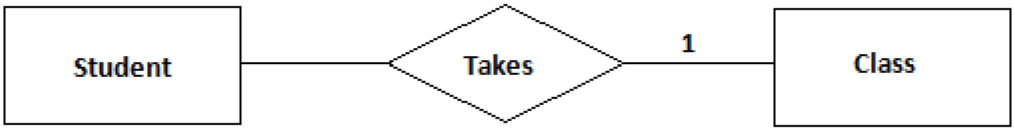
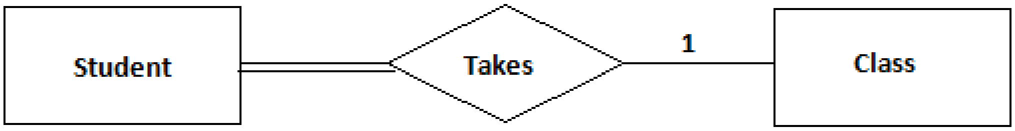
ER Diagram and Schema

Example 1) A student takes exactly 1 class. A class should be taken by at least 1 student.

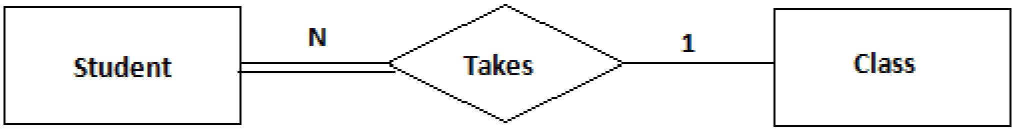
Let's consider the sentence "A student takes exactly 1 class" first. Because every student takes one class, the cardinality is 1. We show it as below:



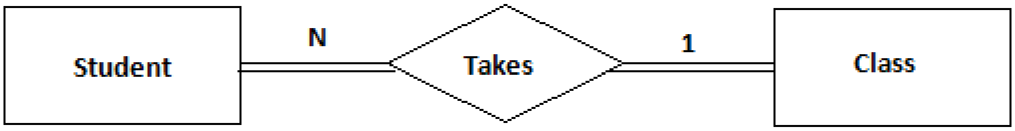
Now look at the same sentence from a different perspective. Ask yourself, do all students participate in this relationship? The answer is yes, because this sentence is actually saying that every student takes a class, so Student has total participation with Class. We show the total participation with double lines and it goes on the same side as the entity that has the total participation. We edit the previous diagram to represent the total participation of Student.



Ok, now consider the sentence "A class should be taken by at least 1 student". This sentence is actually saying that a class should have minimum of 1 student and maximum of many students, so the cardinality is N because we always consider the maximum for cardinality. We just add N to the diagram as you see below:

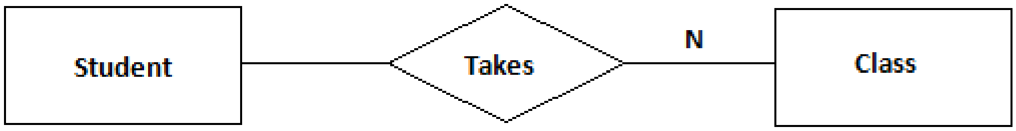


Now for total participation, we ask do all classes participate in this relationship? The answer is yes, because this sentence is saying that every class should be taken by some student, so Class has total participation with Student. We show this as below:

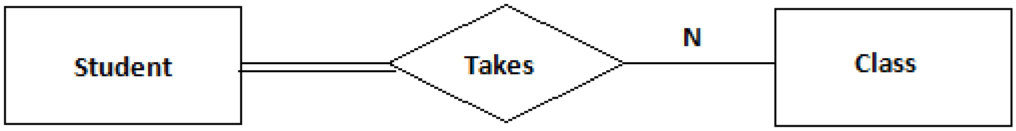


Example 2) A student takes at least 1 class. A class can be taken by 0 or more students.

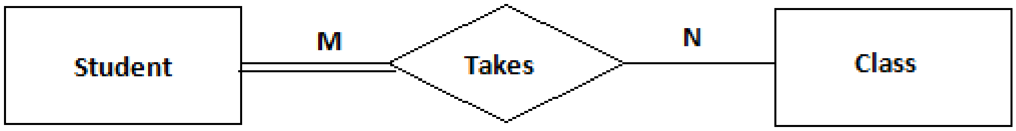
First consider the sentence “A student takes at least 1 class”. Because every student can take many classes, the cardinality is N. We show it as below:



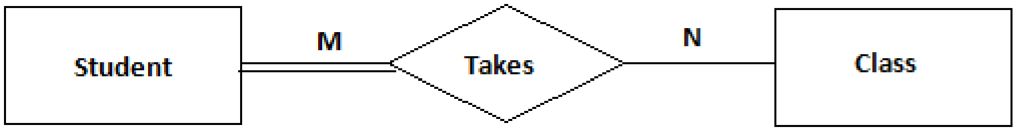
This sentence is also saying that every student takes some class, so Student has total participation with Class.



Now consider the sentence “A class can be taken by 0 or more students”. This sentence may not be correct in real world but assume it is possible to have classes without any student. This sentence is actually saying that a class can have minimum of 0 students and maximum of many students, so the cardinality is many as you see below.

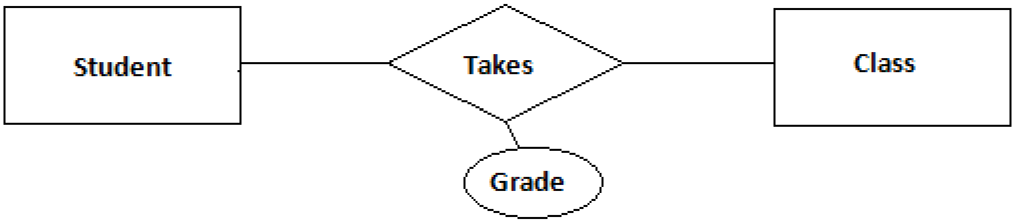


Now for total participation, we say do all classes participate in this relationship? The answer is No, because there might be some classes without any students, so Class does not have total participation with Student and we do not make any changes to the diagram.

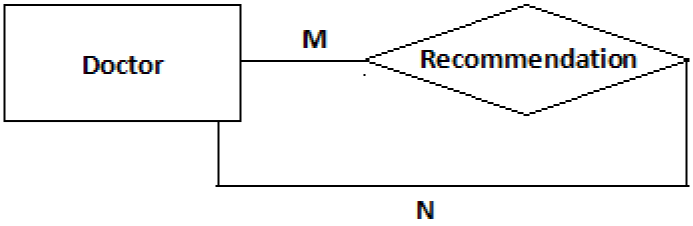


Relationships

Like entities, relationships also can have attributes. For example, assume you want to record the grade that a student gets in a specific class. It does not make sense if you add attribute “grade” to entity Student or entity Class, so we add this attribute to the relationship between Student and Class.

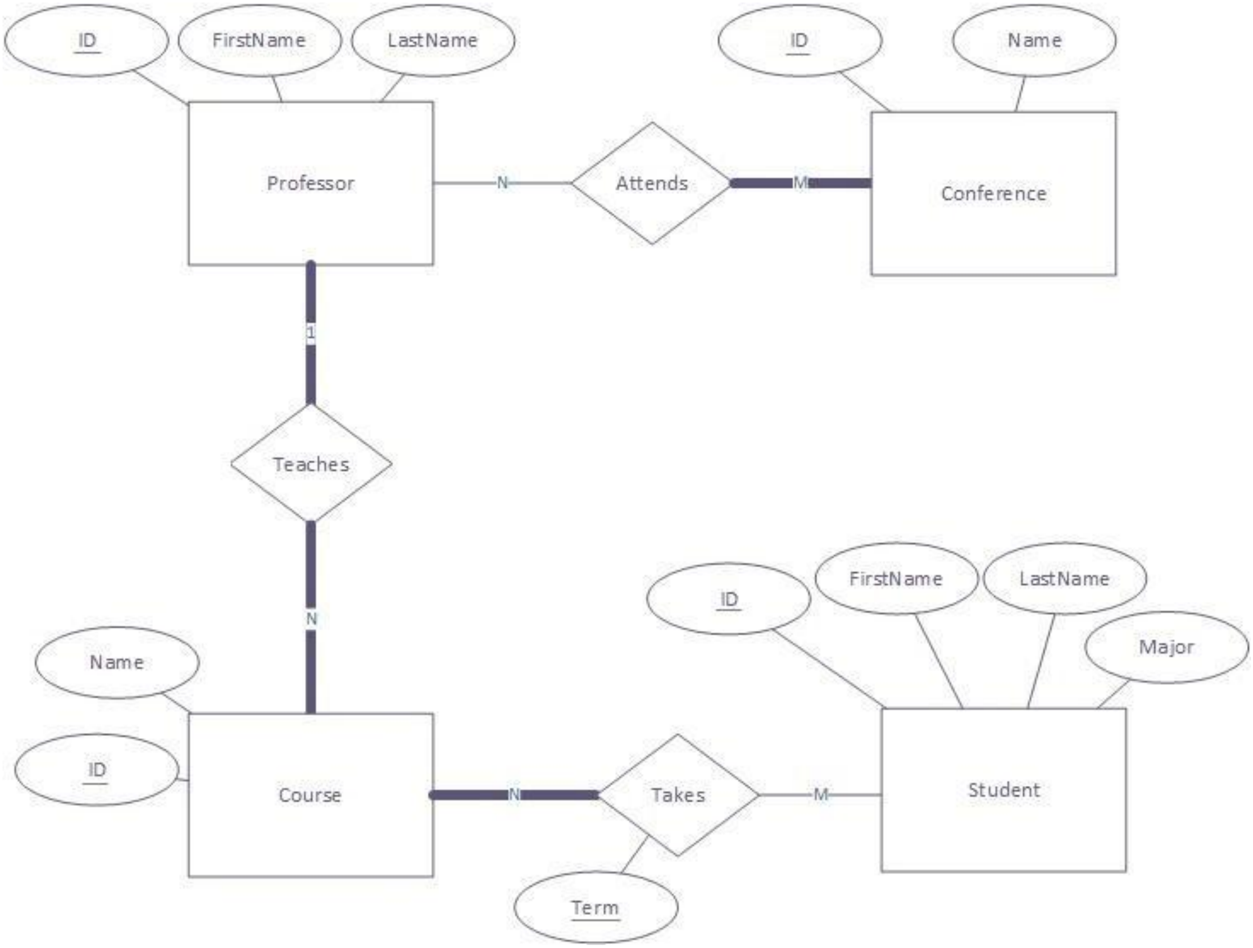


Sometimes we have recursive relationships. That is some entity may have a relationship with itself. For example assume you have an entity Doctor. A doctor can recommend many doctors and can be recommended by many doctors. This is a many to many relationship.



Draw an ER diagram for the following description:

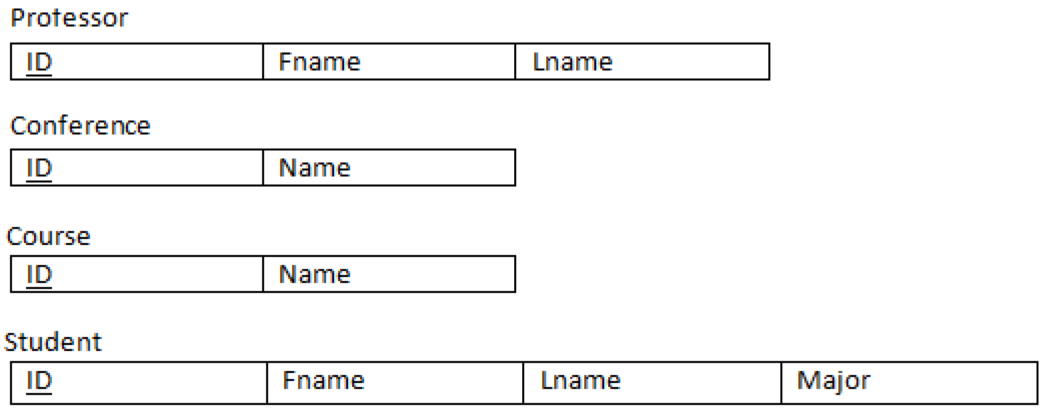
You are making a database for a university. University has Professors who are uniquely identified by their IDs. They have first name and last name. There are students, they have ID, first name, last name and major. There are courses that have ID and name. Each student takes zero or more courses, and each course is taken by at least one student. The term that a student takes a course is recorded. A professor teaches one or more courses, but a course is taught by exactly one professor. There are some conferences, they have ID and name. A professor attends zero or more conferences and a conference has at least one professor attended. Assume IDs are unique for each entity.



A student can take a same course several times in different terms, so attribute "Term" is underlined here because it is part of the key for relationship "Takes".

Now let’s step by step draw a schema for the above ER diagram:

First draw a table for each entity, put its attributes in the tables and underscore the primary keys.



Professor

ID	Fname	Lname

Conference

ID	Name

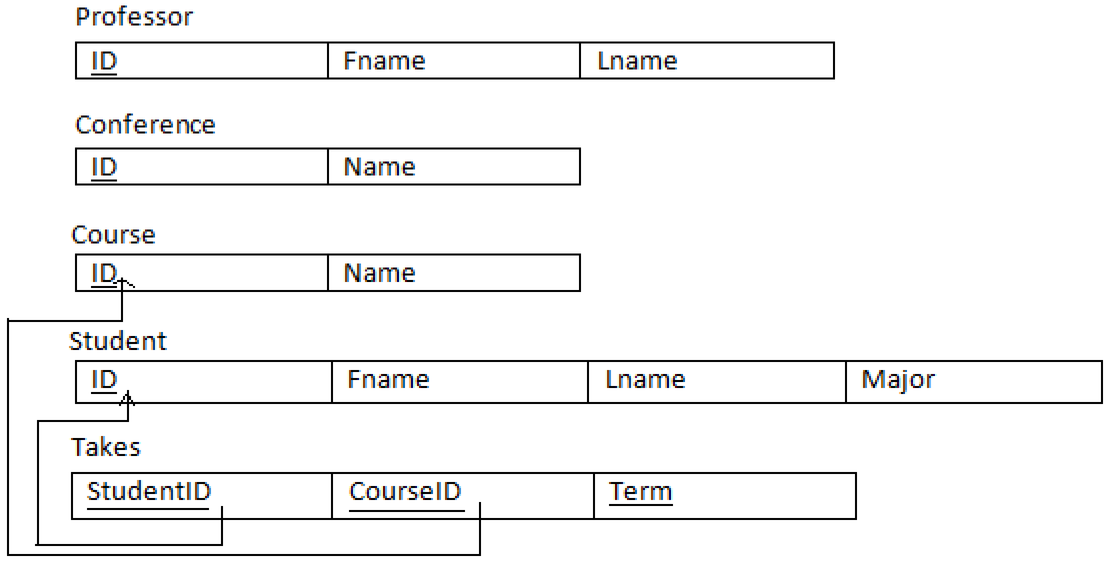
Course

ID	Name

Student

ID	Fname	Lname	Major

“Takes” is a many-to-many relationship, so we create a separate table for that. This table has the primary keys of the entities that make relationship “Takes”, it also has the attribute “Term” of relationship “Takes”. In this example all of these 3 attributes together make the primary key of table “Takes”, so we underline all of them. Then we put arrows from the foreign keys to the attributes they refer.



Professor

ID	Fname	Lname

Conference

ID	Name

Course

ID	Name

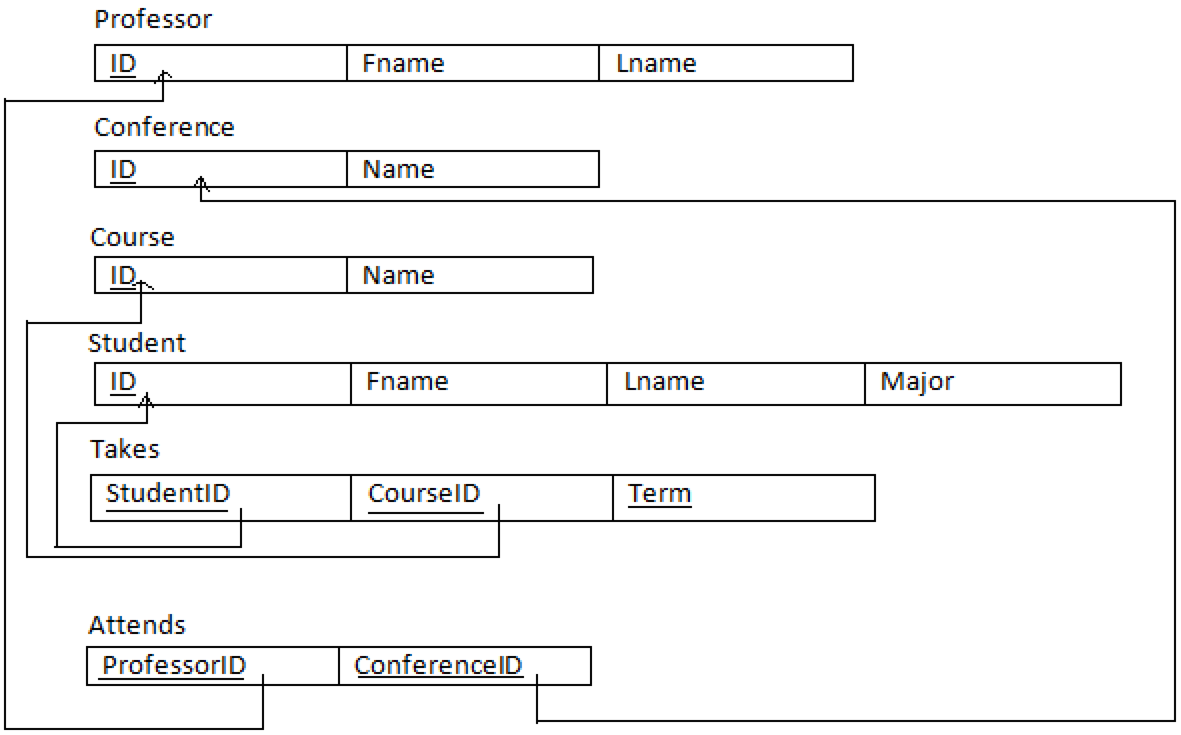
Student

ID	Fname	Lname	Major

Takes

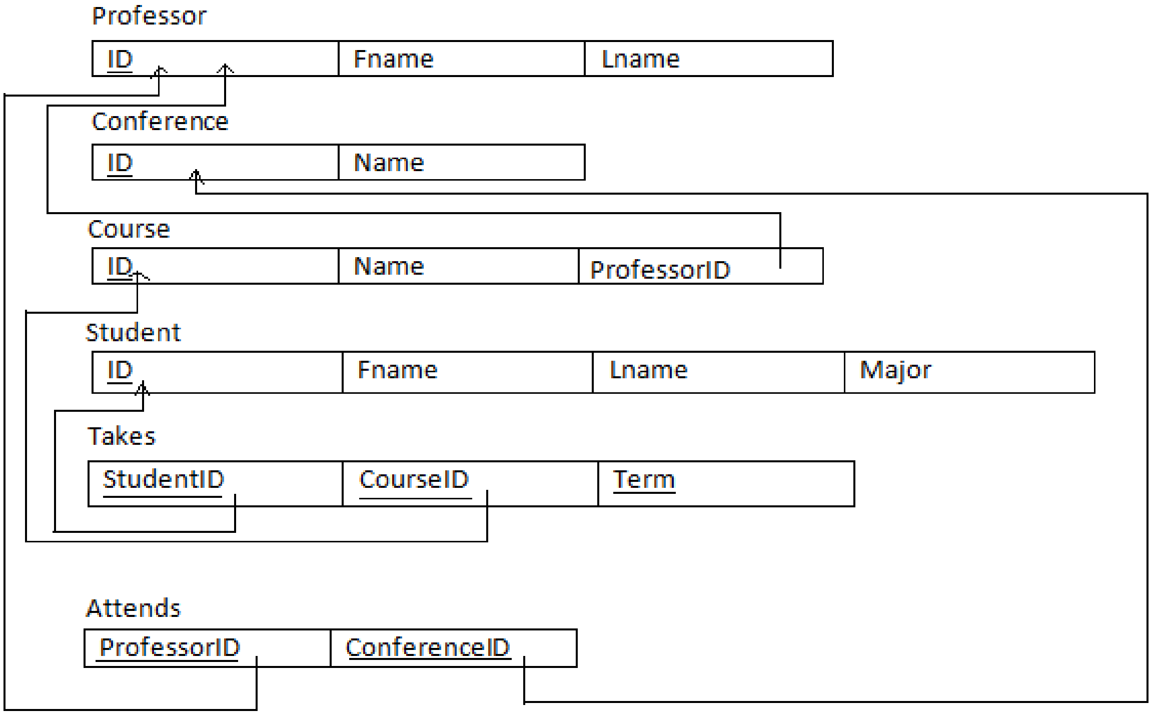
StudentID	CourseID	Term

Now we add table “Attends” which is also many-to-many:



Now consider relationship “Teaches”. This is a one-to-many relationship that has total participation in "many" side. For this relationship we do not create a separate table. This relationship is saying that each course is taught by one professor, so we go to the table for entity “Course” and add to this table “ProfessorID” as another attribute. This is a foreign key that references to ID in table “Professors”.

Below is the final look of the schema:



Professor

ID	Fname	Lname

Conference

ID	Name

Course

ID	Name	ProfessorID

Student

ID	Fname	Lname	Major

Takes

StudentID	CourseID	Term

Attends

ProfessorID	ConferenceID