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ROLE OF ENTITY-RELATIONSHIP (E-R) MODEL IN DATABASE DESIGN : AN ILLUSTRATIVE REVIEW

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ABSTRACT

The purpose of this paper is to show the importance of Entity-Relationship (E-R) model in database design which is a high level data model that helps the database designer to grapes the customer needs in most efficient manner

INTRODUCTION

The Entity-Relationship (E-R) model was first described by Peter Chen[1] in 1976. It is a high-level conceptual data model. The E-R model concepts are designed to be closer to users perception of data. It is used to interpret, specify and document requirements for database processing systems. It provides constructs for showing the overall structures of the users data requirements.

The basic object (thing with or without physical existence) that E-R model represents is an entity. Each entity has particular properties called attributes that describe it. Similar entities define an entity type, which is a set of entities that have the same attribute. Entities can be associated with one another. These associations are called relationship and a relationship type is a set of association among many entity types. An entity type usually has an attribute whose values are distinct for each individual entity. Such an attribute is called a key attribute, and its value can be used to identify each entity uniquely. The cardinality ratio specifies the number of relationship instances that an entity can participate in. If every entity of an entity type associates with a relationship, the participation is called mandatory or total participation. If some of the entities of an entity type associate with a relationship it is called optional or partial participation.

CASE STUDY

We are interested to design the Bangladesh Institute of Technology (BIT), Chittagong database which keeps track of students, teachers, departments, courses of each department, teacher of each courses and grade report of student. After collection of the requirement specification of this database we have got the following points –

1. There are seven departments in BIT Chittagong. Only degree awarding departments offer courses to the students. Every department has a Head.
2. The students are only attached to the degree awarding departments. No students are allowed to attach more than one department. A student must study some predetermined courses each semester. Only the students of fourth year (eighth semester) have to do a Project/Thesis either individually or in a group of two students. Students achieve a result of their performance in each course as a grade.

3. Every teacher must be attached to a particular department. A teacher may teache the courses of other departments. Courses offered by the various departments have their unique name and code. A course is taught usually by a single teacher, but there may some courses that are taught by more than one teacher

SELECTION OF ENTITY TYPES

According to the requirement specification, we can identify the following entity types of this database:

1. An entity type DEPARTMENT with attributes Name, DeptCode, DeptHead. We can specify that each of Name and DeptCode is a key attribute.
2. An entity type STUDENT with attributes Name, RollNo, RegistrationNo, Semester, Year, Address, Department. Each name and RollNo is a key attribute.
3. An entity type TEACHER with attributes Name, Designation, Address, BirthDate, Department, Sex, joiningDate, Salary. Name is the key attribute.
4. An entity type COURSE with attributes Title, CourseNo, CreditHour, CourseContent, Grade, Department. Each of CourseNo and Title is a key attribute.

RELATIONSHIP TYPES

Whenever an attribute of one entity type refers to another entity type, some relationship exists among them. The above four entity types are related to another in different ways. They are explain below—

1. Dept-Teacher: It is a relationship between the entity type DEPARTMENT and entity type TEACHER Every teacher is attached to any one of the seven departments. It means that every entity of entity type TEACHER is participating to the relationship. Thus the entity type TEACHER has a total participation. On the other hand, every department has teachers and in this case the participation of the entity type DEPARTMENT is also total. Every teacher of the institute is attached to a particular department and a department may have more than one teacher. So the cardinality ratio Departmet :Teacher :: 1: N. The E-R diagram shows the relationship in fig.1.
2. Dept-Head: It is another relation between the entity type DEPARTMENT and TEACHER. The relation indicates that in every department there will be a Head of the department. Among the teachers one teacher will be the Head of the department. For this reason the participation of the entity type TEACHER is partial. On the other hand every department must have one of its teachers as the head of the department. Therefore, participation of the entity type DEPARTMENT is total. Here, the cardinality ratio, Department : Teacher :: 1 : 1.
3. Dept-Course: The relationship formed between entity type DEPARTMENT and COURSE points at the courses of every department. All the degree awarding departments offer courses to the students, so the participation of the entity type DEPARTMENT to the relation Dept-Course is total and in the same way participation of course is also total. A department offers more than one course and a course belongs to only one department. So ratio, Department : Course :: 1 : N.
4. Dept-Student: It is a relationship between the entity type DEPARTMENT and STUDENT. It is observed that every student of the institute only belongs to a particular degree awarding department (*i.e.*, CE, EE & ME); So the participation of the entity type DEPARTMENT is partial whereas that of student is total. Here, the cardinality ratio,Department:Student :: 1 : N.
5. Course-Teacher: The relationship between the entity types COURSE and TEACHER is termed as Course-Teacher, which gives information about teacher of every courses. Here the participation of entity type TEACHER is partial and COURSE is total. A course may be

taught by more than one teacher and a teacher may conduct more than one course. So the cardinality ratio, Course . Teacher : : M . N.

6 Grade-Point: It is a relation between the entity types STUDENT and COURSE. This relationship has an attribute grade. The relation Grade-point keeps track of the grade of the student that he has studied. As every student must study courses offered by the department, the participation of the entity type STUDENT to the relation is partial and participation of the entity type COURSE is also total. The cardinality ratio, Student:Course :: M : N.

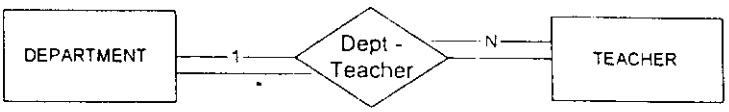

Fig. 1 : E-R diagram of DEPARTMENT-TEACHER

ENTITY-RELATIONSHIP DIAGRAM

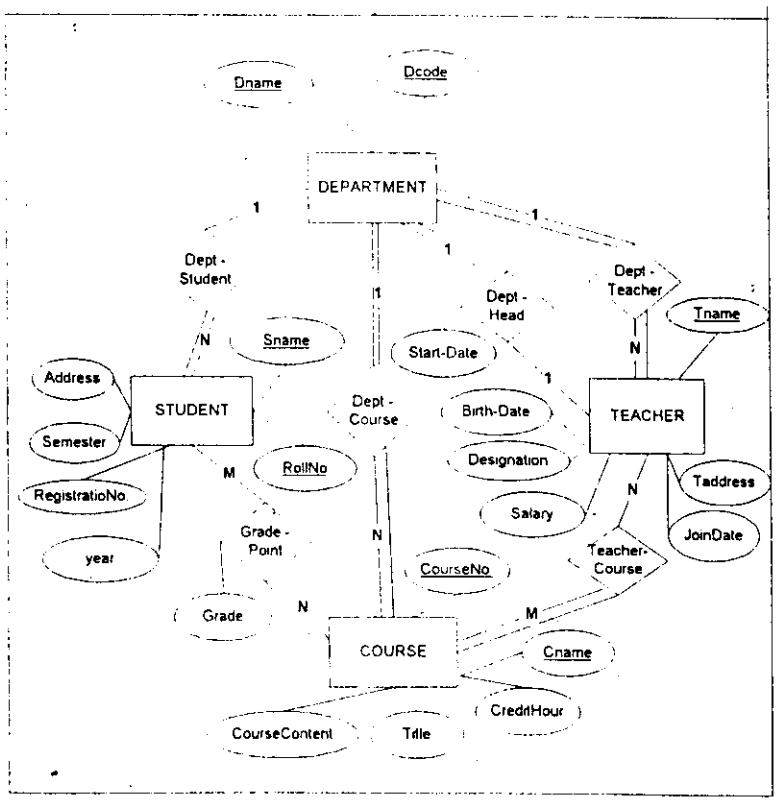

Fig 2 Entity-Relationship (E-R) diagram of BIT Chittagong Database

Fig. 2 displays the BIT Chittagong E-R database schema as an E-R diagram. The entity types DEPARTMENT, TEACHER, STUDENT and COURSE are shown in rectangular boxes. Relationship types Dept-Teacher, Dept-Head, Dept-Course, Dept-Student, Course-Teacher and Grade-Point are shown in diamond shaped boxes attached to the participating entity types with straight line. Attributes are shown in ovals and each attribute is attached to its entity type or relationship type by a straight line. The cardinality ratio of each binary relationship is specified by attaching a 1, M or N on each participating edge. The participation is specified by a single line for partial participation and double line for total participation.

CONCLUSION

Database design is a process through which requirements are translated into representation of software which satisfy the users requirements. Analysis and design phase of a software usually absorbs about 50 percent effort of the total development life-cycle. The E-R model is used primarily in the database design process for conceptual schema design which concern with the description and synthesis of diverse users information requirement into a preliminary design. Once E-R model of a certain miniworld (problem area) is established we can easily map it into any one of the three existing implementation data model (*i.e.*, Relational, Hierarchical & Network) and can be implemented directly using Database Management System (DBMS) based on those models.. Actually all modern DBMS are based on the three models and out of these three models now a days almost all commercially available DBMS are based on relational data model.

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