

2 - Conceptual data modelling

Data Management

Michele Mastroianni

Michele.mastroianni@unicampania.it

mmastroianni@unisa.it

The Conceptual Data Model

A conceptual data model is a model of the things in the real world (**Entities**) and the **relationships** among them, rather than a model of the data about those things.

In a conceptual data model, when you see an entity type called ***car***, then you should think about pieces of metal with engines, not records in databases.

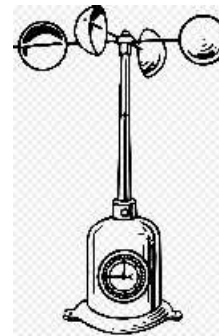
Entities usually have **attributes**. In the case of ***car***, the attributes could be Producer, Model, Engine, ...

Example: using sensor data to monitor and forecast air pollution

- Air Pollution sensors
- Collect numerical values about CO₂, NH₃, Fine dust....
- Weather Stations
- Collect numerical values about Temperature, Air Pressure, Wind speed and direction....

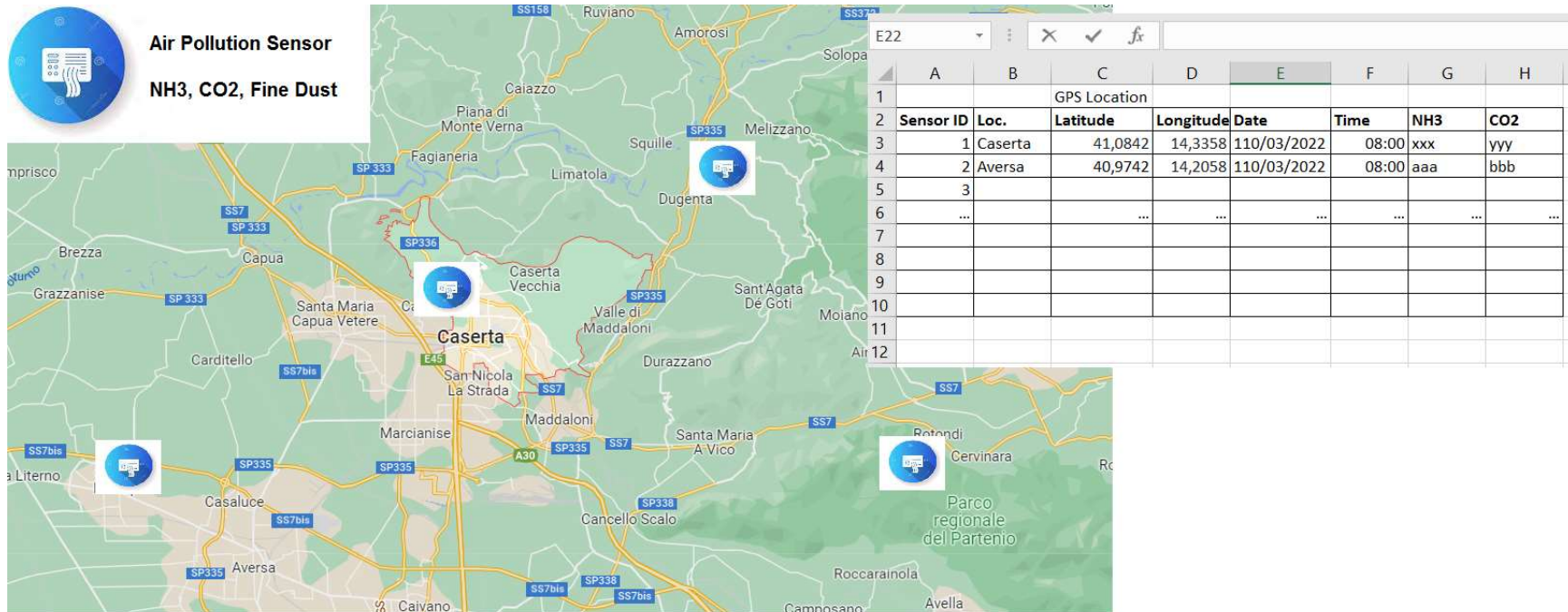


Air Pollution Sensor
NH₃, CO₂, Fine Dust

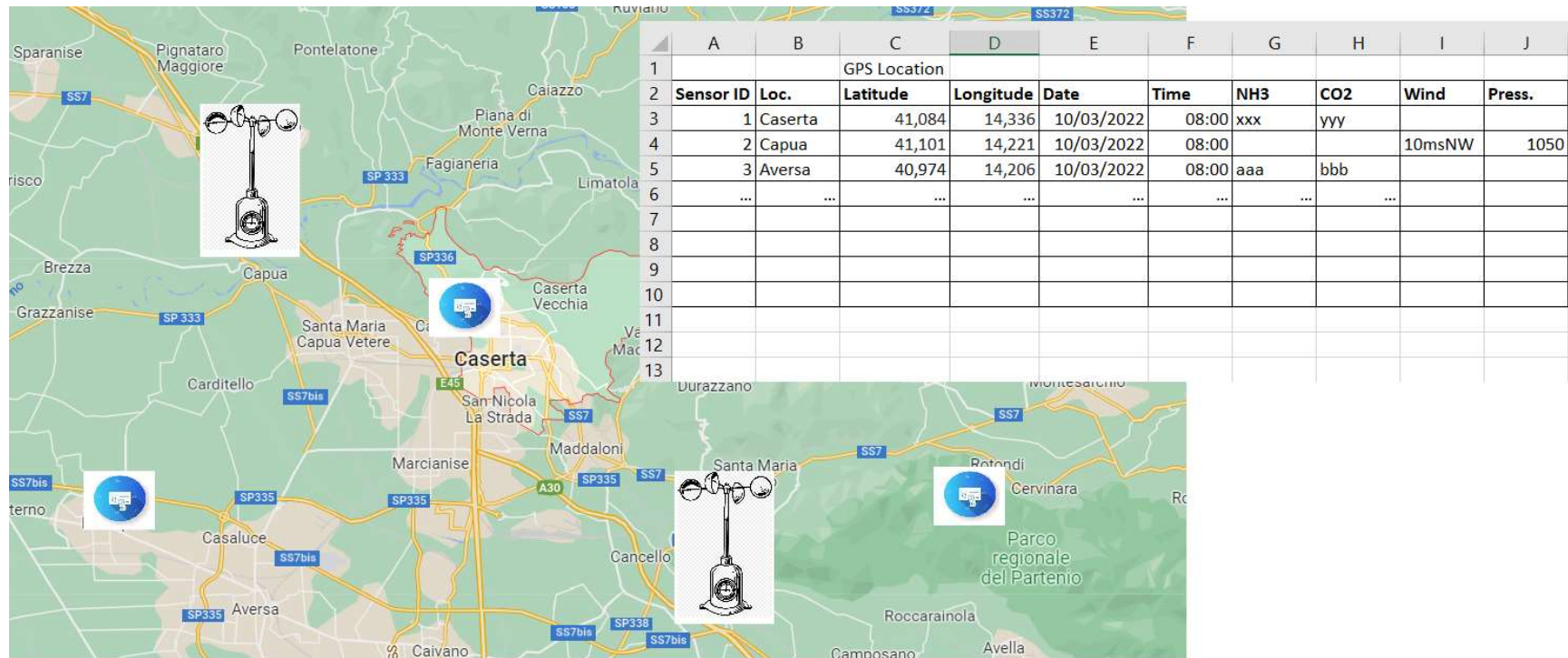


Weather Station
Temp, Press., Wind

Retreiving data from AP sensors



AP and weather stations in different locations



The shape of data between AP and WS is similar (Table) but the meaning is different

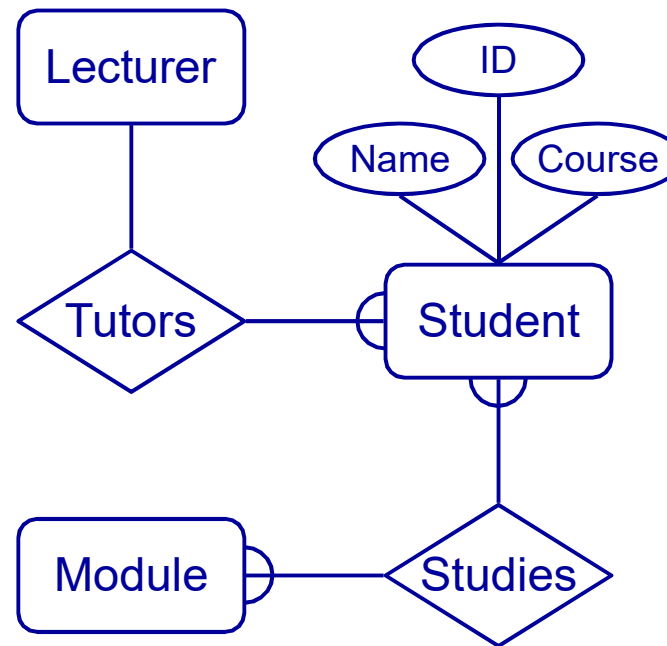
- What are the sources of data?
 - AP Sensors, Weather Stations
 - What are their meaning?
 - Some AP data in some points
 - Some weather data in (different) points
 - What are the relationship between them?
 - How we think to use Sensors and W. Stations data?
 - In which way the Sensors data in a point is related to WS in other points?
 - In which way the AP values in a «third» point is related to APS and WS?
 - Using a Conceptual Data Model to take into account those issues
-

Entity/Relationship Modelling

- E/R Modelling is used for conceptual design
 - Entities - objects or items of interest
 - Attributes - facts about, or properties of, an entity
 - Relationships - links between entities
- Example
 - In a University database we might have entities for Students, Modules and Lecturers. Students might have attributes such as their ID, Name, and Course, and could have relationships with Modules (enrolment) and Lecturers (tutor/tutee)

Entity/Relationship Diagrams

- E/R Models are often represented as E/R diagrams that
 - Give a conceptual view of the database
 - Are independent of the choice of DBMS
 - Can identify some problems in a design

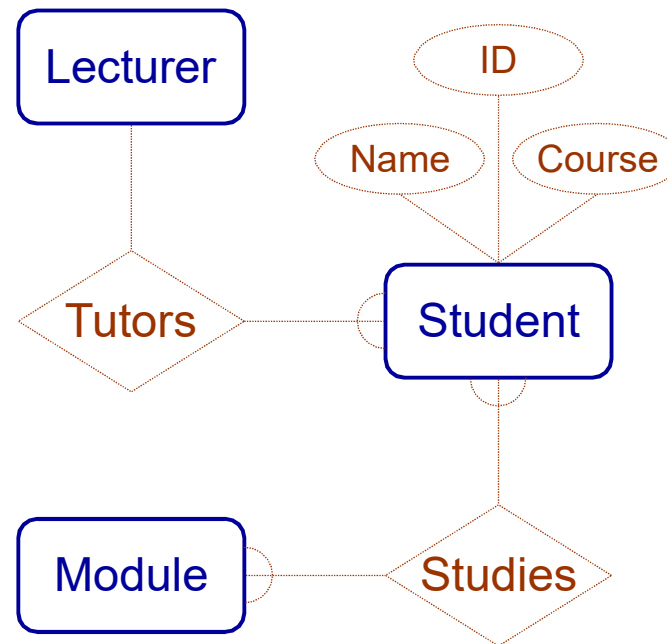


Entities

- Entities represent objects or things of interest
 - Physical things like students, lecturers, employees, products
 - More abstract things like modules, orders, courses, projects
- Entities have
 - A general type or class, such as Lecturer or Module
 - Instances of that particular type, such as Steve Mills, Natasha Alechina are instances of Lecturer
 - Attributes (such as name, email address)

Diagramming Entities

- In an E/R Diagram, an entity is usually drawn as a box with rounded corners
- The box is labelled with the name of the class of objects represented by that entity

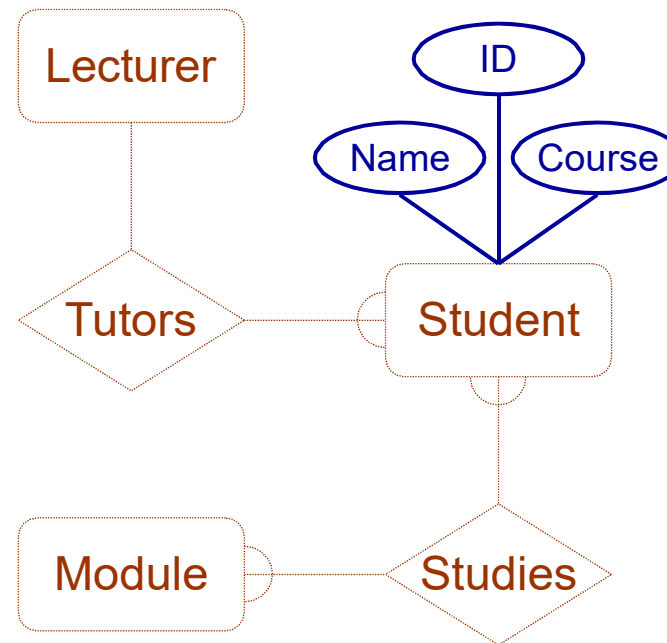


Attributes

- Attributes are facts, aspects, properties, or details about an entity
 - Students have IDs, names, courses, addresses, ...
 - Modules have codes, titles, credit weights, levels, ...
- Attributes have
 - A name
 - An associated entity
 - Domains of possible values
 - Values from the domain for each instance of the entity they are belong to

Diagramming Attributes

- In an E/R Diagram attributes may be drawn as ovals
- Each attribute is linked to its entity by a line
- The name of the attribute is written in the oval



Relationships

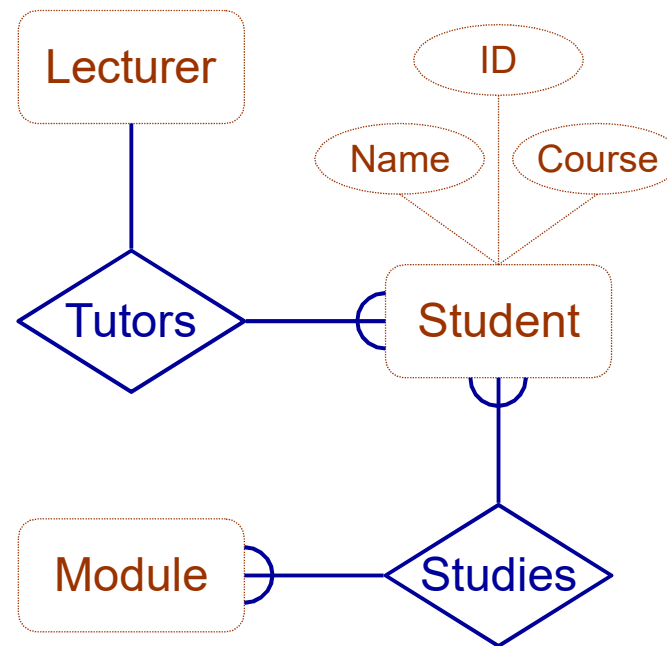
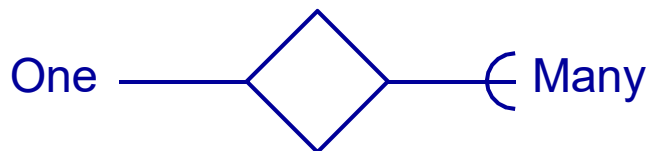
- Relationships are an association between two or more entities
 - Each Student takes several Modules
 - Each Module is taught by a Lecturer
 - Each Employee works for a single Department
- Relationships have
 - A name
 - A set of entities that participate in them
 - A degree - the number of entities that participate (most have degree 2)
 - A cardinality ratio

Cardinality Ratios

- Each entity in a relationship can participate in zero, one, or more than one instances of that relationship
- This leads to 3 types of relationship...
- One to one (1:1)
 - Each lecturer has a unique office
- One to many (1:M)
 - A lecturer may tutor many students, but each student has just one tutor
- Many to many (M:M)
 - Each student takes several modules, and each module is taken by several students

Diagramming Relationships

- Relationships are links between two entities
- The name is given in a diamond box
- The ends of the link show cardinality



Making E/R Models

- To make an E/R model you need to identify
 - Entities
 - Attributes
 - Relationships
 - Cardinality ratios
- from a description
- General guidelines
 - Since entities are things or objects they are often nouns in the description
 - Attributes are facts or properties, and so are often nouns also
 - Verbs often describe relationships between entities

Example

- A university consists of a number of departments. Each department offers several courses. A number of modules make up each course. Students enroll in a particular course and take modules towards the completion of that course. Each module is taught by a lecturer from the appropriate department, and each lecturer tutors a group of students

Example - Entities

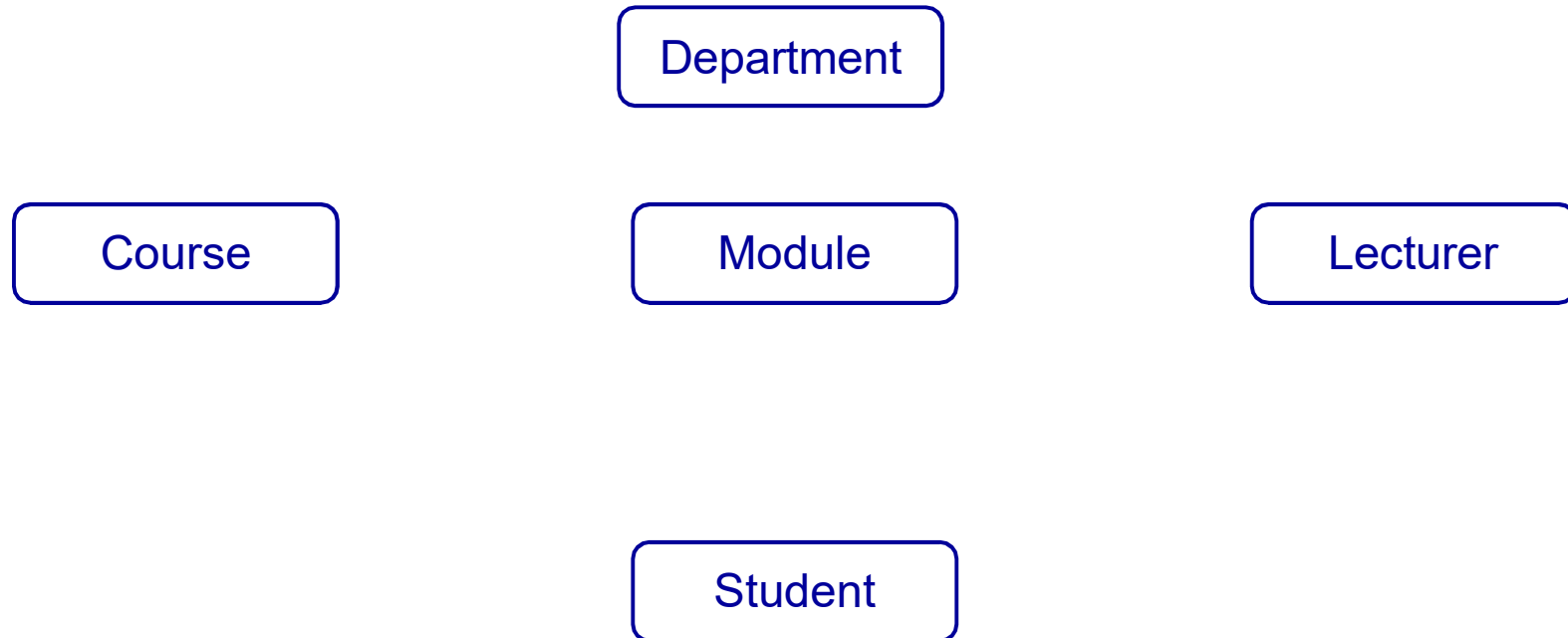
A university consists of a number of **departments**. Each department offers several **courses**. A number of **modules** make up each course. **Students** enroll in a particular course and take modules towards the completion of that course. Each module is taught by a **lecturer** from the appropriate department, and each lecturer tutors a group of students

Example - Relationships

- A university consists of a number of departments. Each department **offers** several courses. A number of modules **make up** each course. Students **enroll in** a particular course and **take** modules towards the completion of that course. Each module is **taught by** a lecturer **from the** appropriate department, and each lecturer **tutors** a group of students

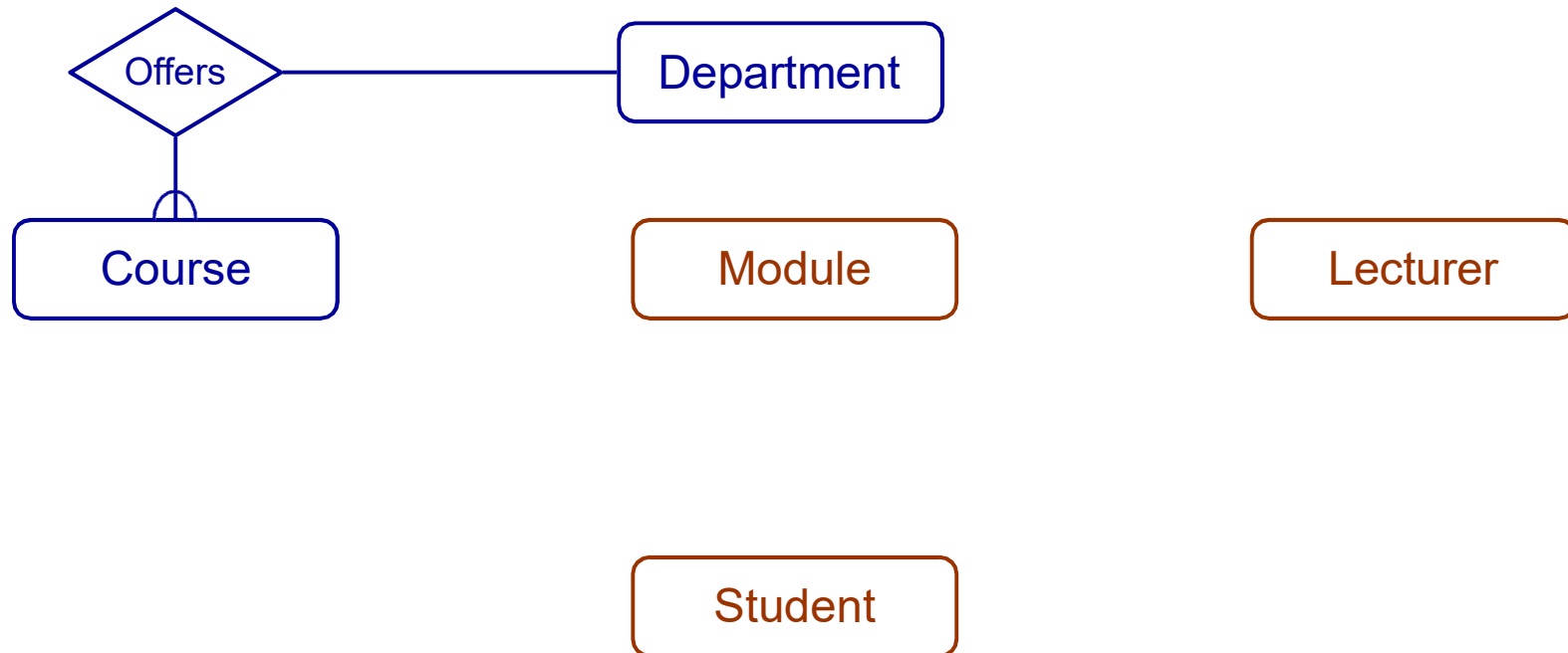
Example - E/R Diagram

Entities: Department, Course, Module, Lecturer, Student



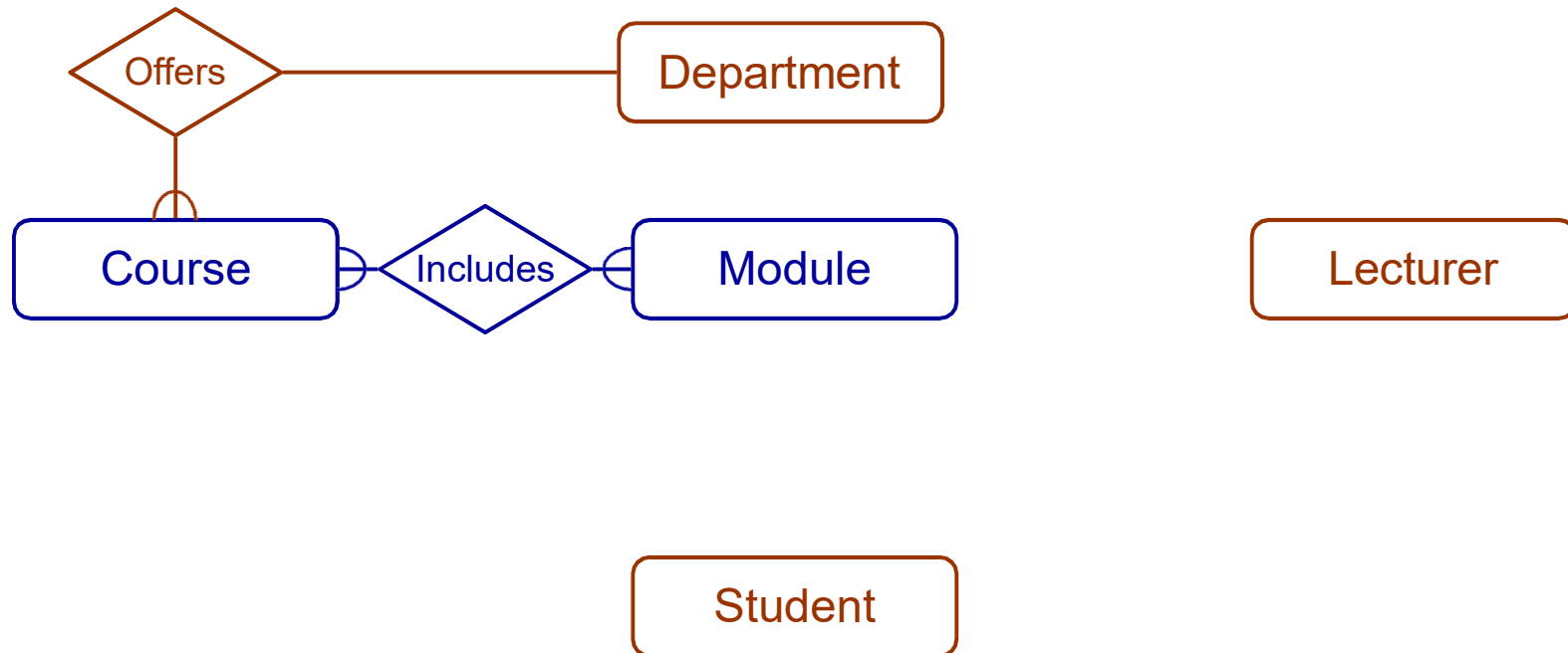
Example - E/R Diagram

Each department offers several courses



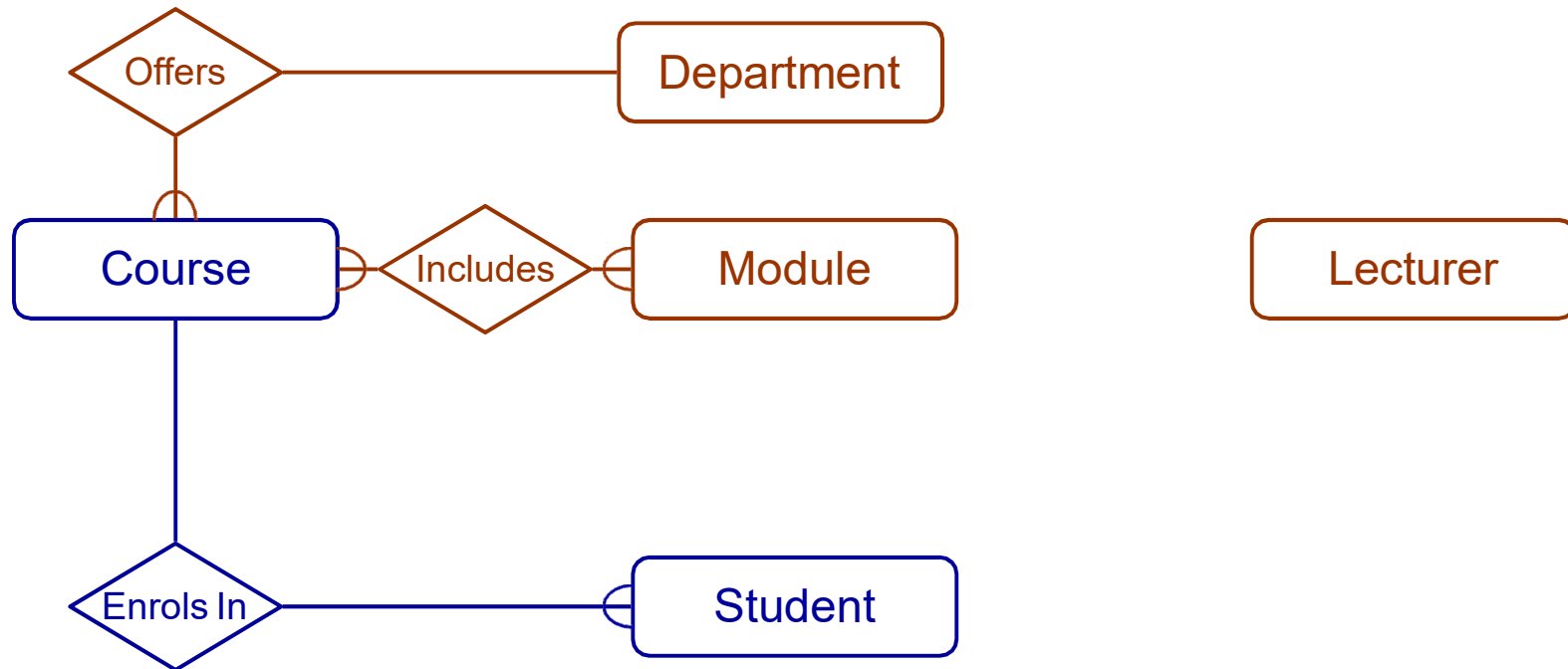
Example - E/R Diagram

A number of modules **make up** each courses



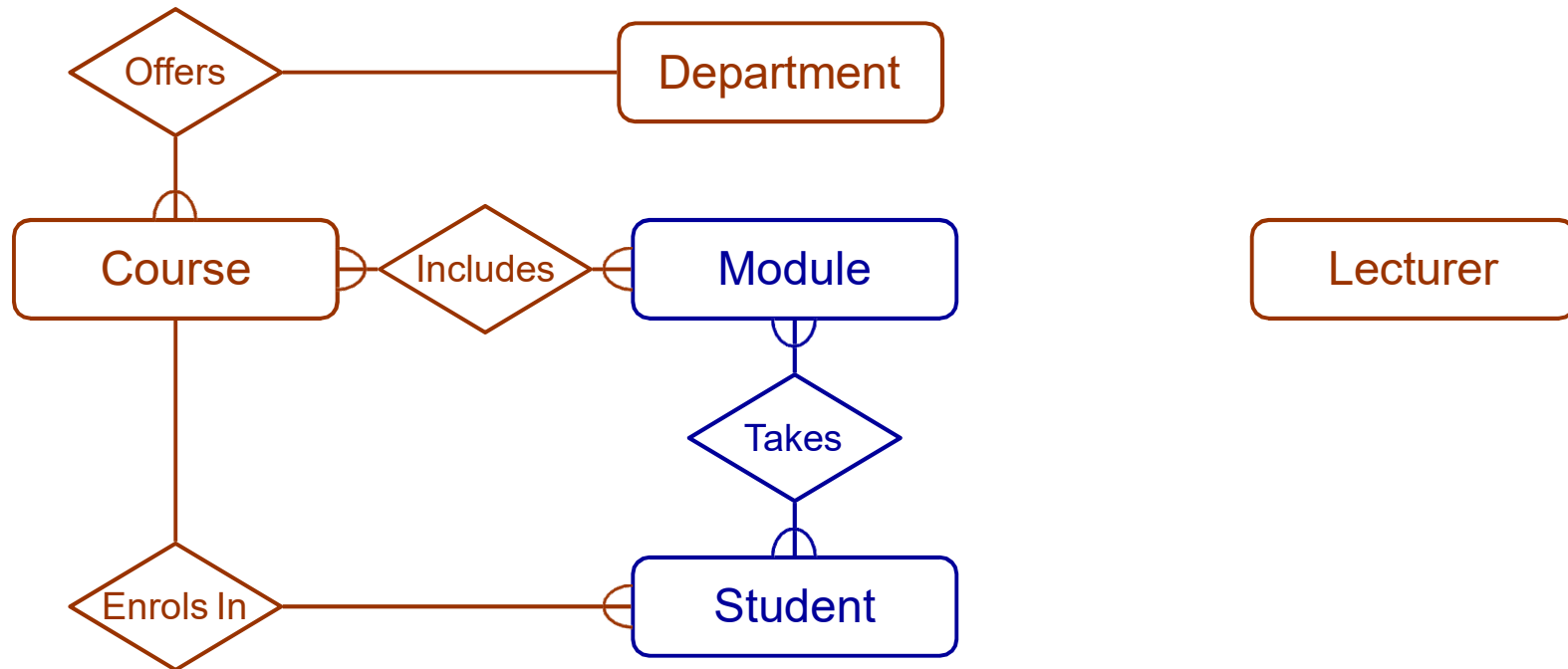
Example - E/R Diagram

Students enrol in a particular course



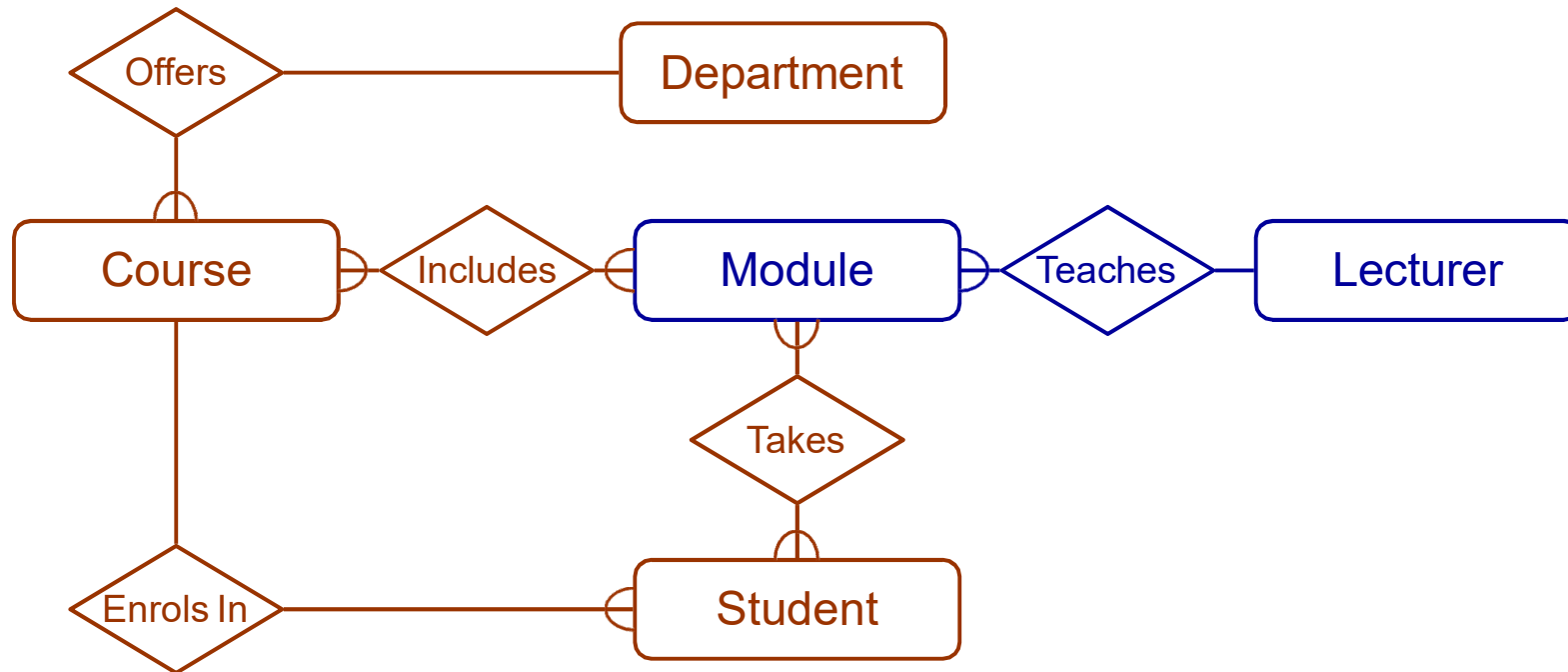
Example - E/R Diagram

Students ... take modules



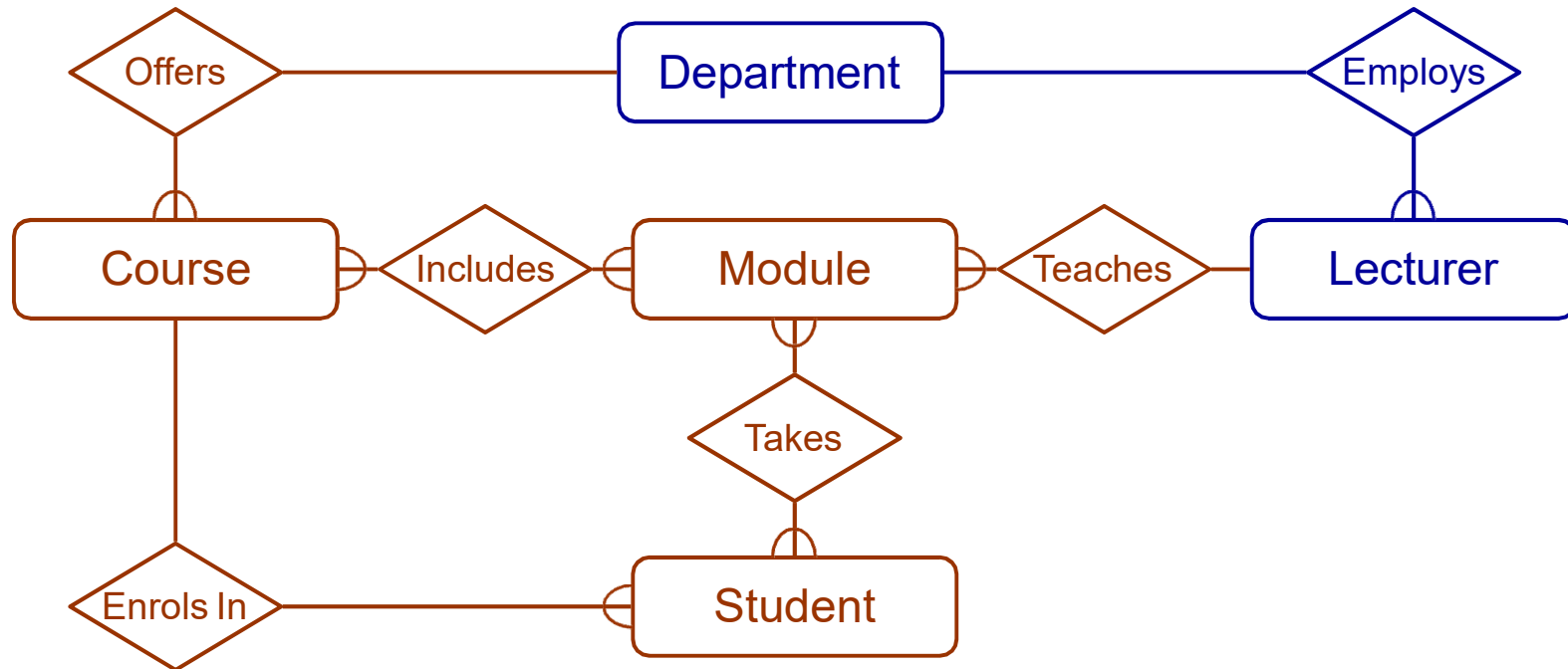
Example - E/R Diagram

Each module is taught by a lecturer



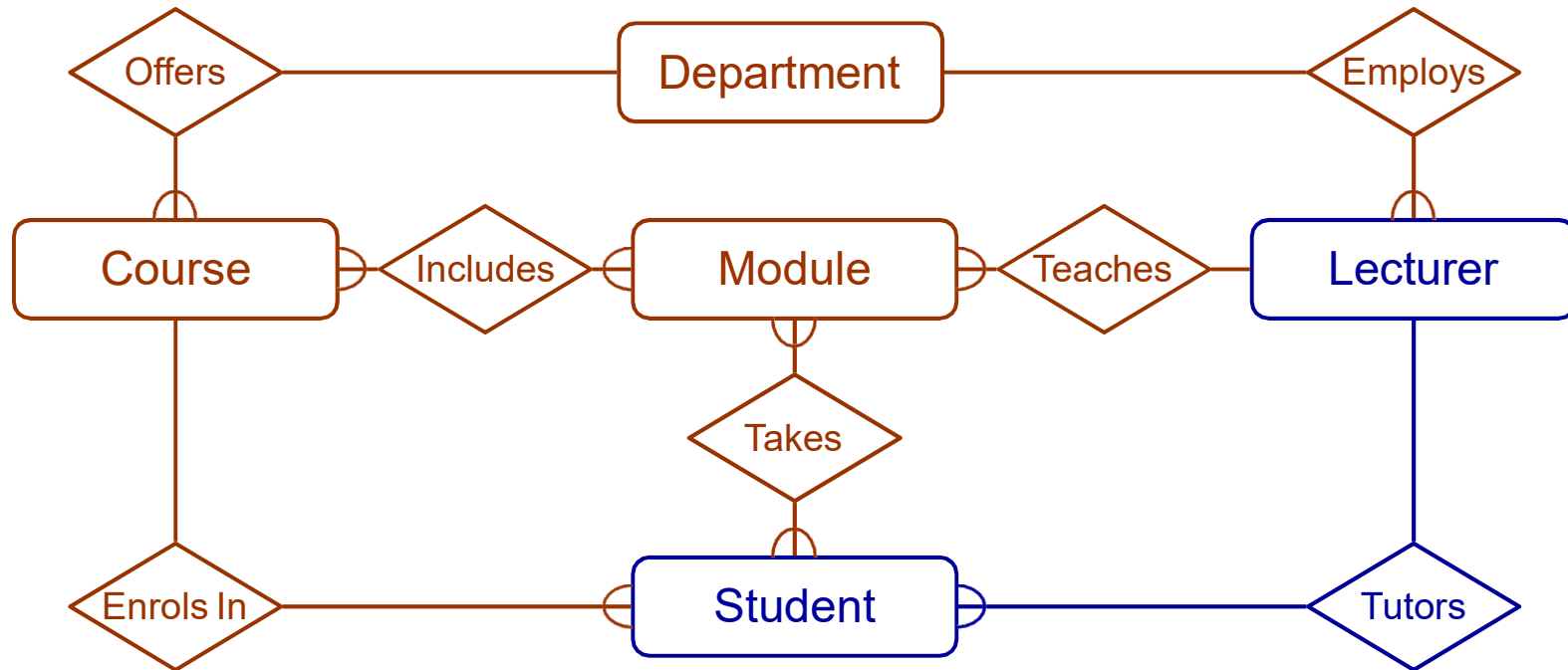
Example - E/R Diagram

a lecturer from the appropriate department

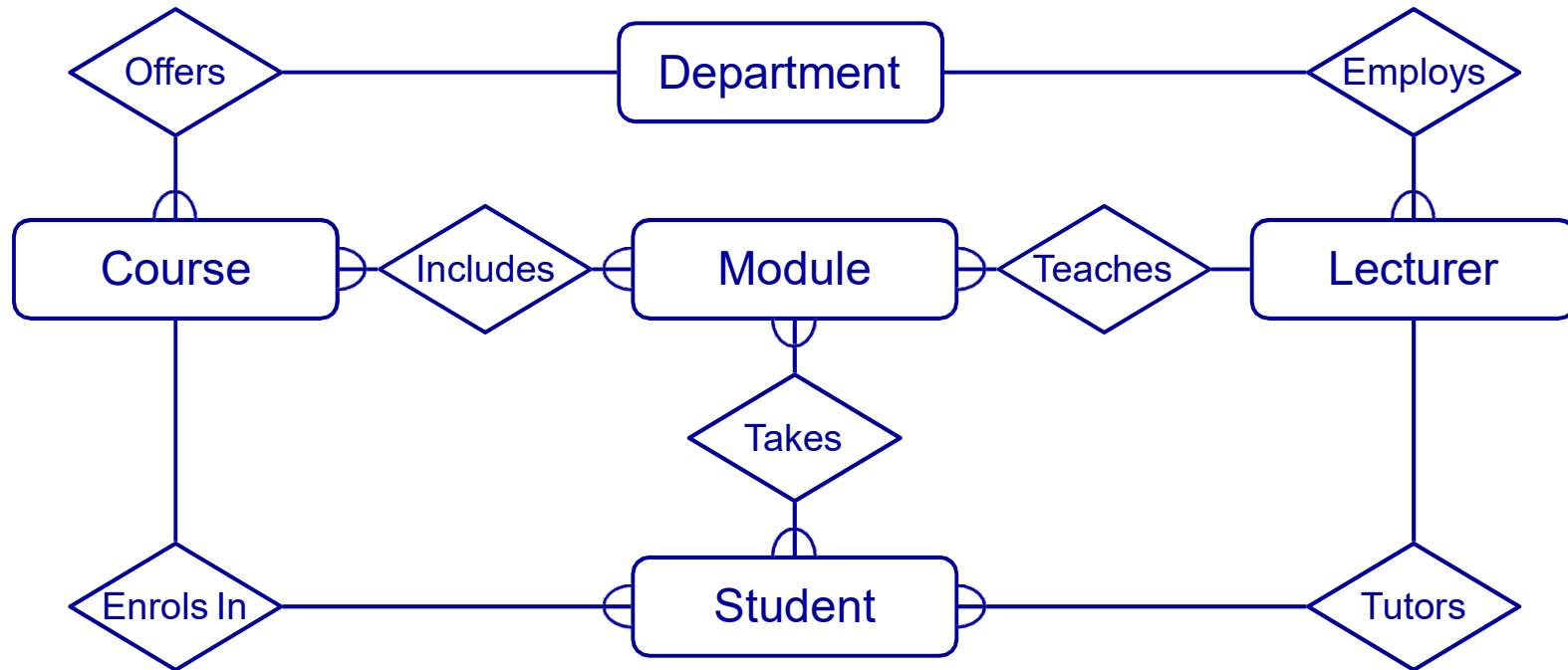


Example - E/R Diagram

each lecturer **tutors** a group of students



Example - E/R Diagram



References

1. Elmasri , R., Navathe, S.B., **Fundamentals of Database Systems**, 7th Edition, Pearson Ed., 2016, ISBN: 978-0133970777

Italian readers could prefer

1. Atzeni, P., Ceri, S., Paraboschi, S., & Torlone, R. (2006). **Basi di dati: modelli e linguaggi di interrogazione (seconda edizione)**. McGraw-Hill.



Università
degli Studi
della Campania
Luigi Vanvitelli