Politecnico di Torino

Examples of time representation in the ER scheme

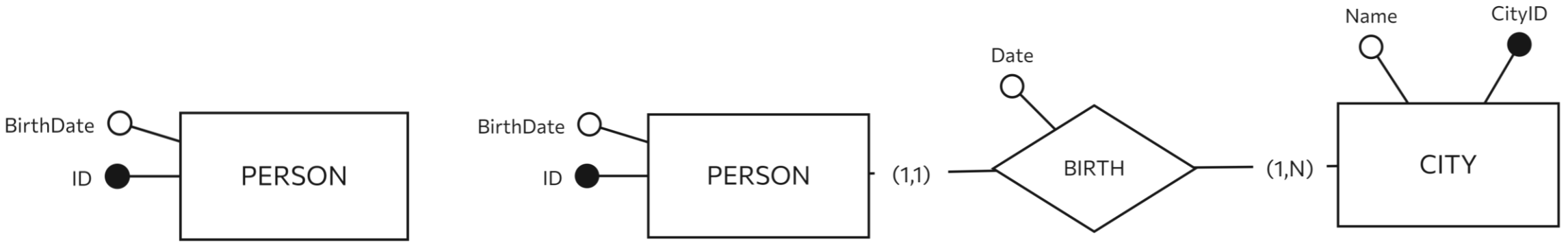
Database design

Time in E-R models

- Time is needed to represent:
  - Events
  - Temporal changes in values and/or relationships
- Time can be modelled using:
  - Temporal attributes
  - Binary relationships
  - Ternary relationships
  - Entity historicization

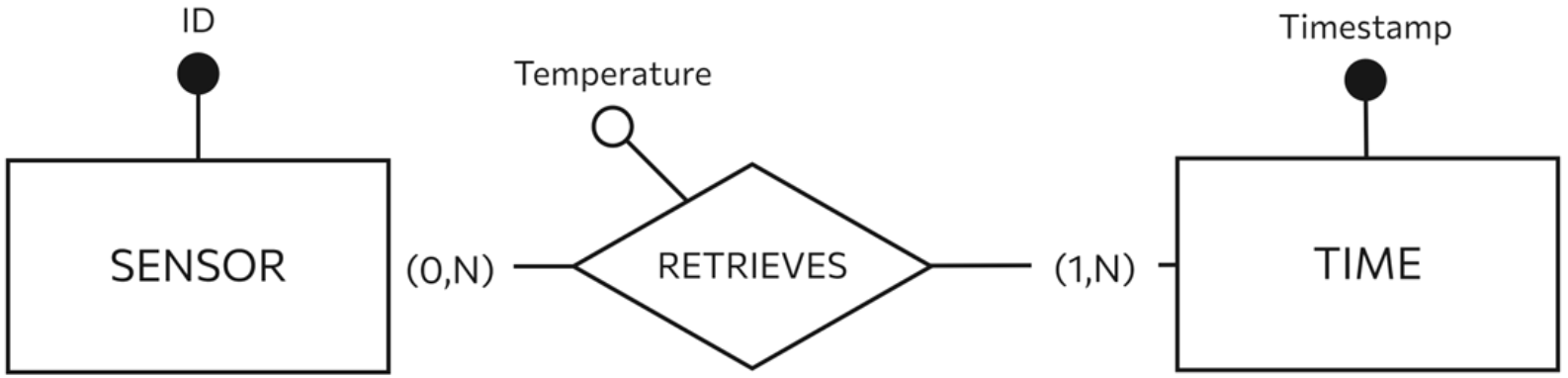
Temporal attributes

- Temporal information related to a single entity or relationship
- Unique events for each entity instance
  - Example: birth date, film release date



Binary relationship

- Example: A set of sensors are available, each identified by a unique code and present within a building.
  - It is requested store the different temperature values detected by each sensor at different time points.



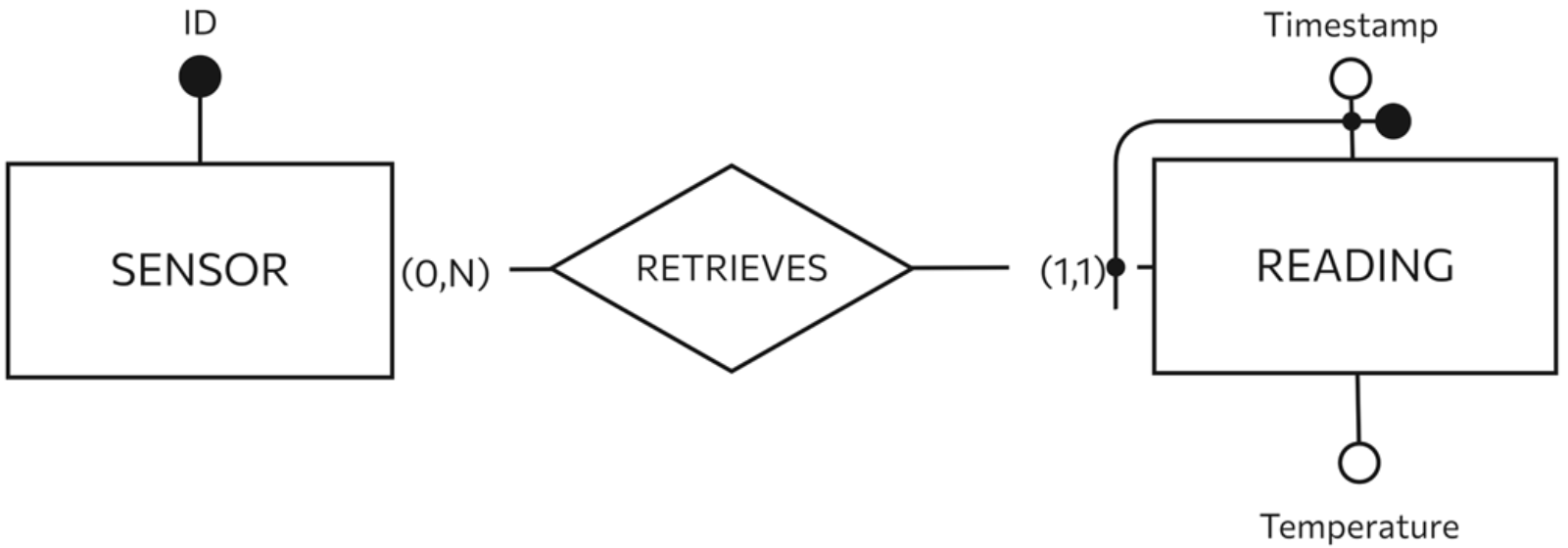
Binary relationship

- We want to represent a time series of events related to an Entity E of the ER diagram
- The information of interest is represented by introducing
  - a ***Time*** entity
    - identified by time information about ***when*** the event occurs/starts (e.g. timestamp, date, date and time)
  - a **binary relationship *R*** that connects the ***Time*** entity to the ***E*** entity
    - The (if any) information on the duration and/or time of the end of the event and/or on other aspects that characterize the occurrence of the event at different time points are attributes of the relationship ***R***

Workaround: Weak Entity

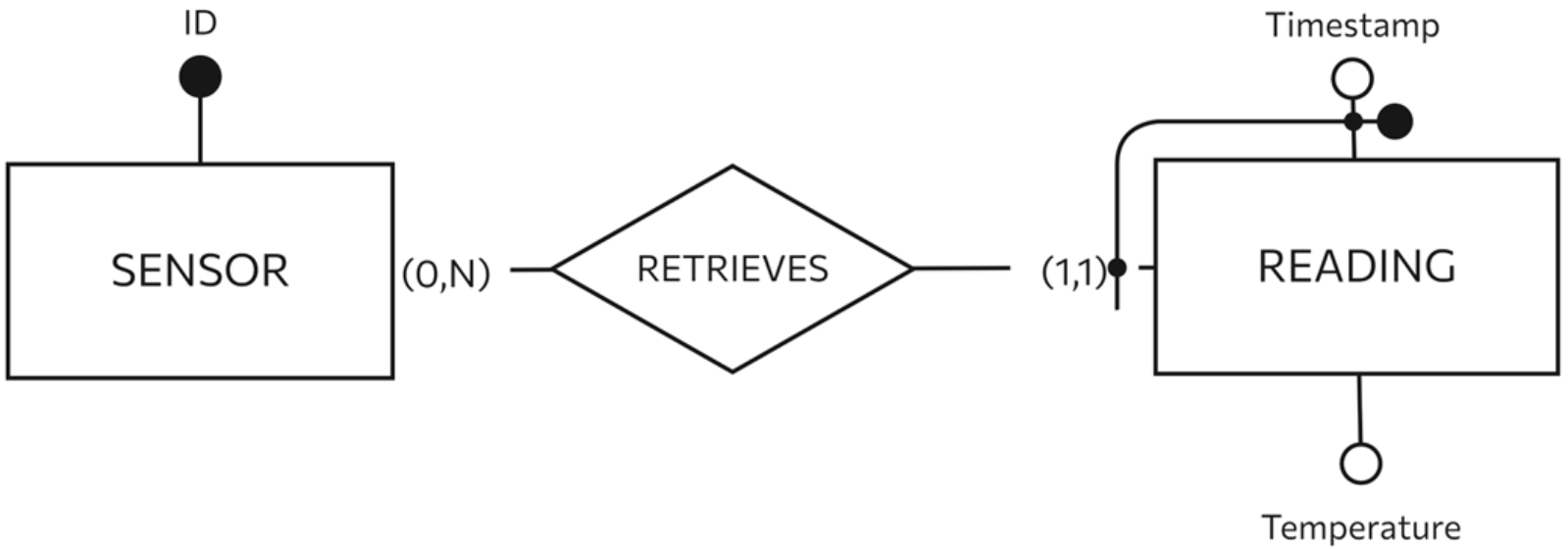
Example: A set of sensors are available, each identified by a unique code and present within a building.

- It is requested store the different temperature values detected by each sensor at different time points.



Workaround: Weak Entity

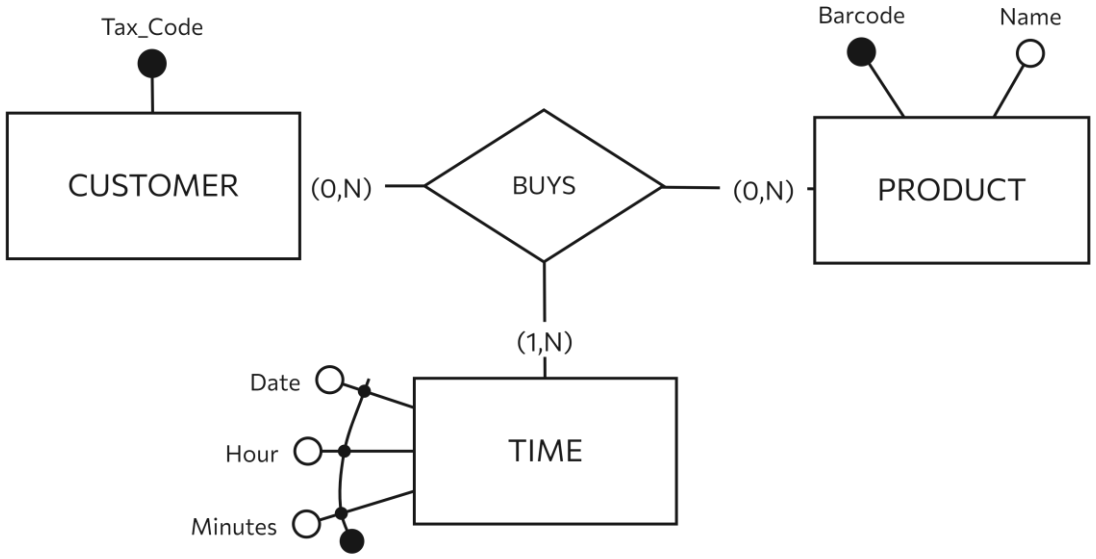
- The Event Entity **E**
  - is a weak entity identified internally by the set of attributes that represent the instant in which the event itself begins/occurs
  - the characteristics of the event are attributed directly to the weak entity **E**



Ternary relationship

Example: It is requested to store the product purchases made by each customer.

- Each customer is uniquely identified by their tax code.
- Each product is uniquely identified by the barcode and characterized by the name.
- Suppose each customer can buy the same product at different times of the same day.



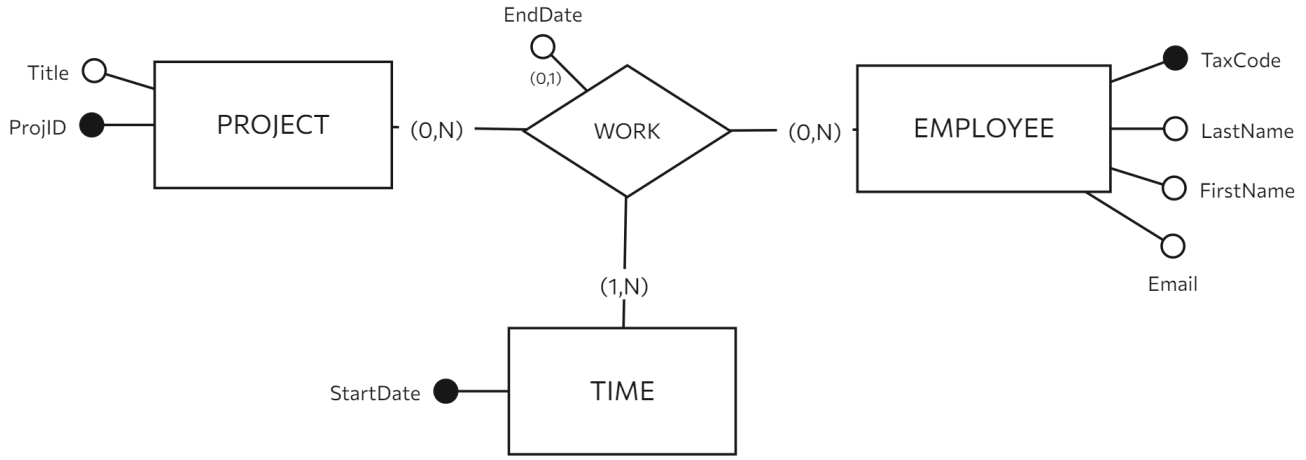
Ternary relationship

- We want to represent a time series of events expressed through an association/relationship between two Entities ***E1*** and ***E2*** of the ER diagram
- The information of interest is represented by introducing
  - a ***Time*** entity
    - identified by time information about ***when*** the event occurs/starts (e.g. timestamp, date, date and time)
  - a ***ternary relationship R*** that connects the ***Time*** entity, the ***E1*** entity, and the ***E2*** entity
    - The (if any) information on the duration and/or time of the end of the event and/or on other aspects that characterize the occurrence of the event at different time points are attributes of the relationship ***R***

Ternary Relationship

Example: A company that provides IT consulting wants to store the work done by its employees for each project.

- Each project is identified by an alphanumeric code and characterized by a title.
- Employees who work at the company are identified by their tax code and characterized by their first and last name and email.
- It is requested to store the time periods (start date, end date) in which an employee works on a project. Multiple employees can work at the same time on the same project.



Historicized Entity

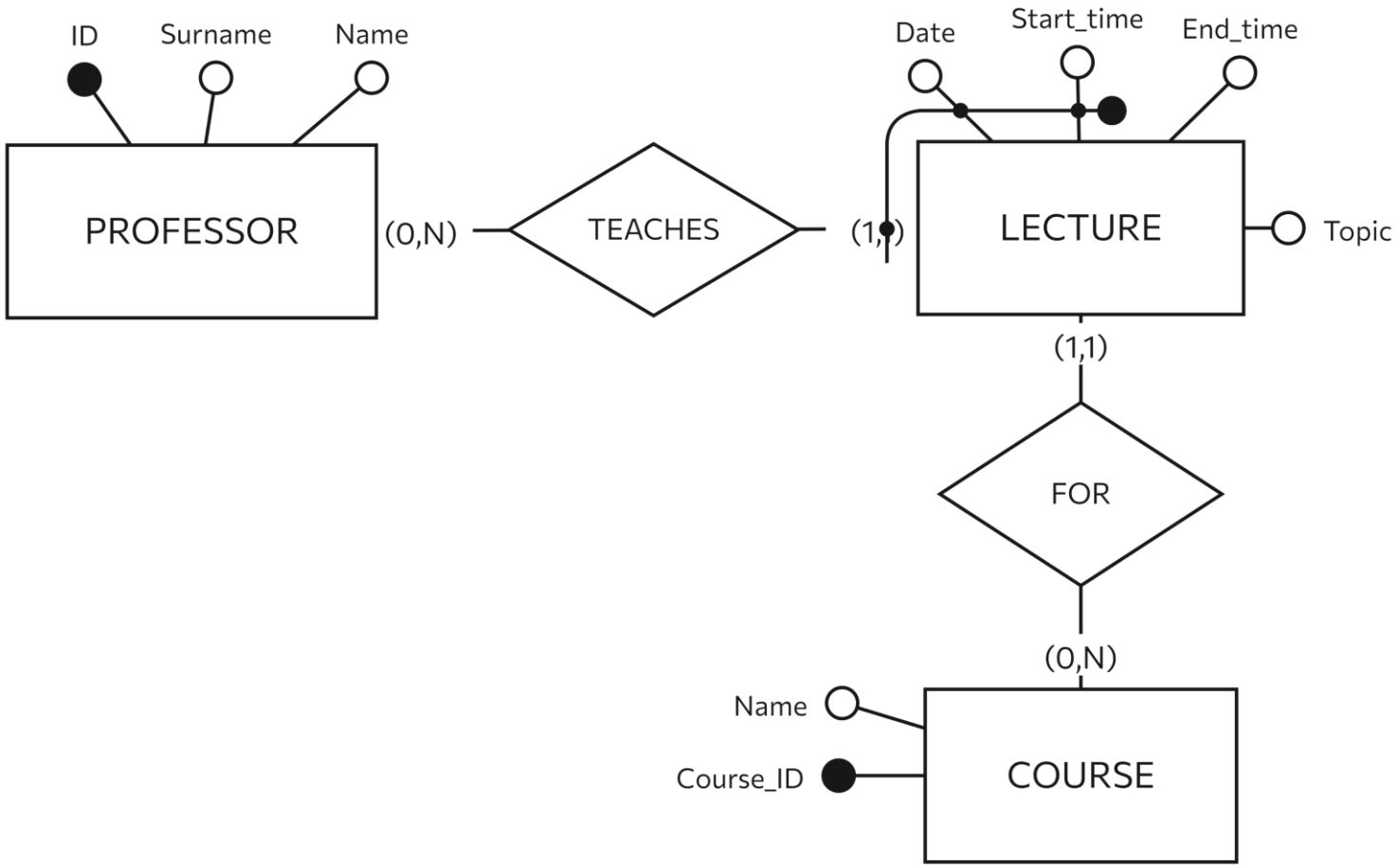
Example: It is requested to store the lectures given by each teacher for each course.

- Each teacher is uniquely identified by a numeric ID and is characterized by surname and first name.
- Each course is identified by an alphanumeric code and characterized by its name.
- Each lesson is characterized by the date and time slot (start time and end time) in which it is held and by the course for which the lesson is delivered. Suppose that each teacher can deliver a maximum of one lecture in the same time slot.

Historicized entity

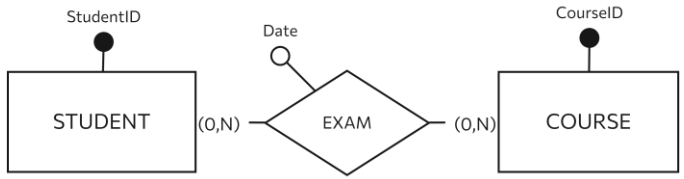
- You want to represent
  - An event that involves two entities
  - There are constraints on an entity's participation in multiple events
- The information of interest is represented by introducing
  - a weak entity **E** identified internally by the time information about **when** the event occurs/starts (e.g. timestamp, date, date and time) and externally by the relationship linked to the entity that **cannot** participate in two events at the same time
  - the characteristics of the event are attributed directly to the weak entity **E**
  - entity **E** participates with cardinality (1,1) in relationships with other entities

Historicized entity



Recap

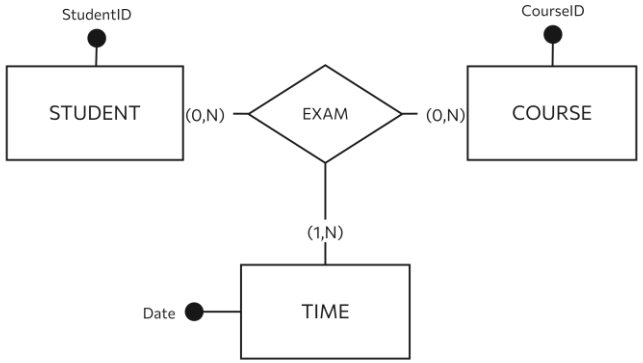
Binary



A student can take the exam for each course only once.

Translation:
STUDENT(<u>StudentID</u>)
COURSE(<u>CourseID</u>)
Exam(<u>StudentID</u>, <u>CourseID</u>, Date)

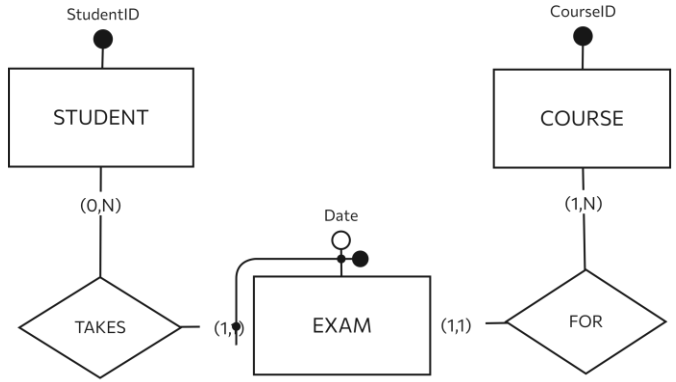
Ternary



A student can take the exam for each course multiple times on different dates.

Translation:
STUDENT(<u>StudentID</u>)
COURSE(<u>CourseID</u>)
~~TIME(<u>Date</u>)~~ Can be omitted
Exam(<u>StudentID</u>, <u>CourseID</u>, <u>Date</u>)

Historicized



A student can take the exam for each course multiple times. A student can only take one exam on a given date.

Translation:
STUDENT(<u>StudentID</u>)
COURSE(<u>CourseID</u>)
Exam(<u>StudentID</u>, <u>Date</u>, CourseID)