Homework Two

The Relational Algebra and RDB

Out September 26, Due October 10

This homework involves using an implementation of the relational algebra (RDB) installed on the GL and CS machines. A manual and tutorial for RDB have been provided as a separate handout and are also available via the 661 web pages In submitting answers, provide a copy of interactive sessions in which the various values and functions are defined, and in which results are displayed. To do this, you should use the **script** command, which saves an interactive session in a file that you list after the command (do *"man script"* for details).

Please submit readable output; we do not want to see your mistakes, only final answers. It will help to do a trial run, or to edit the script file once you are done. You may also use a pen to beautify your output and to add a few appropriate comments– in particular, to indicate in a conspicuous color where each question or part question begins and to explain the use and meaning of identifiers where appropriate.

1 The suppliers, parts and shipments database

This problem uses RDB with a suppliers-parts-projects database. To access this, we suggest you copy `finin/pub/spj.rdb` on umbc8 or any of the CS machines into your own area. You can then say *use 'spj.rdb';* while in RDB to load it. You can then save updated relations during the RDB session.

Write RDB expressions to answer the following queries against the *suppliers-parts-projects* database. You may break an answer up into a series of queries, using "it" to refer to the previous result. You may also store an intermediate answer in variables (*e.g.* "let temp=.....").

1. Get the supplier names for all suppliers who supply project j1.
2. Find triples of suppliers, projects and parts such that all three are located in the same city.
3. Get the names of parts supplied by a supplier in london.
4. Get project numbers for projects using at least one part available from supplier s1.
5. Get project numbers for projects not supplied with any red parts by any london suppliers.
6. Get supplier numbers for suppliers who supply the same part to all projects.
7. Get part numbers for parts that are supplied either by a london supplier or to a london project.
8. What is the average weight of a screw?
9. Which part is the heaviest?

2 University Database

Consider the following design for a "university" database. Primary keys are underlined.

department(<u>Dcode</u>, Dname, Chair)	*course(<u>Dcode, Cnum</u>, Title, Units)*
prereq(<u>Dcode, Cnum, Pcode, Pnum</u>)	*class(<u>Classnum</u>, Dcode, Cnum, Instructor)*
faculty(<u>Ssn</u>, Fname, Dcode, Rank)	*student(<u>Ssn</u>, Sname, Major, Status)*
enrolled(<u>Class, Student</u>)	*transcript(<u>Student, Dcode, Cnum</u>, Grade)*

Notes on domains:

- Values of *Course.Dcode*, *Faculty.Dcode* and *Student.Major* are from *Department.Dcode*.
- Values of (*Prereq.Dcode, Prereq.Cnum*), (*Prereq.Pcode, Prereq.Pnum*), (*Class.Dcode, Class.Cnum*) and (*Transcript.Dcode, Transcript.Cnum*) are from (*Course.Dcode, Course.Cnum*).
- Values of *Department.Chair* and *Class.Instructor* are from *Faculty.Ssn*.
- Values of *Enrolled.Class* are from *Class.Classnum*.
- Values of *Enrolled.Student* and *Transcript.Student* are from *Student.Ssn*.

(a) Formulate each of the following queries in relational algebra using the standard notation (e.g., sigma, pi, etc).
(b) Implement a database using this schema and populate it with at least three tuples for each relation. Hand in a listing showing all of the relations.
(c) Answer the queries below using RDB against your database.

Queries

1. The names of departments that do not offer any classes.
2. The SSNs of students that are enrolled in all the classes taught by Professor Turing from CSEE Department.
3. The SSNs of students and the courses (department codes and course numbers) where the student is enrolled in the course but does not have the prerequisites.
4. The names of department chairs that do not teach any courses.
5. The SSNs of students currently taking courses outside their major department.
6. The SSNs of graduate students not enrolled in any class.

3 Personal CD database

Design a small database to keep track of your personal music CD collection. Assume that you will use this database for the future when you have a good job and can afford to buy all of the CDs you want. Base your design on the information that **you** would want to enter about each CD and the kinds of queries that you imagine you might want to ask. Map your design into the relational model and implement the schema in RDB. Populate the database by entering information for a sample of at least two CDs. Hand in an ER diagram for your database and an RDB file containing the schema and sample data.

The Suppliers-Parts Database

Here is the simple RDB suppliers-parts database to use in the second problem. It can be found in `finin/pub/spj.rdb`.

```
let S =  /* suppliers */

  {snum sname status city

  [s1   Smith 20     London]
  [s2   Jones 10     Paris]
  [s3   Blake 30     Paris]
  [s4   Clark 20     London]
  [s5   Adams 30     Athens] };
```

```
let P =   /* parts */

  {pnum pname color weight city

  [p1   Nut   Red   12     London]
  [p2   Bolt  Green 17     Paris ]
  [p3   Screw Blue  17     Rome  ]
  [p4   Screw Red   14     London]
  [p5   Cam   Blue  12     Paris]
  [p6   Cog   Red   19     London] };

let J =  /* Projects */

  {jnum jname    city

  [j1   sorter   paris]
  [j2   display  rome]
  [j3   ocr      athens]
  [j4   console  athens]
  [j5   raid     london]
  [j6   eds      oslo]
  [j7   tape     london]};

let SPJ =  /* shipments */

  {snum pnum jnum qty

  [s1   p1   j1   200]
  [s1   p1   j4   700]
  [s2   p3   j1   400]
  [s2   p3   j2   200]
  [s2   p3   j3   200]
  [s2   p3   j4   500]
  [s2   p3   j5   600]
  [s2   p3   j6   400]
  [s2   p3   j7   800]
  [s2   p5   j2   100]
  [s3   p3   j1   200]
  [s3   p4   j2   500]
  [s4   p6   j3   300]
  [s4   p6   j7   300]
  [s5   p2   j2   200]
  [s5   p2   j4   100]
  [s5   p5   j5   500]
  [s5   p5   j7   100]
  [s5   p6   j2   200]
  [s5   p1   j4   100]
  [s5   p3   j4   200]
  [s5   p4   j4   800]
  [s5   p5   j4   400]
  [s5   p6   j4   500]};
```