ERD
ENTITY RELATIONSHIP DIAGRAM

M. Rasti-Barzoki
Website: rasti.iut.ac.ir
92-2

Entity Relationship Diagrams for Data Modelling

- An **Entity-Relationship Diagram (ERD)** shows how the data that flows in the system is organised and used.

Entity Relationship Diagrams for Data Modelling

- **The elements of an ERD are the following:**

    - **Entity –**

    - **Attributes –**

    - **Relationships – associations between entities.**

Examples

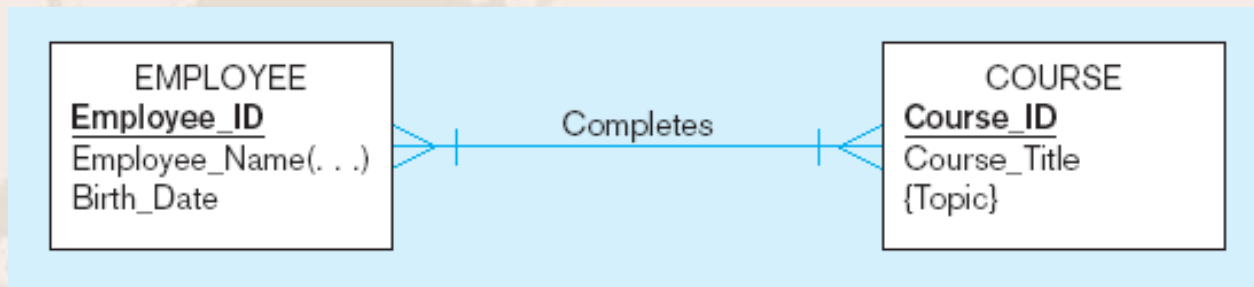**Relationship name:**
writes

Author ⟷ **Book**

An author writes one or more books
A book can be written by one or more authors.

Relationship types and instances

- **Example**

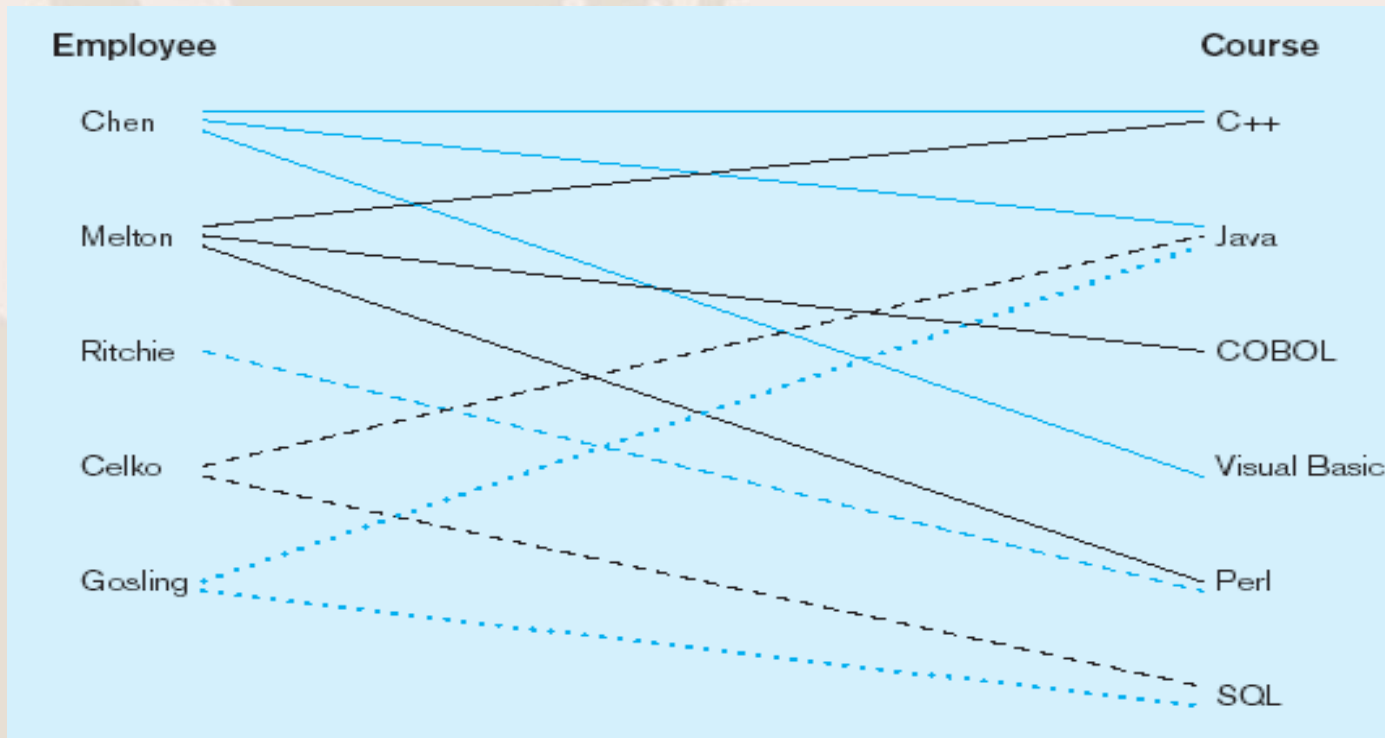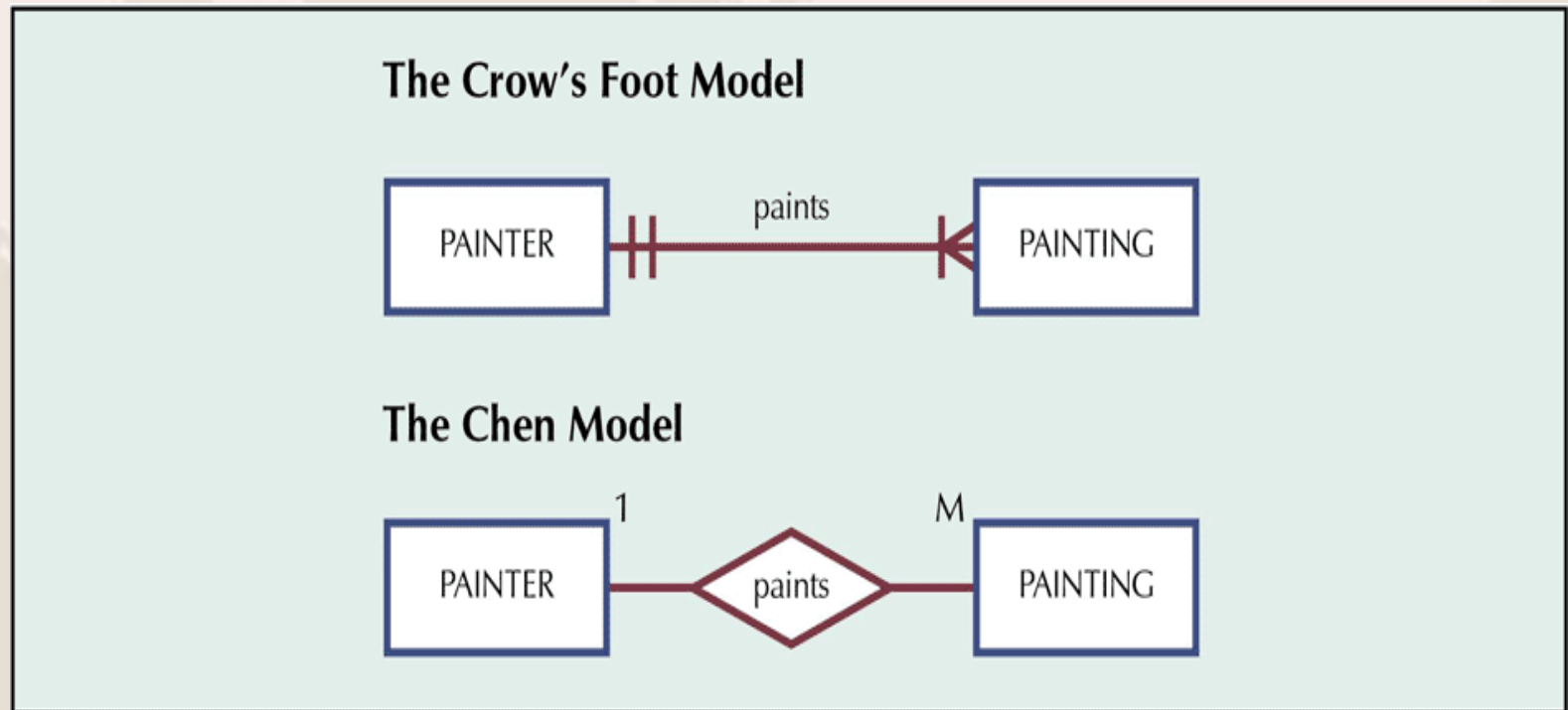## Relationship types and instances

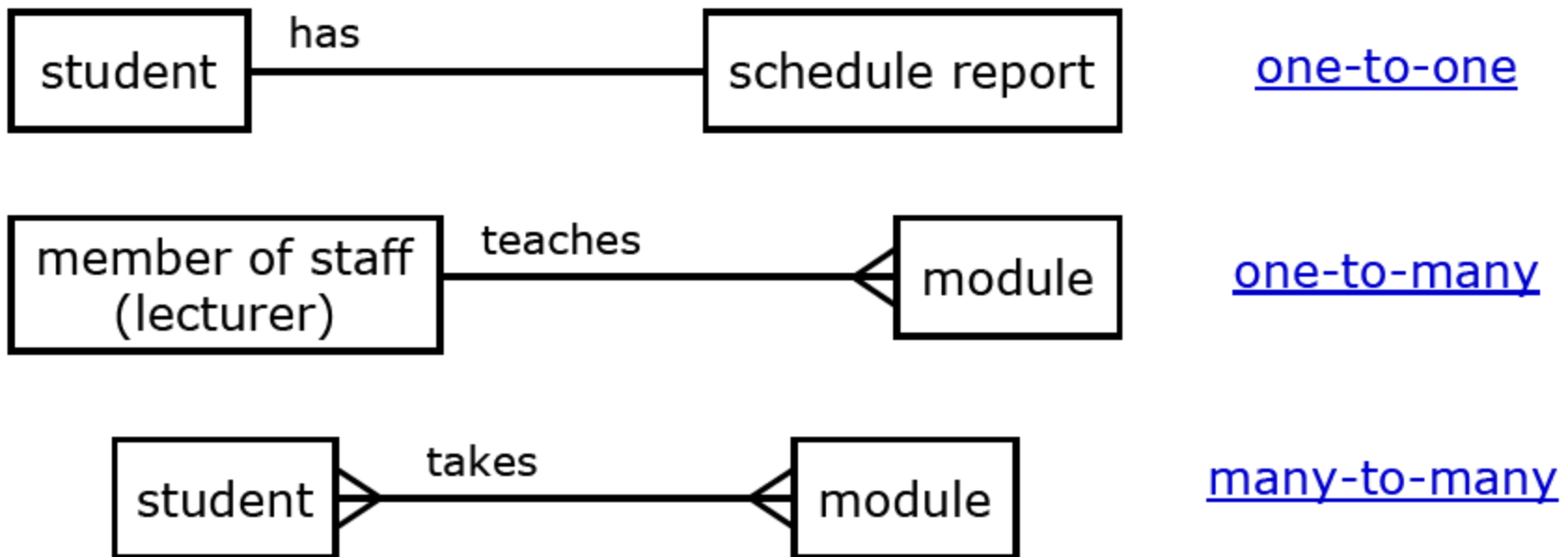- **Relationship instances**

Relationship types and instances

- **Example**

ERD

- **Types of entity relationships and example of their representation:**

ERD

- **Examples**

EMPLOYEE — Is_assigned — PARKING SPACE
One-to-one

PRODUCT LINE — Contains — PRODUCT
One-to-many

STUDENT — Registers_for — COURSE
Many-to-many
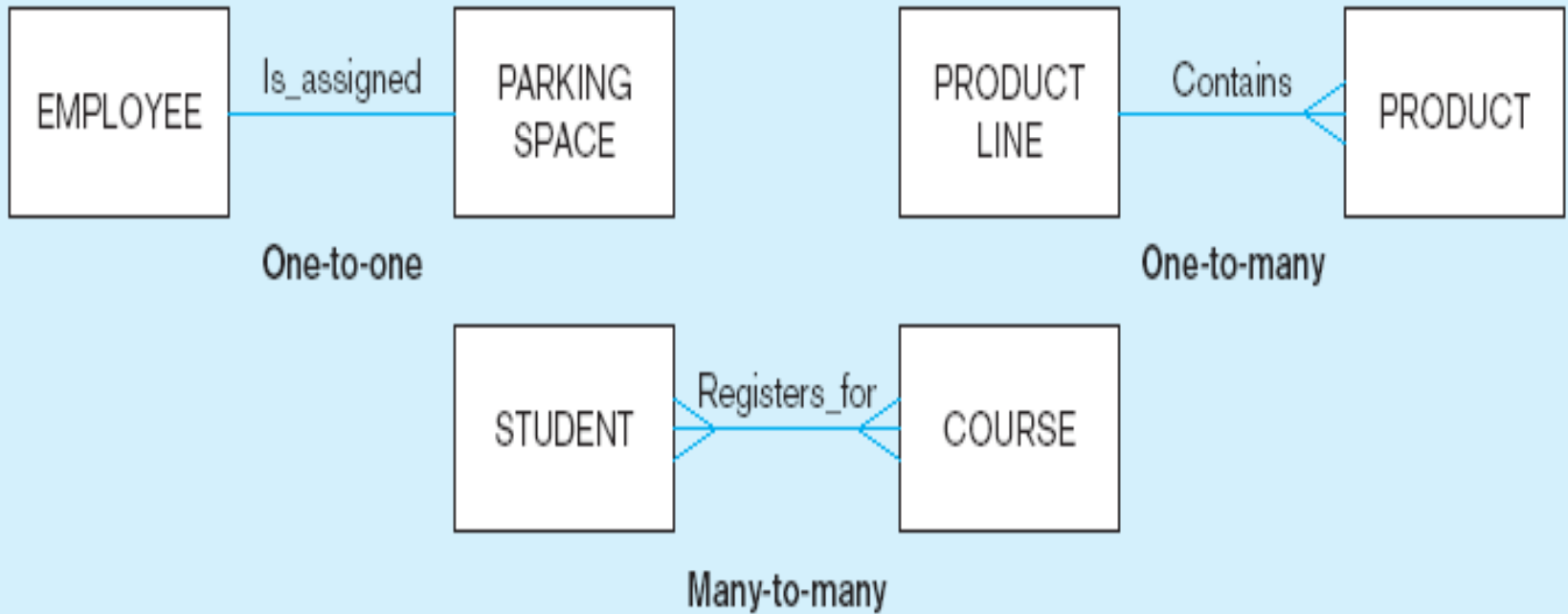
ERD

- **Cardinalities**

    - Cardinality - The number of instances of entity B that can be associated with each instance of entity A.

        – <u>Minimum Cardinality or Modality</u> - The *minimum number* of instances of entity B that may be associated with each instance of entity A.

        – <u>Maximum Cardinality</u> - The *maximum number* of instances of entity B that may be associated with each instance of entity A

Cardinalities

Mandatory One   Optional One

Mandatory Many   Optional Many
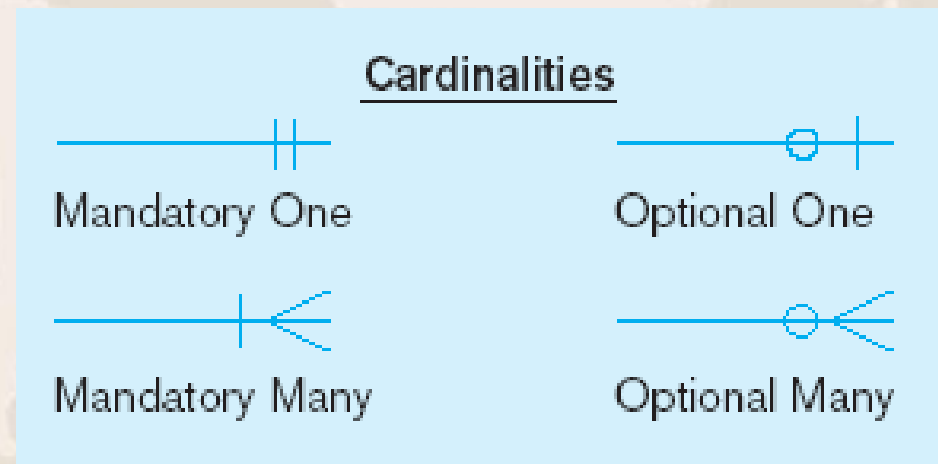
Entity Relationship Diagrams for Data Modelling

Relationships

- A **one-to-one relationship (1:1)** exists when the maximum cardinality for each entity in the relationship is 1.

- A **one-to-many (1:N)** relationship exists when the maximum cardinality on one side is 1 and the maximum on the other side is many.

- A **many-to-many (M:N)** relationship exists when the maximum on both sides is many.
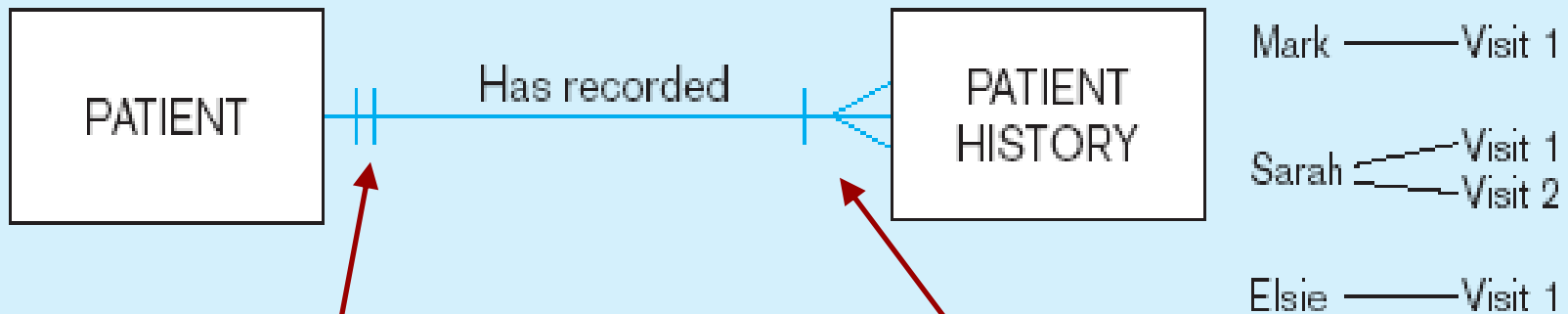
ERD

- **Examples**

A patient history is recorded for one and only one patient

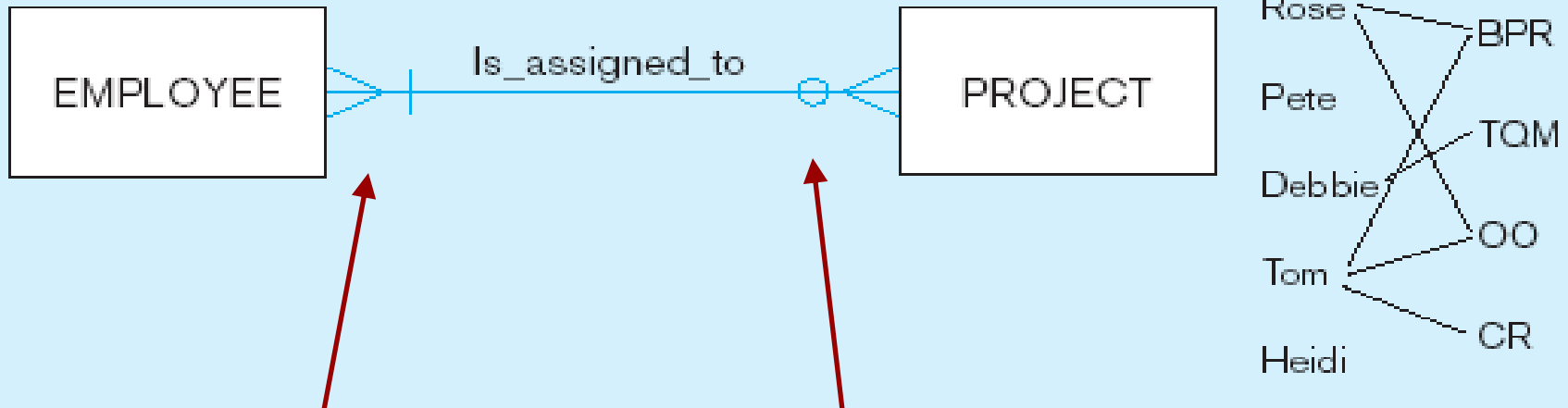A patient must have recorded at least one history, and can have many

ERD

- **Examples**

EMPLOYEE —— Is_assigned_to —— PROJECT

Rose — BPR
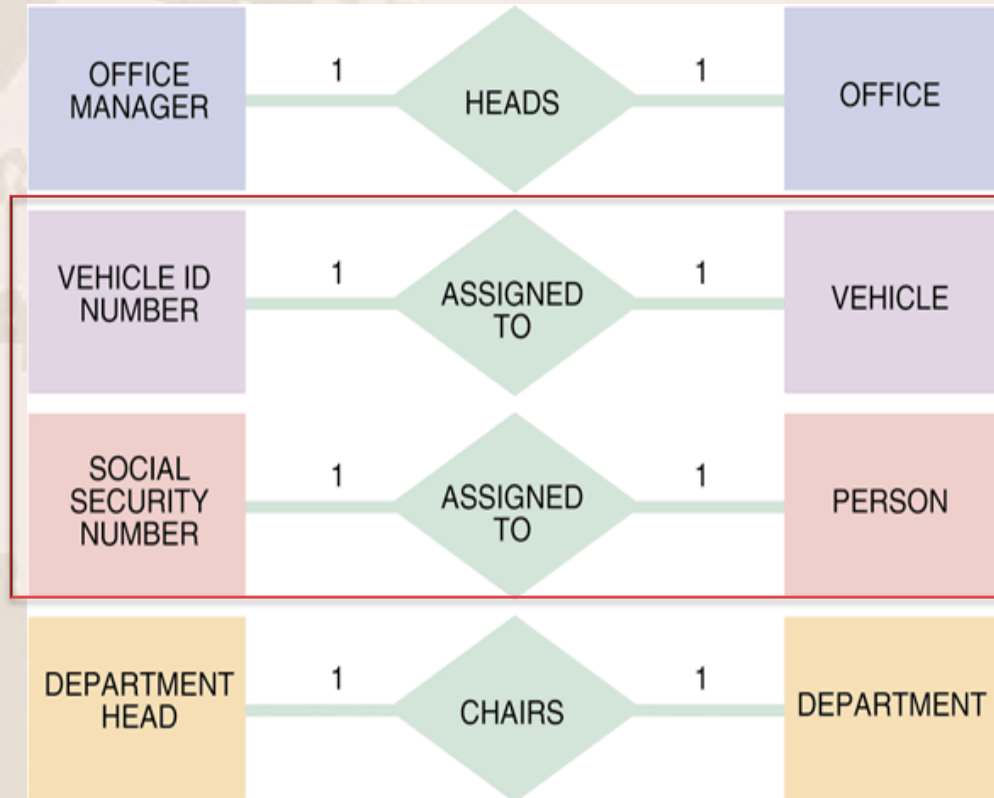Pete — TQM
Debbie — OO
Tom — CR
Heidi

A project must be assigned to at least one employee, and may be assigned to many

An employee can be assigned to any number of projects, or may not be assigned to any at all
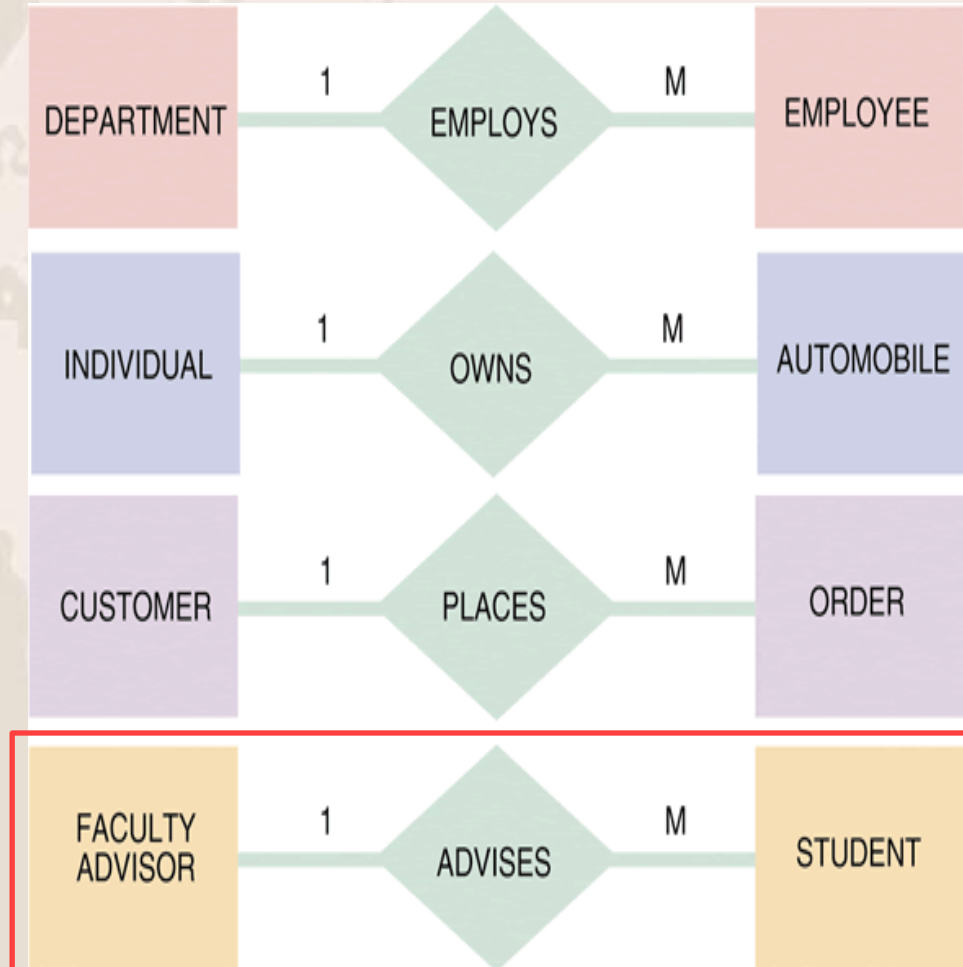
Examples

- **One-to-one relationship (1:1): One instance in an entity (parent) refers to one and only one instance in the related entity (child)**

Examples

- **One-to-many relationship (1:M): One instance in an entity (parent) refers to one or more instances in the related entity (child)**
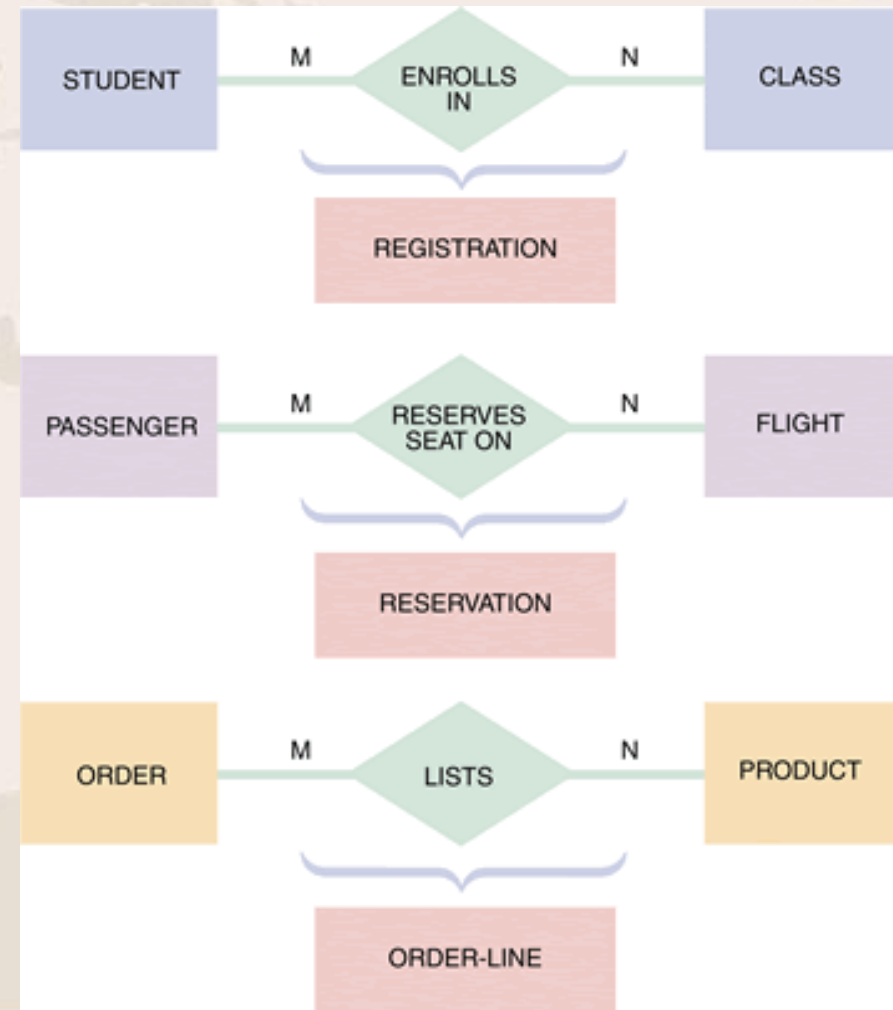
Examples

- **Many-to-many relationship (M:N): exists when one instance of the first entity (parent) can relate to many instances of the second entity (child), and one instance of the second entity can relate to many instances of the first entity.**

Examples

SYMBOL	MEANING	UML REPRESENTATION
	One and only one	1
	One or many	1..*
	Zero, or one, or many	0..*
	Zero, or one	0..1

EXAMPLES OF CARDINALITY NOTATION

CUSTOMER — PLACES — ORDER

One and only one CUSTOMER can place anywhere from zero to many of the ORDER entity.

ORDER — INCLUDES — ITEM ORDERED

One and only one ORDER can include one ITEM ORDERED or many.

EMPLOYEE — ASSIGNED TO — PROJECT

One EMPLOYEE, or many employees, or none, can be assigned to one PROJECT, or many projects, or none.
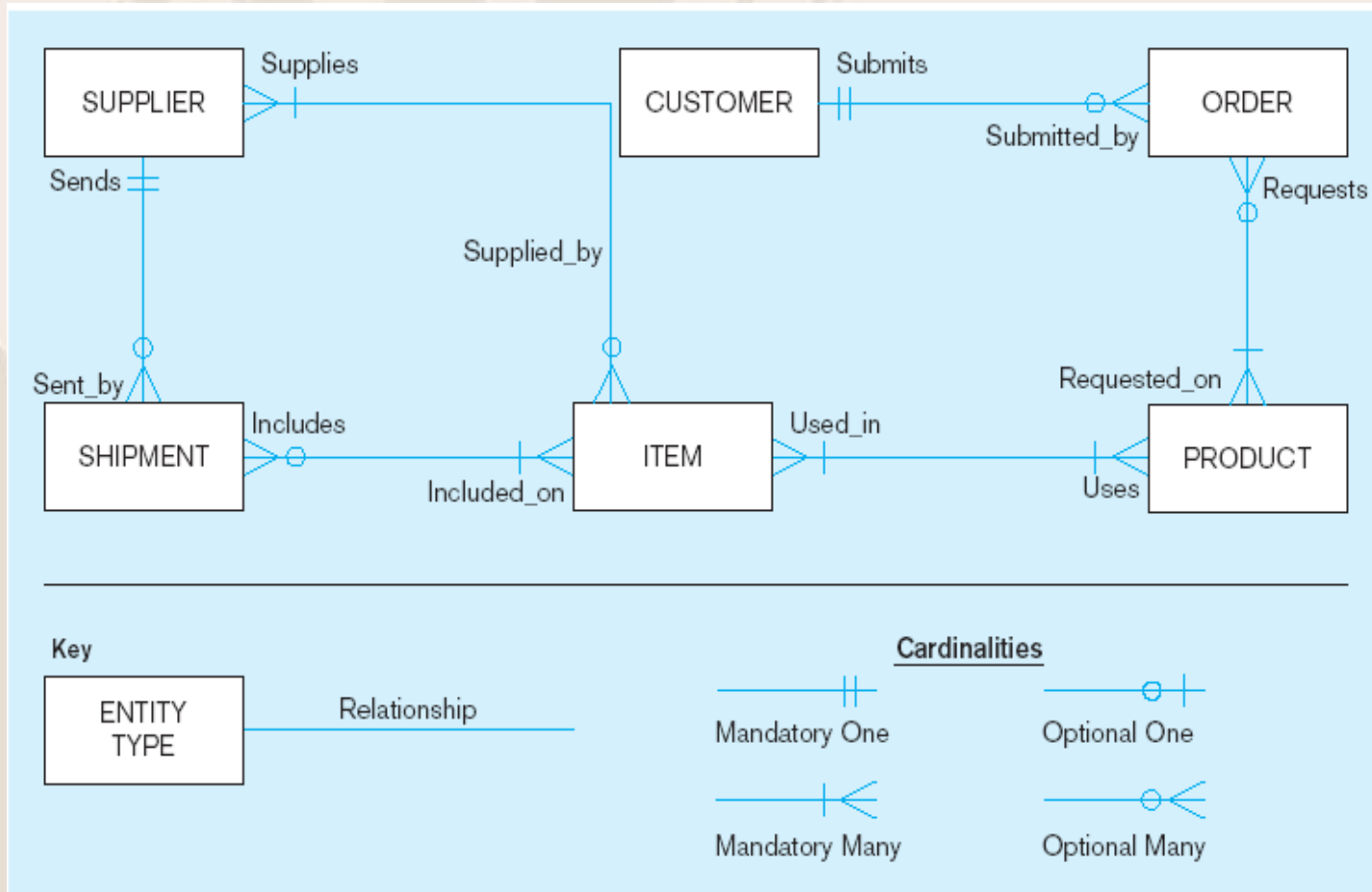
Multiple Relationships

Example

Steps to Construct ERD

- Like constructing *DFDs* and *data dictionaries*, the construction of ERDs is an iterative and evolutionary process that requires refinement as a better understanding of the system to be developed is achieved.

  1. **Identify entities** – use DFDs to identify multiple instance entities.

  2. **Add attributes** – requires detailed analysis and perhaps use of requirements gathering techniques.

  3. **Assign identifiers or Primary keys** – Each entity type must have an attribute or set of attributes that distinguishes one instance from other instances of the same type.

  4. **Foreign Keys** - The attributes of a foreign key in one entity are the attributes of a primary key in another entity.

  5. **Identify Relationships** –

ERD

- **Three Types of Relationships**

  - **One-to-one relationships (1:1)**

    - Each store is managed by a single employee and each store manager (employee) only manages a single store.

      - EMPLOYEE (1) manages STORE (1)

  - **One-to-many relationships (1:M)**

    - A painter paints many different paintings, but each one of them is painted by only that painter.

      - PAINTER (1) paints PAINTING (M)

  - **Many-to-many relationships (M:N)**

    - An employee might learn many job skills, and each job skill might be learned by many employees.

      - EMPLOYEE (M) learns SKILL (N)

Entity Relationship Diagrams for Data Modelling

- **Implement One-to-One Relationships**

  – In a relational database, *one-to-one relationships* between entities can be implemented by merging the two tables/entities together.

- **Implement One-to-Many Relationships**

  – Place the *primary key* of the entity that can occur only once as a *foreign key* in the entity that can occur many times.

- **Implement Many-to-Many Relationships**

  – In a relational database, *many-to-many relationships* between entities can be implemented by creating a new entity that links the other two entities together. In most cases, the primary key of the new entity consists of the primary keys of the entities that it is relating together.

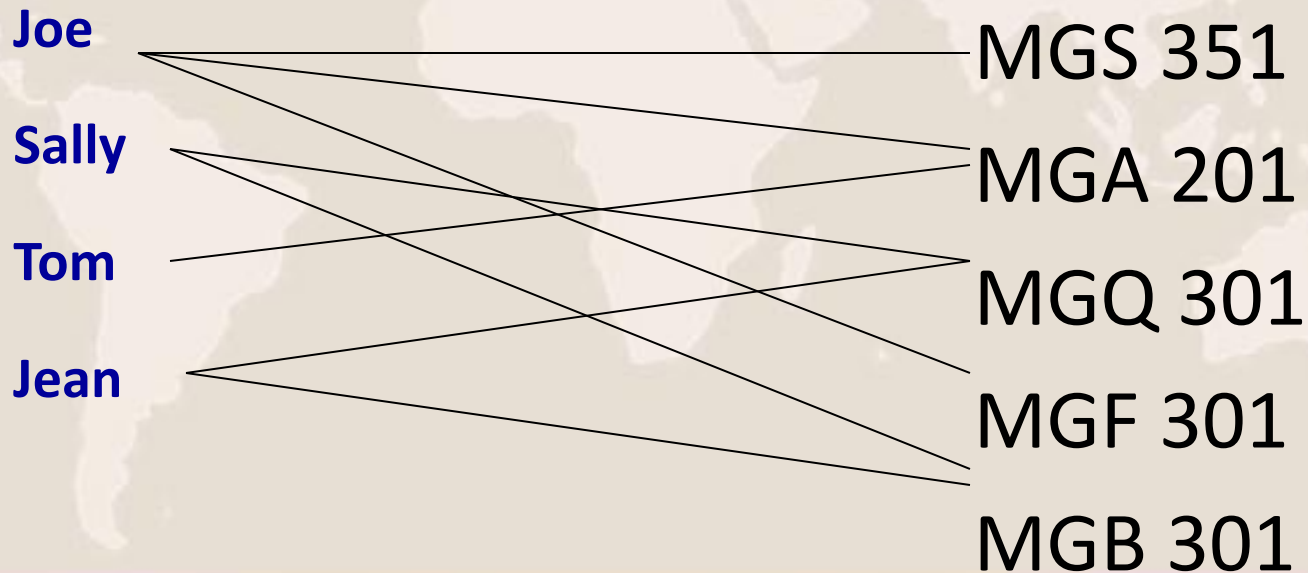 – Spit it into two one-to-many relationships!

Transforming ERD to Tables – N:M Detailed Steps

1. **Add intersection table**

2. **Flip relationship lines around so "many" side faces the intersection table**

3. **Add primary keys from original tables as fields in the intersection table**

4. **Assign a name the intersection table**

5. **Add other relevant fields to intersection table if necessary**

Many-to-Many Relationship (N:M)

Student — N — Enrolls — M — Course

Joe
Sally
Tom
Jean

MGS 351
MGA 201
MGQ 301
MGF 301
MGB 301

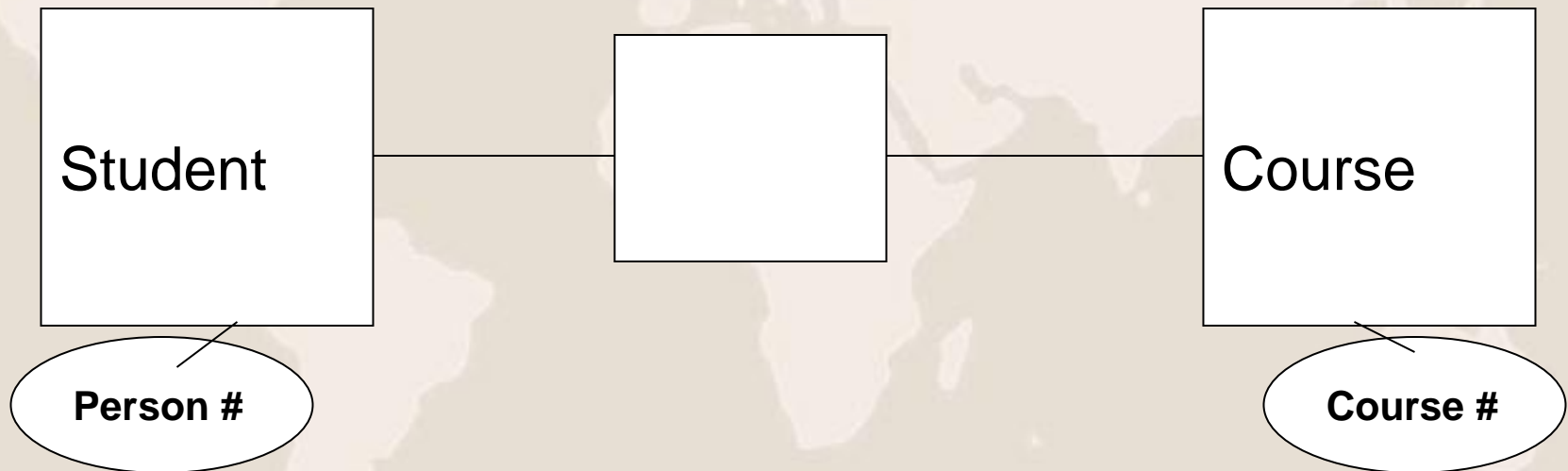## Transforming ERD to Tables – N:M (Before)

- **M:N - Add intersection table which includes primary keys from both tables**
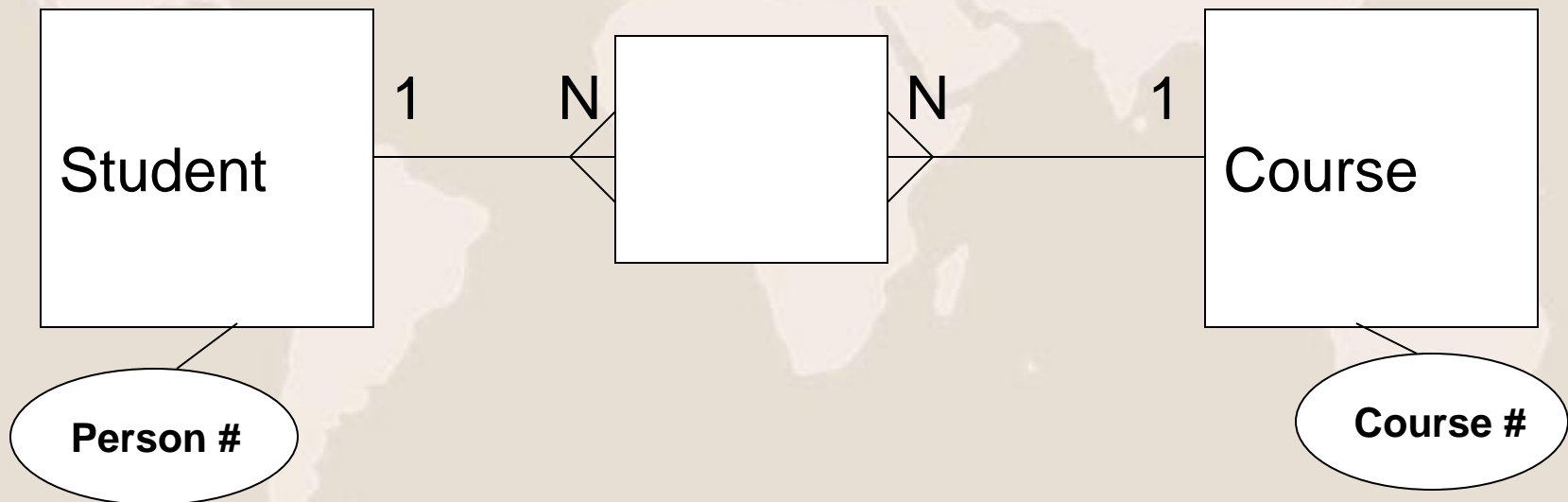
Transforming ERD to Tables – N:M (After)

- **Add intersection table**

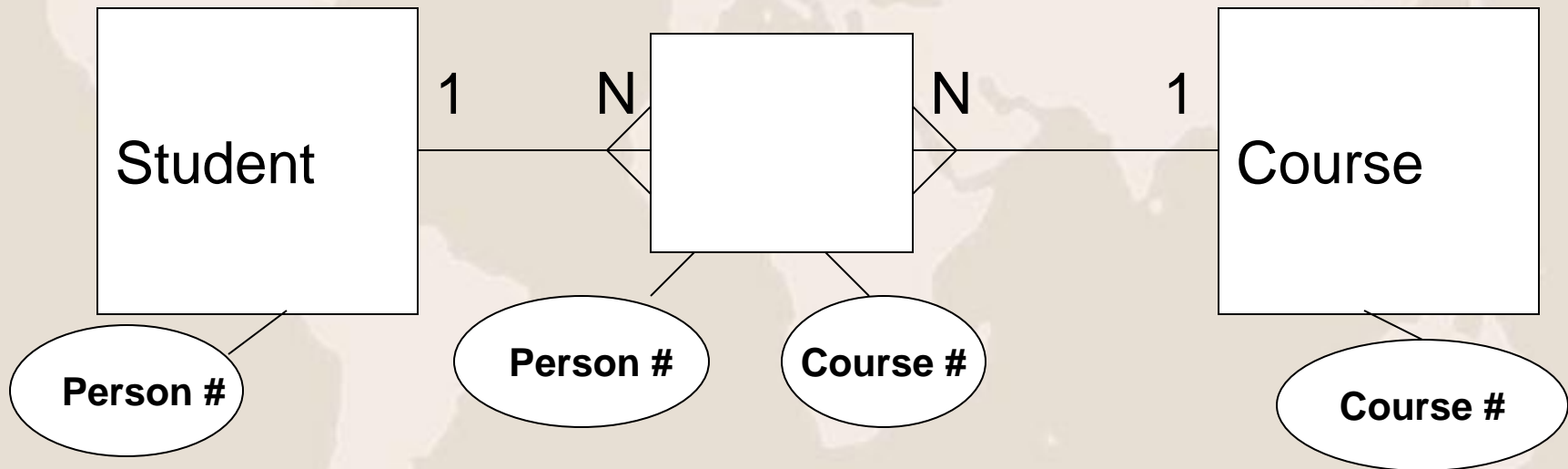## Transforming ERD to Tables – N:M (After)

- **Flip relationship lines around so "many" side faces the intersection table**

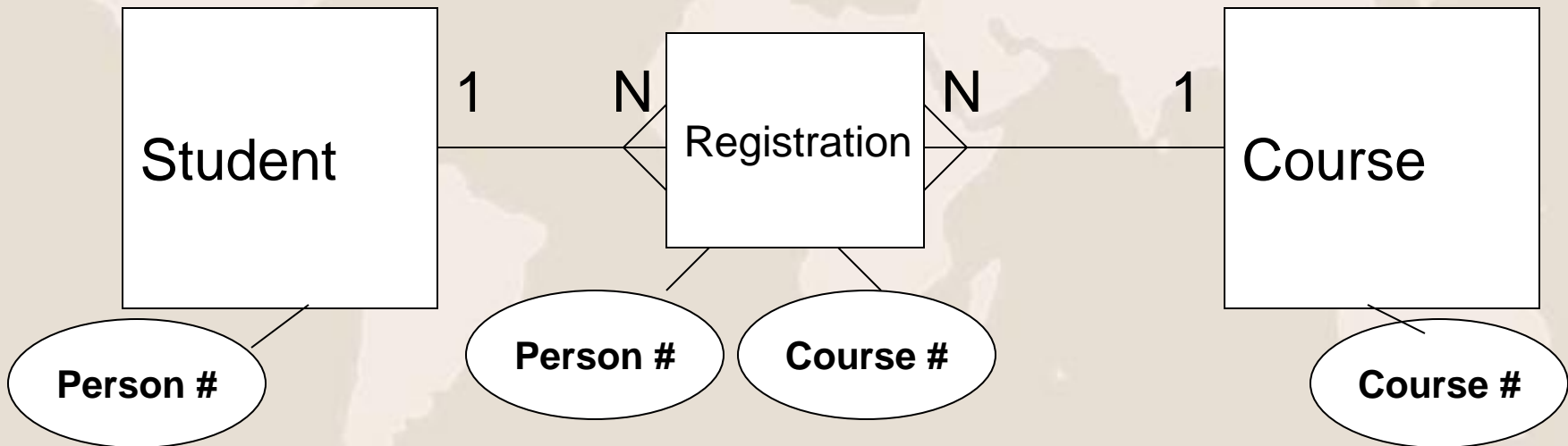## Transforming ERD to Tables – N:M (After)

- **Add primary keys from original tables as foreign key fields in the intersection table**

Transforming ERD to Tables – N:M (After)

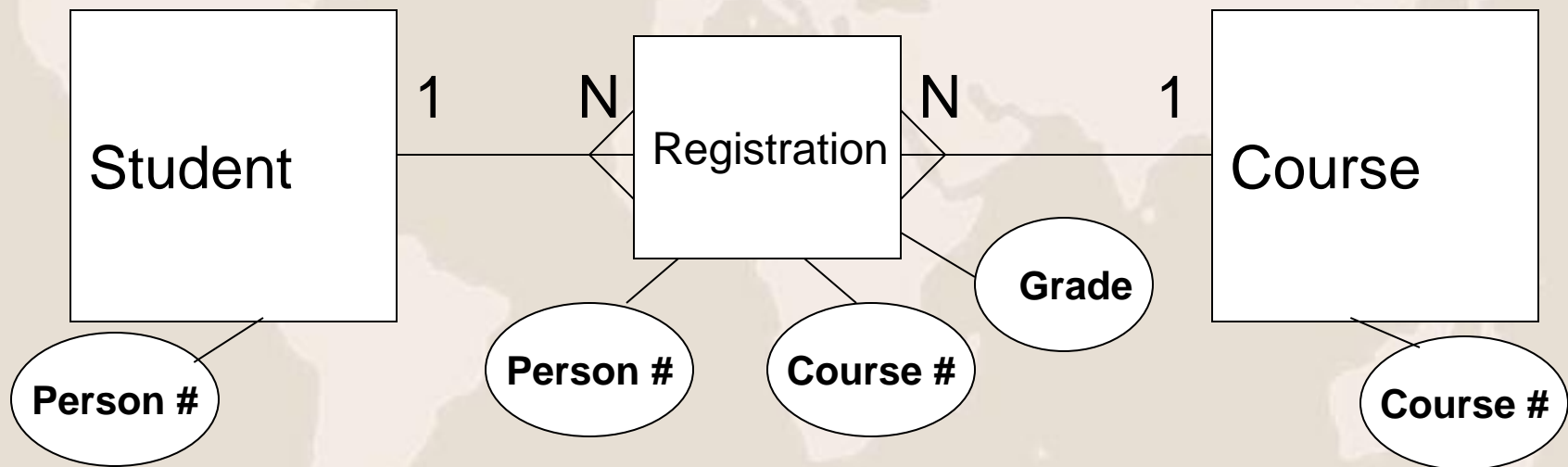- **Assign a name the intersection table**
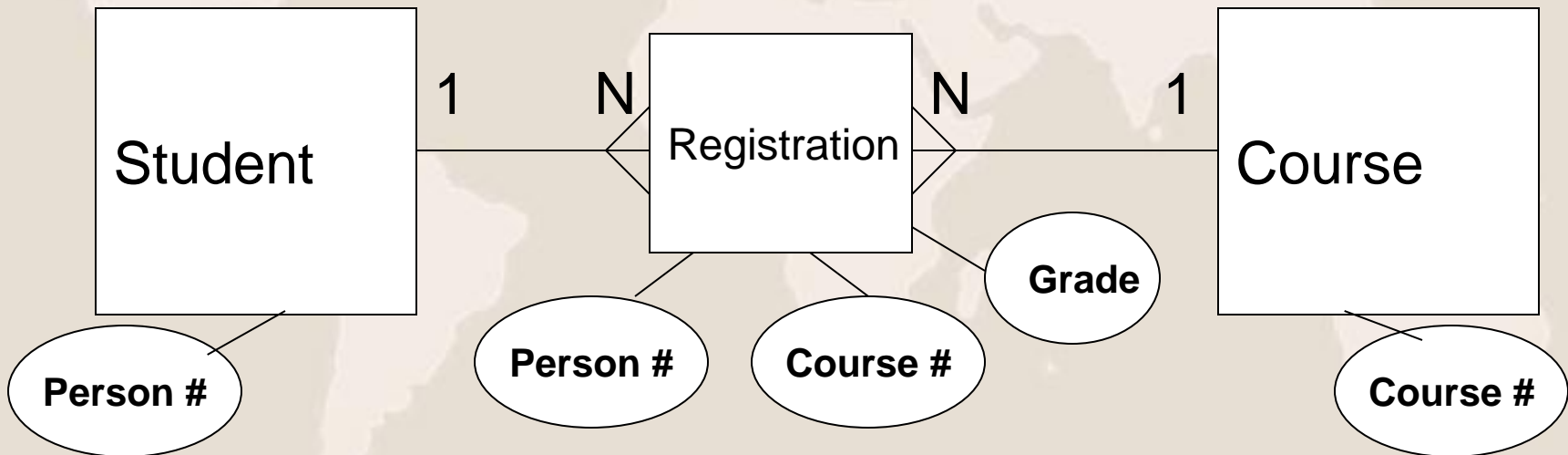
Transforming ERD to Tables – N:M (After)

- **Add other relevant fields to intersection table if necessary**

What should be used as Primary Key in the intersection table?

Composite Primary Key or Auto-number

Steps to Construct ERD

- **Important guidelines when creating ERDs:**

    – **Use consistent labels and names**

    – **Avoid unnecessary attributes**

    – **Determine cardinality correctly**

DFDs and ERDs

- **DFDs and ERDs are both used to model systems, but they show two very different perspectives on the system.**

    - **Entities on an ERD often correspond to data stores on a DFD**

    - **Attributes on an ERD usually correspond to data elements (listed in the data dictionary) that make up the data store and data flows on a DFD**

    - **Relationships on an ERD do not correspond to processes on a DFD.**

References

System Analysis and Design, Sixth Edition.
   Authors: Gary B. Shelly, Thomas J. Cashman and Harry J. Rosenblatt
   Publisher: SHELLY CASHMAN SEWIES.

امام علی علیه السلام :

وصول المرء الی کل ما یبتغیه من طیب عیشه و امن سربه و سعة رزقه، بحسن نیته و سعة خلقه

انسان، با نیّت خوب و اخلاق خوب، به تمام آنچه در جستجوی آن است، از زندگی خوش و امنیت محیط و روزی زیاد، دست می یابد.

غررالحکم، ح 10141

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