Access Tutorial 3: Relationships

3.1 Introduction: The advantage of using tables and relationships

A common mistake made by inexperienced database designers (or those who have more experience with spreadsheets than databases) is to ignore the recommendation to model the domain of interest in terms of entities and relationships and to put all the information they need into a single, large table. Figure 3.1 shows such a table containing information about courses and sections.

- If you have not already done so, open the `univ0_vx.mdb` database.
- Open the `Catalog View` table.

The advantage of the single-table approach is that it requires less thought during the initial stages of application development. The disadvantages are too numerous to mention, but some of the most important ones are listed below:

1. Wasted space — Note that for COMM 290, the same basic course information is repeated for every section. Although the amount of disk space wasted in this case is trivial, this becomes an important issue for very large databases.
2. Difficulty in making changes — What happens if the name of COMM 290 is changed to “Mathematical Optimization”? This would require the same change to be made eight times. What if the person responsible for making the change forgets to change all the sections of COMM 290? What then is the “true” name of the course?
3. Deletion problems — What if there is only one section of COMM 290 and it is not offered in a particular year? If section 001 is deleted, then the system no longer contains any information about the course itself, including its name and number of credits.

FIGURE 3.1: The "monolithic" approach to database design—the `Catalog View` table contains information about courses and sections.

The course "COMM 290" consists of many sections.

Each section has some information unique to that section (such as `Time`, `Days`, `Building`, `Room`); however, the basic course information (e.g., `Title`, `Credits`) is the same for all sections of a particular course.

Catalog View : Table

CatalogNum	DeptCode	CrsNum	Title	Section
34134	COMM	290	Introduction to Quai	006
44411	COMM	290	Introduction to Quai	001
69495	COMM	290	Introduction to Quai	005
57455	COMM	290	Introduction to Quai	002
48516	COMM	290	Introduction to Quai	003
71845	COMM	290	Introduction to Quai	004
45938	COMM	290	Introduction to Quai	007
27839	COMM	290	Introduction to Quai	008
83920	COMM	291	Applied Statistics in	002
30293	COMM	291	Applied Statistics in	003

4. Addition problems — If a new section is added to any course, all the course information has to be typed in again. Not only is this a waste of time, it increases the probability of introducing errors into the system.

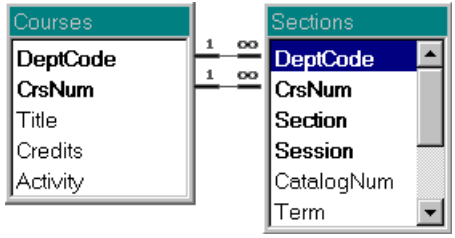
3.1.1 "Normalized" table design

The problems identified above can be avoided by spitting the `Catalog View` table into two separate tables:

1. `Courses`— information about courses only
2. `Sections` — information about sections only.

The key to making this work is to specify a relationship between `Courses` and `Sections` so that when we look at a section, we know which course it belongs to (see Figure 3.2). Since each course can have one or more sections, such a relationship is called "one-to-many".

FIGURE 3.2: A one-to-many relationship between `Courses` and `Sections`.



Access uses relationships in the following way: Assume you are looking at Section 004 of COMM 290. Since `Dept` and `CrsNum` are included in the `Sections` table, and since a relationship line exists between the same two fields in the `Courses` table, Access can trace back along this line to the `Courses` table and find all the course-specific information. All other sections of COMM 290 point back

to the same record in the `Courses` table so the course information only needs to be stored once.

3.2 Learning objectives

- Why do I want to represent my information in multiple tables connected by relationships?
- How do I create relationships in Access?
- How do I edit or change relationships?
- What is referential integrity and why is it important?

3.3 Tutorial exercises

3.3.1 Creating relationships between tables

- Close the `Catalog View` table and return to the database window.
- Select *Tools > Relationships* from the main menu.

In version 2.0 the menu structure is slightly different. As such, you select *Edit > Relationships* instead.

- To add a table to the relationship window, select *Relationships > Show Table* from menu or press the show table icon () on the tool bar.
- Perform the steps shown in Figure 3.3 to add the `Courses` and `Sections` tables.
- Specify the relationship between the **primary key** in `Courses` and the **foreign key** in `Sections`. This is shown in Figure 3.4.

Do not check cascading deletions or updates unless you are absolutely sure what they mean. See on-line help if you are curious.

FIGURE 3.3: Add the `Courses` and `Sections` tables to the relationship window.

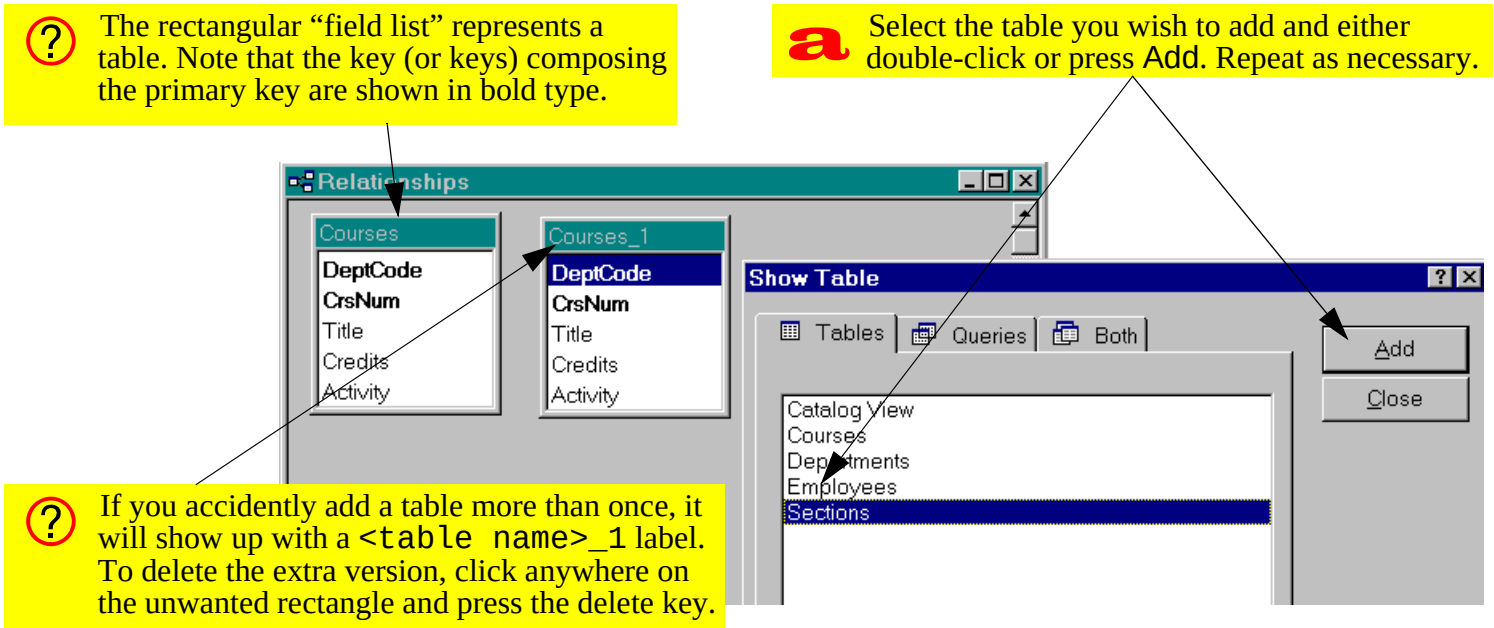


FIGURE 3.4: Create a relationship between the two tables.

a Select the primary key on the "one" side of the relationship.

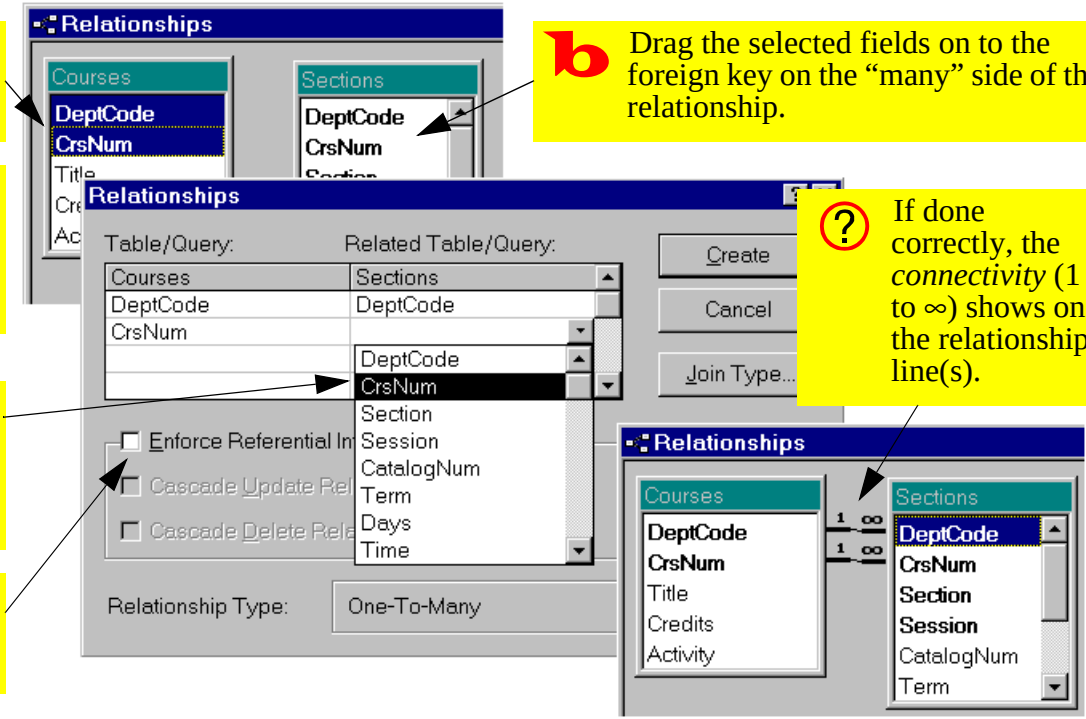
? To select a concatenated key (more than one field) hold down the Control key while selecting.

c Ensure that the correct fields are associated with each other (this must be done manually for concatenated keys).

d Check the box to enforce referential integrity.

b Drag the selected fields on to the foreign key on the "many" side of the relationship.

? If done correctly, the *connectivity* (1 to ∞) shows on the relationship line(s).



3.3.2 Editing and deleting relationships

There are two common reasons for having to edit or delete a relationship:

1. You want to change the data type of one of the fields in the relationship — Access will not let you do this without first deleting the relationship (after you change the data type, you must re-create the relationship).
2. You forget to specify referential integrity — if the "1" and "∞" symbols do not appear on the relationship line, then you have not checked the box to enforce referential integrity.

In this section, assume that we have forgotten to enforce referential integrity between `Courses` and `Sections`.

- Perform the steps shown in Figure 3.5 to edit the relationship between `Courses` and `Sections`.

Note that simply deleting the table in the relationship window does not delete the relationship, it merely hides it from view.

3.4 Discussion

3.4.1 One-to-many relationships

There are three types of relationships that occur in data modeling:

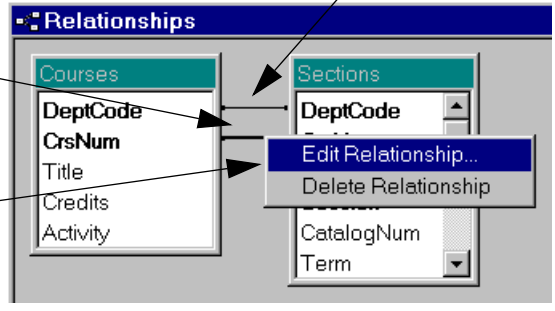
1. **one-to-one** — A one-to-one relationship exists between a student and a student number.
2. **one-to-many** — A one-to-many relationship exists between courses and sections: each course may consist of many sections, but each section is associated with exactly one course.
3. **many-to-many** — A many-to-many relationship exists between students and courses: each student can take many courses and each course can contain many students.

FIGURE 3.5: Edit an existing relationship.

The missing "1" and "∞" symbols indicate that referential integrity has not been enforced.

a Select the relationship by clicking on the joining line (click on either line if the key is concatenated). If you do this correctly, the line becomes darker.

b With the relationship selected, right-click to get the edit/delete pop-up menu. If you do not get this menu, make sure you have correctly selected the relationship.



Although the data modeling technique used most often in information system development—**Entity-Relationship diagraming**—permits the specification of many-to-many relationships, these relationships cannot be implemented in a relational database. As a consequence, many-to-many relationships are usually broken down into a series of one-to-many relationships via “composite entities” (alternatively, “bridging tables”). Thus to implement the student-takes-course relationship, three tables are used: `Students`, `Courses`, and `StudentTakesCourse`.

3.4.2 Referential integrity

One important feature of Access is that it allows you to enforce referential integrity at the relationship level. What is referential integrity? Essentially, referential integrity means that every record on the “many” side of a relationship has a corresponding record on the “one” side.

Enforcing referential integrity means that you cannot, for instance, create a new record in the `Sections` table without having a valid record in the `Courses` table. This is because having a section called “BSKW 101 Section 001” is meaningless unless there is a course called “BSKW 101”. In addition, referential integrity prevents you from deleting records on the “one” side if related records exist on the “many” side. This eliminates the problem of “orphaned” records created when parent records are deleted.

Referential integrity is especially important in the context of transaction processing systems. Imagine that someone comes into your store, makes a large purchase, asks you to bill customer number “123”, and leaves. What if your order entry system allows you to create an order for customer “123” without

first checking that such a customer exists? If you have no customer 123 record, where do you send the bill?

In systems that do not automatically enforce referential integrity, these checks have to be written in a programming language. This is just one example of how table-level features can save you enormous programming effort.

Enforcing referential integrity has obvious implications for data entry: You cannot populate the “many” side of the table until you populate the “one” side.

3.5 Application to the assignment

- Specify all relationships—including referential integrity constraints—between tables in your system. You are not responsible for cascading updates/deletions in this assignment.

A primary key and a foreign key must be of the same data type before a relationship can be created between them. Because of this, it is important to remember that the autonumber data type (or counter in version 2.0) is really a long integer.

It never makes sense to have a relationship between two autonumber fields. A foreign key cannot be an autonumber since referential integrity constraints require it to take on a an existing value from a parent table.