|  |  |  |
| --- | --- | --- |
| [COMP9311 16s2](http://www.cse.unsw.edu.au/~cs9311/16s2/) | **Assignment 3** | [Database Systems](http://www.cse.unsw.edu.au/~cs9311/16s2/) |

**Aims**

This is a written assignment for you to practise and verify your knowledge on data dependencies, data normalisation, relational algebra, basic transaction and concurrency. You will need to answer all the questions and submit your solution as a PDF file (max 3MB) via the give command. This assignment is worth a total of **45 marks**.

**Questions**

1. *[16 marks]*

Consider a relation *R(A,B,C,D,E,F)*. For each of the following sets of functional dependencies (i.e, i. to iv.), assuming that those are the only dependencies that hold for *R*, do the following:

* 1. List all of the candidate keys for *R*.
  2. What are the BCNF violations, if any?
  3. Decompose the relation, as necessary, into collections of BCNF relations?

1. *AD → B,   C → D,   BC → A,   B → D*

Answers:

1. Candidate keys: ACEF, BCEF

Appear only in Left: C

Appear only in Right: None

Appear in Left & Right: A,B,D

No Appear: E,F

So, the Candidate key must have C, might have E,F and might combine with A or B or D.

* + - 1. C->{C,D}
      2. CEF->{C,D,E,F}
      3. ACEF->{ACDEF}->{ABCDEF}, So ACEF is one candidate key
      4. BCEF->{ABCEF}->{ABCDEF}, So BCEF is one candidate key
      5. CDEF->{CDEF}

b. BCNF violations: Not BCNF… because none of the left hand sides( AD, C,BC,B) contains a key. e.g. in BC → A does not contain a key

c. Decompose the relation:

if pk: ACEF

ABD, CD,ACEF

If pk:BCEF

ABD,CD,ACEF

1. *BC → E,   C → AB,   AF → CD*

a. Candidate keys: AF, CF

b. BCNF violations:

c. Decompose the relation:

if pf: AF

BCE, ABC,CDF

If pk: CF

BCE,AFCD,ABF

* + 1. *ABF → D,   CD → E,   BD → A*

a. Candidate keys: ABCF, BCDF

b. BCNF violations: Not BCNF… because none of the left hand sides( ABF, CD,BD) contains a key. e.g. in CD → E, CD does not contain a key

c. Decompose the relation:

if pk: ABCF

CDE,ABDF,ABCF

If pk:BCDF

CDE,ABDF,ABCF

* + 1. *AB → D,   BCD → EF,   B → C*

a. Candidate keys: AB

b. BCNF violations: Not BCNF… e.g. in BCD → EF, BCD does not contain a key

c. Decompose the relation:

pk: AB

BC, ABD,ABEF

1. *[12 marks]*

Assuming the schema from [assignment 2](http://cgi.cse.unsw.edu.au/~cs9311/16s2/assignments/a2/index.php) (i.e., the ASX database), give the following queries in relational algebra.

* 1. List all the company names that are in the sector of "Technology".

select Company.Name

from Company, Category

where Company.Code = Category.Code and Sector='Technology' ;

SectorCode=Proj[code](Sel[sector=’Technology’] (Category))

Answer=Proj[Company.name](SectorCode join Company)

* 1. List all the company codes that have more than five executive members on record (i.e., at least six).

select c.code

from (

select Company.code, count(Executive.person) as num

from Company, Executive

where Company.Code=Executive.Code

group by Company.code

) as c

where num>5

;

* 1. Output the person names of the executives that are affiliated with more than one company.

select Person

from Executive

group by Person

having count(Code)>1;

* 1. List all the companies (by their Code) that are the only one in their Industry (i.e., no competitors). Same as Assignment 2, please include both Code and Industry in the output.

select Company.Code, m.Industry

from Company, Category,(

select Sector, Industry, count(Category.Code) as c

from Company, Category

where Company.Code=Category.Code

group by Sector, Industry) as m

where Company.Code=Category.Code and Category.Industry=m.Industry and m.c=1 ;

1. *[9 marks]*

Suppose relations R, S and T have *r* tuples, *s* tuples and *t* tuples, respectively. Derive the minimum and maximum numbers of tuples that the results of the following expressions can have.

* 1. R UNION (S INTERSECT T).
  2. SEL[c](R × S), for some condition c.
  3. R - PROJ[a](R JOIN S), for some list of attributes a.

1. *[8 marks]*
   1. For the following execution schedule, construct its precedence graph. Is this schedule serialisable? Explain your answer.

T1:R(X) T2:R(X) T1:W(X) T2:W(X) T2:R(Y) T1:R(Y) T1:W(Y) T2:W(X)

* 1. For the following execution schedule, construct its precedence graph. Is this schedule serialisable? Explain your answer.

T3:R(X) T4:W(Y) T4:W(Z) T1:W(Y) T2:R(Y) T3:R(D) T2:W(X) T1:R(X)