

# The Student Schema Description

Based on <http://www.informit.com/articles/article.aspx?p=31475&seqNum=7>

## THE STUDENT TABLE

Examine the STUDENT schema diagram and locate the STUDENT table. This table contains data about individual students, such as their name, address, employer, and date they registered in the program.

### DataTYPES

Next to each column name in the diagram you find the datatype of the column. Each column contains a different kind of data, which can be classified by a datatype. You will notice that the FIRST\_NAME column is of datatype VARCHAR2(25). This means that a variable length of (with a maximum of 25) alphanumeric characters (letters or numbers) may be stored in this column. Another datatype, the CHAR datatype, also stores alphanumeric data, but is a fixed-length datatype and pads any unused space in the column with blanks until it reaches the defined column length. The STUDENT\_ID column is of datatype NUMBER with a maximum number of eight integer digits and no decimal place digits; the column is the primary key as denoted with the "(PK)" symbol. Oracle also provides a DATE datatype (as seen on the CREATED\_DATE and MODIFIED\_DATE columns) that stores both the date and time. You will learn more about the various datatypes in the next chapter.

Next to each column, the schema diagram indicates if a column allows NULL values. A NULL value is an unknown value. A space or value of zero is not the same as NULL. When a column in a row is defined as allowing NULL values, it means that a column does not need to contain a value. When a column is defined as NOT NULL it must always contain a value.

You will observe that the STUDENT table does not show the city and state. This information can be looked up via the foreign key column ZIP as indicated with the "(FK)" symbol after the column name. The ZIP column is a NOT NULL column and requires that every student row have a corresponding zip code entered.

## The COURSE TABLE

The COURSE table lists all the available courses that a student may take. The primary key of the table is the COURSE\_NO column. The DESCRIPTION column shows the course description and the COST column lists the dollar amount charged for the enrollment in the course. The PREREQUISITE column displays the course number, which must be taken as a prerequisite to this course. This column is a foreign key column and its values refer back the COURSE\_NO column. Only valid COURSE\_NO values may be listed in this column. The relationship line of the COURSE table to itself represents a *recursive* or *self-referencing relationship*.

## RECURSIVE RELATIONSHIP

As the term recursive or self-referencing relationship implies, a column in the course table refers back to another column in the same table. The prerequisite column refers back to the course\_no column, which provides the list of acceptable values (also referred to as a *domain*) for the prerequisite column. Because the relationship is optional, the foreign key column PREREQUISITE column allows null. Recursive relationships are always optional relationships; otherwise, there is no starting point in the hierarchy.

Figure 1.32 lists an excerpt of data from the COURSE table. Notice that the courses with the COURSE\_NO column values of 10 and 20 do not have a value in the PREREQUISITE column, those are the courses which a student must take to be able to take any subsequent courses (unless equivalent experience can be substituted). Course number 20 is a prerequisite course for course number 100, Hands-On-Windows, and course number 140, Structured Analysis. You will explore more about the intricacies of recursive relationships in Chapter 15, "Advanced SQL Queries."

| COURSE_NO | COURSE_DESCRIPTION   | PREREQUISITE |
|-----------|----------------------|--------------|
| 10        | SQL Overview         |              |
| 20        | Structured Analysis  |              |
| 100       | Hands-On-Windows     | 20           |
| 140       | Structured Analysis  | 20           |
| 170       | Advanced Programming | 100          |

Figure 1.32 Data from the COURSE table.

## The SECTION TABLE

The SECTION TABLE includes all the individual sections a course may have. An individual course may have zero, one, or many sections, each of which can be taught at different rooms, times, and by different instructors. The primary key of the table is the SECTION\_ID. The foreign key that links back to the COURSE table is the COURSE\_NO column. The SECTION\_NO column identifies the individual section number. For example, for the first section of a course, it contains the number 1; the second section lists the number 2, and so on. The two columns, course\_no and section\_no, also uniquely identify a row, but section\_id has been created instead. This SECTION\_ID column is called a surrogate key because it does not have any meaning to the user.

The column START\_DATE\_TIME shows the date and time the section meets for the first time. The LOCATION column lists the classroom. The CAPACITY column shows the maximum number of students that may enroll in this section. The instructor\_ID column is another foreign key column within the SECTION table; it links back to the INSTRUCTOR table. The relationship between the SECTION and the INSTRUCTOR table indicates that an instructor must always be assigned to a section. The INSTRUCTOR\_ID column of the SECTION table may never be null and when you read the relationship from the opposite end, you can say that an individual instructor may teach zero, one, or multiple sections.

The relationship line leading from the course table to the section table means that a course may have zero, one, or multiple sections. Conversely, every individual section *must* have a corresponding row in the course table.

Relationships between tables are based on *business rules*. In this case, the business rule is that a course can exist without a section, but a section cannot exist unless it is assigned to a course. As mentioned, this is indicated with the bar (|) on the other end of the relationship line. Most of the child relationships on the schema diagram are considered mandatory relationships (with two exceptions); this dictates that the foreign key columns in the child table must contain a value (must be NOT NULL) and that value must correspond to a row in the parent table via its primary key value.

## **The INSTRUCTOR TABLE**

The INSTRUCTOR table lists information related to an individual instructor, such as name, address, phone, and zip code. The ZIP column is the foreign key column to the ZIPCODE table. The relationship between the INSTRUCTOR and the ZIPCODE is an optional relationship so a null value in the ZIP column is allowed. For a given ZIP column value there is one and only one value in the ZIPCODE table. For a given ZIP value in the ZIPCODE table you may find zero, one, or many of the same value in the INSTRUCTOR table. Another foreign key relationship exists to the SECTION table: an instructor may teach zero, one, or multiple sections and an individual section can be taught by one and only one instructor.

## **THE ZIPCODE TABLE**

The primary key of zipcode is the ZIP column. For an individual zip code it allows you to look up the corresponding CITY and STATE column values. The datatype of this column is VARCHAR2 and not a NUMBER, as it allows you to enter leading zeros. Both the STUDENT and the INSTRUCTOR table reference the ZIPCODE table. The relationship between the ZIPCODE and STUDENT tables is mandatory: For every ZIP value in the STUDENT table there must be a corresponding value in the ZIPCODE table, and for one given zip code, there may be zero, one, or multiple students with that zip code. In contrast, the relationship between the INSTRUCTOR and ZIPCODE table is optional; the ZIP column of the INSTRUCTOR table may be null.

## **What about Delete Operations?**

Referential integrity does not allow deletion in a parent table of a primary key value that exists in a child table as a foreign key value. This would create orphan rows in the child table. There are many ways to handle deletes and you will learn about this topic and the effects of the deletes on other tables in Chapter 10, "Insert, Update, and Delete."

## THE ENROLLMENT TABLE

The enrollment table is an intersection table between the STUDENT and the SECTION table. It lists the students enrolled in the various sections. The primary key of the table is a composite primary key consisting of the STUDENT\_ID and SECTION\_ID columns. This unique combination does not allow a student to register for the same section twice. The ENROLL\_DATE column contains the date the student registered for the section and the FINAL\_GRADE column lists the student's final grade. The final grade is to be computed from individual grades such as quizzes, homework assignments, and so on.

The relationship line between the ENROLLMENT and STUDENT tables indicates that one student may be enrolled in zero, one, or many sections. For one row of the enrollment table you can find one and only one corresponding row in the STUDENT table. The relationship between the ENROLLMENT and SECTION table shows that a section may have zero, one, or multiple enrollments. A single row in the ENROLLMENT table always links back to one and only one row in the SECTION table.

## The GRADE\_TYPE table

The GRADE\_TYPE table is a lookup table for other tables as it relates to grade information. The table's primary key is the GRADE\_TYPE\_CODE column that lists the unique category of grade, such as MT, HW, PA, and so on. The DESCRIPTION column describes the abbreviated code. For example, for the GRADE\_TYPE\_CODE of MT you will find the description Midterm, for HW you see Homework.

## The GRADE TABLE

This table lists the grades a student received for an individual section. The primary key columns are STUDENT\_ID, SECTION\_ID, GRADE\_TYPE\_CODE, and GRADE\_CODE\_OCCURRENCE. For an individual student you will find the all the grades related to the section the student is enrolled in. For example, the listed grades in the table may include the midterm grade, individual quizzes, final examination grade, and so on. For some grades (e.g., quizzes, homework assignments) there may be multiple grades and the sequence number is shown in the GRADE\_CODE\_OCCURRENCE column. [Figure 1.33](#) displays an excerpt of data from the GRADE table. The NUMERIC\_GRADE column lists the actual grade received. This grade may be converted to a letter grade with the help of the GRADE\_CONVERSION table discussed later.

| STUDENT_ID | SECTION_ID | GRADE_TYPE_CODE | GRADE_CODE_OCCURRENCE | NUMERIC_GRADE |
|------------|------------|-----------------|-----------------------|---------------|
| 101        | 104        | MT              | 1                     | 75            |
| 101        | 104        | HW              | 1                     | 75            |
| 101        | 104        | HW              | 2                     | 75            |
| 101        | 104        | HW              | 3                     | 75            |
| 101        | 104        | HW              | 4                     | 75            |
| 101        | 104        | HW              | 5                     | 75            |
| 101        | 104        | PA              | 1                     | 75            |
| 101        | 104        | PA              | 2                     | 75            |
| 101        | 104        | PA              | 3                     | 75            |
| 101        | 104        | PA              | 4                     | 75            |
| 101        | 104        | PA              | 5                     | 75            |
| 101        | 104        | PA              | 6                     | 75            |
| 101        | 104        | PA              | 7                     | 75            |
| 101        | 104        | PA              | 8                     | 75            |
| 101        | 104        | PA              | 9                     | 75            |
| 101        | 104        | PA              | 10                    | 75            |
| 101        | 104        | PA              | 11                    | 75            |
| 101        | 104        | PA              | 12                    | 75            |
| 101        | 104        | PA              | 13                    | 75            |
| 101        | 104        | PA              | 14                    | 75            |
| 101        | 104        | PA              | 15                    | 75            |
| 101        | 104        | PA              | 16                    | 75            |
| 101        | 104        | PA              | 17                    | 75            |
| 101        | 104        | PA              | 18                    | 75            |
| 101        | 104        | PA              | 19                    | 75            |
| 101        | 104        | PA              | 20                    | 75            |
| 101        | 104        | PA              | 21                    | 75            |
| 101        | 104        | PA              | 22                    | 75            |
| 101        | 104        | PA              | 23                    | 75            |
| 101        | 104        | PA              | 24                    | 75            |
| 101        | 104        | PA              | 25                    | 75            |
| 101        | 104        | PA              | 26                    | 75            |
| 101        | 104        | PA              | 27                    | 75            |
| 101        | 104        | PA              | 28                    | 75            |
| 101        | 104        | PA              | 29                    | 75            |
| 101        | 104        | PA              | 30                    | 75            |
| 101        | 104        | PA              | 31                    | 75            |
| 101        | 104        | PA              | 32                    | 75            |
| 101        | 104        | PA              | 33                    | 75            |
| 101        | 104        | PA              | 34                    | 75            |
| 101        | 104        | PA              | 35                    | 75            |
| 101        | 104        | PA              | 36                    | 75            |
| 101        | 104        | PA              | 37                    | 75            |
| 101        | 104        | PA              | 38                    | 75            |
| 101        | 104        | PA              | 39                    | 75            |
| 101        | 104        | PA              | 40                    | 75            |
| 101        | 104        | PA              | 41                    | 75            |
| 101        | 104        | PA              | 42                    | 75            |
| 101        | 104        | PA              | 43                    | 75            |
| 101        | 104        | PA              | 44                    | 75            |
| 101        | 104        | PA              | 45                    | 75            |
| 101        | 104        | PA              | 46                    | 75            |
| 101        | 104        | PA              | 47                    | 75            |
| 101        | 104        | PA              | 48                    | 75            |
| 101        | 104        | PA              | 49                    | 75            |
| 101        | 104        | PA              | 50                    | 75            |
| 101        | 104        | PA              | 51                    | 75            |
| 101        | 104        | PA              | 52                    | 75            |
| 101        | 104        | PA              | 53                    | 75            |
| 101        | 104        | PA              | 54                    | 75            |
| 101        | 104        | PA              | 55                    | 75            |
| 101        | 104        | PA              | 56                    | 75            |
| 101        | 104        | PA              | 57                    | 75            |
| 101        | 104        | PA              | 58                    | 75            |
| 101        | 104        | PA              | 59                    | 75            |
| 101        | 104        | PA              | 60                    | 75            |
| 101        | 104        | PA              | 61                    | 75            |
| 101        | 104        | PA              | 62                    | 75            |
| 101        | 104        | PA              | 63                    | 75            |
| 101        | 104        | PA              | 64                    | 75            |
| 101        | 104        | PA              | 65                    | 75            |
| 101        | 104        | PA              | 66                    | 75            |
| 101        | 104        | PA              | 67                    | 75            |
| 101        | 104        | PA              | 68                    | 75            |
| 101        | 104        | PA              | 69                    | 75            |
| 101        | 104        | PA              | 70                    | 75            |
| 101        | 104        | PA              | 71                    | 75            |
| 101        | 104        | PA              | 72                    | 75            |
| 101        | 104        | PA              | 73                    | 75            |
| 101        | 104        | PA              | 74                    | 75            |
| 101        | 104        | PA              | 75                    | 75            |
| 101        | 104        | PA              | 76                    | 75            |
| 101        | 104        | PA              | 77                    | 75            |
| 101        | 104        | PA              | 78                    | 75            |
| 101        | 104        | PA              | 79                    | 75            |
| 101        | 104        | PA              | 80                    | 75            |
| 101        | 104        | PA              | 81                    | 75            |
| 101        | 104        | PA              | 82                    | 75            |
| 101        | 104        | PA              | 83                    | 75            |
| 101        | 104        | PA              | 84                    | 75            |
| 101        | 104        | PA              | 85                    | 75            |
| 101        | 104        | PA              | 86                    | 75            |
| 101        | 104        | PA              | 87                    | 75            |
| 101        | 104        | PA              | 88                    | 75            |
| 101        | 104        | PA              | 89                    | 75            |
| 101        | 104        | PA              | 90                    | 75            |
| 101        | 104        | PA              | 91                    | 75            |
| 101        | 104        | PA              | 92                    | 75            |
| 101        | 104        | PA              | 93                    | 75            |
| 101        | 104        | PA              | 94                    | 75            |
| 101        | 104        | PA              | 95                    | 75            |
| 101        | 104        | PA              | 96                    | 75            |
| 101        | 104        | PA              | 97                    | 75            |
| 101        | 104        | PA              | 98                    | 75            |
| 101        | 104        | PA              | 99                    | 75            |
| 101        | 104        | PA              | 100                   | 75            |

**Figure 1.33** Data from the GRADE table.

From the relationship between the ENROLLMENT and GRADE table, you can learn that rows only exist in the GRADE table if the student is actually enrolled in the section listed in the ENROLLMENT table. In other words, it is not possible for a student to have grades for a section in which he or she is not enrolled. The foreign key columns STUDENT\_ID and SECTON\_ID from the ENROLLMENT table enforce this relationship.

## **THE GRADE\_TYPE\_WEIGHT table**

The GRADE\_TYPE\_WEIGHT table aids in computation of the final grade a student receives for an individual section. This table lists how the final grade for an individual section is computed. For example, the midterm may constitute 50 percent of the final grade, all the quizzes 10 percent, and the final examination 40 percent. If there are multiple grades for a given GRADE\_TYPE\_CODE, the lowest grade may be dropped if the column DROP\_LOWEST contains the value "Y". The final grade is determined by using the individual grades of the student and section in the GRADE table in conjunction with this table. This computed final grade value is stored in the FINAL\_GRADE column of the ENROLLMENT table discussed previously. (The FINAL\_GRADE column is a derived column. As mentioned, the values to compute this number are available in the GRADE and GRADE\_TYPE\_WEIGHT tables, but because the computation of this value is complex, it is stored to simplify queries.)

The primary key of this table consists of the SECTION\_ID and GRADE\_TYPE\_CODE columns. A particular grade\_type\_cd value may exist zero, one, or multiple times in the GRADE\_TYPE\_WEIGHT table. For every row of the GRADE\_TYPE\_WEIGHT table you will find one and only one corresponding GRADE\_TYPE\_CODE value in the GRADE\_TYPE table.

The relationship between the GRADE\_TYPE\_WEIGHT table and the SECTION table indicates that a section may have zero, one, or multiple rows in the GRADE\_TYPE\_WEIGHT table for a given SECTION\_ID value. For one SECTION\_ID value in the GRADE\_TYPE\_WEIGHT table there must always be one and only one corresponding value in the SECTION table.

## **The GRADE\_CONVERSION TABLE**

The purpose of the GRADE\_CONVERSION table is to convert a number grade to a letter grade. The table does not have any relationship with any other tables. The column LETTER\_GRADE contains the unique grades, such as A+, A, A-, B, and so forth. For each of these letter grades, there is an equivalent number range. For example, for the letter B, the range is 83 through 86 and is listed in the MIN\_GRADE and MAX\_GRADE columns.