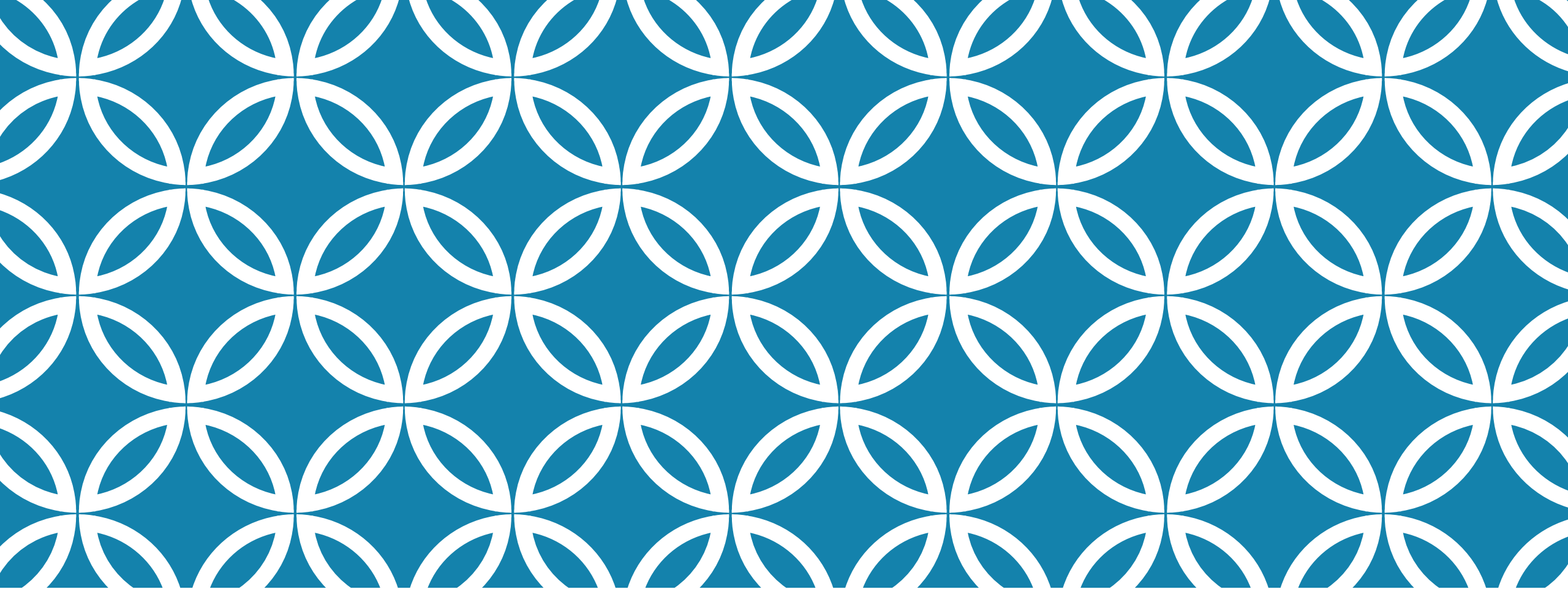




DATABASES AND DATA MANAGEMENT

Entity Relationship Diagrams

DATA MODELING

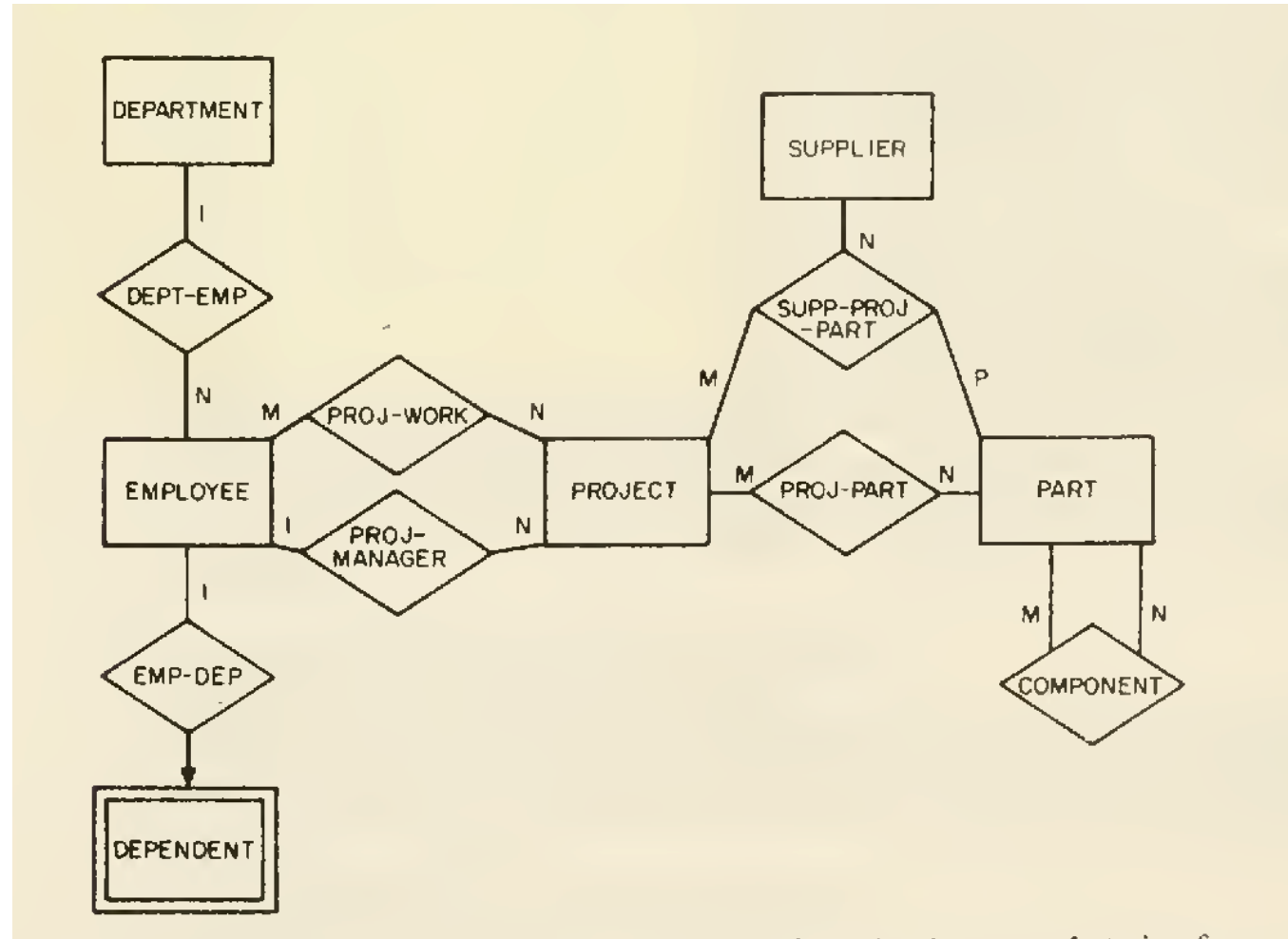
1. A technique to document a software system using diagrams and symbols.
2. It is used to represent communication of data.
3. Entity Relationship Diagram (ERD) is a graphical representation of data requirements for a database.

ENTITY RELATIONSHIP DATA MODEL

1. The entity relationship (ER) data model is used for data modelling for use with databases as it is easy to discuss and explain.
2. It is readily translated to relations/tables.
3. ER models are represented by **ER Diagrams**
4. ER modelling is based on two concepts:
 - **Entities** defined as tables that hold specific information
 - **Relationships** defined as the associations or interactions between entities

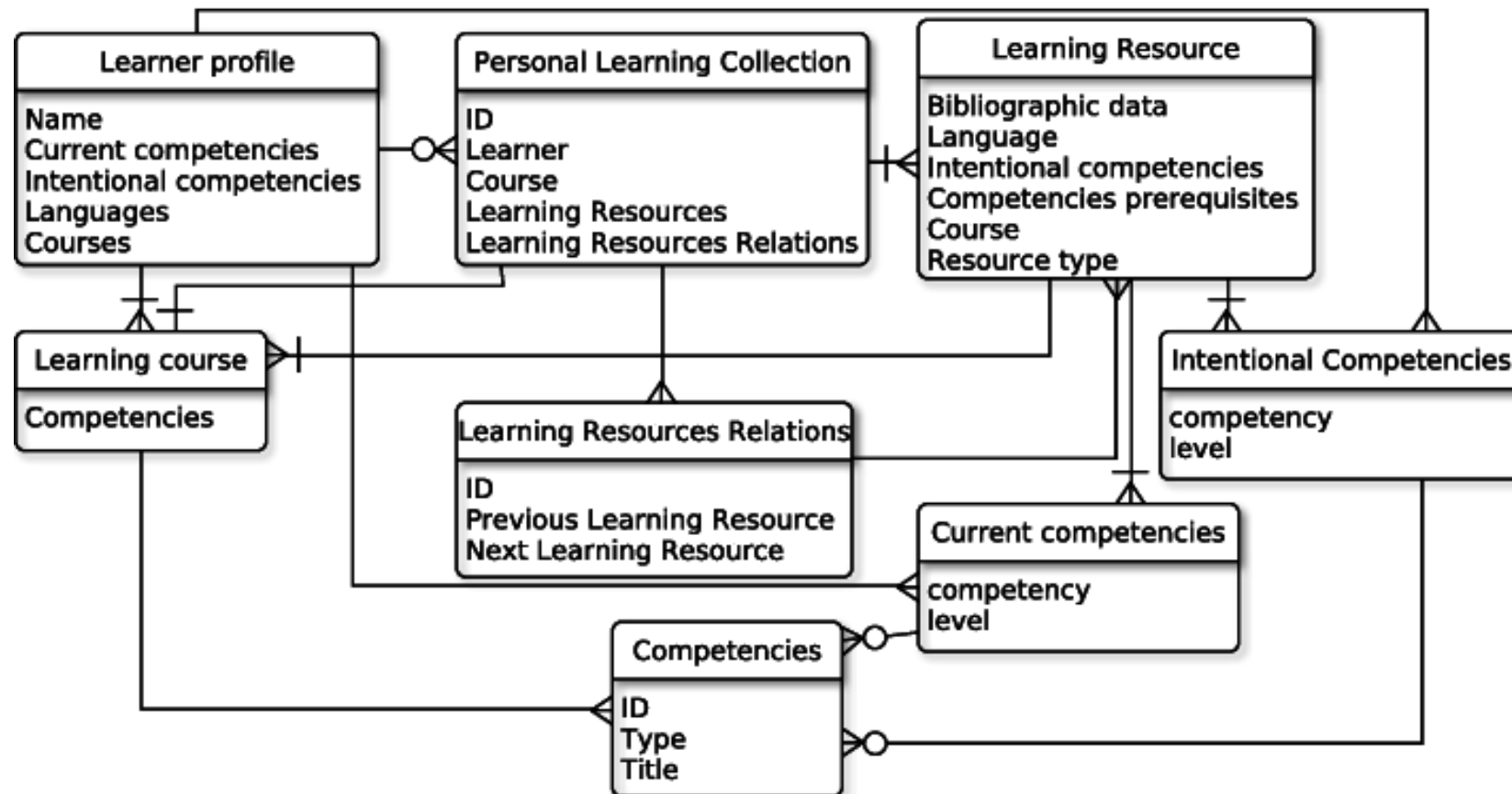
TYPES OF ER MODEL NOTATION (INFO ONLY)

Chan Notation



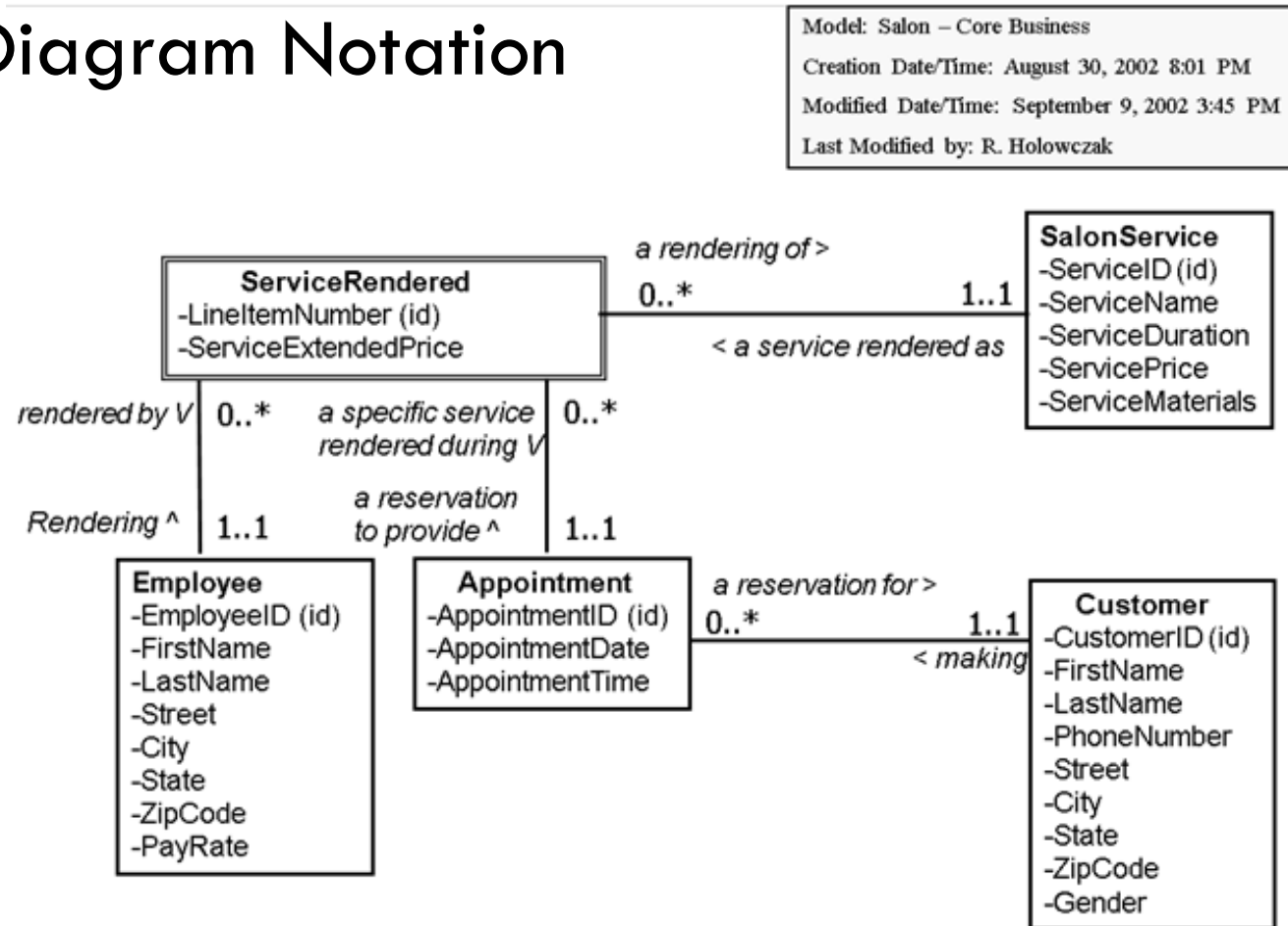
TYPES OF ER MODEL NOTATION (INFO ONLY)

Crow's Foot Notation



TYPES OF ER MODEL NOTATION (INFO ONLY)

UML Class Diagram Notation



ENTITY RELATIONSHIP DATA MODEL

An **Entity** is a specific object of interest.

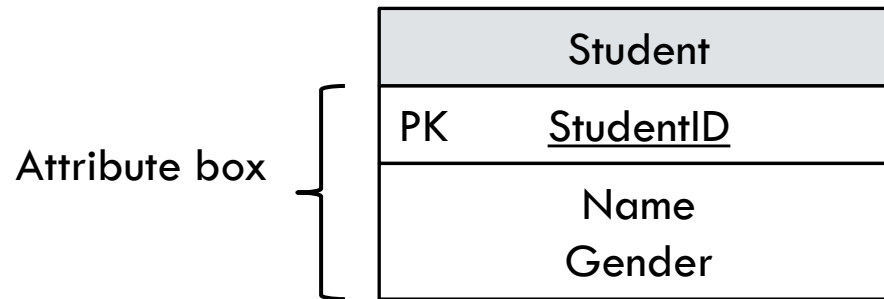
Nouns are usually used to name entities.

Entities are represented by rectangles in ERD.



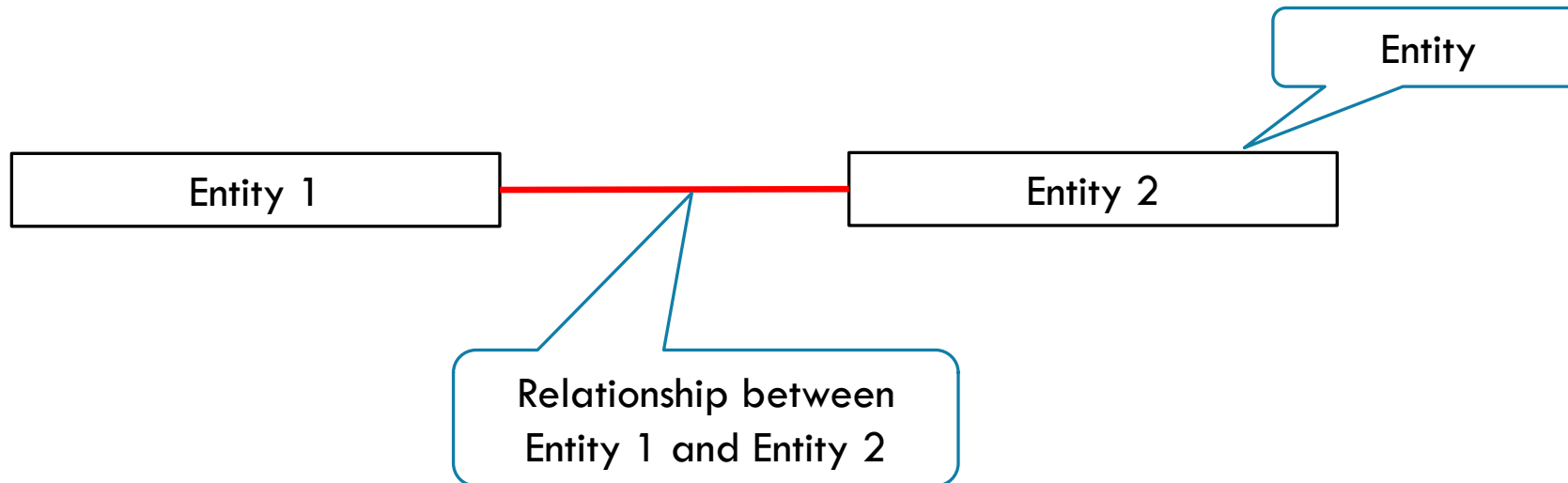
ENTITY RELATIONSHIP DATA MODEL (INFO ONLY)

Attributes are characteristics of entities. (For Info only – not required to draw the attribute box for ERD)



ENTITY RELATIONSHIP DATA MODEL

Relationship is the associations or interactions between entities. It describe the link between 2 entities.



RELATIONSHIPS

Relationships between entities always operate in both directions.

Eg. Relationship between **Student** and **Subject**

1. A Student takes many Subjects
2. A Subject can be taken by many Students

RELATIONSHIPS -CONNECTIVITY

Connectivity is used to describe the relationship classification between entities.

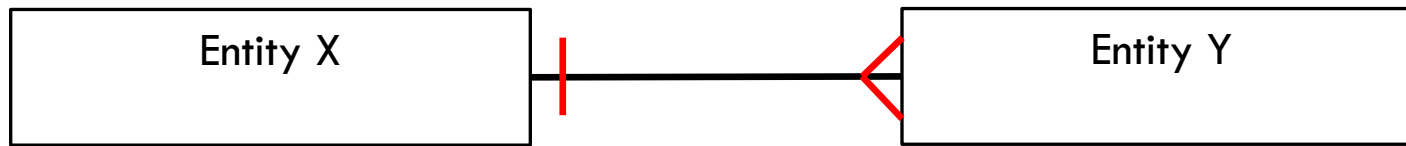
One to One Relationship



A one-to-one relationship is mostly used to split an entity into two to provide information concisely and make it more understandable.

RELATIONSHIPS -CONNECTIVITY

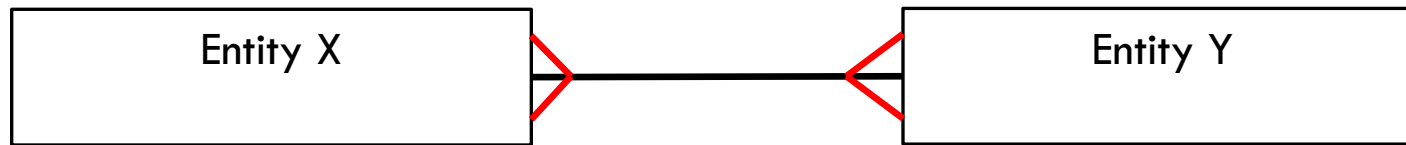
One to Many Relationship



A one-to-many relationship refers to the relationship between two entities X and Y in which an instance of **X may be linked to many instances of Y**, but an instance of Y is linked to only one instance of X.

RELATIONSHIPS -CONNECTIVITY

Many to Many Relationship



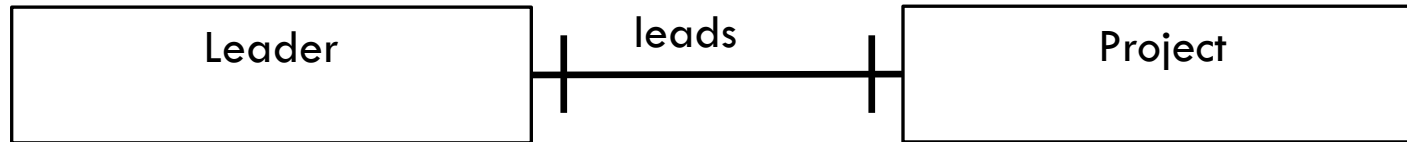
A many-to-many relationship refers to the relationship between two entities X and Y in which X may be linked to many instances of Y and Y may be linked to many instances of X.

RELATIONSHIPS —CONNECTIVITY (EXERCISE)

Project Leader policy in an organization

- Each leader leads a project
- Each project is led by a leader

Exercise: Draw the Entities and their relationship...



RELATIONSHIPS —CONNECTIVITY (EXERCISE)

Customer & Orders

- Each customer can place multiple orders
- Each order can only be placed by one customer

Exercise: Draw the Entities and their relationship...

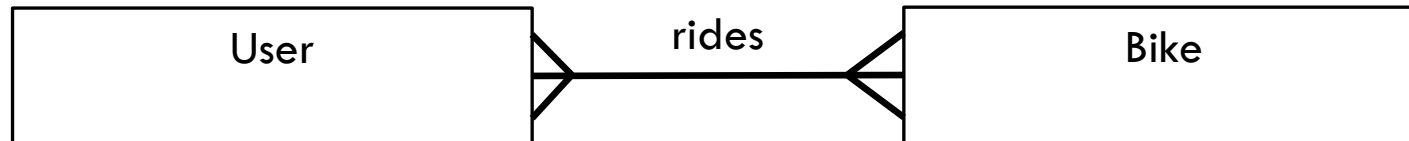


RELATIONSHIPS —CONNECTIVITY (EXERCISE)

Bike-sharing usage

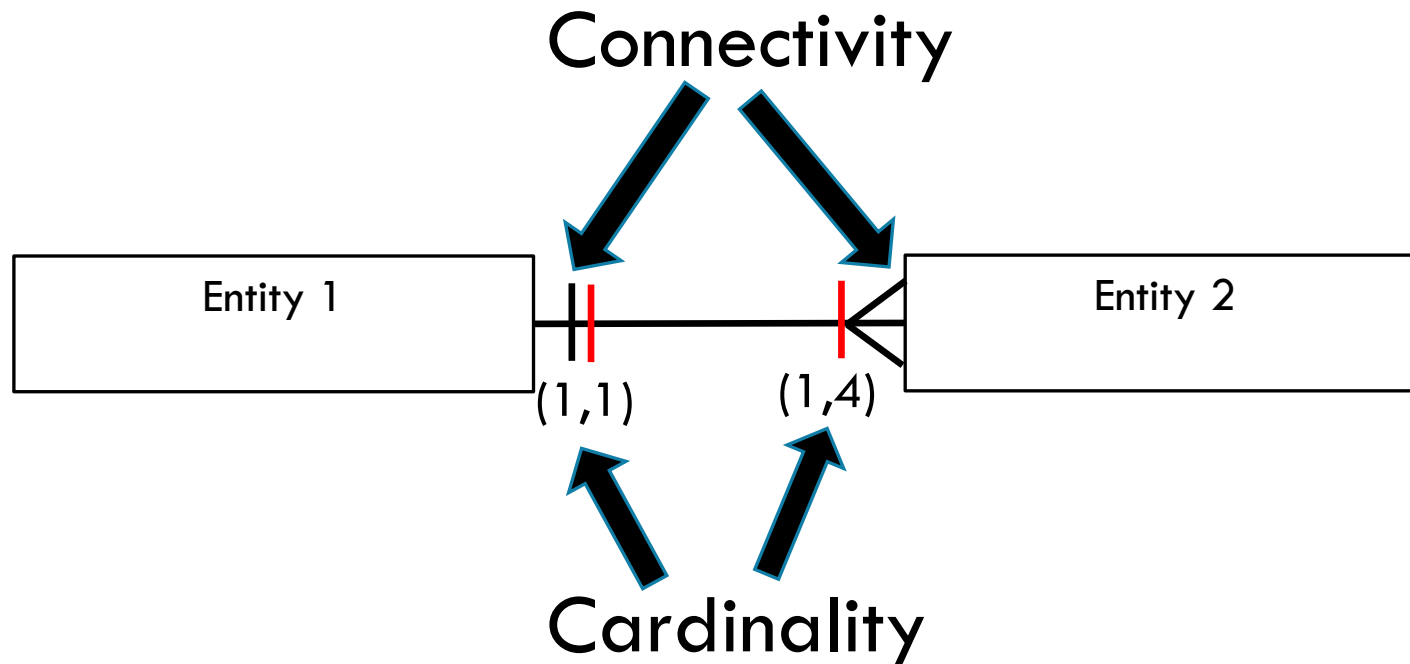
- Each user can ride many bikes
- Each bike can have many users

Exercise: Draw the Entities and their relationship...



RELATIONSHIPS – CARDINALITY (INFO ONLY)

Cardinality expresses the minimum and maximum number of entity occurrences associated with one occurrence of the related entity.



RELATIONSHIPS - CARDINALITY (INFO ONLY)

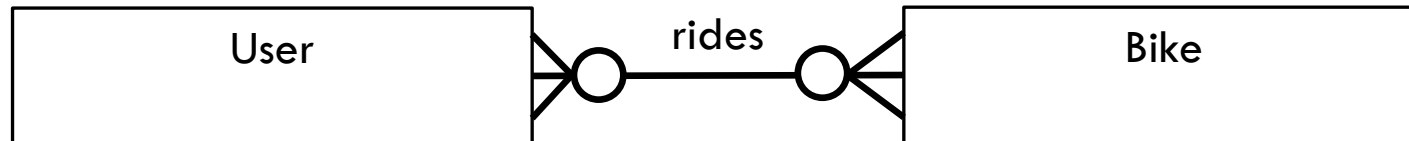
Symbol	Cardinality	Comment
$\bigcirc \Leftarrow$	(0,N)	Zero or many
$\Leftarrow$	(1,N)	One or many
$\#$	(1,1)	One and only one
$\bigcirc \vdash$	(0,1)	Zero or one

RELATIONSHIPS -CONNECTIVITY (INFO ONLY)

Bike-sharing usage

- Each person can ride zero or many bike
- Each bike can have zero or many users

Exercise: Draw the Entities and their relationship...



ENTITY RELATIONSHIP DIAGRAM (ERD)

Identify all the relevant **entities** in a given system and determine the relationships among these entities.

An entity should appear **only once** in a particular diagram.

Provide a **precise and appropriate** name for each entity, and relationship in the diagram. **In naming entities, remember to use singular nouns.**

Remove redundant or unnecessary relationships between entities.

Never connect a relationship to another relationship.

STEPS TO CREATE ERD

1. Identify the Entities
2. Identify the relationships between the entities
3. Decide the connectivity of the relationships
 - One-to-one (1:1)
 - One-to-Many (1:M)
 - Many-to-One (M:1)
 - Many-to-Many (M:M)
4. Refinement for (M:M) (if required)

STEPS TO CREATE ERD (EXERCISE)

Each class has 25 or more students.

Each subject is taken by at least one student.

Each student is assigned to a class and take 3 or 4 subjects.

Exercise :

**Identify the Entities, Relationship and
Connectivity of the relationships**

STEPS TO CREATE ERD

1. Identify the Entities

- Look for nouns.

STEPS TO CREATE ERD

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- Look for nouns.

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Entities : Student, Class, Subject

STEPS TO CREATE ERD

Student

Class

Subject

STEPS TO CREATE ERD

1. Identify the Entities
2. Identify the relationships

STEPS TO CREATE ERD

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2. Identify the relationships

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Relationships : Student and class, student and subject

STEPS TO CREATE ERD



STEPS TO CREATE ERD

1. Identify the Entities
2. Identify the relationships
3. Decide the connectivity of the relationships

STEPS TO CREATE ERD

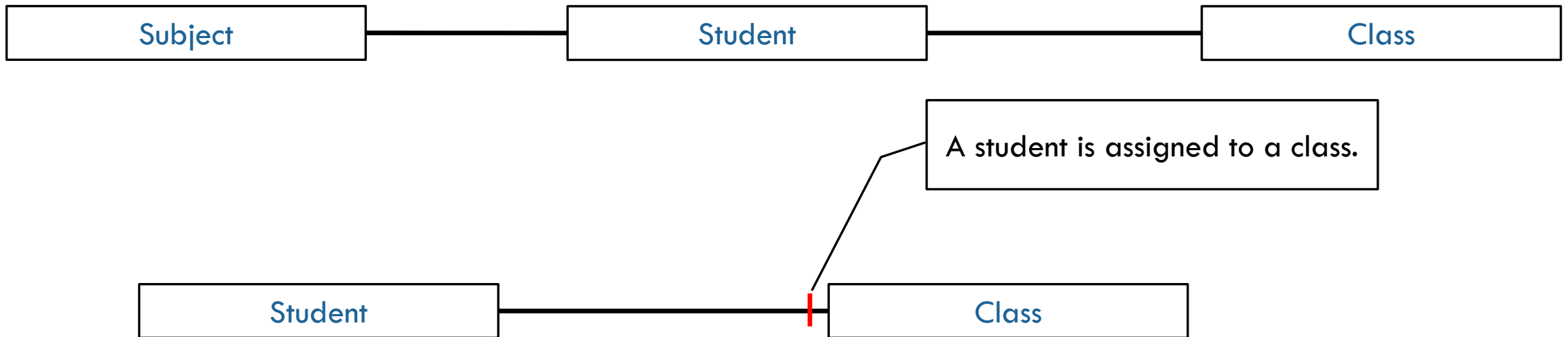
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 - Many-to-One (M:1)
 - Many-to-Many (M:N)

STEPS TO CREATE ERD

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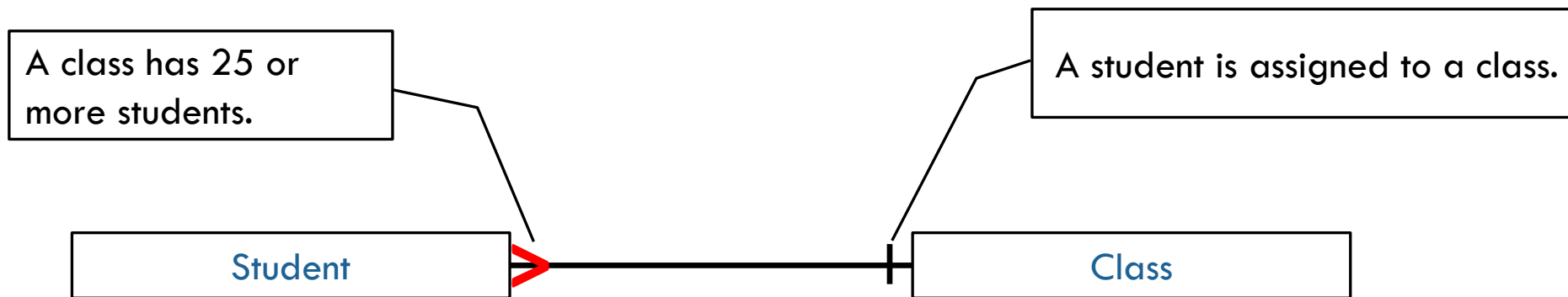


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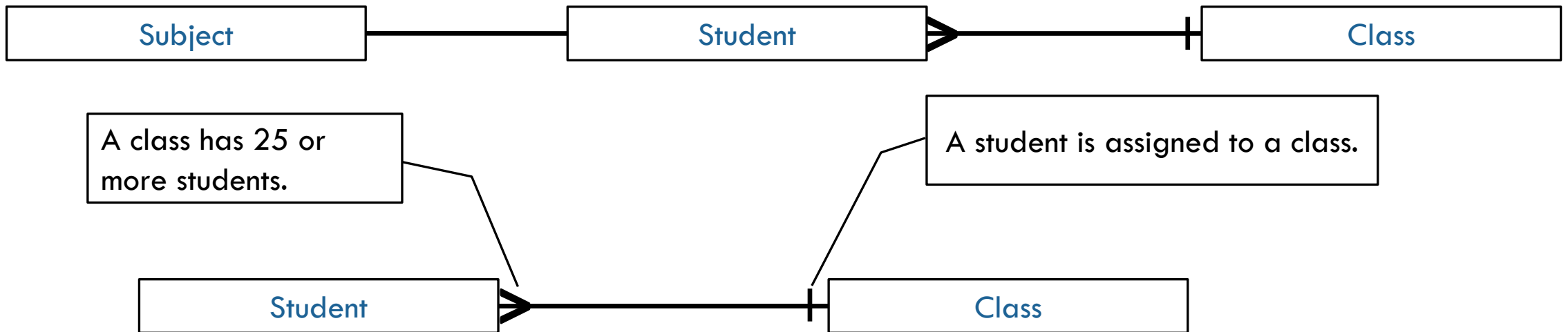


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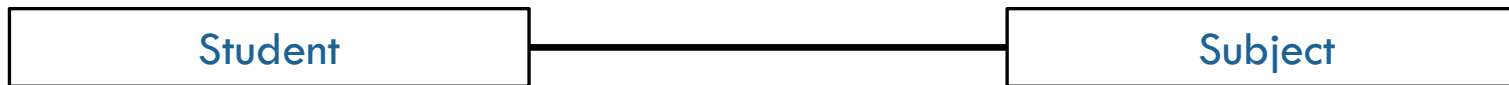


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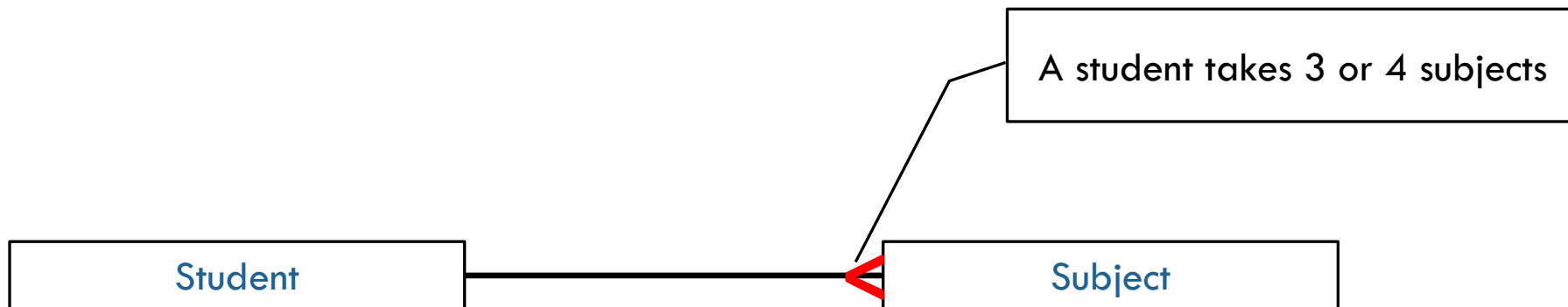


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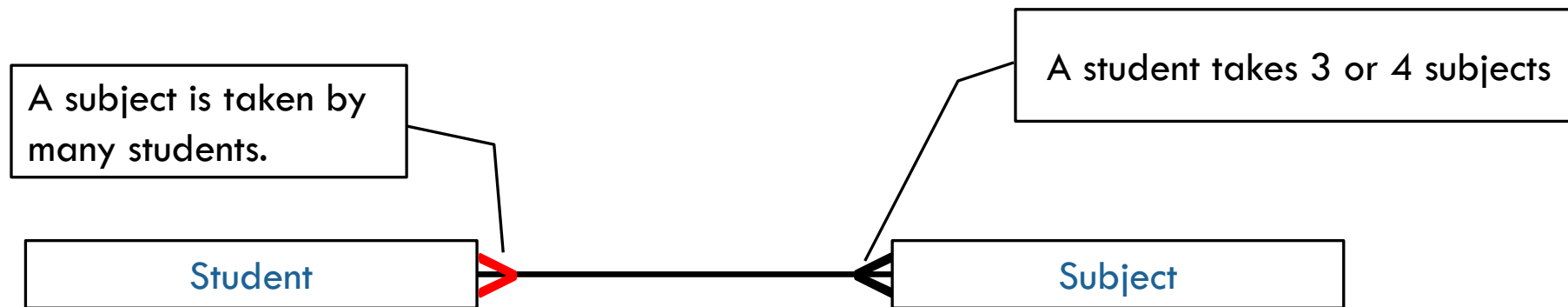


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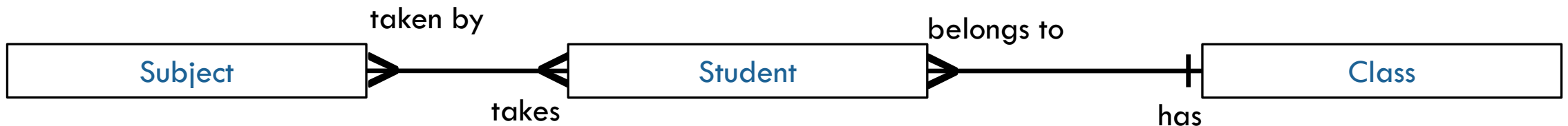


STEPS TO CREATE ERD

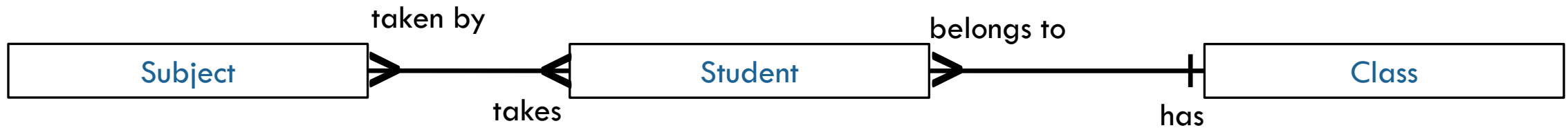
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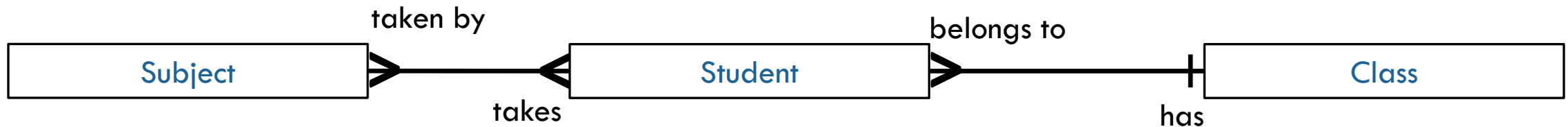


ERD TO RELATIONAL DATABASE



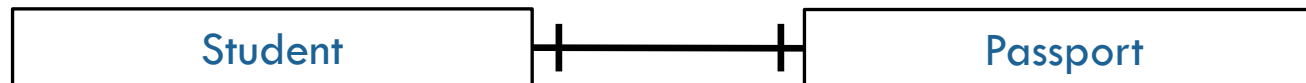
If the relationship is 1:1 ➡ there are options for implementation

ERD TO RELATIONAL DATABASE



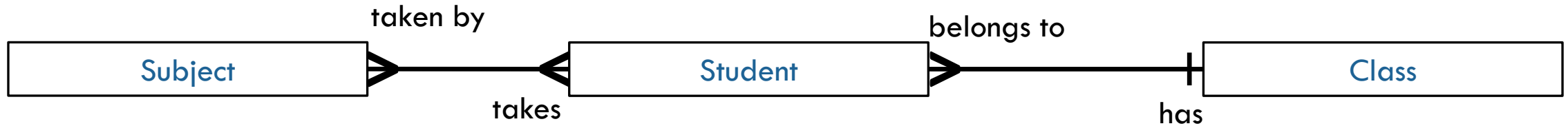
If the relationship is 1:1 ➔ there are options for implementation

Example :



You can either merge the passport information with student information or separate them.

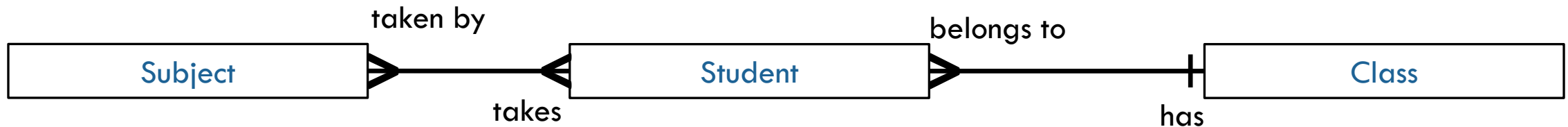
ERD TO RELATIONAL DATABASE



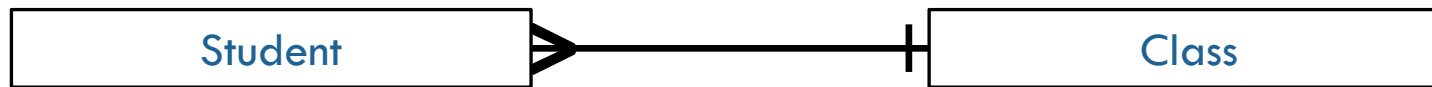
If the relationship is 1:M → no further refinement is needed.



ERD TO RELATIONAL DATABASE



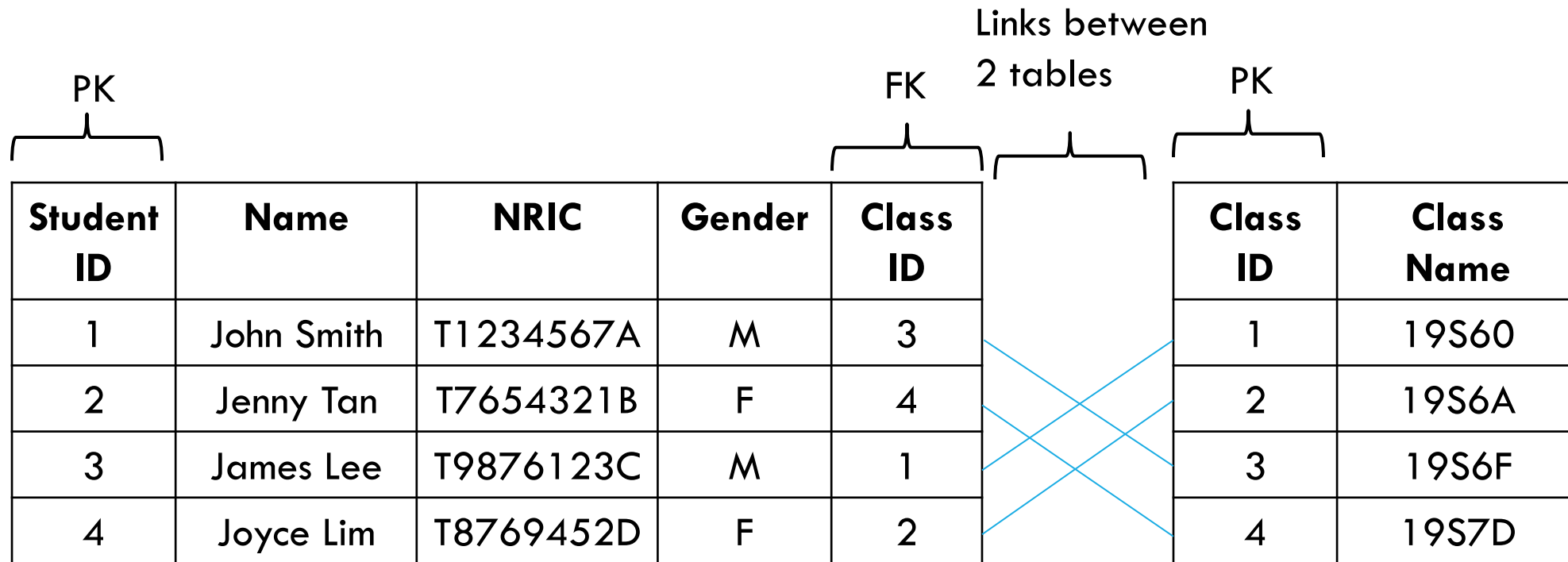
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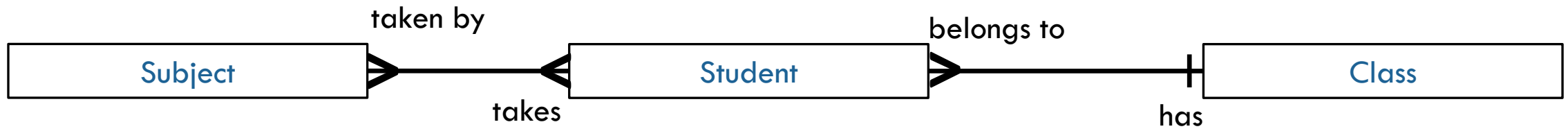
The relationship shows that the entity at the **many end** (**Student**) needs to have a foreign key(FK) referencing the primary key(PK) on the entity at the **one end** (**Class**).

RELATIONAL KEYS

Foreign key – attribute which provide a logical link between tables.

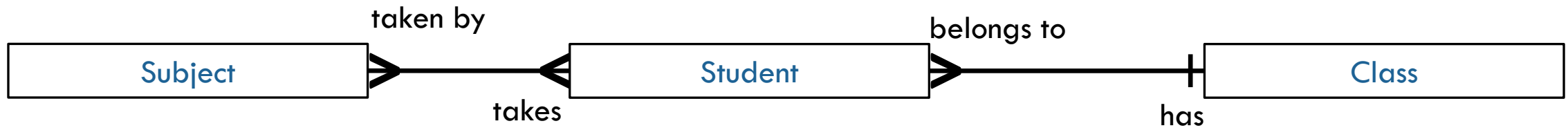


ERD TO RELATIONAL DATABASE



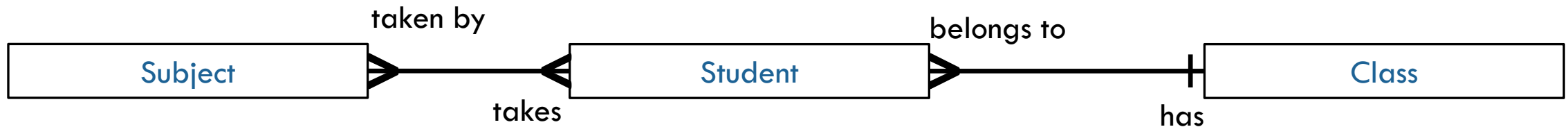
If the relationship is $M:N$

ERD TO RELATIONAL DATABASE



If the relationship is $M:N$ → problematic relationship

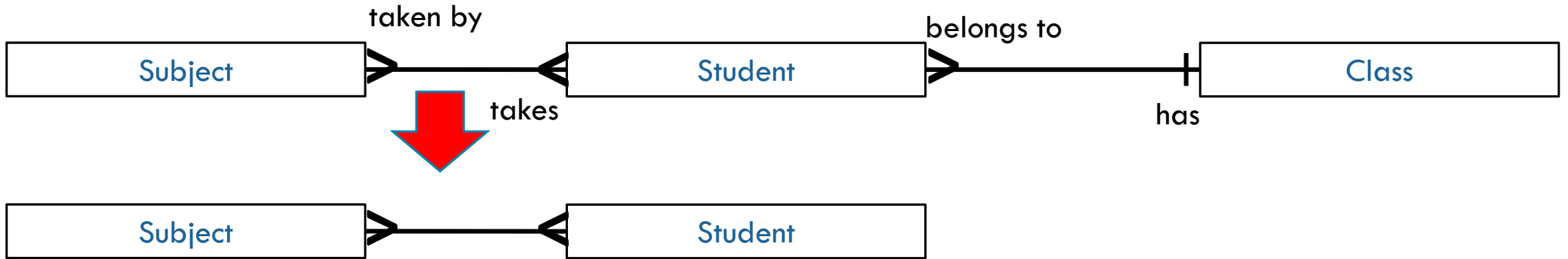
ERD TO RELATIONAL DATABASE



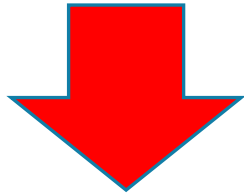
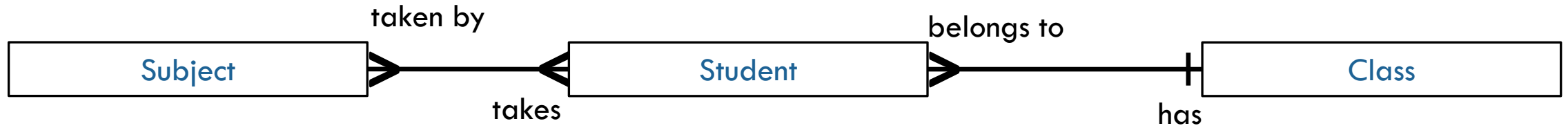
If the relationship is $M:N$ → **problematic relationship**

A foreign key cannot be used. A foreign key attribute can only have a single value so it cannot handle the many references required.

ERD TO RELATIONAL DATABASE



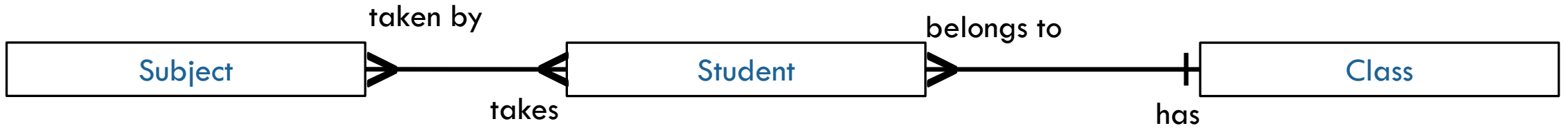
ERD TO RELATIONAL DATABASE



Split the M:N relationship to 2 x 1:M relationship



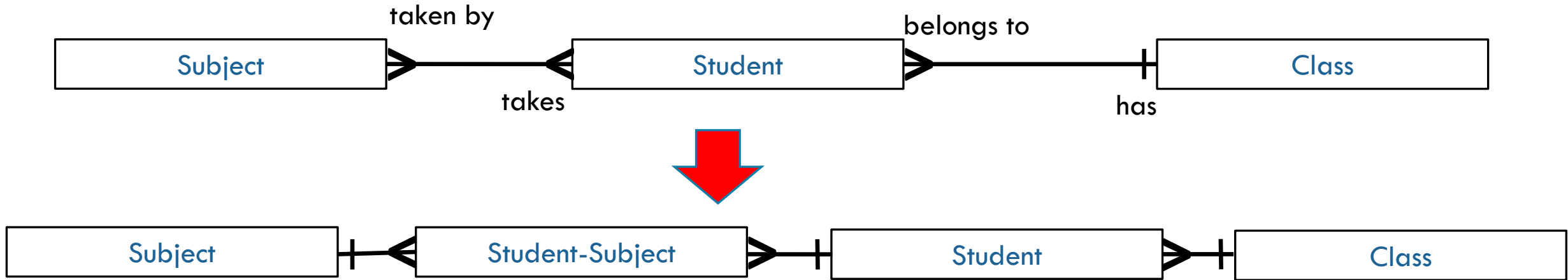
ERD TO RELATIONAL DATABASE



ENTITY RELATIONSHIP DATA MODEL (IN FRONT)

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ERD TO RELATIONAL DATABASE



ERD TO RELATIONAL DATABASE

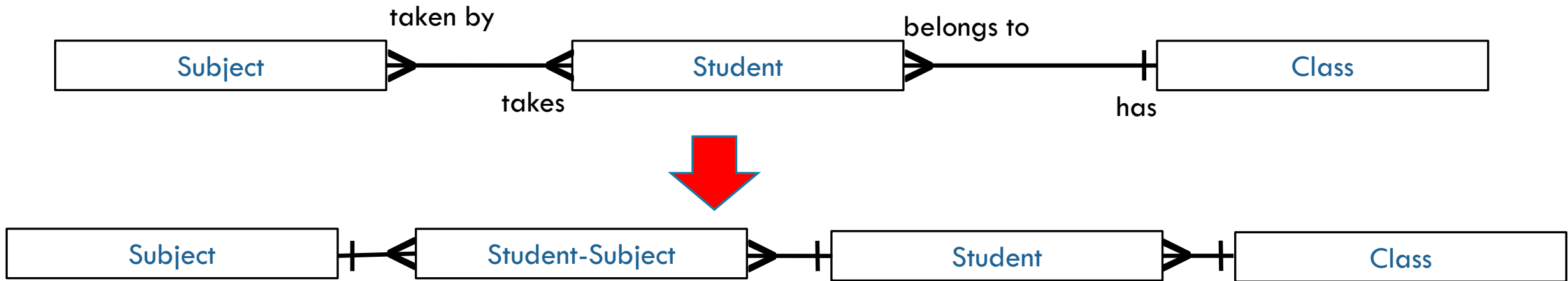


Table	Primary Key	Foreign Key
Student	Student ID	Class ID
Class	Class ID	
Student-Subject	Student ID, Subject ID	Student ID, Subject ID
Subject	Subject ID	