Entity Relationship Modelling II

DBI - Databases and Interfaces

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What’s next?

- We have learnt E/R Model and Diagram
- We will be given the problem description
- Task: design database for given problem

Problem Description → E/R Model

Example

A department offers several courses. A number of modules make up each course. Students enrol in a particular course and take modules towards the completion of that course. Each module is taught by a lecturer from the appropriate department (several lecturers work in the same department), and each lecturer tutors a group of students. A lecturer can teach more than one module but can work only in one department.

Making E/R Models

- To make an E/R model you need to identify
  - Entities
  - Attributes
  - Relationships
  - Cardinality ratios
- We obtain these from a problem 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

Nouns and Verbs

- A **noun** is a part of speech that denotes a person, animal, place, thing, or idea
    - Student
    - Staff
    - Module
    - Age
- A **verb** is a word used to describe an action, state, or occurrence, and forming the main part of the predicate of a sentence, such as hear, become, happen.
    - Studies
    - Tutors

Example

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Example - Entities

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Entities – Department, Course, Module, Student, Lecturer

Example - Relationships

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Entities – Department, Course, Module, Student, Lecturer

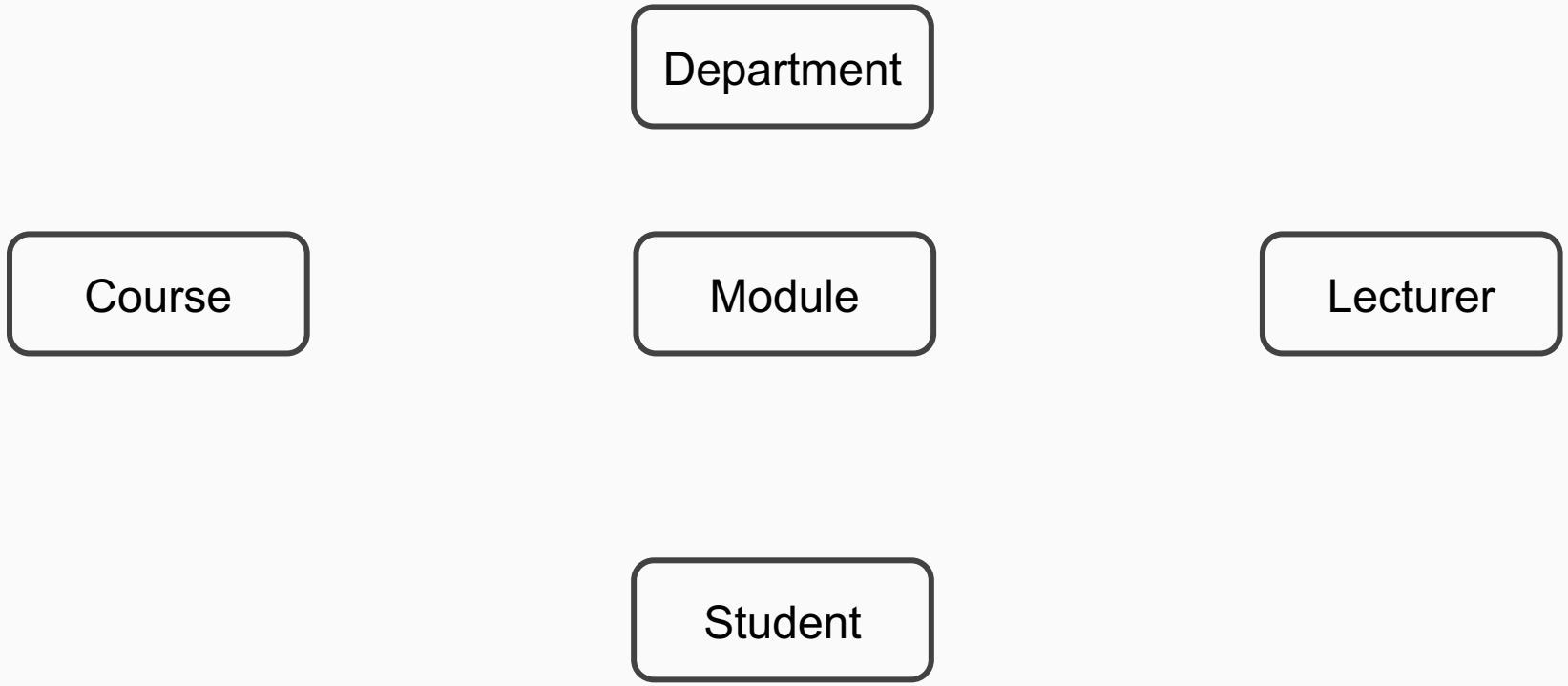
Relationships – Offers, Make Up, Enrol, Take, Taught By, From The, Tutors

Example

- A department offers several courses.
- A number of modules make up each course.
- Students enrol in a particular course.
- Students take several modules.
- Each module is taught by a lecturer.
- Each department employs a number of lecturers.
- Each lecturer tutors a group of students.

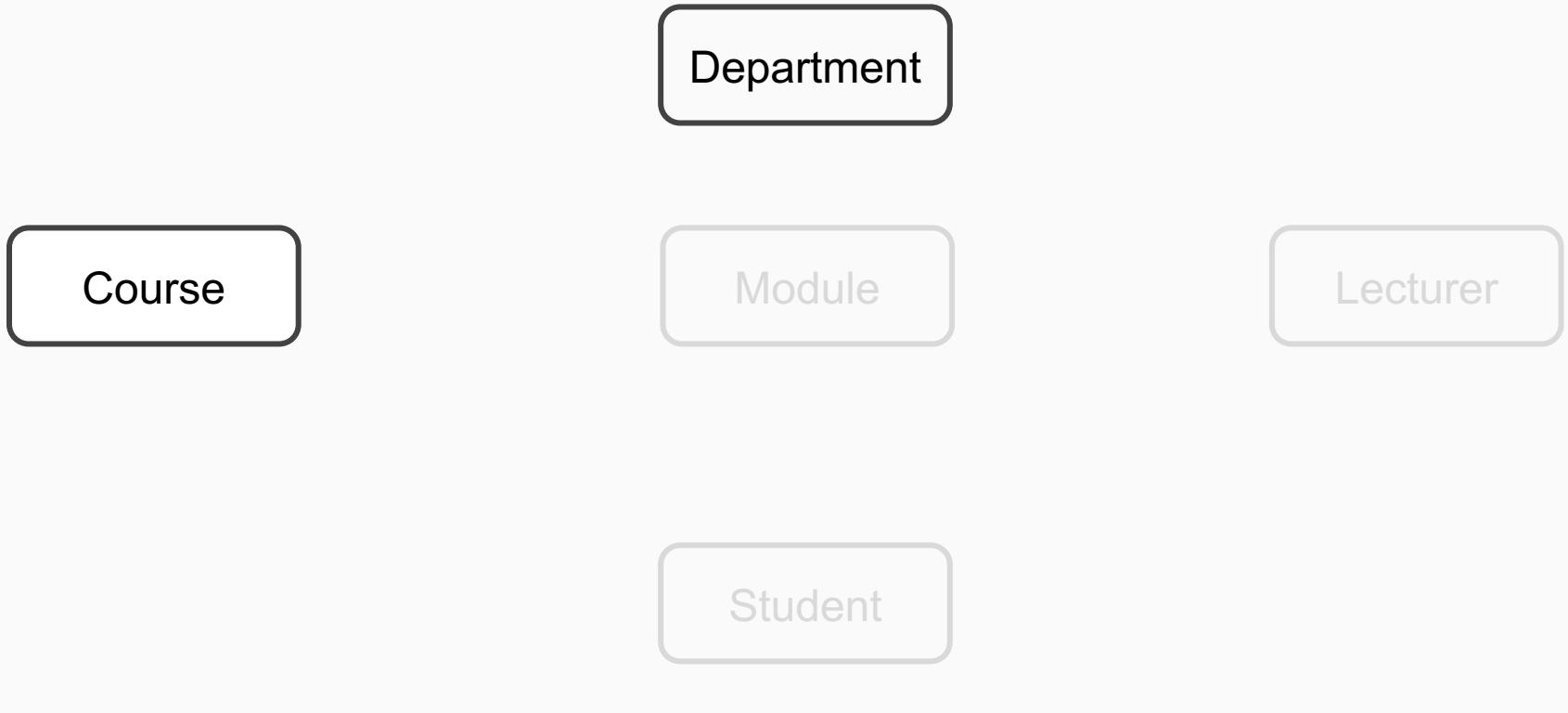
Example - E/R Diagram

Entities – Department, Course, Module, Student, Lecturer



Example - E/R Diagram

A department offers several courses



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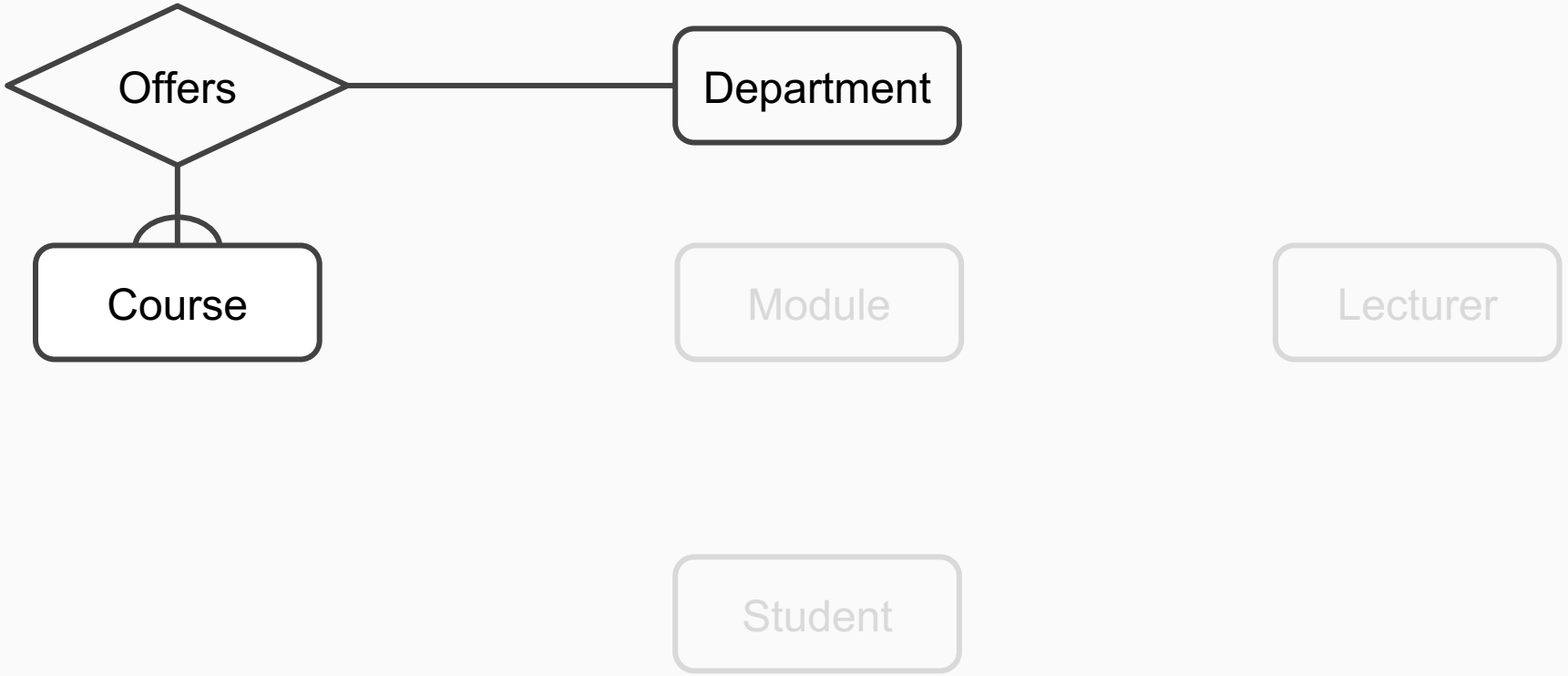
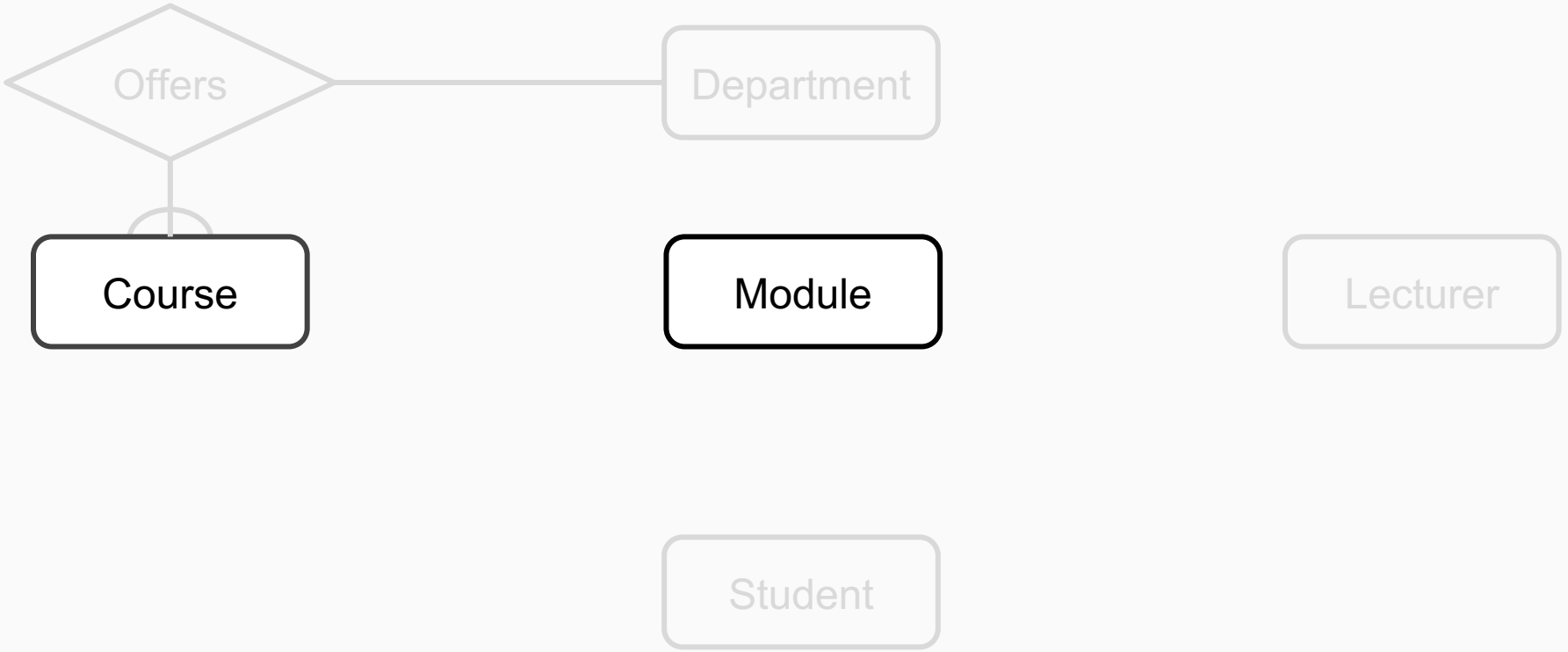


Example - E/R Diagram

A number of modules make up each course.



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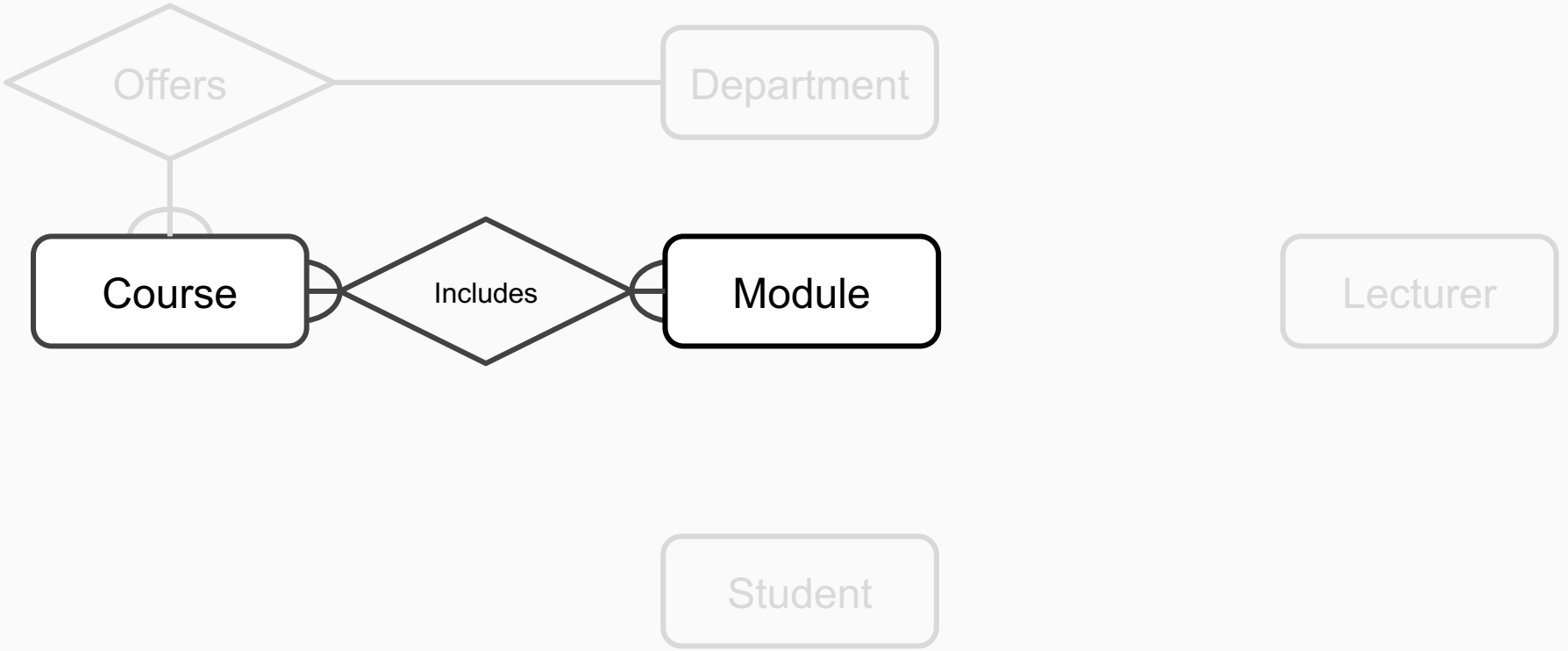
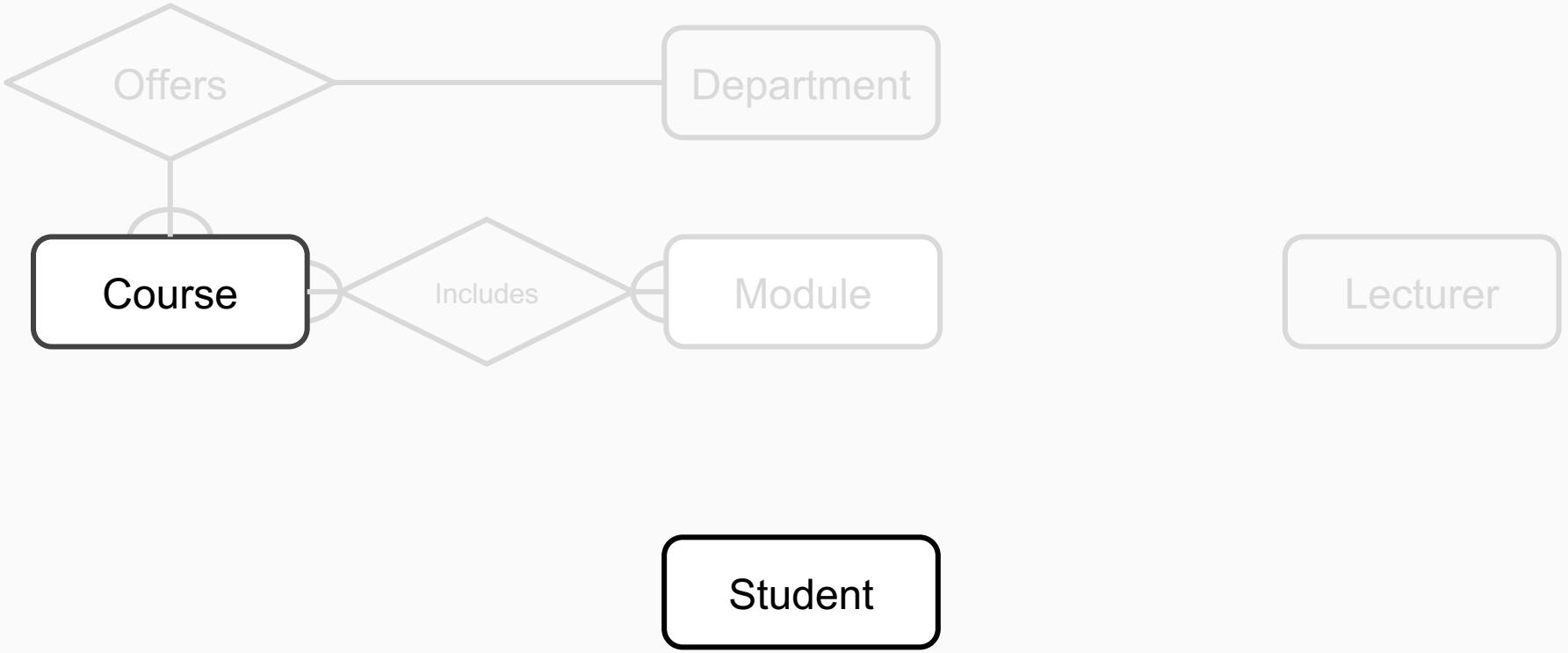


Example - E/R Diagram

Students enrol in a particular course.



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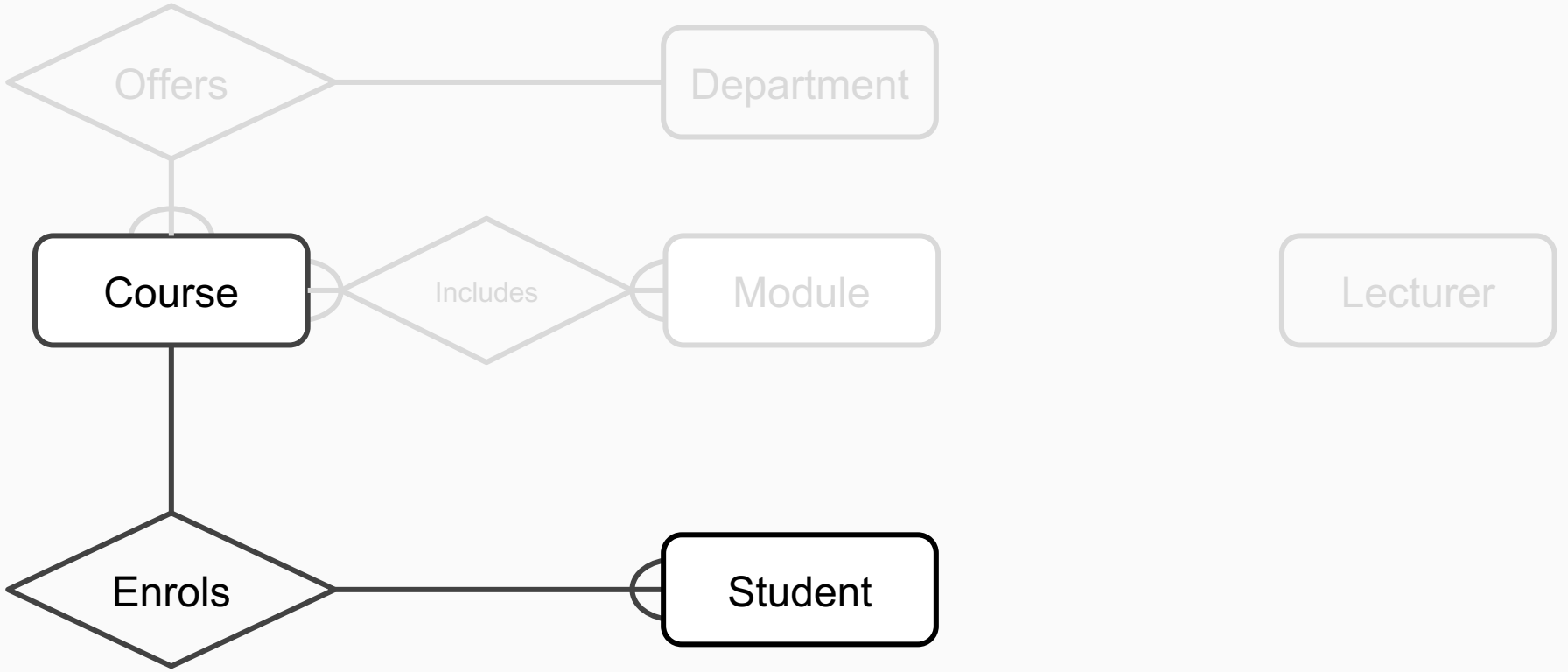
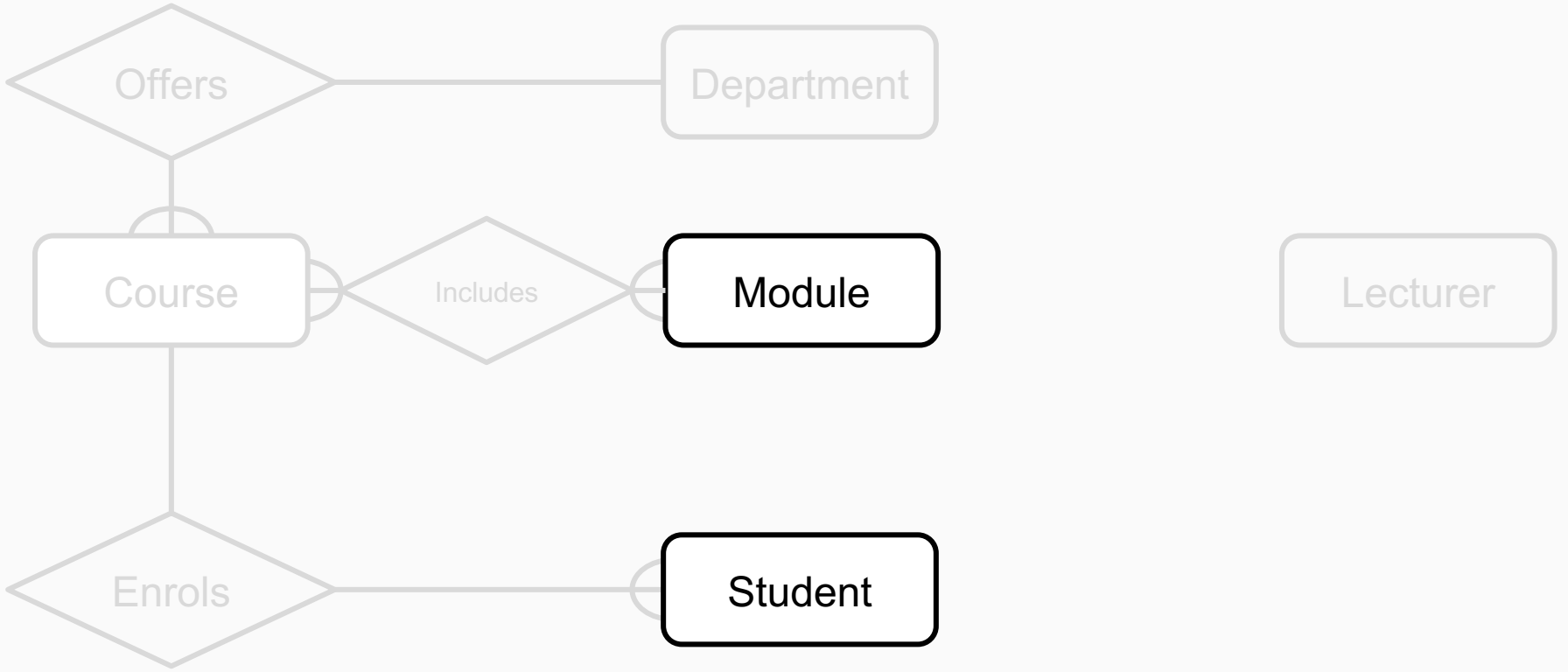


Example - E/R Diagram

Students take several modules.



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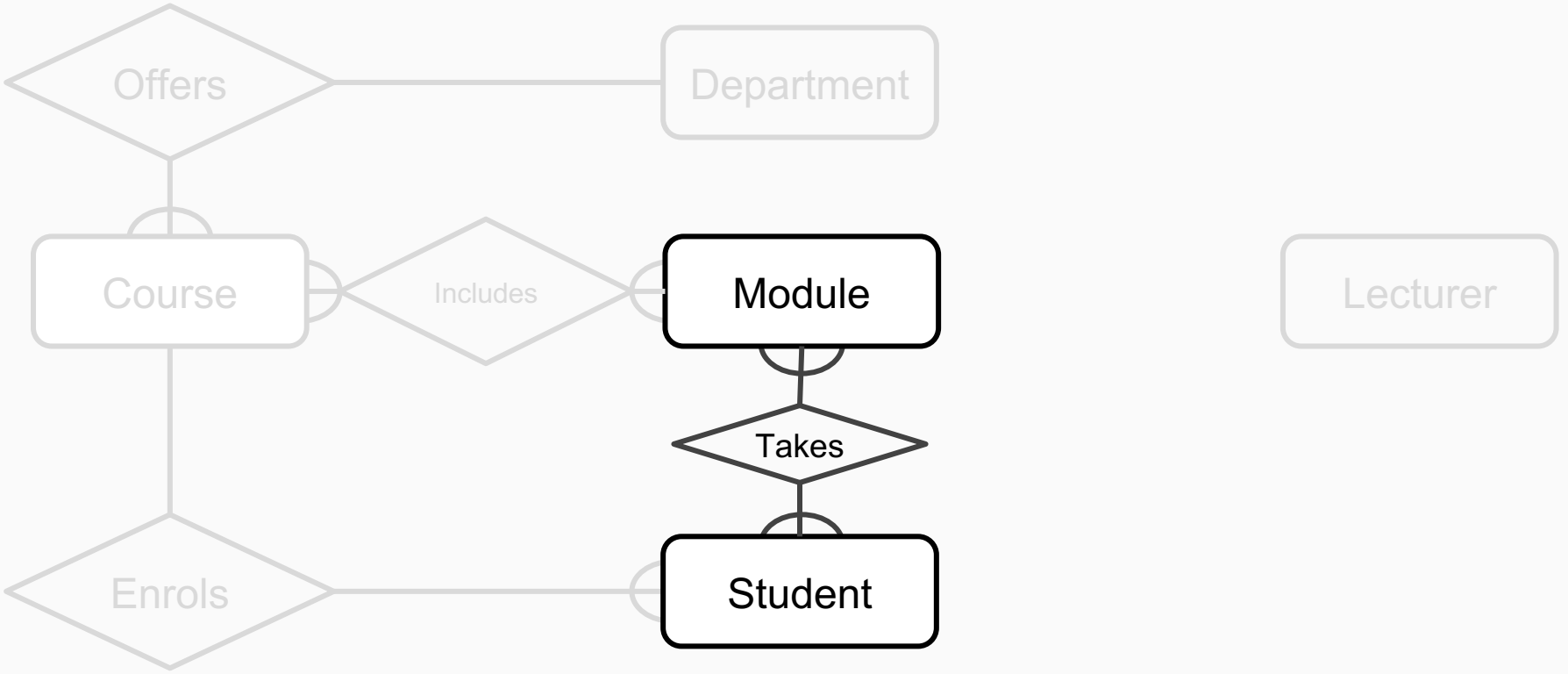
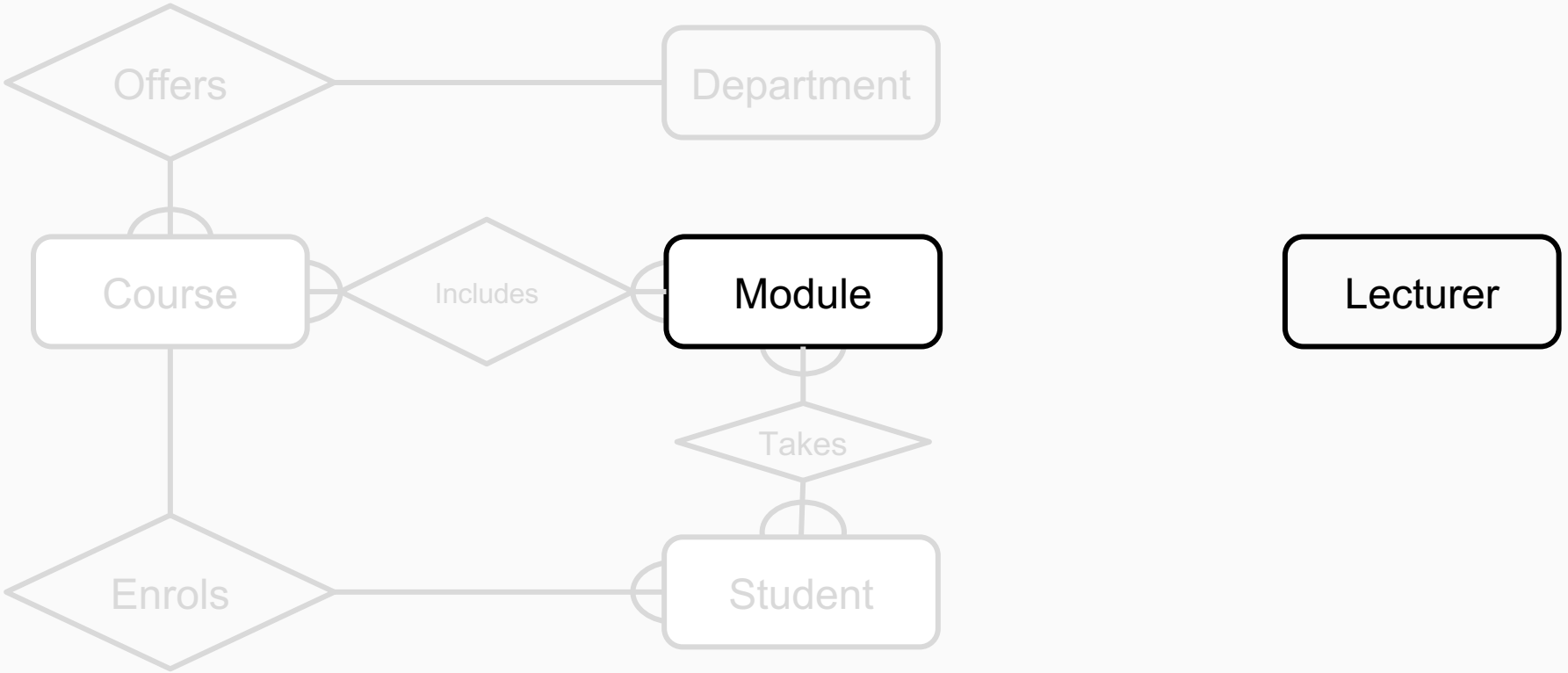


Example - E/R Diagram

Each module is taught by a lecturer



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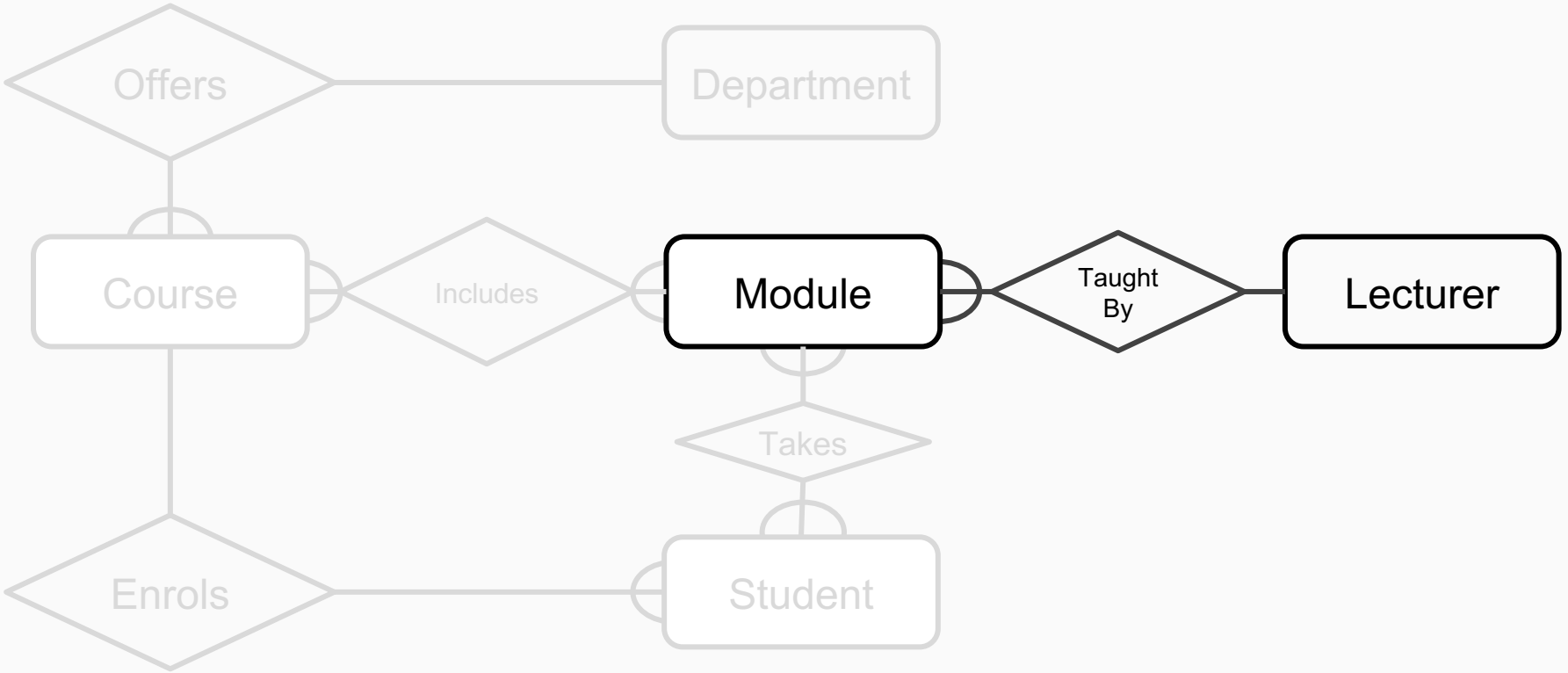
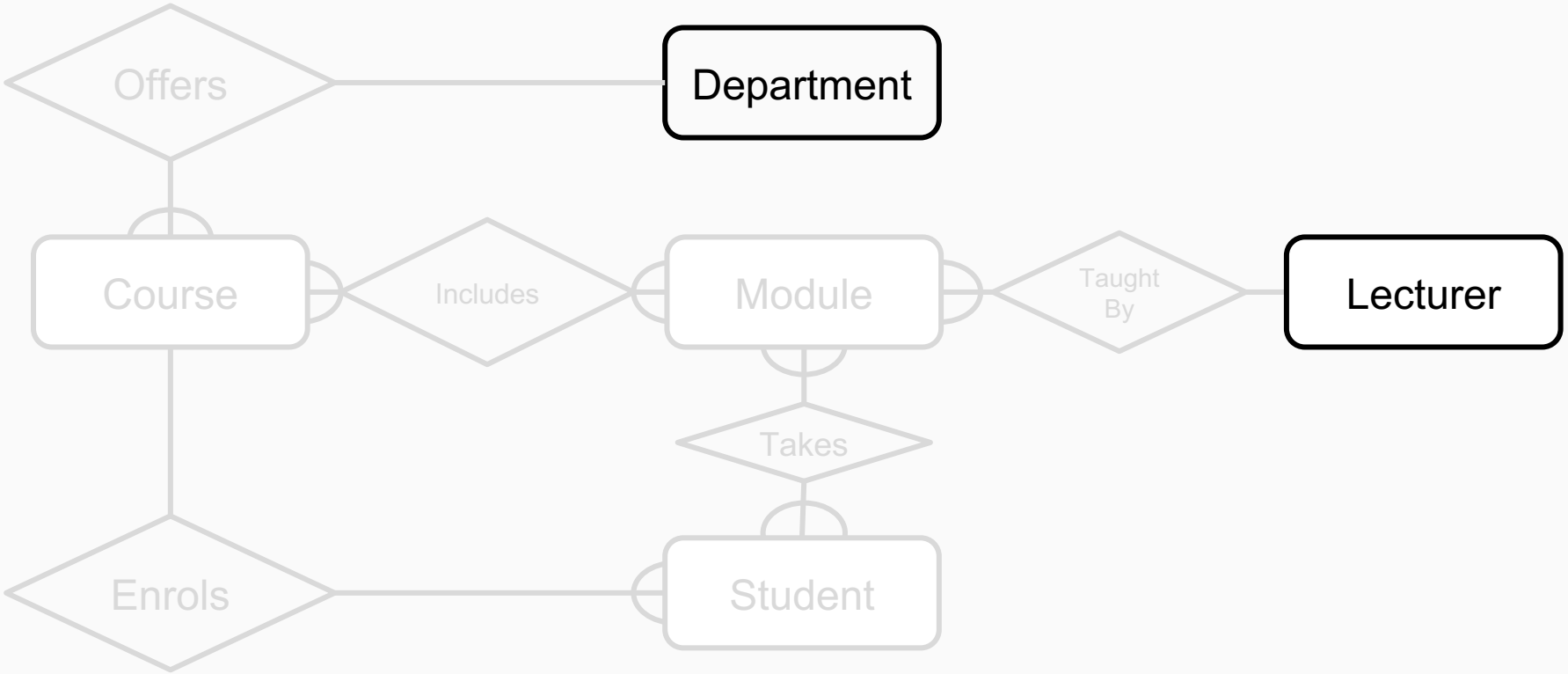


Example - E/R Diagram

Each department employs a number of lecturers.



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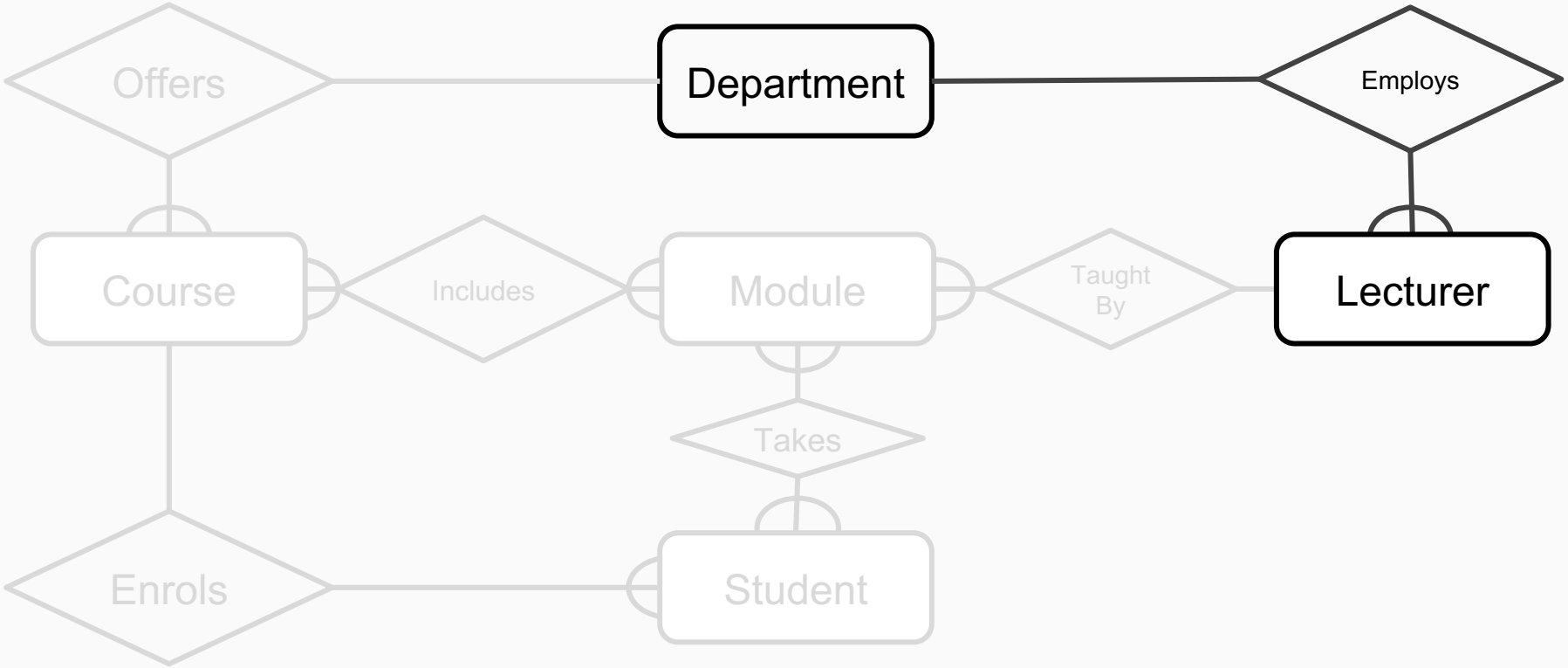
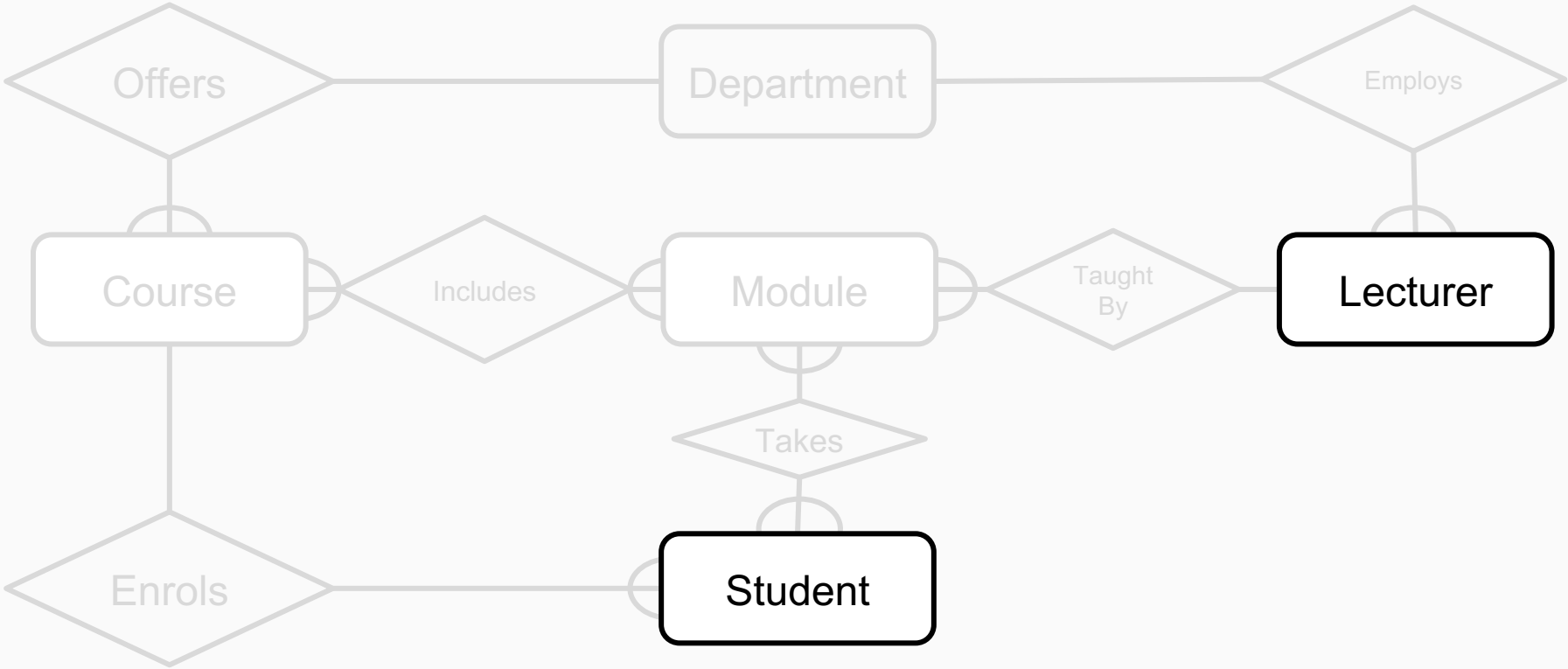


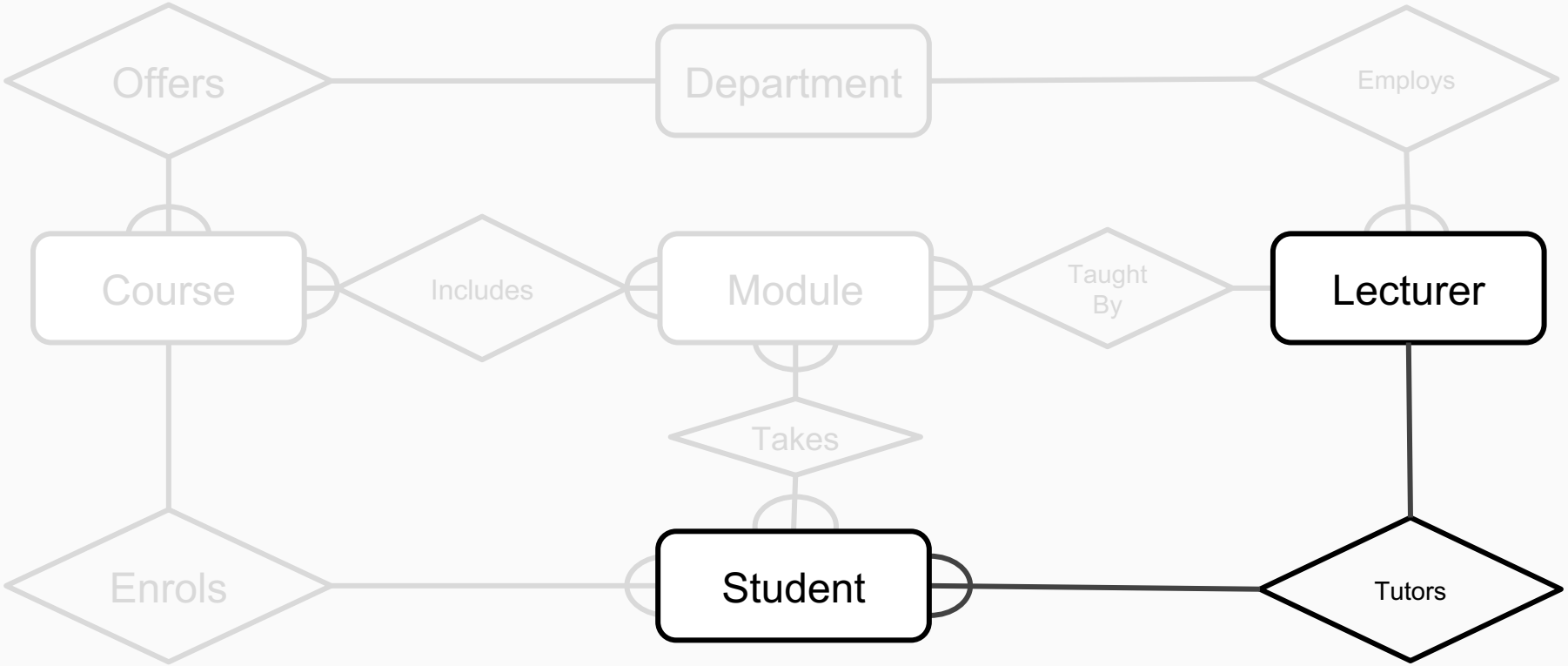
Example - E/R Diagram

Each lecturer tutors a number of students



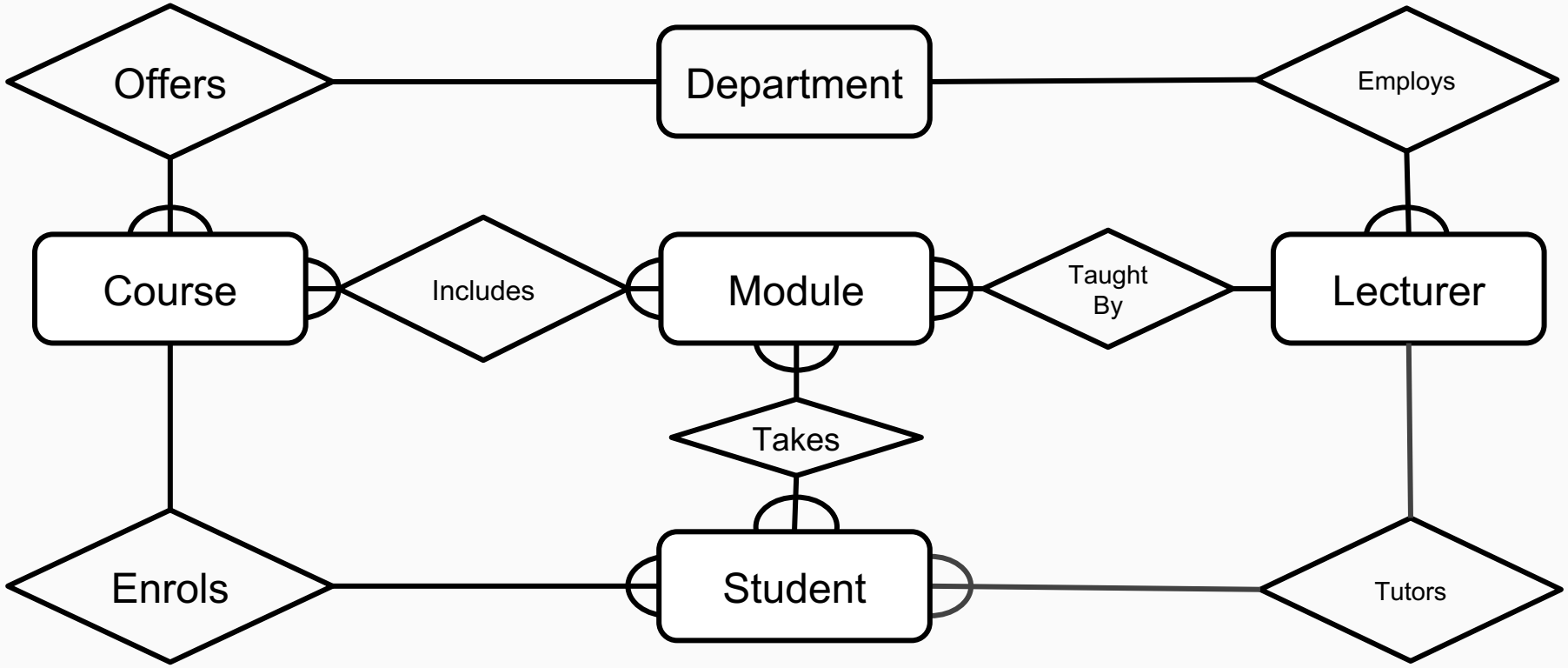
Example - E/R Diagram

Each lecturer tutors a number of students



Example - E/R Diagram

The completed diagram. Anything else we need to do?



Removing M:M Relationships

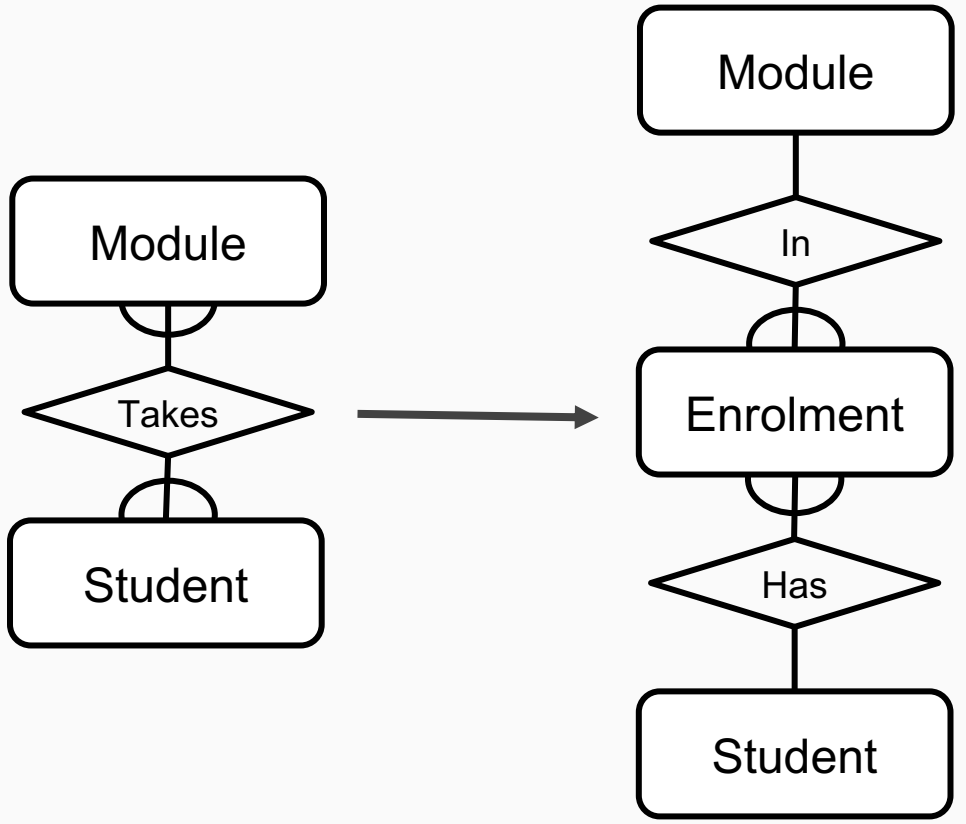
Many to many relationships are difficult to represent in a database:

Student		
SID	**sName**	**sMod**
1001	Jack Smith	DBI
1001	Jack Smith	PRG
1001	Jack Smith	IAI
1002	Anne Jones	PRG
1002	Anne Jones	IAI
1002	Anne Jones	VIS

Module	
MID	**mName**
DBI	Databases and Interfaces
PRG	Programming
IAI	AI
VIS	Computer Vision

Removing M:M Relationships

- Many to many relationships are difficult to represent in a database
- We can split a many to many relationship into two, one to many relationships
- An additional entity is created to represent the M:M relationship



Removing M:M Relationships

Many to many relationships are difficult to represent in a database:

Module	
MID	**mName**
DBI	Databases and Interfaces
PRG	Programming
IAI	AI
VIS	Computer Vision

Student	
SID	**sName**
1001	Jack Smith
1002	Anne Jones

Enrolment		
ID	SID	MID
1	1001	DBI
2	1001	PRG
3	1001	IAI
4	1002	PRG
5	1002	IAI
6	1002	VIS

Entities and Attributes

- Sometimes it is hard to tell if something should be an entity or an attribute
  - They both represent objects or facts about the world
  - They are both often represented by nouns in descriptions
- General guidelines
  - Entities can have attributes but attributes have no smaller parts
  - Entities can have relationships between them, but an attribute belongs to a single entity

Example

We want to represent information about products in a database. Each product has a description, a price and a supplier. Suppliers have addresses, phone numbers, and names. Each address is made up of a street address, a city name, and a postcode.

Example - Entities/Attributes

- Entities or attributes:
  - product
  - description
  - price
  - supplier
  - address
  - phone number
  - name
  - street address
  - city name
  - postcode

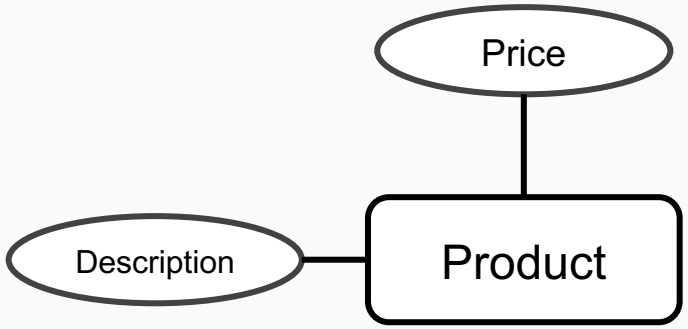
Example - Entities/Attributes

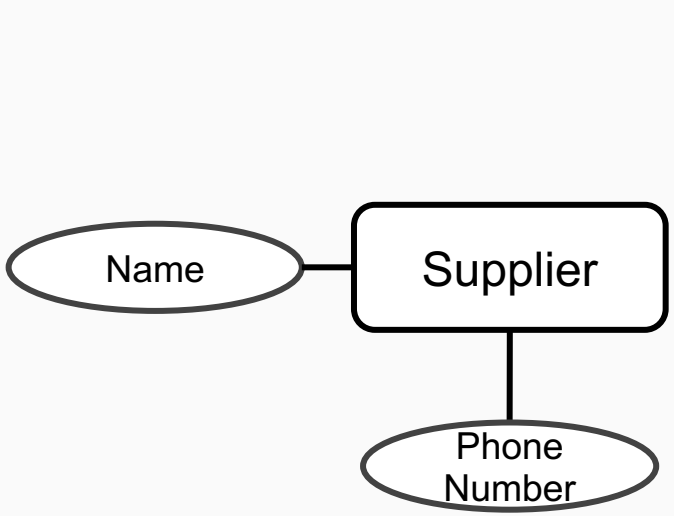
- Entities or attributes:
  - product
  - description
  - price
  - supplier
  - address
  - phone number
  - name
  - street address
  - city name
  - postcode

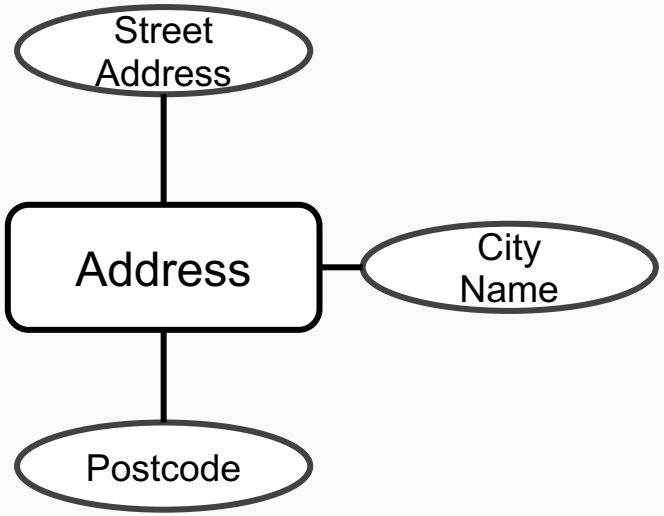
- Products, suppliers, and addresses all have smaller parts so we make them entities

- The others have no smaller parts and belong to a single entity

Example - E/R Diagram



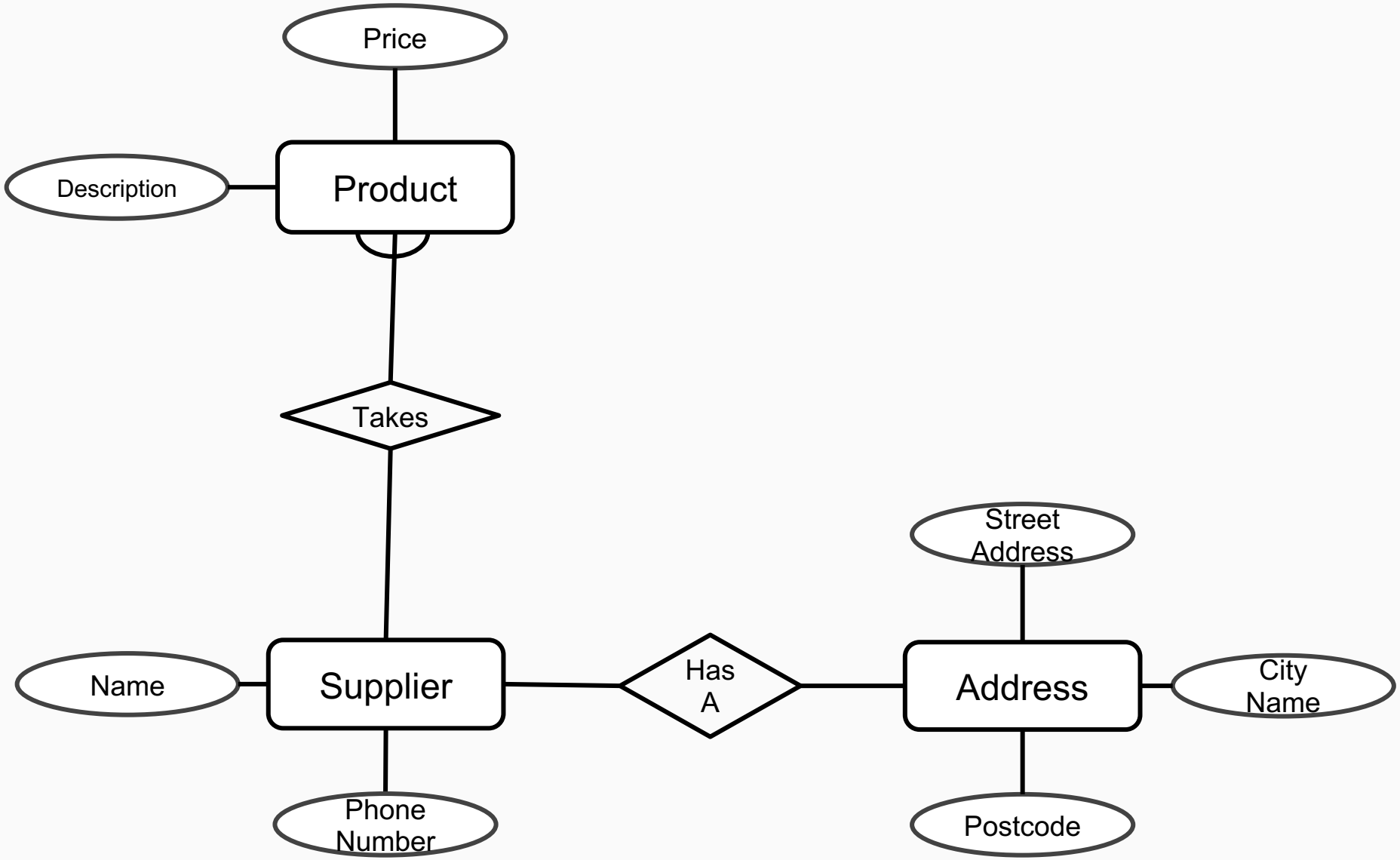




Example - Relationships

- Each product has a supplier
  - Each product has a single supplier but there is nothing to stop a supplier supplying many products
  - A one to many relationship
- Each supplier has an address
  - A supplier has a single address
  - It does not seem sensible for two different suppliers to have the same address
  - A one to one relationship

Example - E/R Diagram



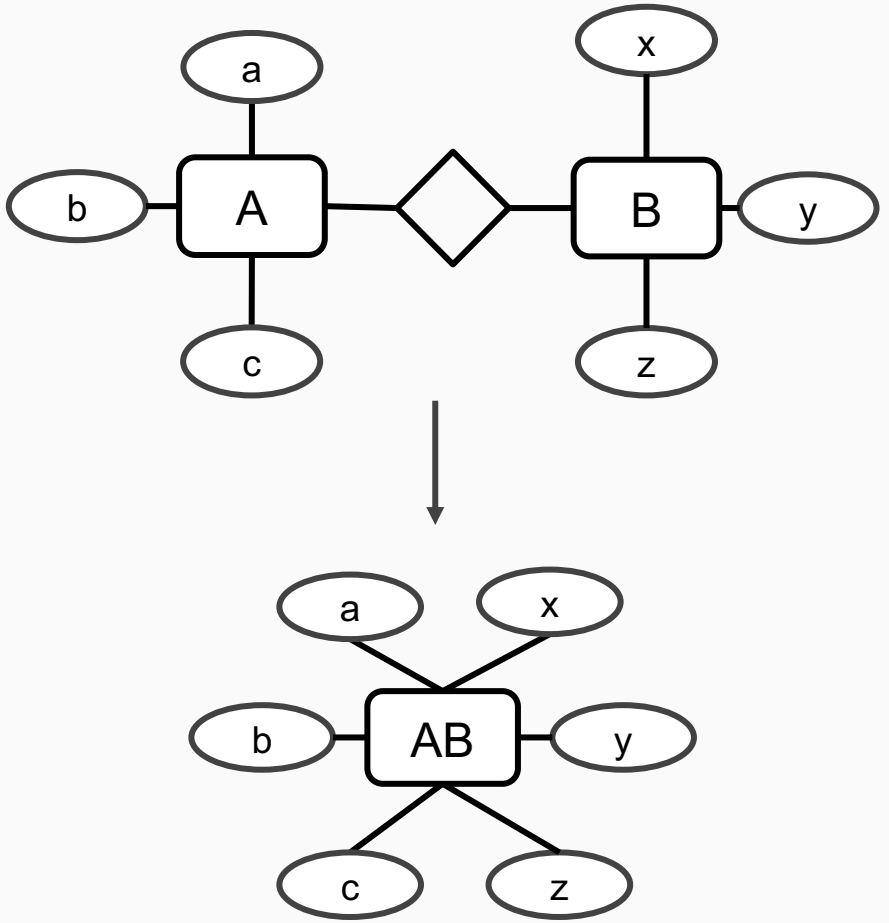
One to One Relationships

- Some relationships between entities, A and B, might be redundant if
  - It is a 1:1 relationship between A and B
  - Every A is related to a B and every B is related to an A

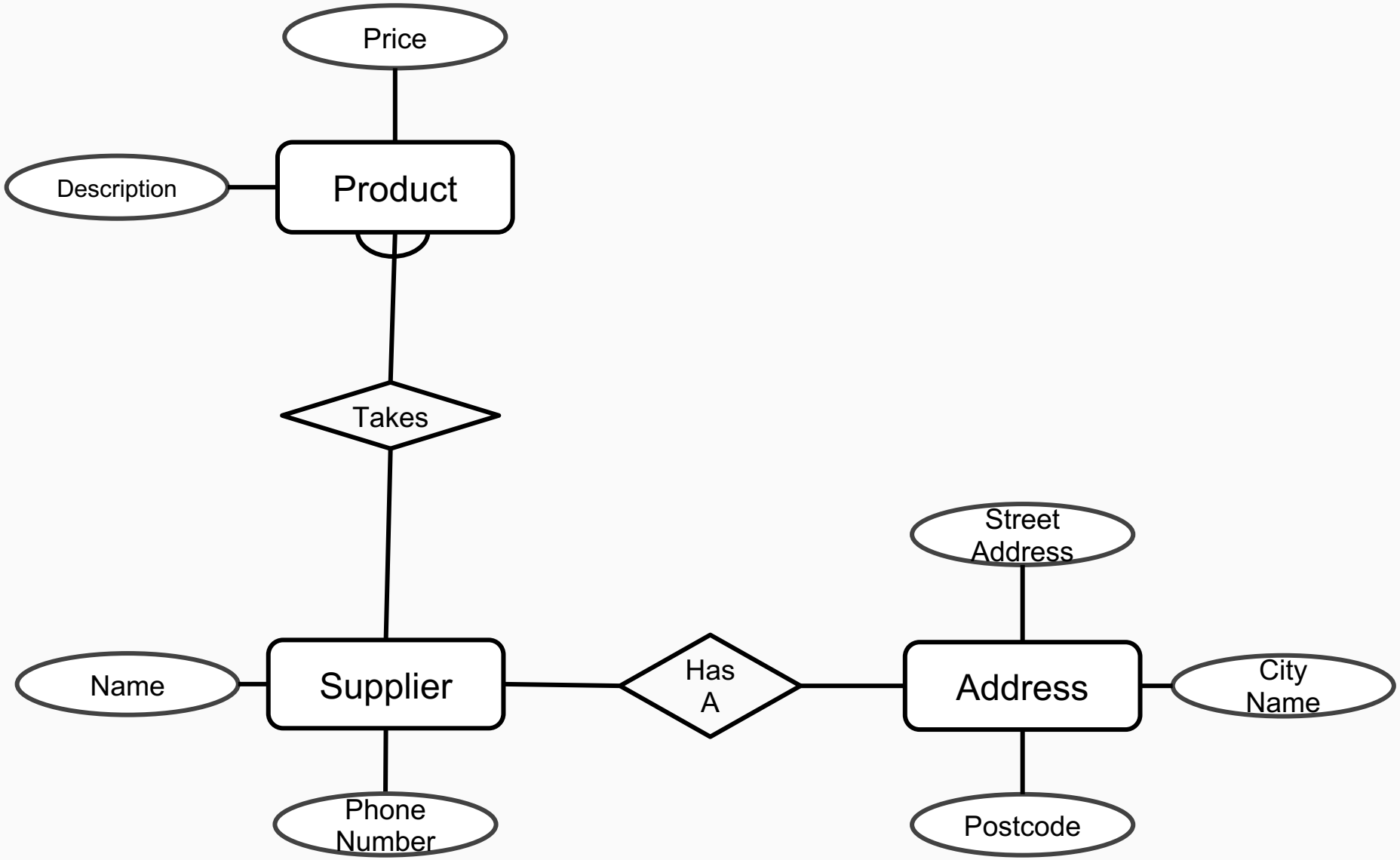
- Example
  - the supplier-address relationship - Is one to one
  - Every supplier has an address
  - We don’t need addresses that are not related to a supplier

One to One Relationships

- We can merge the two entities that take part in a redundant relationship together
  - They become a single entity
  - The new entity has all the attributes of the old ones



Example – Eliminating 1:1 relationship



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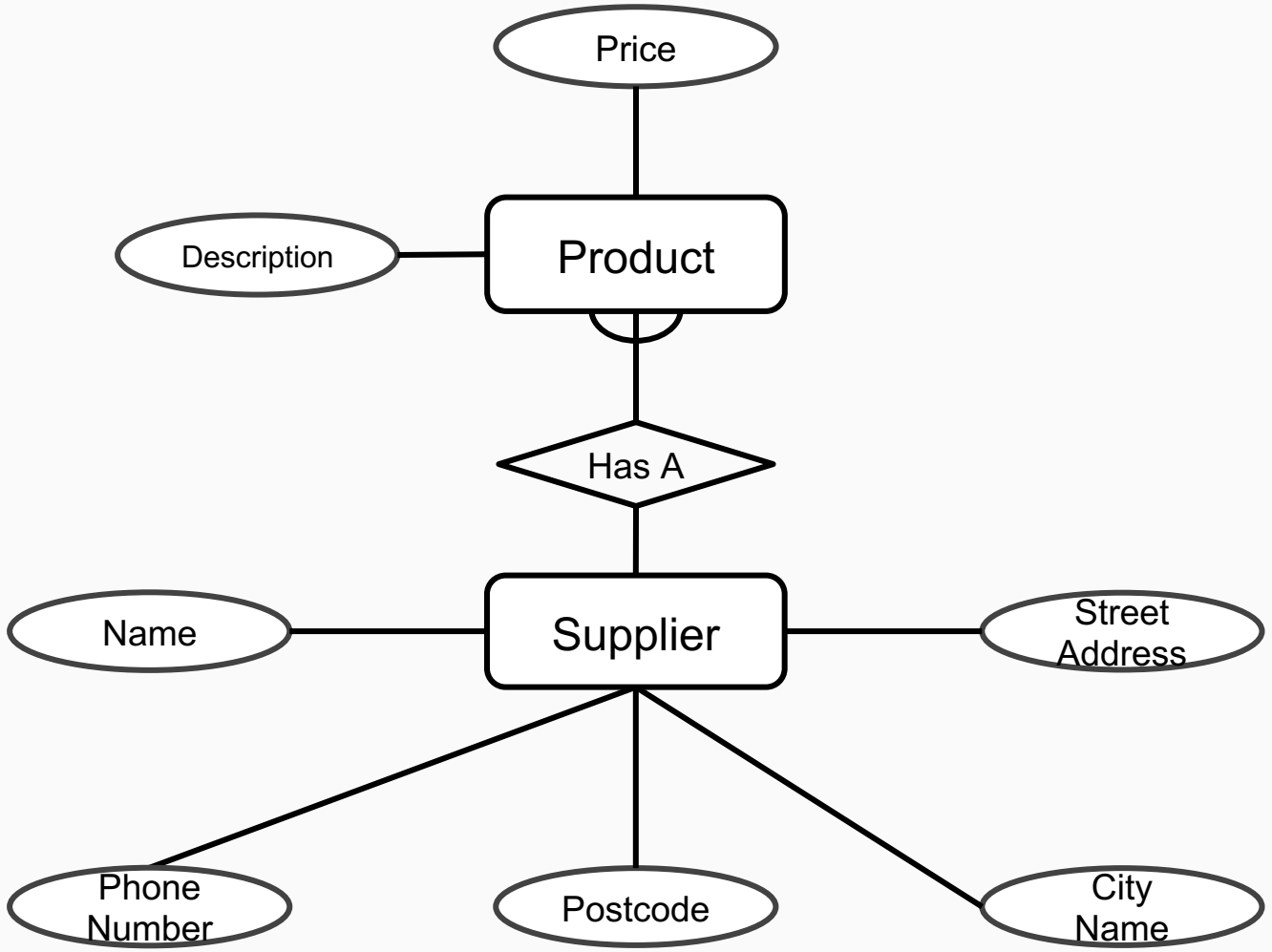
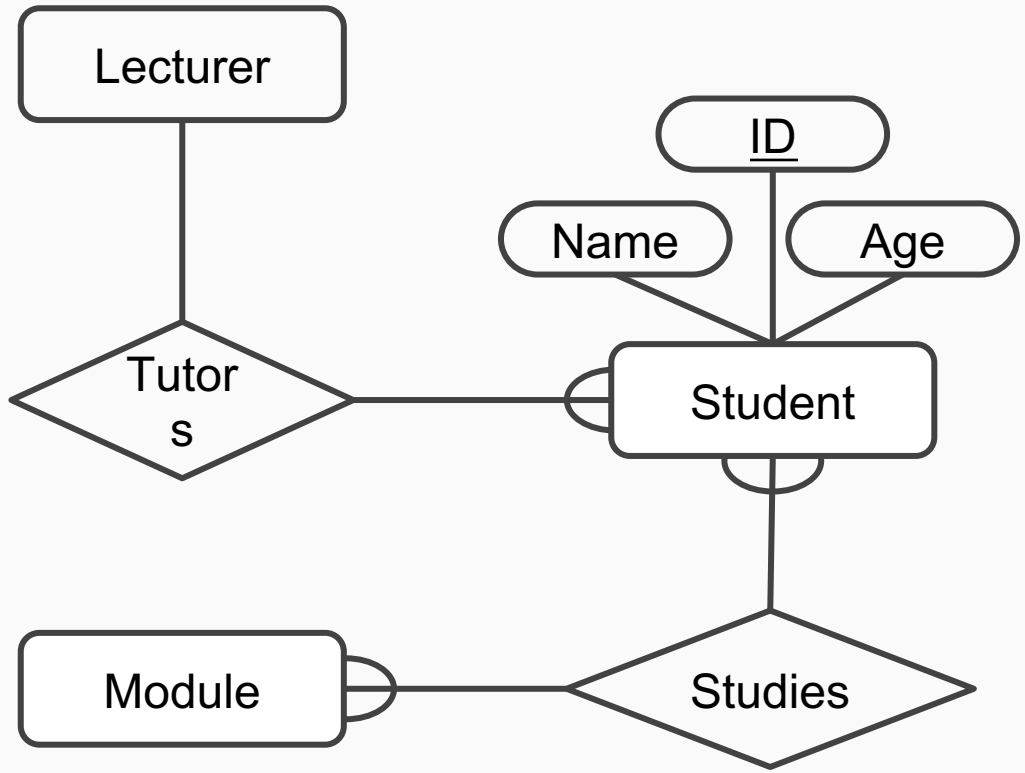


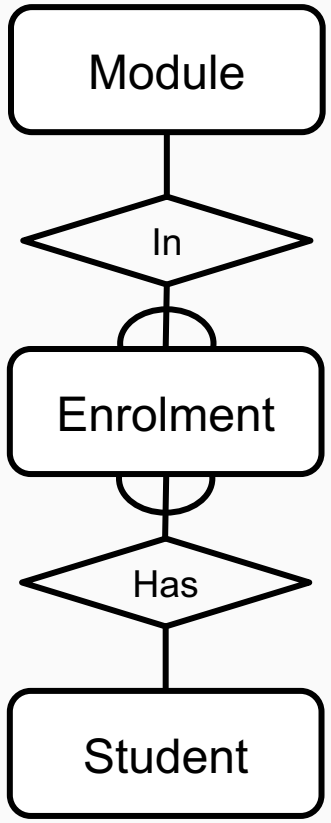
Primary Keys

- We often find that we need to specify which attributes will serve as Primary Keys in our ER diagrams
- We do this by underlining the attribute in the relation
  - E.g. <u>ID</u>



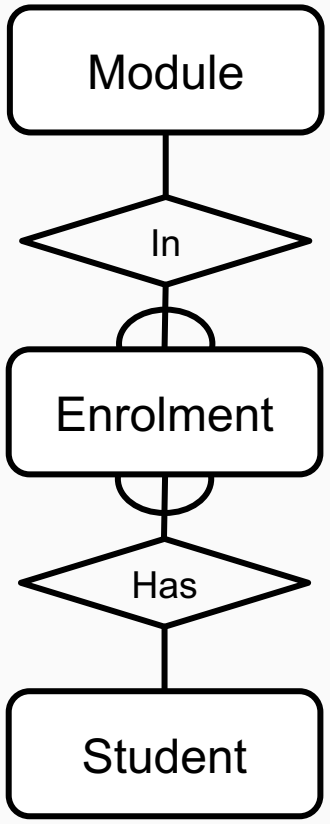
Debugging Designs

- With a bit of practice E/R diagram can be used to plan queries
  - Look at the diagram and figure out how to find useful information
  - If you can't find the information you want, then you need to change the design



Question: How can you find a list of students who are enrolled in Database systems

Debugging Designs



1) Find the instances of the Module entity with module name ‘Database systems’

2) Find the instances of the Enrolment entity with the same MID as the result of 1)

3) For each instance of the Enrolment entity in the result of 2), find the corresponding student entities

Making E/R Diagrams

- From a description of the requirements identify the
  - Entities
  - Attributes
  - Relationships
  - Cardinality ratios of the relationships
- Draw the E/R diagram and then
  - Look at one to one relationships as they might be redundant
  - Look at many to many relationships as they will often need to be split into two one to many links, using an intermediate entity

Exams and Coursework Simplified Example

- Identify the *entities, attributes, relationships,* and *cardinality ratios* from the description.
- Draw an entity-relationship diagram showing the items you identified.
- Many-to-many relationships are hard to represent in database tables. Explain the nature of these problems, and describe how they may be overcome.

Hints

- Be Organised
  - If we can’t read it, how can we mark it?
- Find software you like - now
  - This will save you time during the lab
- Summarise the rules e.g.
  - Entities can have attributes but attributes have no smaller parts
- This is a skill that needs practice
- Rarely will you get it right first time