CSC3170 Homework1 120090694

Tong Zhen

February 2022

1 Question 1

1.1 Design an E-R diagrams for this situation, indicating the data attributes and stating clearly any assumptions that you make.

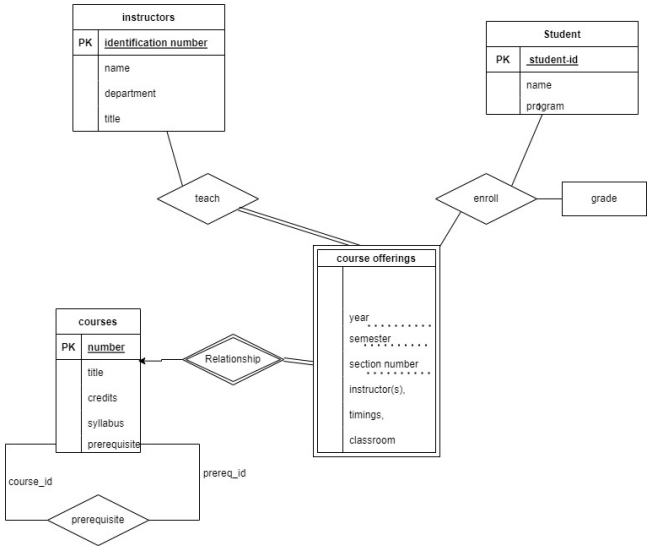

Figure 1: question 1.1 figure

1.2 Construct relational schemas for the above E-R diagram.

students(student-id , name, program)
instructors(identification number , name, department,title)
courses(number , title, credits, syllabus, prerequisites)
course offerings(course number , year , semester , section number , instructor(s), timings, classroom.)
enroll (student-id, section number, year, semester, timmings, classroom)
teaches(instructors, section number, year, semester, timmings, classroom)
prerequisites(course_number, prere_number)

2 Question 2

2.1 identify the columns in the database that would need to be changed.

COURSE.Course_number
COURSE.Department
SECTION.Course_number
SECTION.Department
PREREQUISITE.Course_number
PREREQUISITE.Department

2.2 The kind of changes in (a) above can occur from time to time. Can you restructure the columns in the database schema to reduce the impact of the above change?

add a new entity set Department(dept_id, Dept_name)
Other entity sets change into:
STUDENT (Student_number, Name, Class, Major)
COURSE (Course_name, Course_number , Credit_hours, dept_id)
PREREQUISITE (Course_number, Prerequisite_number)

3 Question 3

Design a generalization–specialization hierarchy for a motor-vehicle sales company. The company sells motorcycles, passenger cars, vans, and buses. Assume that there are the two categories of vehicles: commercial and non-commercial. Note that each vehicle would attract a general sales tax, as well as an additional tax applicable to its category.
You should determine the attributes of each entity type and indicate these attributes using appropriate notations. You should state any assumptions you make

Assumptions:Vehicles can be divided into Commercial and non-commercial. Commercial-vehicles have buses and vans. Non-commercial-vehicles have passenger cars and motocycles. Each vehicle is with a general tax, while the additional tax is depended on the commercial or non-commercial type.

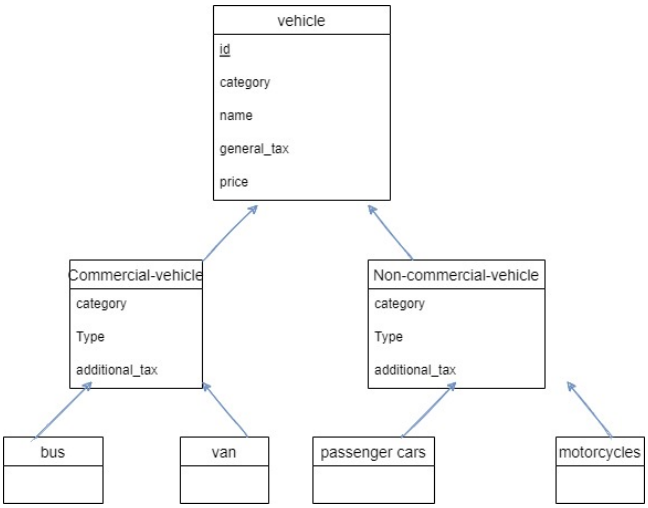

Figure 2: question 3 figure

Question 4-10

EMPLOYEE (Fname, Minit, Lname, Ssn, Bdate, Address, Sex, Salary, Super_ssn, Dno)
DEPARTMENT (Dname, Dnumber, Mgr_ssn, Mgr_start_date),
DEPT_LOCATIONS (Dnumber, Dlocation)
WORKS_ON (Essn, Pnumber, Hours)
PROJECT (Pname, Pnumber, Plocation, Dnum)
DEPENDENT (Essn, Dependent_name, Sex, Bdate, Relationship)

where Fname signifies first name; Minit, middle initial; Lname, last name; Ssn, Essn are the social security numbers; Super_ssn is the social security number of the supervisor; Dname, Dnum, Dno, Dlocation are department name, number and location (similarly for projects); while other attributes have an obvious interpretation.

4 Question 4

Retrieve the name and address of all employees who work for the "Research" department.

$$\prod_{Fname,Minit,Lname,Address}(EMPLOYEE \triangleright\!\triangleleft_{Dno=Dnumber}(\sigma_{Dname="Research"}(DEPARTMENT)))$$

5 Question 5

For every project located in 'Stafford', list the project number, the controlling department manager's last name, address, and birth date.

$$\prod_{(Pname,Lname,Address,Bdate)}(\sigma_{Plocation="Stafford"}(PROJECT)\rhd\lhd_{Dnum=Dnumber}(EMPLOYEE) \rhd\lhd_{Mgr_sn=Ssn}(DEPARTMENT))$$

6 Question 6

Make a list of project numbers for projects that involve an employee whose last name is "Smith", either as a worker or as a manager of the department that controls the project.

$$\prod_{(Pnumber)}(\sigma_{Lname="Smith"}(EMPLOYEE)\rhd\lhd_{Ssn=Mgr_sn}(DEPARTMENT) \rhd\lhd_{Dnumber=Dnum}(PROJECT)) \cup \prod_{(Pnumber)}(\sigma_{Lname="Simth"}(EMPLOYEE) \rhd\lhd_{Ssn=Essn}(WORK_ON))$$

7 Question 7

Retrieve the names of employees who have no dependents

$$\prod_{Fname,Minit,Lname}(EMPLOYEE) - \prod_{Fname,Minit,Lname}((EMPLOYEE) \rhd\lhd_{Ssn=Essn}(DEPENDENT))$$

8 Question 8

List the names of managers who have at least one dependent.

$$\prod_{Fname,Minit,Lname}((DEPENDENT)\rhd\lhd_{Essn=ssn}(EMPLOYEE)\rhd\lhd_{Ssn=Mgr_sn}(DEPARTMENT))$$

9 Question 9

Find all employees directly supervised by "James Borg".

9.1 method 1

$$JB_{ssn} \leftarrow \prod_{Ssn}(\sigma_{Fname="James"\wedge Lname="Borg"}(EMPLOYEE\rhd\lhd_{Ssn=Mgr_sn}DEPARTMENT)) \sigma_{Super_{ssn}=JB_{ssn}}(EMPLOYEE)$$

9.2 method 2

$\prod_{Em,Ssn}(\rho_{Em}(EMPLOYEE)\triangleright\triangleleft_{Em,Super_S sn=S.ssn}(\rho_s(\sigma_{Fname="James \wedge Lname="Borg"}(EMPLOYEE)))$

10 Question 10

Find all employees directly supervised by those directly supervised by "James Borg". Would it be possible to find all employees supervised by a given employee at all levels?

10.1 method1

$JB\_ssn \leftarrow \prod_{Ssn}(\sigma_{Fname="James \wedge Lname="Borg"}(EMPLOYEE\triangleright\triangleleft_{Ssn=Mgr\_ssn}DEPARTMENT))$

$ES\_ssn \leftarrow \prod_{Ssn}(\sigma_{Super\_ssn=JB\_ssn}(EMPLOYEE\triangleright\triangleleft_{Ssn=Mgr\_ssn}DEPARTMENT))$

$\sigma_{Super_{ssn}=ES\_ssn}(EMPLOYEE)$

10.2 method 2

$\prod_{E0Ssm}(\rho_{E0}(EMPLOYEE)\triangleright\triangleleft_{E0.Super_s sn=E1.Ssn}(\rho_{E1}(EMPLOYEE)\triangleright\triangleleft_{E1.Super_s sn=S.ssn}\rho_s($
$\sigma_{Fname="James \wedge Lname="Borg"}(EMPLOYEE))))$