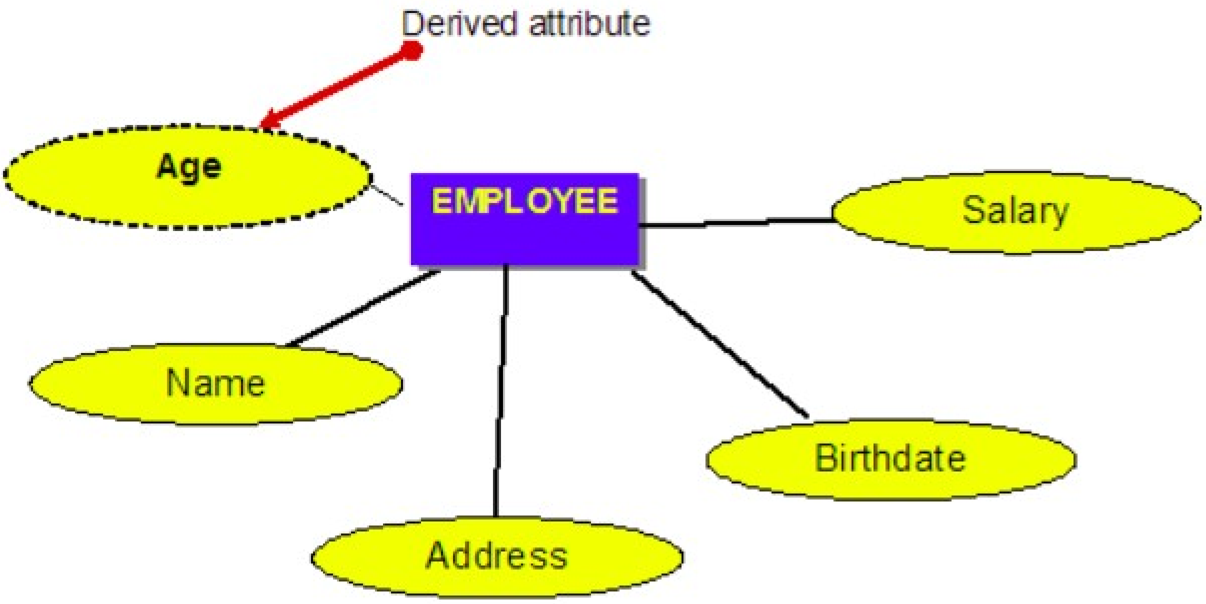
- **Types of attributes :**
    - Composite versus Simple(atomic):
        - can be divided into smaller subparts :
            - **Name** can First Name, Middle Name, Lastname.
            - **Address** can have Street_Address, city, state and postal_code



- Single-valued versus Multivalued:
    - Single Valued: Age is a single-valued attribute of person.
    - **multivalued** attribute may take on more than one value:
        - E.g. An EMPLOYEE may have more than one **degree**



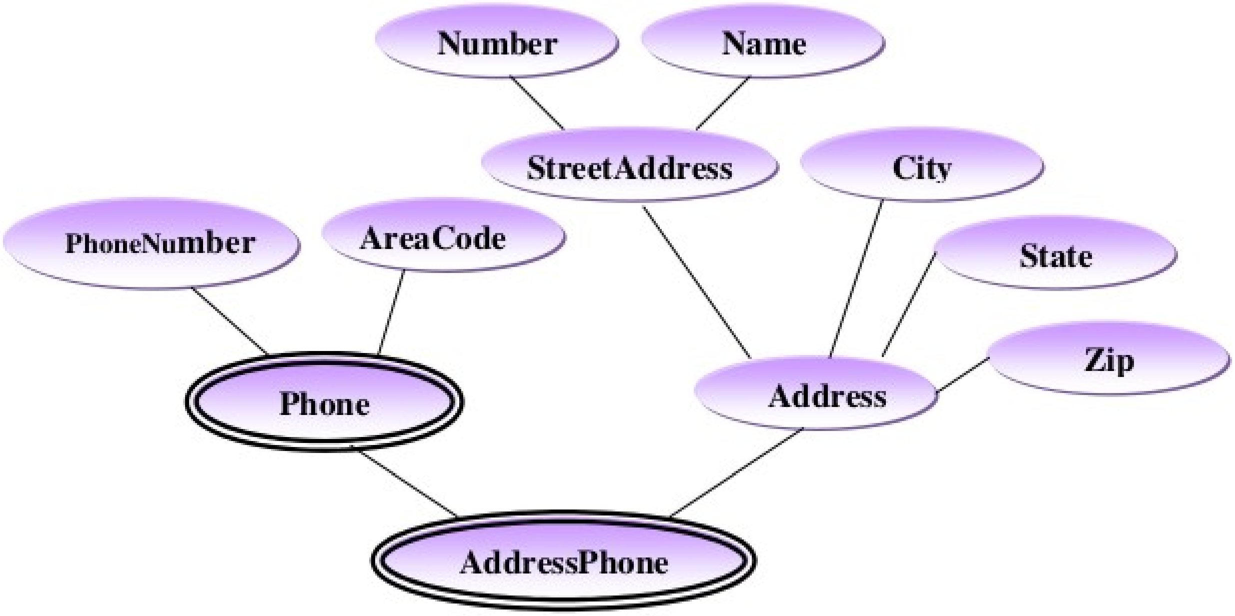
- Stored versus Derived.
  - Derived attributes: Attributes Contain values that are calculated from other attributes.
  - **Age** can be **derived** from attribute Birthdate.
  - **Birthdate** is **stored** attribute.

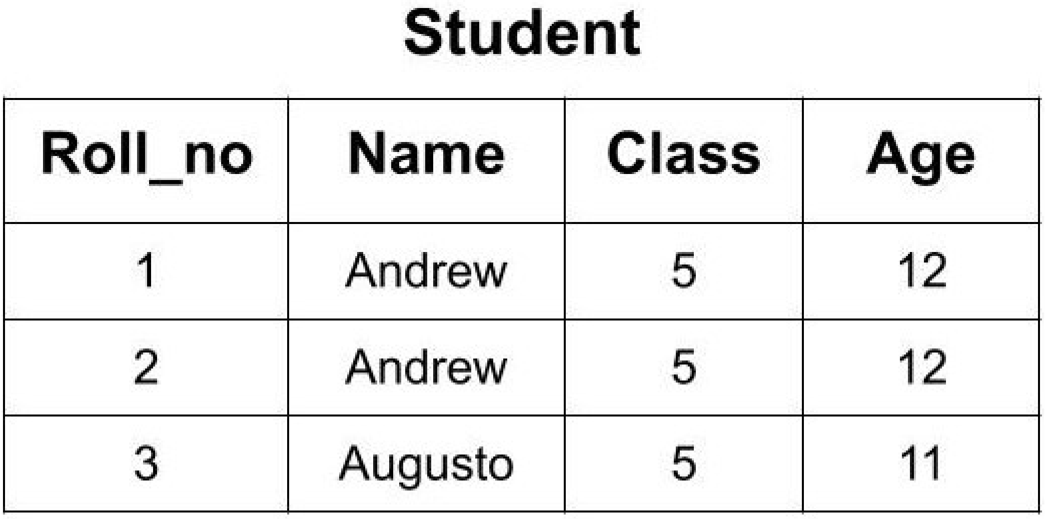


- Null values:
  - Some values may not be applicable e.g. **Deceased Date**

- Complex values:

    - Nested Composite and multi-valued attributes .
    - Example:
      - **PreviousDegrees** of a STUDENT is a composite multi-valued attribute denoted by {PreviousDegrees(College, Year, Degree, Field)}.
      - Address and Phone





Student

| Roll_no | Name | Class | Age |
|---|---|---|---|
| 1 | Andrew | 5 | 12 |
| 2 | Andrew | 5 | 12 |
| 3 | Augusto | 5 | 11 |

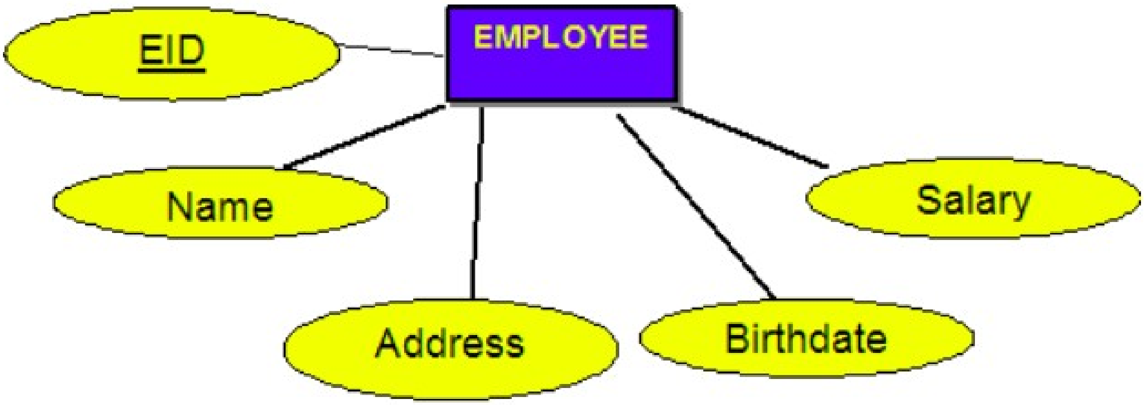
- **Key:**
  - **important constraint on the entities**
  - Key is an **attribute** or a group of attributes that **uniquely identify** individual entity in an entity set.
  - E.g.
    - Student’s **Roll Number** is unique for each person.
    - Employee = {**EID**, Name, Address, Age, Salary}
      •Definite keys are any set that involving EID

•Possible keys might be {Name, Address}

•Unlikely keys: {Name}, {Age}

•**Primary Key:**

- The primary key is the **minimal set of attributes which uniquely identifies** any row of a table.
- key that is chosen as an identifying mechanism for the whole entity set
- indicated by underlying attributes in the ER model.



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