5 An Example

A university has oral examinations at the end of each semester, and wants to manage related data using a relational database. The relevant attributes to be stored are:

\[ R = \{ \text{Student, Course, Chapter, Time, Room} \} \]

Here Chapter denotes a chapter from the course textbook the student will be examined about. Every student can get examined about multiple chapters, and chapters may vary for each student. Multiple students can get examined at the same time in the same room, but the course must be the same. Further constraints are that a student gets examined for a course only once, and can’t be in multiple rooms at the same time.

Errata

The gentleman expresses himself backwards. Second, some requirements are missing. Based on the possibility that the universal relation, by "multiple chapters" apparently he means:

- multiple courses per student
- one exam per course
- multiple chapters per exam, in one sitting.

Data Model

In order to record the facts given (above), and to understand the data, a Relational data model was erected. This layout employs the Explorer style, the data hierarchies are horizontal, and indented.

Note

1. The facts regarding the data, given in text form in the paper, were translated into Relational form, the Relational context. Verification was requested.
2. No keys were given in the source document. Other than to support the given facts, Key determination (formal Normalisation) was not attempted.
3. StudentExamination.PK provides: a student gets examined for a course only once
4. StudentExamination.AK provides: a student can’t be in multiple rooms at the same time
5. CourseExamination.AK provides (restated): one course per (DateTime, Room)
6. The "functional dependencies" given in the referenced document had not been examined. Key determination from "functional dependencies" had not been attempted.
7. Upon further evaluation, it was determined that the Keys were correct and complete.
8. The simple act of placing the data in a Relational context eliminated the problem that the paper proposes to solve. All requirements are fulfilled, all reports can be produced via natural joins.
9. A number of additional constraints that are above and beyond the simple requirements identified, these are either 'obvious', or the minimum a standard-compliant practitioner would implement.
10. The data model is Relational, in the original 3NF, with no Redundancies; no Update Anomalies ("5NF" to the theoreticians). No further Normalisation; decomposition; or reduction, is possible.
11. Although the Relational solution is provided here, it is alien to the paper. In order to furnish some element that can be readily compared, sample data for the universal relation on page 6, if implemented using this data model, is given on the right. The critical table StudentExamination can be discerned by omitting (ignoring) the Chapter column.
12. The model is complete, awaiting verification of the declared basis [1][4][5][7].
An alternate layout, employing the organisation chart style, is presented here. This is easier for novices to understand, the data hierarchies are plain, vertical.

Business Rule

These are all the Constraints that govern the data, expressed formally (to the user, not to theoreticians).

Chapter is a Dependent of Course, and is an element of 1 Course ( )

Course is Independent

Course is a Dependent of Time, and is a schedule of 1 Time

Course is Identified by ( Course )

Course is Described by ( Textbook )

Course Identifies, and requires 0-n CourseExaminations

Course Identifies, and attracted 0-n StudentEnrolments

Course Identifies, and comprises 0-n Chapters

CourseExamination is a Dependent of Time, and is a schedule of 1 Time

CourseExamination is a Dependent of Room, and is located in 1 Room

CourseExamination is a Dependent of Course, and is a requirement of 1 Course

CourseExamination is Primarily Identified by ( DateTime, Room, Course )

CourseExamination is Alternately Identified by ( DateTime, Room )

CourseExamination hosted 0-n StudentExaminations

ExaminationChapter is a Dependent of StudentExamination, and is used by 1 StudentExamination

ExaminationChapter is a Dependent of Chapter, and uses 1 Chapter

ExaminationChapter is Identified by ( Student, Course, Chapter )

Room is Independent

Room is Identified by ( Room )

Room Identifies, and locates 0-n CourseExaminations

Student is Independent

Student is Identified by ( Student )

Student Identifies, and enrolled 0-n StudentEnrolments

StudentEnrolment is a Dependent of Student, and is an enrollment of 1 Student

StudentEnrolment is a Dependent of Course, and is attracted by 1 Course

StudentEnrolment is Identified by ( Student, Course )

StudentEnrolment Identifies, and sat for 0-1 StudentExaminations

StudentExamination is a Dependent of StudentEnrolment, and is a sitting of 1 StudentEnrolment

StudentExamination is Primarily Identified by ( Student, Course )

StudentExamination is Alternately Identified by ( Student DateTime )

StudentExamination is hosted by 1 CourseExamination

StudentExamination Identifies, and used 0-n ExaminationChapter

Time is Independent

Time is Identified by ( DateTime )

Time Identifies, and schedules 0-n CourseExaminations