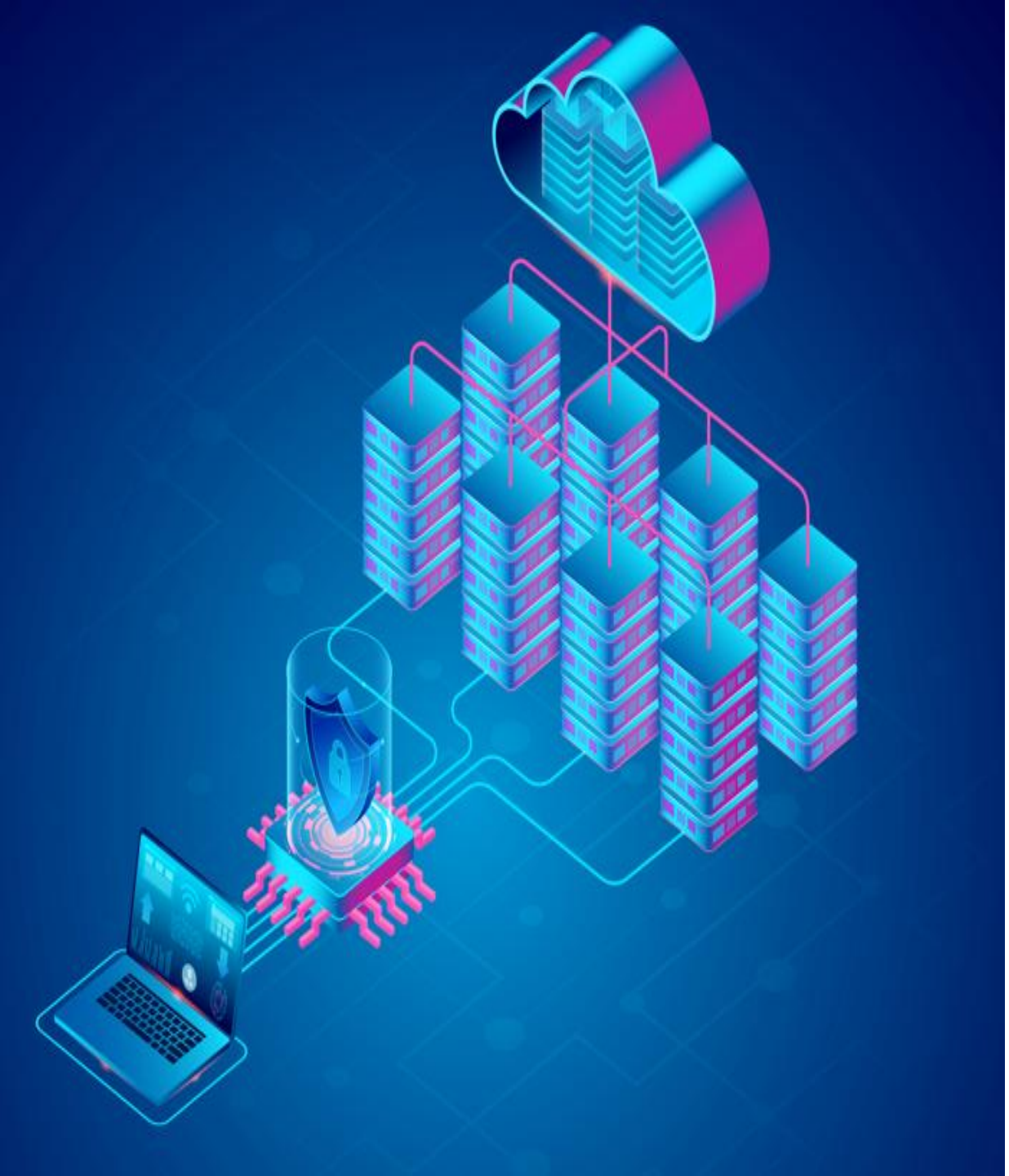
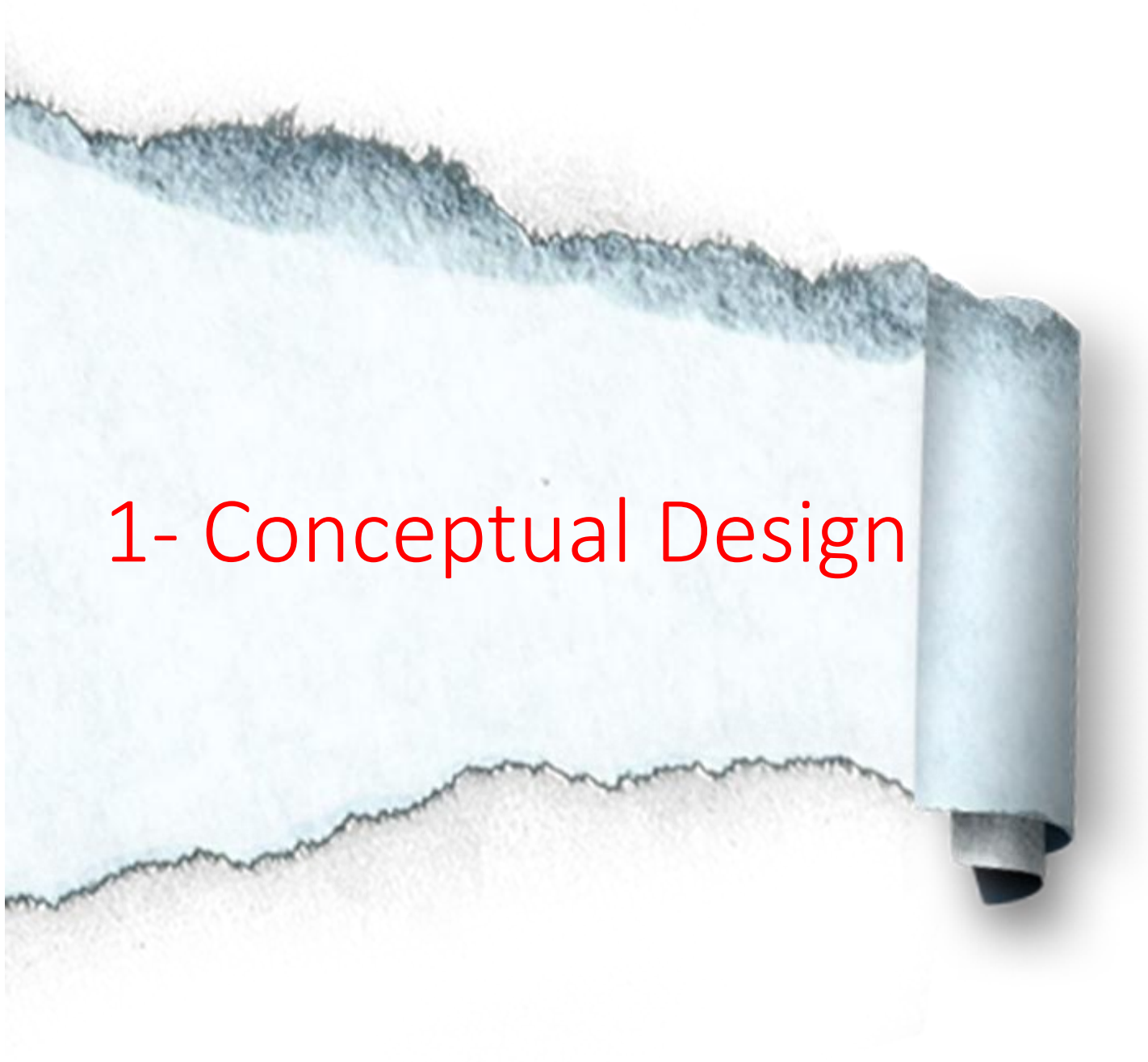


Database Fundementals

Entity Relationship Diagram (ERD)

Eng. Doaa Soleiman


1- Conceptual Design

Conceptual Design

- All requirements have been collected and analyzed from analysis phase.
- It called "**High level conceptual model**" which means, High Level or Conceptual data models provide concepts that are close to the way many users perceive data, entities, attributes and relationships. (Ex. **ERD**)

Entity Relationship Modeling

- Identifies information required by the business by displaying the relevant entities and the relationships between them.
- It is first proposed by Peter Chen at 1970.
- **ERD model** is often created graphically and specific software converts the graphical representation into SQL code that is required to create data structure.

Entity

- **Entity -** An entity is a thing that exists and is distinguishable -- an object, something in the environment.
  - Types of entities: **Weak**- **Regular**

- **Entity Instance -** An instance is a particular occurrence of an entity. For example, each person is an instance of an entity, each car is an instance of an entity, etc.

Entity

- Regular entity:

It is represented as 

- Example: Employees, books, products, …. etc.

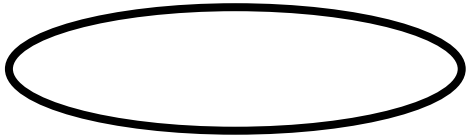
Weak Entity

- An entity that does not have a key attribute
- Its existence depends on some other entity.

- Entities are identified by the combination of:
    - A partial key of the weak entity type
    - The particular entity they are related to in the identifying entity type

Example: Relatives of employee

Attributes

- It is the entity properties.
- It is represented as 
- Each attribute has its own Data Type
- The attribute may have default value
- Null Attribute: The attribute that may accept NULL values

Key Attributes

- **Primary Key** is a unique identifier for the entity, it may be single or composite, It must be UNIQUE and NOT NULL.
- Each entity has only ONE Primary Key, it is one of the candidate keys.

  Example: SSN of EMPLOYEE.
- A key attribute may be composite.

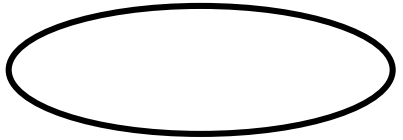
  Example: (National_ID, Application_no)

Candidate Key / Foreign Key

- Each entity has at least one **Candidate Key**, and may have more than one.
- **Foreign Key** is an attribute in one entity whose values are required to match those values of the primary key of some other entity.

Simple / Composite Attribute

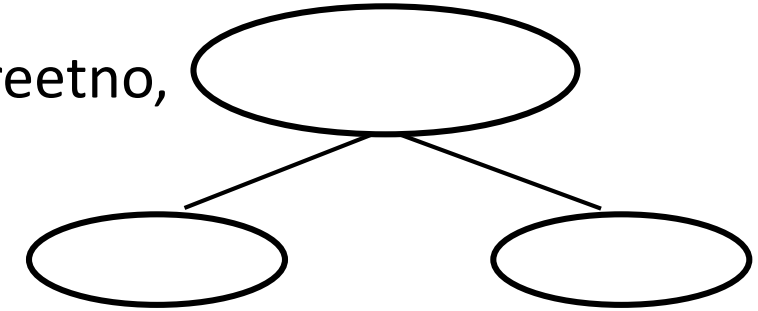
- **Simple attribute:** means it can't be divided.



Example: salary , grade, ….

- **Composite attribute:** means it can be divided into subparts.

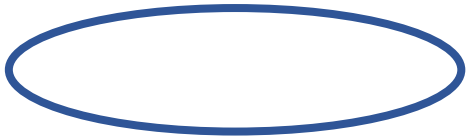
Example: Address can be divided into streetno, streetname, zone, city



Single / Multi-value Attribute

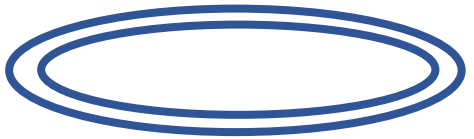
- **Single attribute:** means it has one value for particular entity

  Example: name (employee have one name only)



- **Multi-value attribute:** means it has a set of values for the same entity

  Example: Telephone (The same employee may have more than one telephone number)



Base/ Derived Attribute

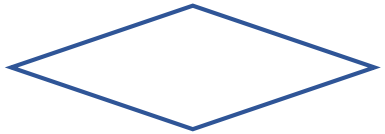
- **Base attribute:** means that its value can’t be deduced or calculated. It is represented as 

  Example: Birthdate
- **Derived attribute:** means that its value can be deduced or calculated. It is represented as

  Example: Age 

Relationships

- **Types:**
  - Unary
  - Binary
  - Ternary
  - N-ary
- Relationship is an association between two or more entities represented as



Cardinality Ratio Constraints

The cardinality of a relationship indicates the number of instances in entity class E1 that can or must be associated with instances in entity class E2.

Cardinality Ratio Constraints (Conti.)

- **One-One Relationship**

  (citizen , passport) , (Dept. , Manager)

- **One-Many Relationship**

  (student-Advisor, Customer-Order , Dept. , Employees)

- **Many- Many Relationship**

  (Student-Organization, Order-Products, Student – courses)

- **Recursive Relationships** A relationship in which the same entity participates more than once.

  (Employee – Manager)

Membership class constraint

- **Obligatory "Total Participation"**

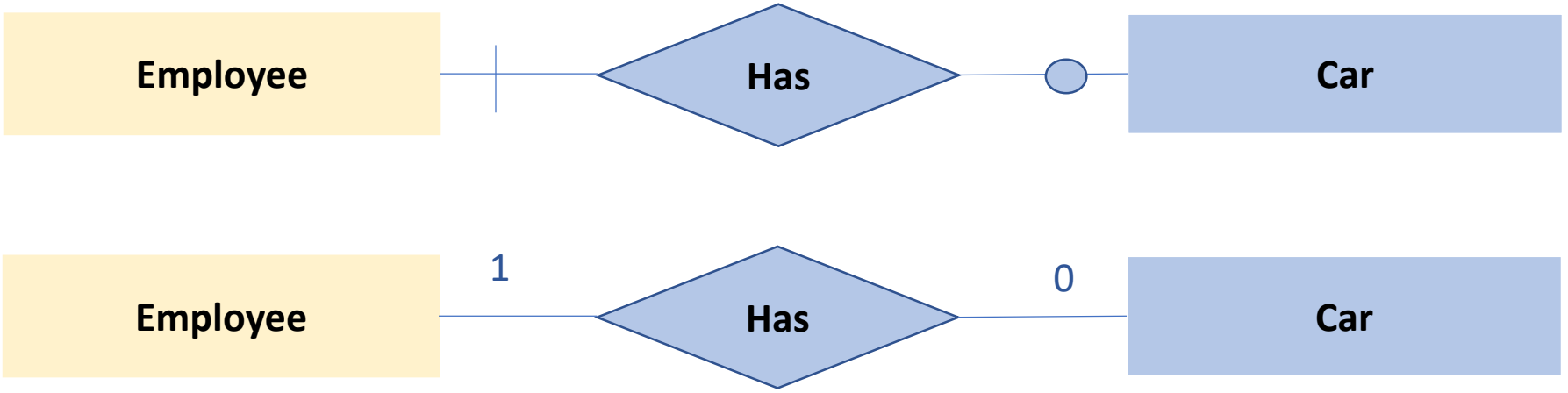
  If every E occurrence MUST participate in R relation occurrence Example: An employee MUST work for a department

- **Non Obligatory " Partial Participation"**

  If E can exists without participating in R relation occurrence

  Example: Some employees manage departments

PARTICIPATION CONSTRAINT



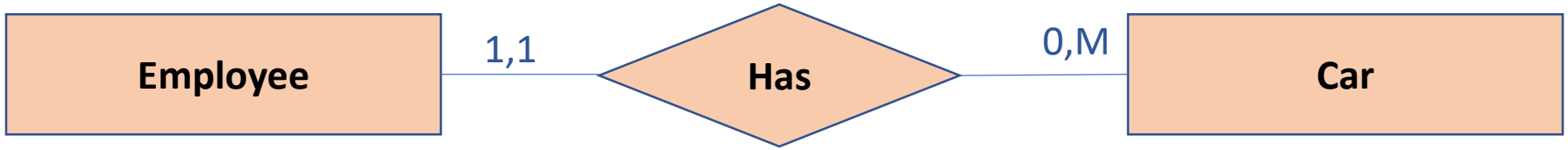
- An Employee may have a car.
- A Car must be assigned to particular employee

PARTICIPATION CONSTRAINT

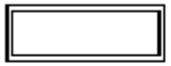
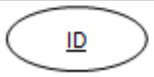
A formal constraint: (min,max) where m, n are min and max number of times an entity participates in a relationship instance.

For example,

(0,10) means partial participation, and (1,max) means total participation.



ERD notation

	**Regular Entity**
	**Weak entity**
	**Base , simple attribute**
	**Relationship**
	**Relationship with weak entity**
	**Derived attribute**
	**Key Attribute**
	**Composite Attribute**
	One to One
	**One to Many**
	**Many to Many**
	**Membership class constraint**
	**Relation Attribute**

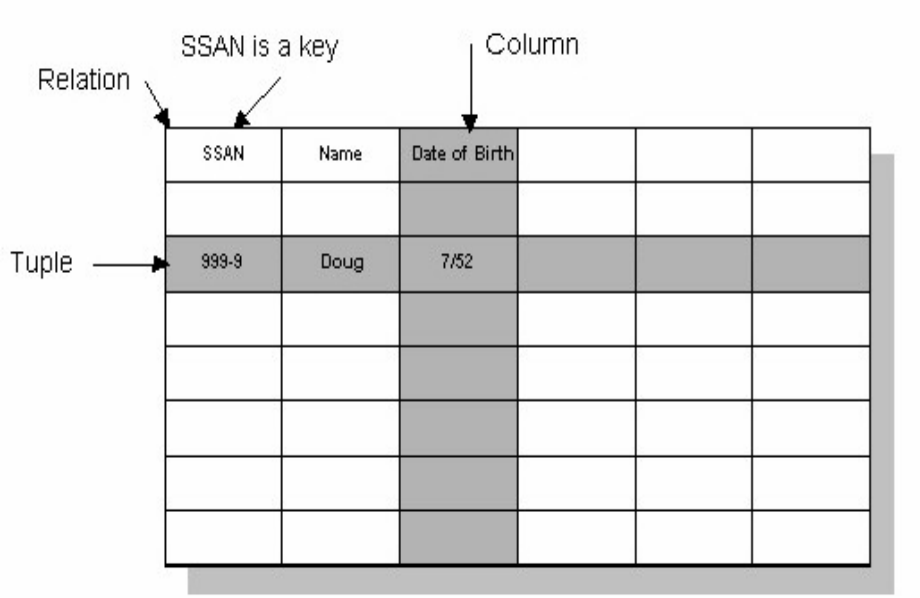

I NEED A BREAK!
TAKE ONE!


2- Logical Design

Definitions

Relation:

- A Collection of attributes describing the data.
- Relation is what normally called Table.
- Table consists of rows and columns, Data value is stored in the rows and columns intersection



Definitions

Tuple:

Rows of such a table

Attribute:

Columns of such a table.

Primary Key:

Unique identifier for the table, may be single or composite.

Domains:

Pool of values from which one or more attributes draw their actual values.

Definitions

Candidate Key:

Each relation has at least one candidate key, each candidate key K of a relation R has two properties:-

Uniqueness: At any given time no two tuples of R have the same value for K.

Minimality: If K is composite, no component of K can be eliminated without destroying the uniqueness.

Definitions

Primary Key:

Each relation has only ONE primary key, It is chosen from the candidate keys.

Foreign Key:

An attribute in relation R2 whose values are required to match those of the primary key of some relation R1.

Integrity Rules

Entity Integrity Rule

- No attribute participating in the primary key of base relation is allowed to accept NULL values
- The rows in a relation represent entities and each one must be uniquely identified

Referential Integrity Rule

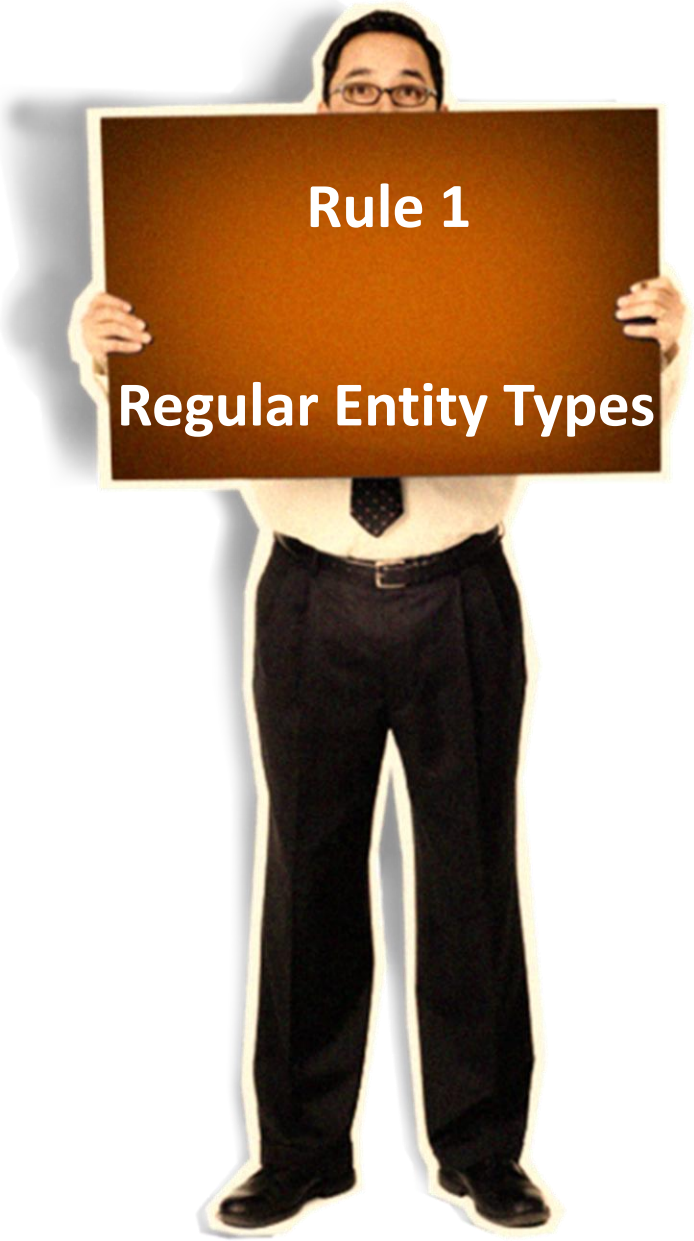
base relation R2 includes Foreign Key matching the Primary key of some base relation R1, then every value of Foreign Key must either equal a value of Primary Key in some tuple of R1, or be NULL.

Cascade Update / Delete commands

- Cascade: Delete / Update the target row and all rows that point to it (via foreign keys) are also deleted
- Restricted: The user cannot delete the target row until all rows that point to it (via foreign keys) have been deleted.
- Nullifies: can delete the target row and all foreign keys (pointing to it) are set to null

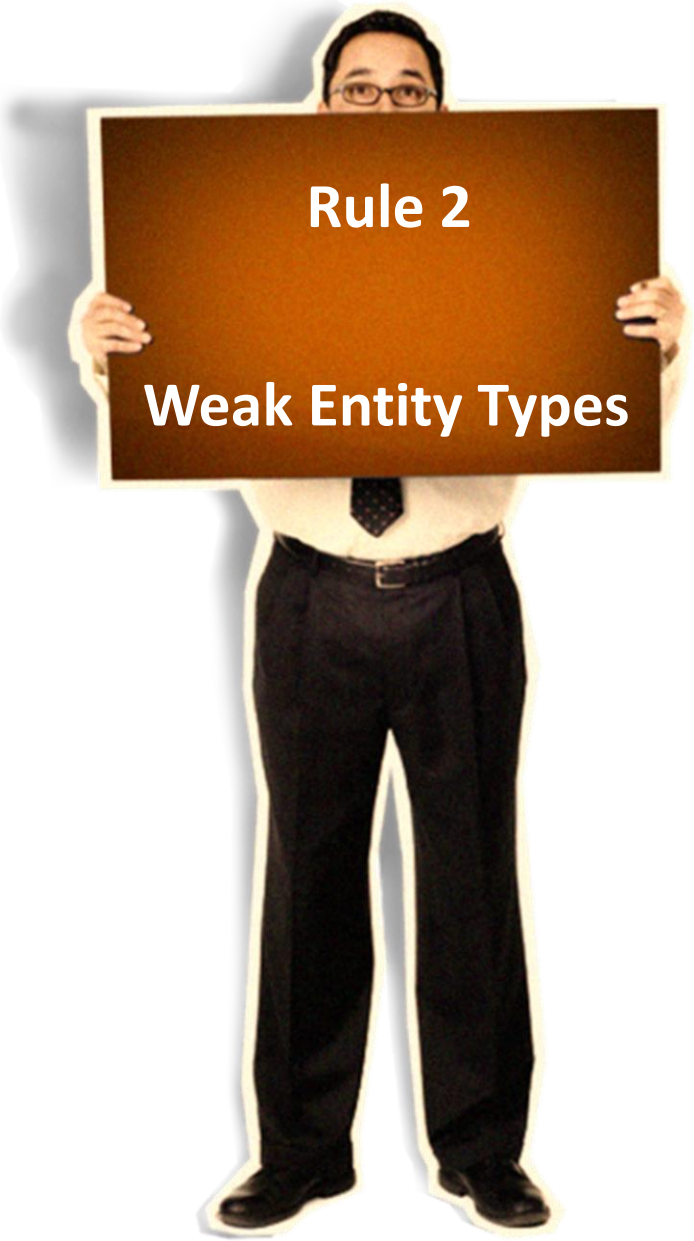
Mapping Rules 1

- Create table for each entity type include all simple attribute.
- For composite attribute, include only the simple attribute.
- Choose one of key attributes to be the primary key



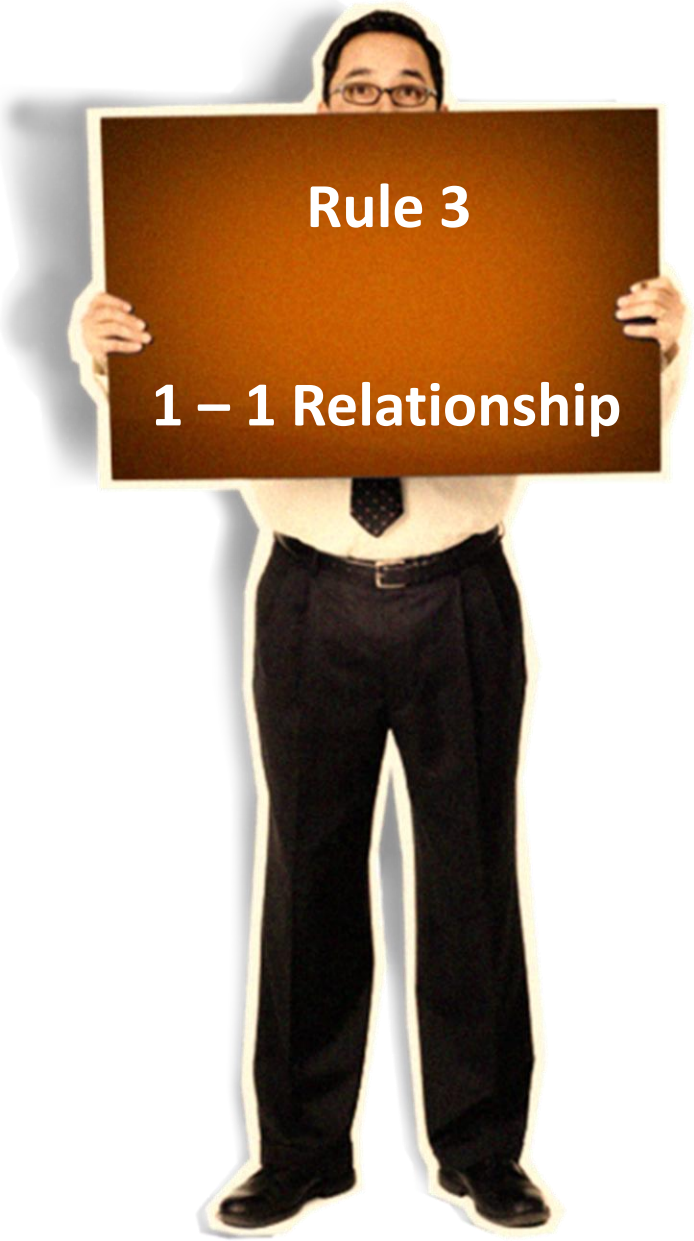
Mapping Rules 2

- Create table for each weak entity.
- Add foreign key that correspond to the owner entity type.
- Choose the primary key : (FK + weak entity Partial PK if any)



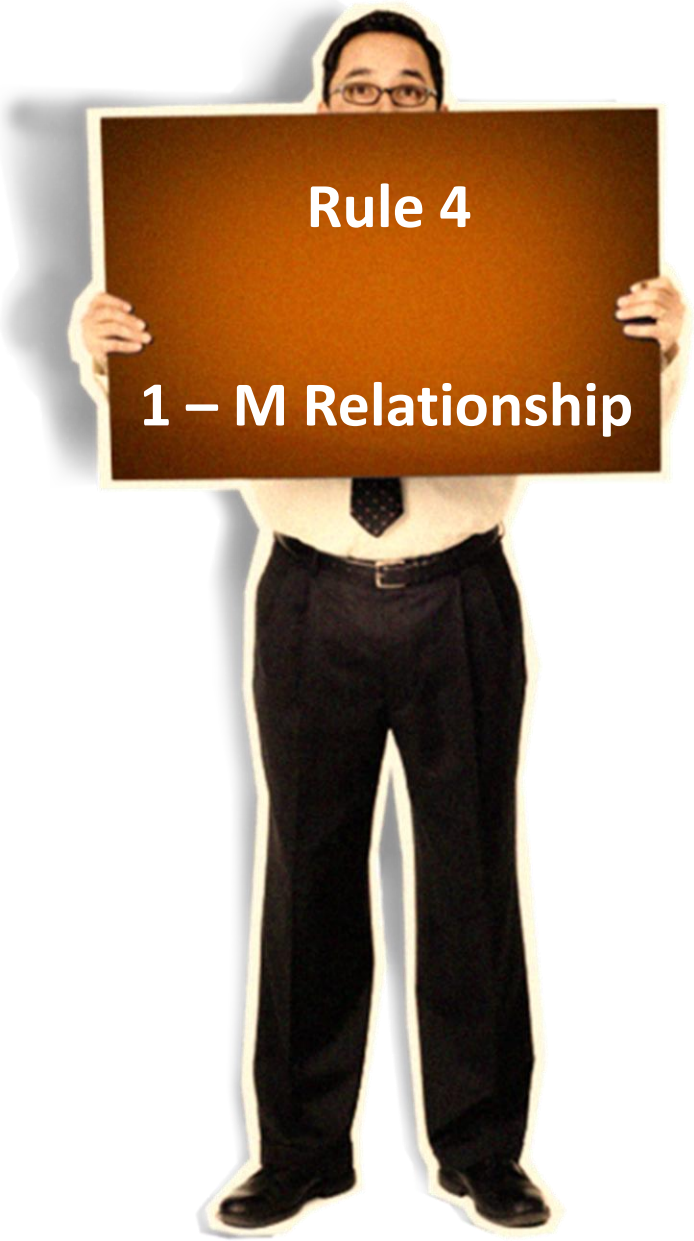
Mapping Rules 3

- Merged two tables if both sides are Mandatory.
- Add FK into table with the total participation relationship to represent optional side.
- Create third table if both sides are optional.



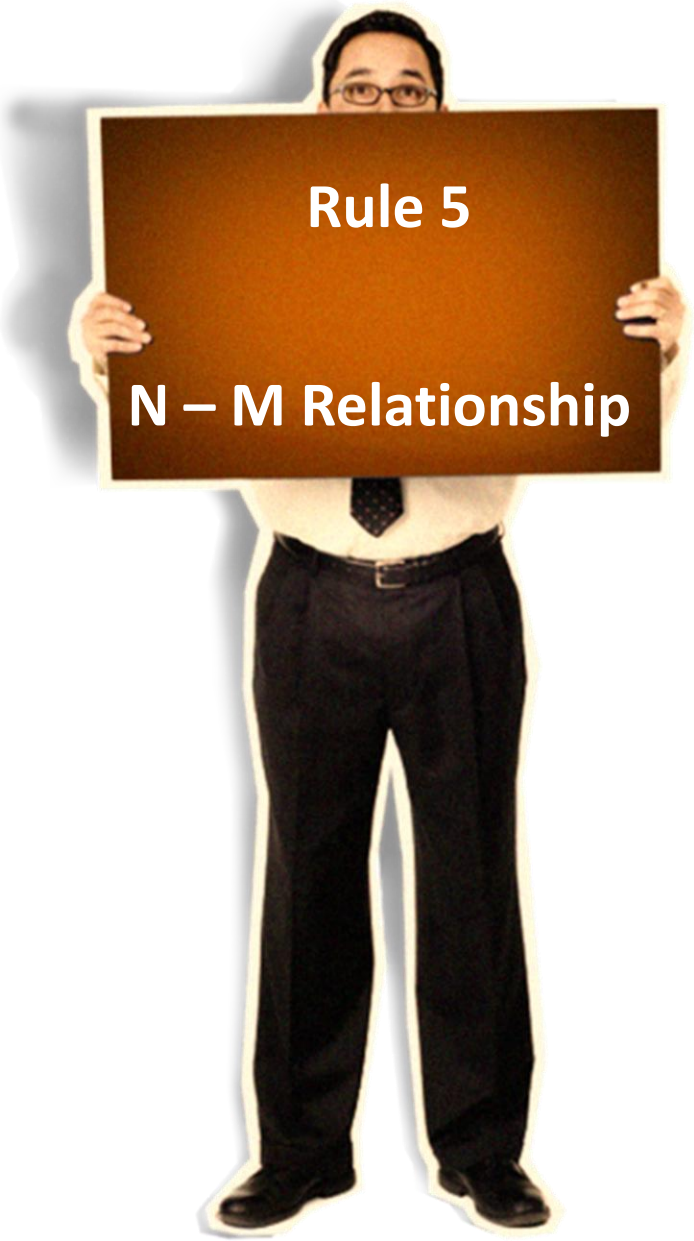
Mapping Rules 4

- Add FK to N-side table
- Add any simple attributes of relationship as column to N-side table.



Mapping Rules 5

- Create a new third table
- Add FKs to the new table for both parent tables
- PK is the combination of both FKs.
- Add simple attributes of relationship to the new table if any.



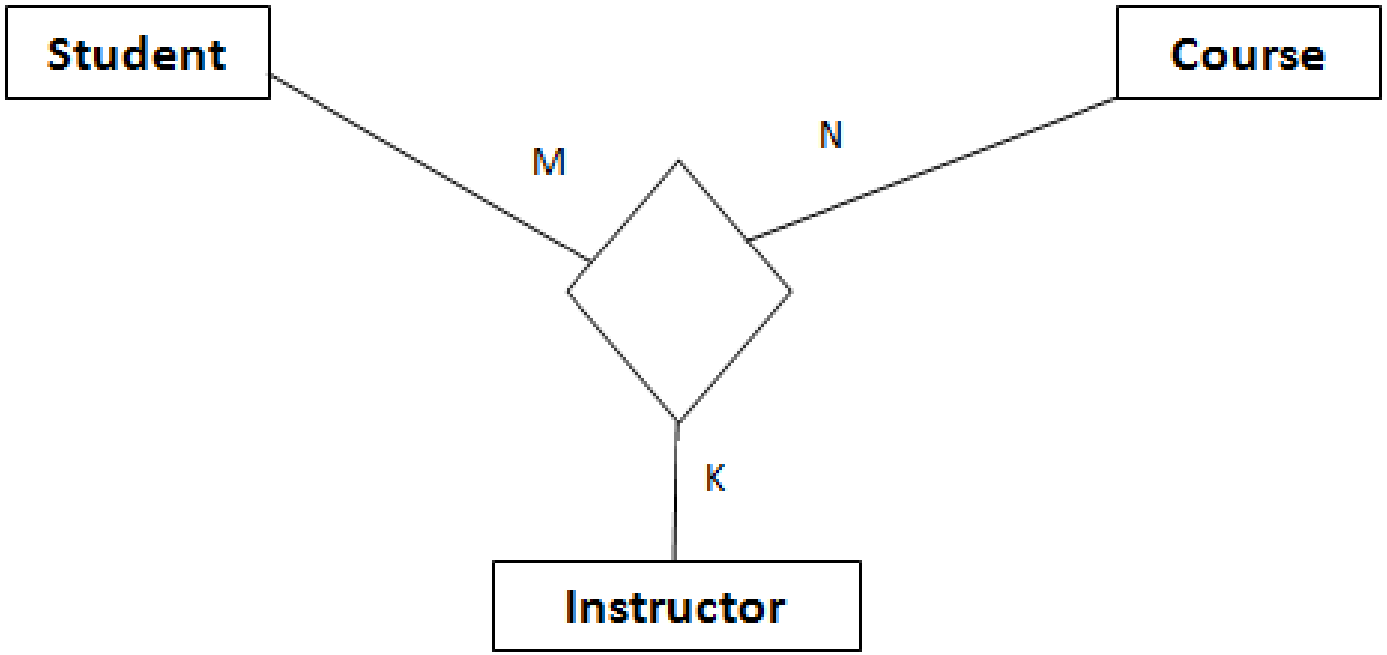
Mapping Rules 6

- Create new table for each multi-valued attribute
- Table will include two columns: One for multi-valued attribute + FK column.
- PK is the combination of FK and the attributes.

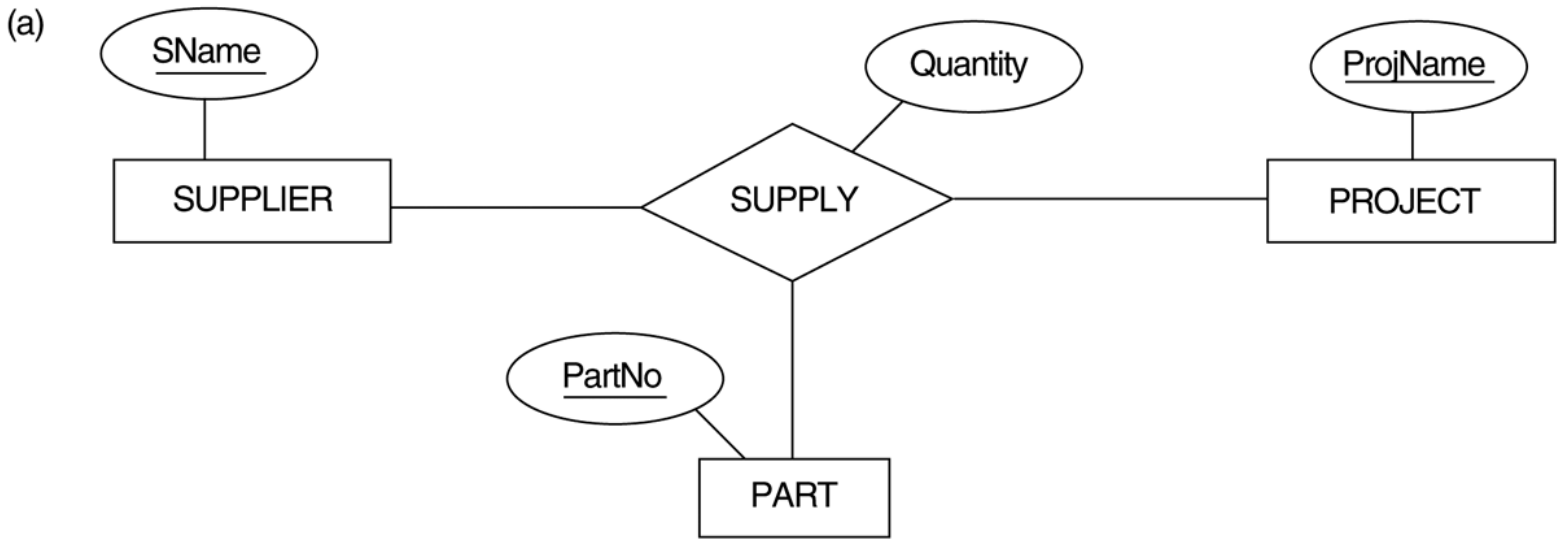
Mapping Rules 7

- If n > 2 then : Create a new third table
- Add FKs to the new table for all parent tables
- PK is the combination of all FKs.
- Add simple attributes of relationship to the new table if any.

N-ary Relationship



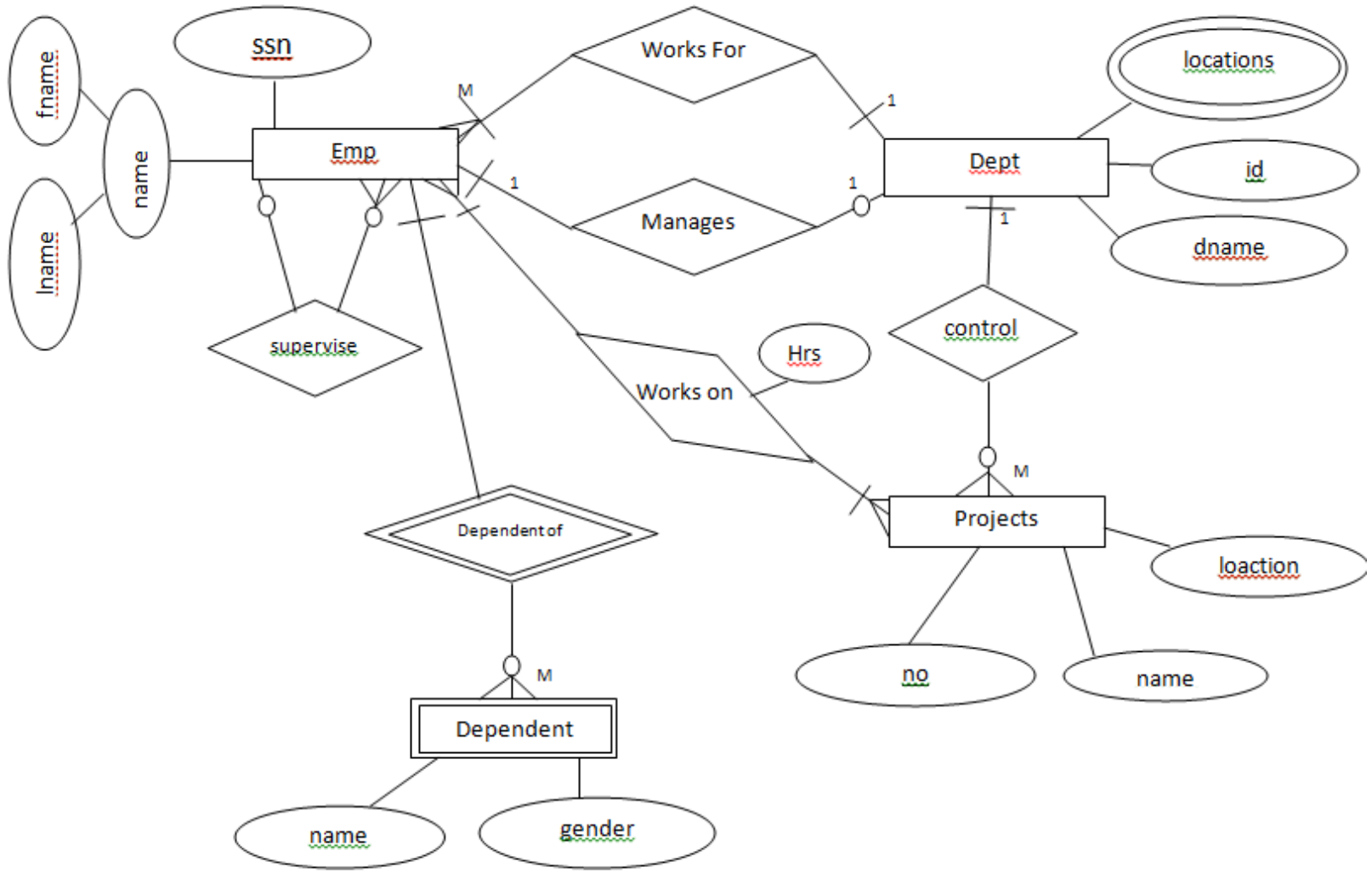
N-ary Relationship



Example 1

- A company is organized into departments. Each department has a unique name, a unique number, and a particular employee who manages the department. A department may have several locations.
- A department may control a number of projects, each of which has a unique name, a unique number, and a single location. A project must controlled by department
- We store employee's name, social security number, address, salary, gender and birth date. An employee must be assigned to one department and must work on one or more 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 that employee.

Solution


fname
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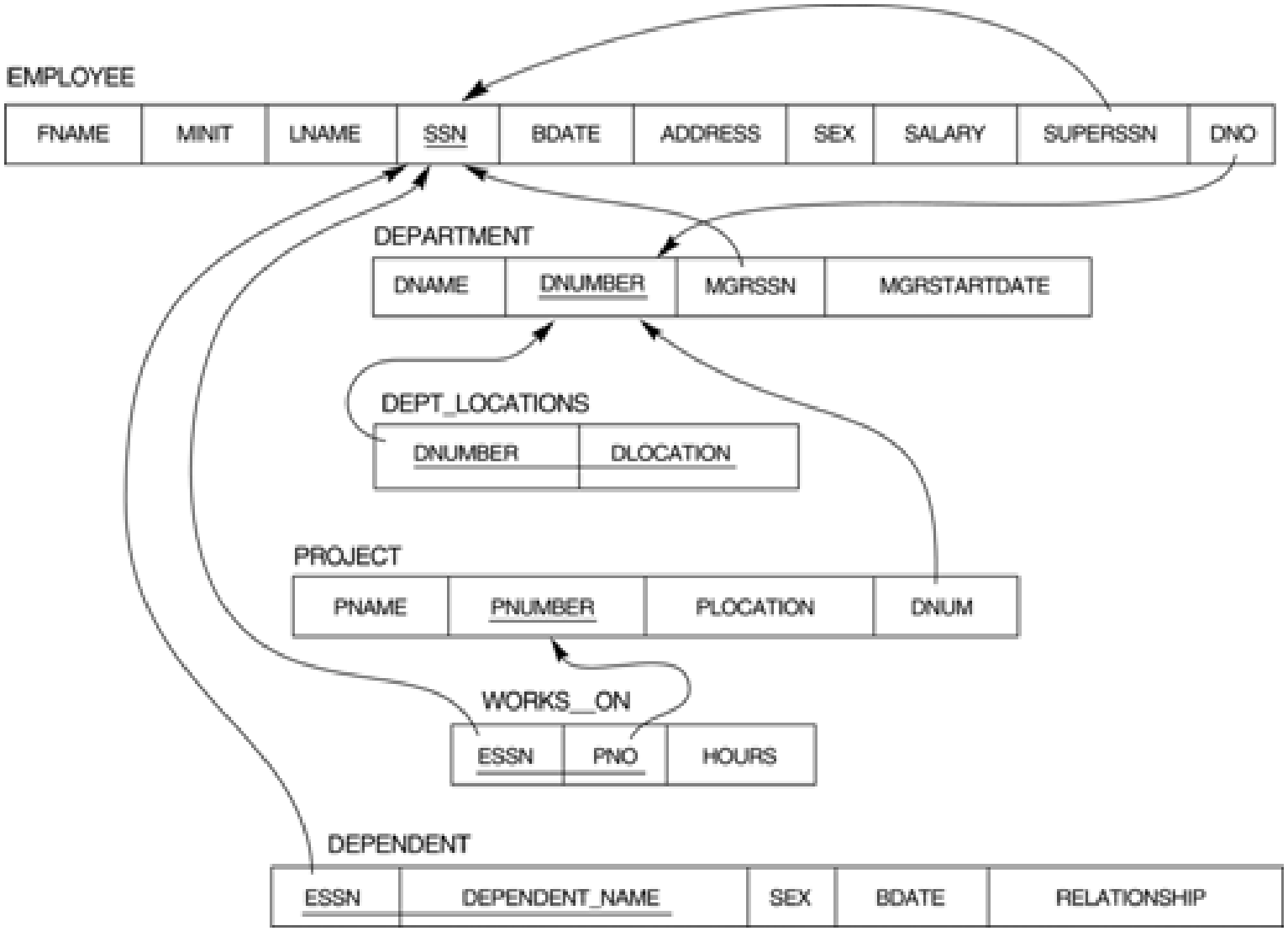
EMPLOYEE
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SUPERSSN
DNO
DEPARTMENT
DNAME
DNUMBER
MGRSSN
MGRSTARTDATE
DEPT_LOCATIONS
DNUMBER
DLOCATION
PROJECT
PNAME
PNUMBER
PLOCATION
DNUM
WORKS_ON
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PNO
HOURS
DEPENDENT
ESSN
DEPENDENT_NAME
SEX
BDATE
RELATIONSHIP

Example 2

Musicana records have decided to store information on musicians who perform on their albums in a database. The company has wisely chosen to hire you as a database designer.

- Each musician that is recorded at Musicana has an ID number, a name, an address (street, city) and a phone number.
- Each instrument that is used in songs recorded at Musicana has a unique name and a musical type (e.g., C, B-flat, E-flat).
- Each album that is recorded at the Musicana label has a title, a copyright date, and an album identifier.
- Each song recorded at Musicana has a unique title and an author.
- Each musician plays several instruments (at least one instrument), and a given instrument is played by one or more musicians.
- Each album has a number of songs on it, but no song appears on more than one album.
- Each song is performed by one or more musicians, and a musician performs at least one song or more.
- Each album has exactly one musician who acts as its producer. A producer may produce several albums.

Design a conceptual schema for Musicana. Be sure to indicate all keys and cardinality constraints and any assumptions that you make.

Example 3

- An organization makes many models of cars, where a model is characterized by a unique name and a suffix (such as GL or XL) and an engine size.
- Each model is made up from many parts and Each part has a description , an id code, production year, and many images.
- each part may be used in the manufacturing of more than one model
- Each model must be produced at just one of the firm's factories, which are located in London, Birmingham, Bristol, Wolver Hampton and Manchester - one in each city. Each factory has number of machines, capacity, and computer system used (OS , DBMS, Internet).
- A factory produces many models of cars and many types of parts.

Example 4

- A country bus company owns a number of buses. A bus is characterized by number, No. of Chairs, Options (AC , Automatic, PS) , and brand-name
- Each bus is allocated to a particular route, although some routes may have several buses . Each route is described by KM, start point, end point and the duration.
- Each route can passes through a number of towns.
- A town may be situated along several routes. We keep track of unique name and station names in each town.
- One or more drivers are allocated to one route during a period of time. The system keep information about the driver name , mobile number , hire date, basic salary , job grade.
- The system keep information about any changes in the allocations of the drivers to the routes.


Questions
?
?
Answers
?