CSE2DBF – CSE4DBF

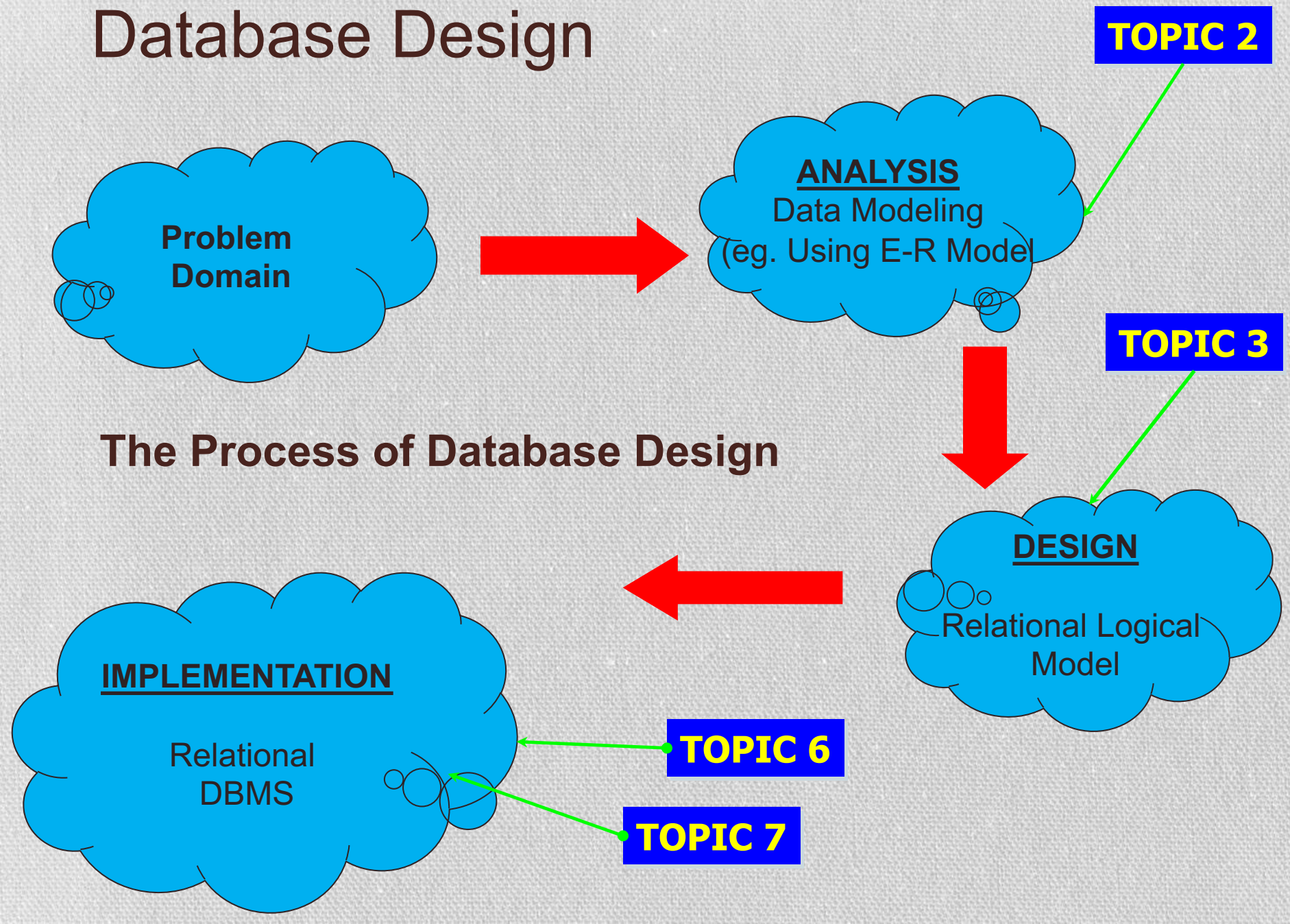
Database Modeling using Entity Relationship Model (E-R Model)

Reading:

Elmasri and Navathe, "Fundamentals of Database Systems, Chapters 1 & 2", Pearson, 2016.

Ebook: https://ebookcentral-proquest-com.ez.library.latrobe.edu.au/lib/latrobe/detail.action?docID=5573709

Database Design



Database Design

In the previous lecture, we have discussed:

- The Relational Model which is the foundation of Relational DBMS, Data Structure and Data Integrity

The problem that we haven't solved, given a problem description:

- How do we know what tables and how many tables need to be implemented ?
- How do we establish the relationships / connections among the tables ?

We will solve the above problems using a data modelling technique called **E-R Modelling.**

ER Model

The ER model is well-suited to data modelling for databases.

- ER modelling is based on two concepts:
  - **Entities**, that is, things.
  - **Relationships**, that is, associations or interactions between entities.
- It is fairly abstract and it can be explained fairly easily.
- ER models are readily translated to relations.

ER models (or ER schemas) are represented by ER diagrams.

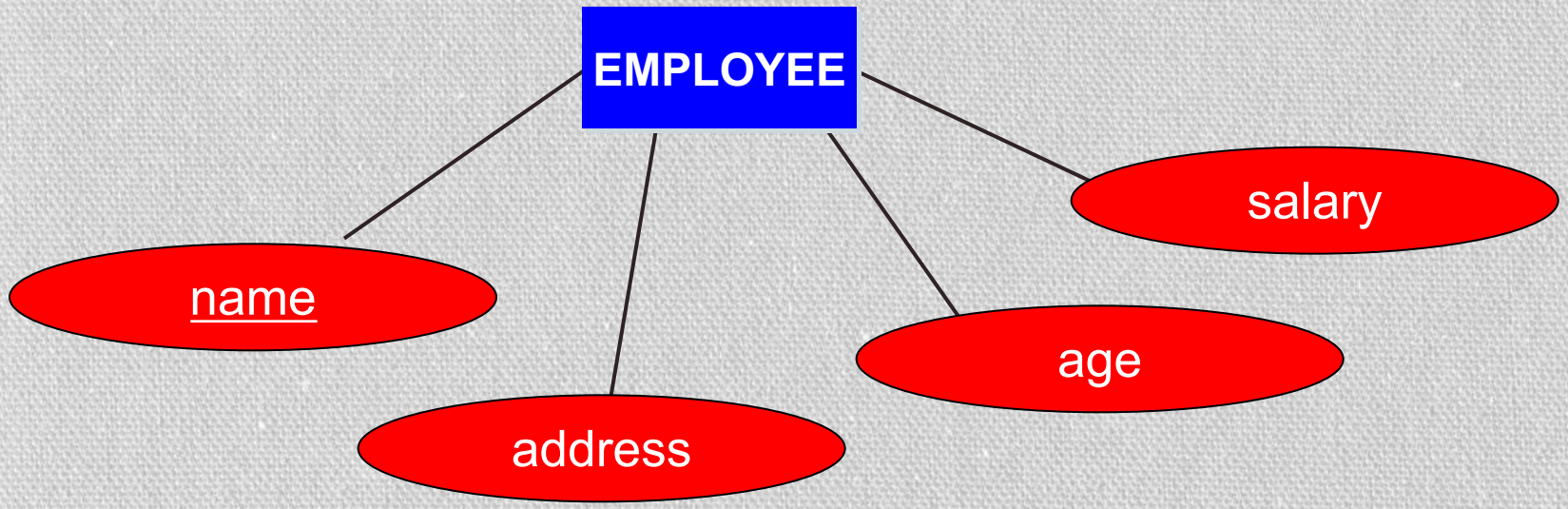
Entities and Attributes

A central element of the ER model is the concept of an **entity**, which is usually an object or event in the real world: an employee, subject, account, video, receipt, public holiday, …

An entity is represented by a name in a box.

Entities and Attributes

Each entity is associated with a set of **attributes** that describe it. For example, in a chain of video shops an employee has a name, address, age, and salary.



Each attribute is represented by **an oval** and is associated with a domain of legal values.

Entities and Attributes

- A particular entity, or instance of an entity, has a value for each of its attributes.
- Thus an employee entity might have name “Fred”, address “Clayton”, and so on.
- These values are not the entity itself, but they do identify the entity: they are values that can correspond to one item in the real world.

- **Primary Key attribute** (which uniquely identifies an entity) is indicated by underlining.

Types of Attributes

- **SIMPLE or ATOMIC** Attributes

eg: “Database”; “3083”; “Bundoora”

- **COMPOSITE** Attributes

eg: Address may consist of Number, Street, and Suburb

(“5”+ “Plenty Road”+ “Bundoora”)

- **MULTIVALUED** Attributes

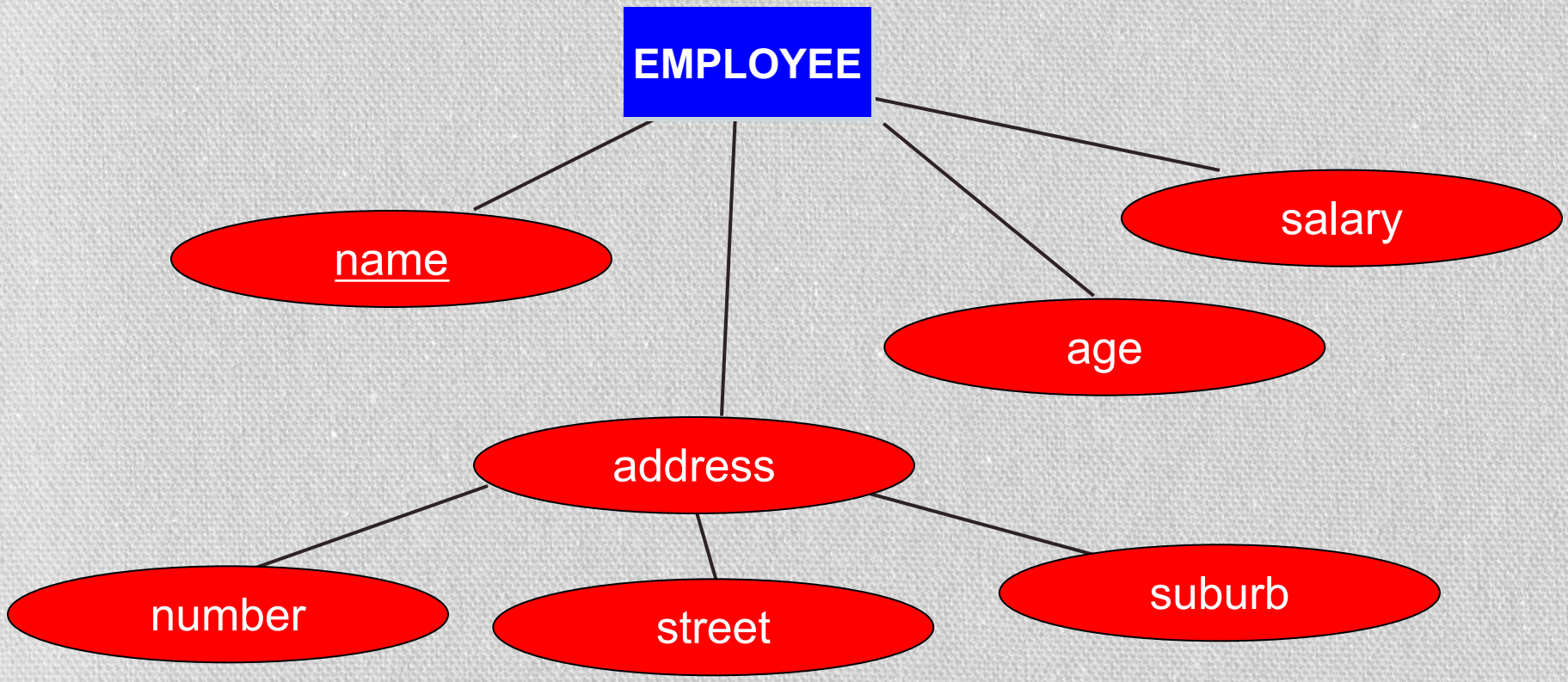
eg: Degrees of a person (“BCS”, “MIT”, “PhD”)

- **DERIVED** Attributes

eg: Derived a person’s age from attribute *date of birth*

Composite Attributes

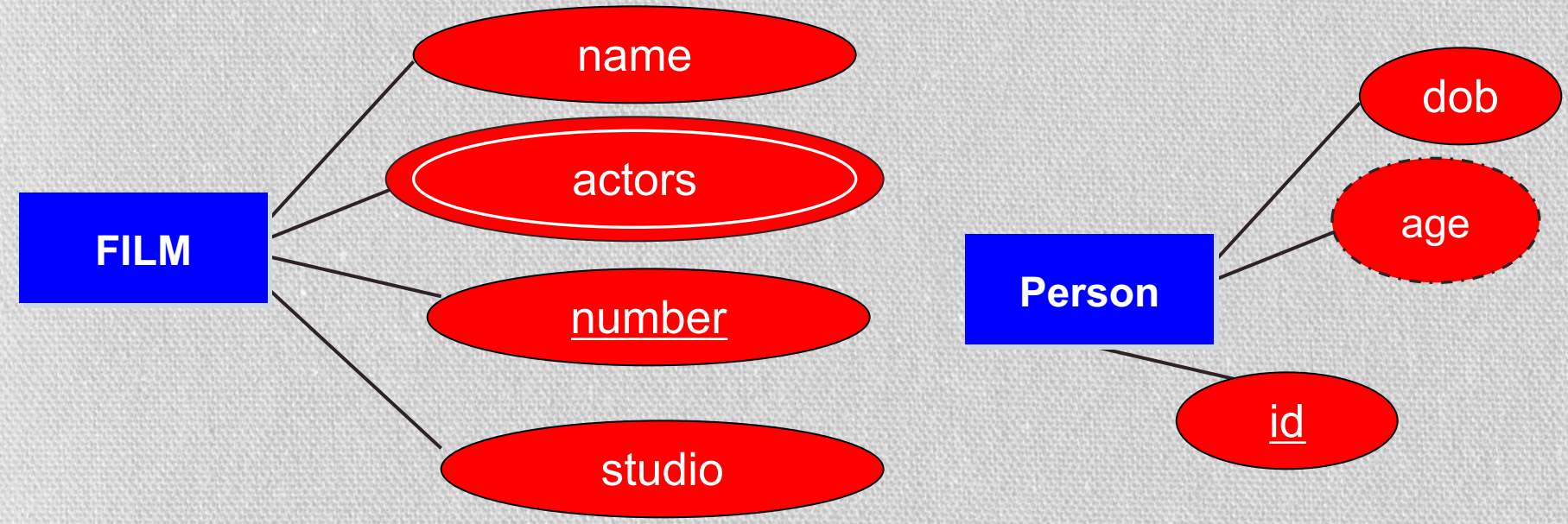
Most attributes are atomic or simple, eg. name, age, salary. Attributes can be **composite**; eg. address has several components.



Multi-valued Attributes

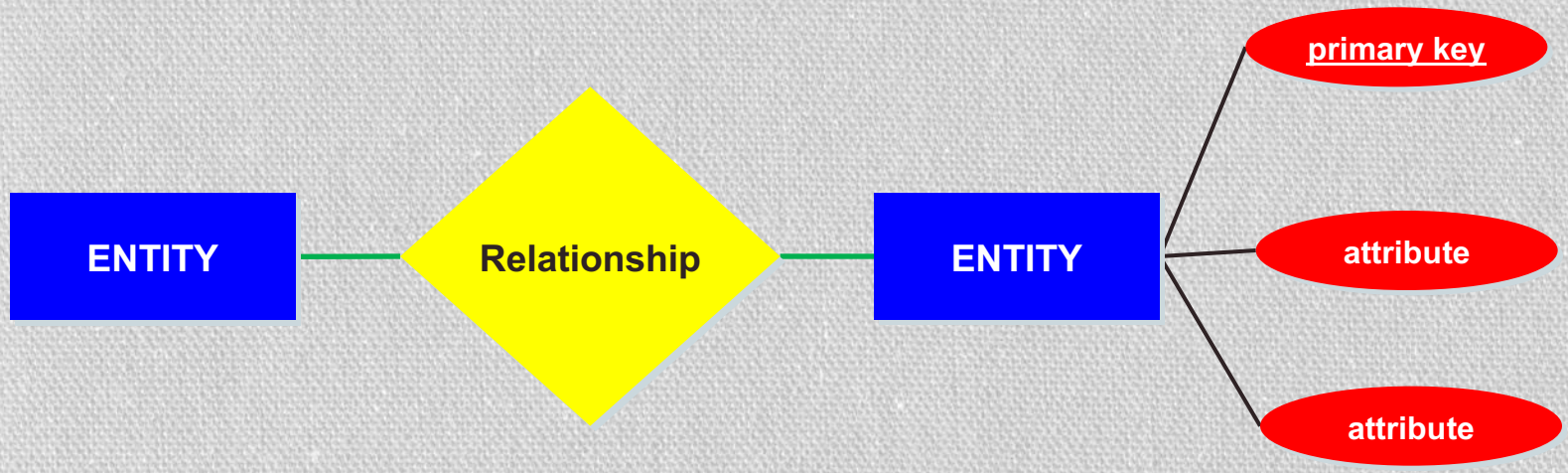
Most attributes are single-valued.

Attributes can be **multi-valued**; a video can have several actors, for example. Multivalued attributes are represented with **a double oval**.



Relationships

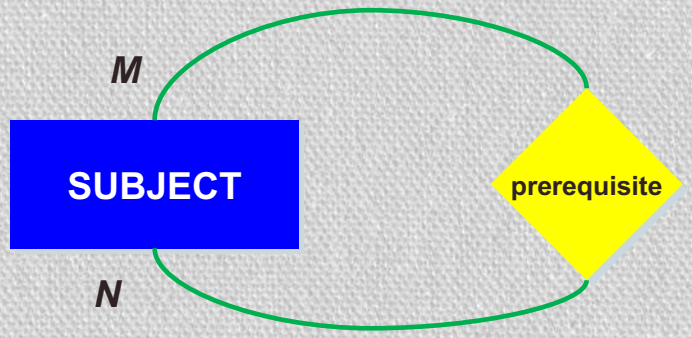
Association between two (or more) entities.



Degree of Relationships

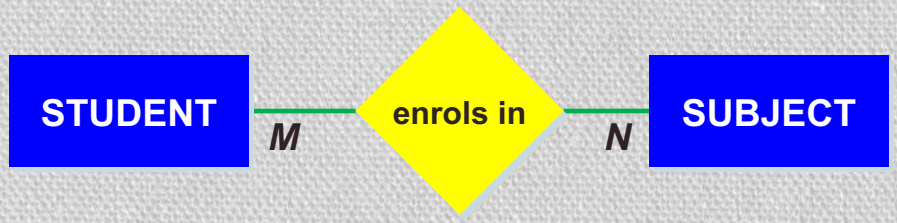
UNARY

One entity set, recursive.



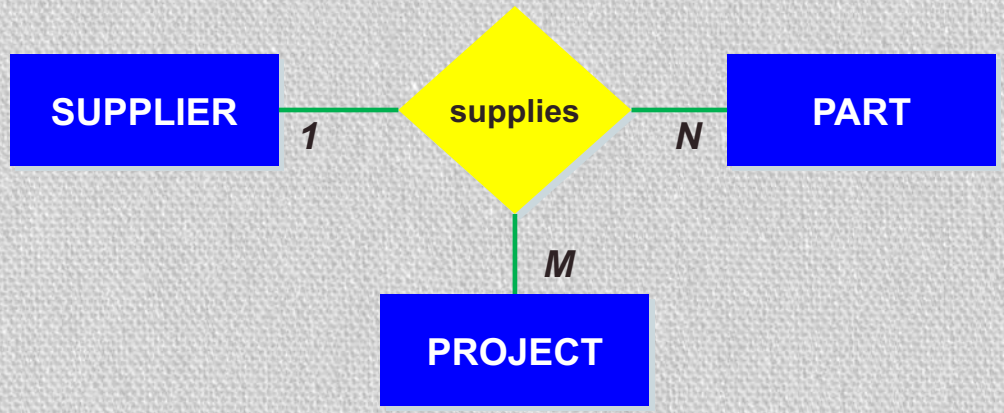
BINARY

Two entity sets linked (mostly used).



TERNARY

Three entity sets linked.



Cardinality Constraints on Relationships

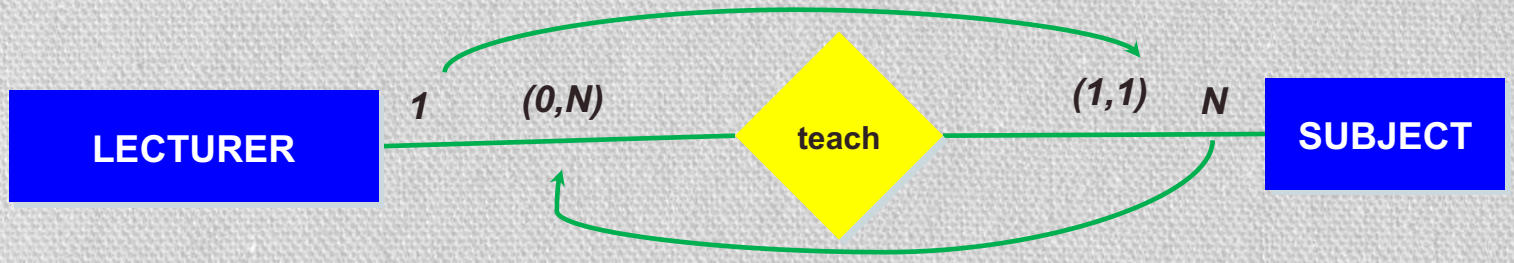
Cardinality: The number of entity instances in a relationship instance, consists of three types.

- 1 TO 1 : one-to-one association
- 1 TO N : one-to-many association
- M TO N : many-to-many association

It is sometimes necessary to use a more precise method in expressing cardinality.

An alternative notation is to use a pair of integer numbers (min, max) with each participation of an entity in a relationship, where

$0 \subseteq \text{min} \subseteq \text{max}$, and $\text{max} \supseteq 1$



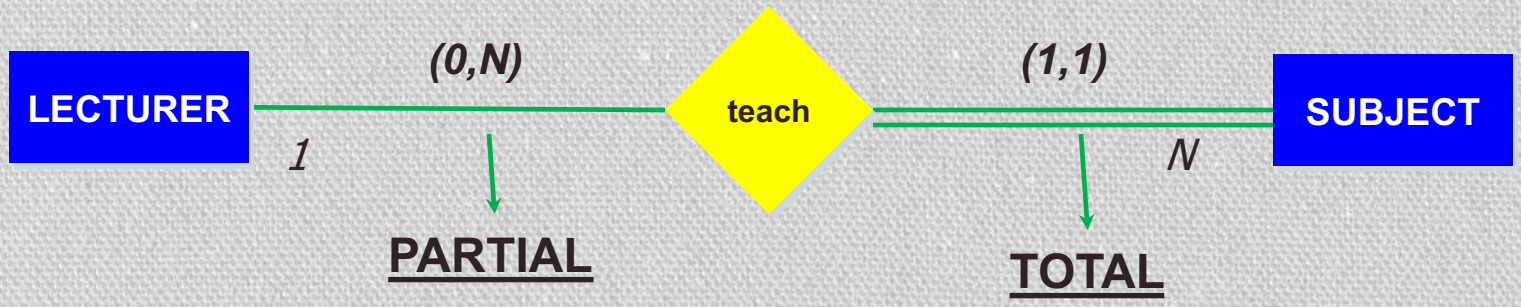
Participations Constraints on Relationships

To specify whether the existence of an entity depends on its being associated with another entity via the relationship.

Two Types of participation:

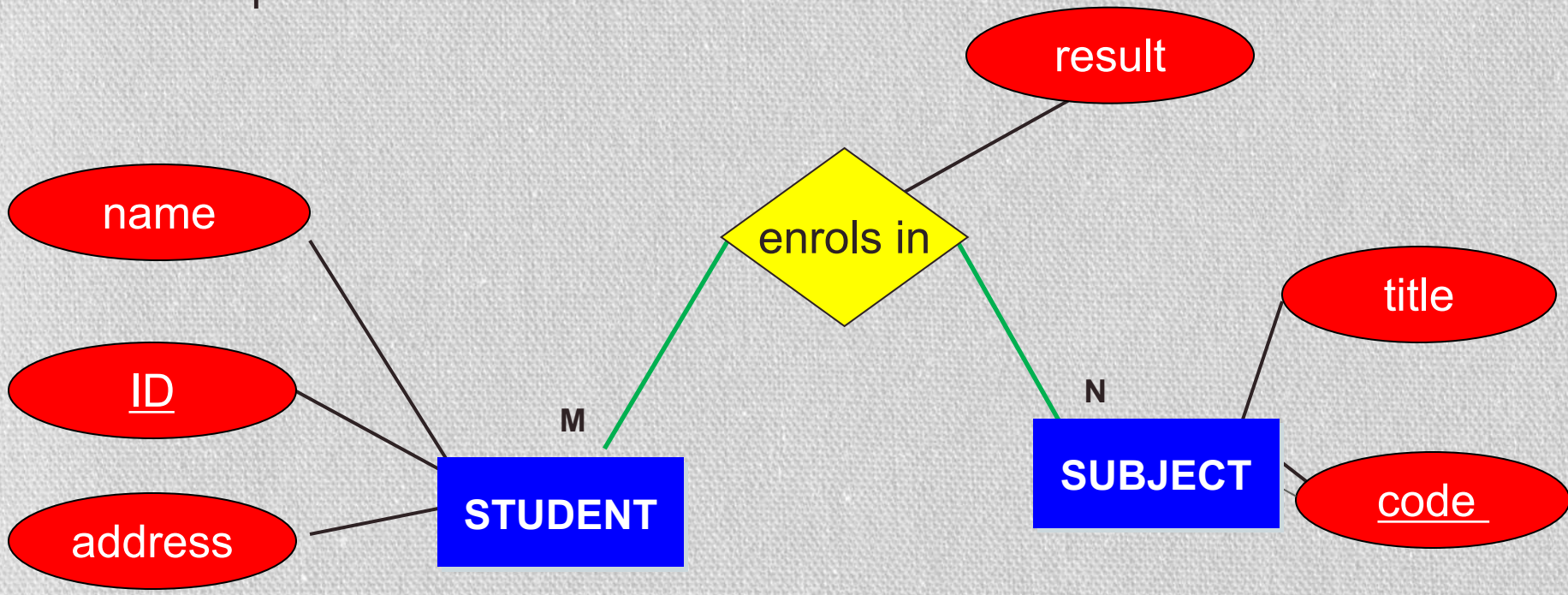
1. TOTAL Participation
The existence of an entity is totally dependent on the other entity.

2. PARTIAL Participation
The existence of an entity is partially dependent on the other entity.



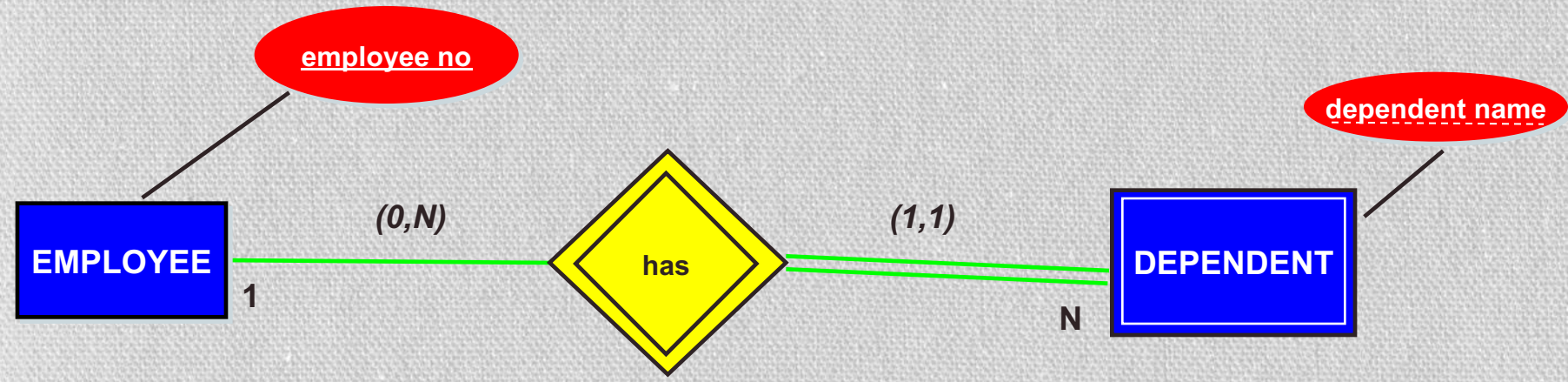
Attributes of Relationships

Relationships can have attributes.



Weak Entity

- Existence depends on the existence of one or more other entities.
- Primary key partially or totally derived from the ‘owner’ entity.
- In the following example, EMPLOYEE is the ‘owner’ entity, and DEPENDENT is the weak entity.
- Note that both the weak entity and the relationship between the weak entity and the ‘owner’ entity are represented using double - lined rectangular/diamond.



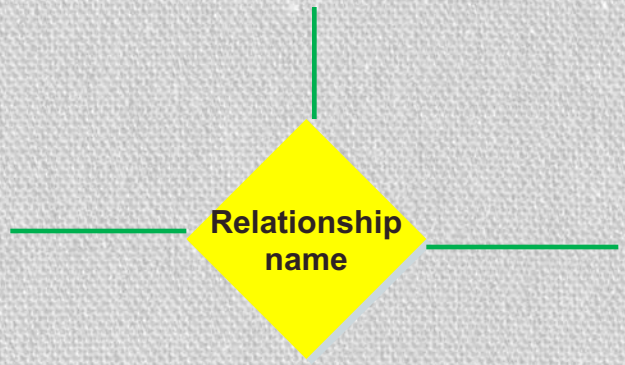
ER Diagram

The steps to draw an E-R diagram

- Identify **entities** (including weak entities) in the required system
- Represent the entities graphically by a **rectangle**.

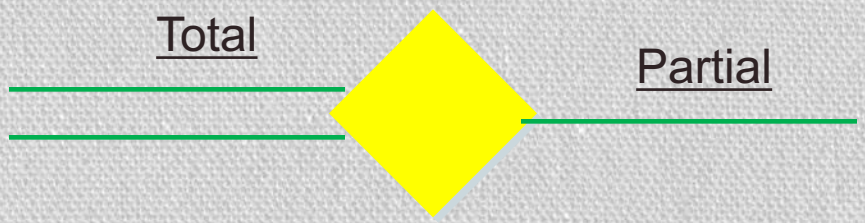
- Search for relationships between the entities and represent them graphically by a **diamond**.

(Note : Check for unary, binary OR ternary relationships).



ER Diagram

- Identify **constraints** on relationships
  - Cardinality : Use 1, N or M and (min, max)
  - Participation : Total Participation is shown with double lines, Partial participation is shown with a single line.



- Identify **all attributes**, underline **primary key** attributes.

E-R Diagram Case (Real-Estate Agency)

Properties are rented by tenants. Each tenant is assigned a unique number by the agency. Data held about each tenant includes family name, first name, contact address, phone number and property rented. A tenant may rent more than one property at any given time.

Properties are owned by owners. Each property is assigned a unique building number. The agency only encourages a single owner for any of the properties it handles. The owner, address and value are recorded for each property. In addition, the lease period and bond, are recorded for each property rented. An owner may own several properties.

Regular property maintenance is also recorded. The property, date, type of maintenance and cost are stored. Maintenance costs are charged to the property owner.

Tenants pay accounts to the agency for each property they rent. These consists of date of payment, tenant, property, type of account (rental, Bond or damage) and the amount.

E-R Diagram Case Solution

To be discussed during lecture

Next Lecture

More exercise on E-R Diagram & Relational Database Design

Reading:

Elmasri and Navathe, "Fundamentals of Database Systems, Chapters 1 & 2", Pearson, 2016.

Ebook: https://ebookcentral-proquest-com.ez.library.latrobe.edu.au/lib/latrobe/detail.action?docID=5573709