

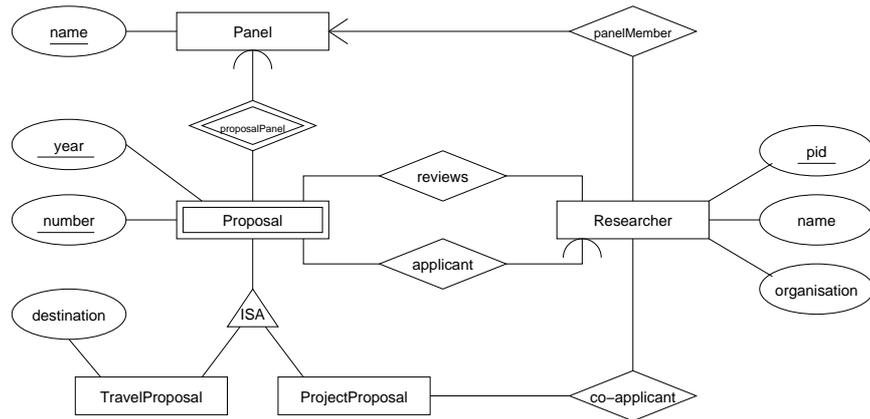
CHALMERS UNIVERSITY OF TECHNOLOGY
Department of Computer Science and Engineering
Examination in Databases, TDA357/DIT620
Saturday 19 December 2009, 08:30-12:30

Solutions

Updated 2013-12-13

Question 1. a) E-R diagram:

12 p



b) *Researchers*(pid, name, organisation)

Panels(name)

Proposals(panel, year, number, applicant)

panel → *Panels.name*

applicant → *Researchers.pid*

TravelProposals(panel, year, number, destination)

(*panel*, *year*, *number*) → *Proposals.(panel, year, number)*

ProjectProposals(panel, year, number)

(*panel*, *year*, *number*) → *Proposals.(panel, year, number)*

CoApplicants(panel, year, number, researcher)

(*panel*, *year*, *number*) → *ProjectProposals.(panel, year, number)*

researcher → *Researchers.pid*

Reviews(panel, year, number, researcher)

(*panel*, *year*, *number*) → *Proposals.(panel, year, number)*

researcher → *Researchers.pid*

PanelMembers(researcher, panel)

researcher → *Researchers.pid*

panel → *Panels.name*

Question 2. a) i) AB \rightarrow C
 10 p B \rightarrow D
 CE \rightarrow F
 D \rightarrow G
 F \rightarrow A

ii) Decompose on AB \rightarrow C
 $\{AB\}^+ = \{ABCDG\}$

R1(A,_B,C,D,G)
 R2(A,B,E,F)
 (A,B) \rightarrow R1.(A,B)

Decompose R1 on B \rightarrow D
 $\{B\}^+ = \{BDG\}$

R11(B,D,G)
 R12(A,_B,C)
 B \rightarrow R11.B

Decompose R11 on D \rightarrow G
 $\{D\}^+ = \{DG\}$

R111(D,G)
 R112(B,D)
 D \rightarrow R111.D

Decompose R2 on F \rightarrow A
 $\{F\}^+ = \{AF\}$

R21(A,_F)
 R22(B,_E,_F)
 F \rightarrow R21.F

b) i) A,B,C,E and F are prime

ii) B \rightarrow D
 D \rightarrow G

iii) Compute the minimal closure of F
 (Remove A \rightarrow C if we have A \rightarrow B and B \rightarrow C, etc.)

Group together FDs with the same LHS

ABE \rightarrow FG

For each group, create a relation with the LHS as the key.

R1(A,B,C)
 R2(B,D)
 R3(C,E,F)
 R4(A,B,E,F,G)
 R5(D,G)
 R6(A,F)

If no relation contains a key of R, add one relation containing only a key of R.

Relation R4 contains a key of R.

Question 3. a) *Employees*(empId, name, year, salary, entitlement, branch)
ParentalLeave(employee, startDay, startYear, endDay, endYear)
 employee → *Employees.empId*

9 p

```
CREATE TABLE Employees (
  empId          INT PRIMARY KEY,
  name           VARCHAR(40),
  year           INT,
  salary         INT,
  entitlement     INT DEFAULT 30,
  branch         VARCHAR(40),
);

CREATE TABLE ParentalLeave (
  employee       INT,
  startDay       INT,
  startYear      INT,
  endDay         INT,
  endYear        INT,
  PRIMARY KEY (employee, startDay, startYear),
  FOREIGN KEY (employee) REFERENCES Employees(empId)
    ON DELETE CASCADE
    ON UPDATE CASCADE,
  CONSTRAINT CheckStartDay CHECK (StartDay BETWEEN 1 and 366),
  CONSTRAINT CheckEndDay CHECK (EndDay BETWEEN 1 and 366),
  CONSTRAINT CheckStartBeforeEnd (startYear < endYear OR
    (startYear = endYear AND startDay < endDay)),
);
```

```
b) CREATE ASSERTION PayRangeLimit CHECK
  ( NOT EXISTS (
    SELECT A.empId
    FROM   Employees A, Employees B
    WHERE  A.salary - B.salary > 10000 ) )

or

CREATE ASSERTION PayRangeLimit CHECK
  ( ( (SELECT MAX(salary) FROM Employees)
    - (SELECT MIN(salary) FROM Employees) ) <= 10000);

c) CREATE TRIGGER IncreaseEntitlement
  BEFORE INSERT ON Employees
  REFERENCING NEW ROW AS new
  FOR EACH ROW
  WHEN (new.year < 1970 AND new.entitlement < 35)
  SET  new.entitlement = 35;
```

- Question 4.** a) $\pi(\text{Employees} \bowtie_{\text{empId}=\text{employee}} (\sigma_{\text{startYear}=2007}(\text{ParentalLeave})))$
 5 p
- b) $\tau_{\text{branch}}(\pi_{\text{name,branch,salary}}(\sigma_{\text{salary}=\text{maxSal}}(\text{Employees} \bowtie (\gamma_{\text{branch},\text{MAX}(\text{salary})\rightarrow\text{maxSal}}(\text{Employees}))))))$

- Question 5.** a) `SELECT DISTINCT empId, name
 FROM Employees JOIN (
 SELECT employee
 FROM ParentalLeave
 WHERE startYear < endYear) ON employee=empId;`
 7 p
- b) `SELECT A.name, B.name
 FROM Employees A, Employees B
 WHERE A.empId <> B.empId
 AND A.year = B.year
 AND A.entitlement = B.entitlement
 AND A.salary < B.salary;`
- c) `CREATE VIEW V AS
 SELECT branch, startYear, COUNT(empId) AS numParents
 FROM Employees JOIN ParentalLeave on empId = employee
 GROUP BY branch, startYear`

- Question 6.** a) Either T1 runs completely before T2, or vice versa. In either case, the output is: 2,2
 3 p
- b) In addition to the above, several other orderings are now possible.
 T1B will see at least the same tuples as T1A.
 T2A,T1A,T1B,T2B gives 1,1
 T2A,T1A,T2B,T1B gives 1,2
 T1A,T2A,T1B,T2B gives 2,2
 T1A,T2A,T2B,T1B gives 2,3

- Question 7.** a) i) task 1: 2, task 2: 30, task 3: 30.
 6 p
 ii) task 1: 4, task 2: 30, task 3: 11.
 iii) task 1: 4, task 2: 6, task 3: 30.
 iv) task 1: 6, task 2: 6, task 3: 11.
- b) (iv) has lowest cost of 6.5, with (iii) next with cost of 7.4.

Question 8.

a) (Alternative tags and structures are also acceptable.)

8 p

Note: Branch numbers have been modified so that they start with a letter.
We'll accept solutions where these begin with digits.)

```
<?xml version="1.0" standalone="yes" ?>

<!DOCTYPE Question8 [

<!ELEMENT Question8 (Employees, Branches)>

<!ELEMENT Employees (Employee*)>
  <!ELEMENT Employee EMPTY>
  <!ATTLIST Employee
    name ID #REQUIRED
    branch IDREF #REQUIRED
    salary CDATA #REQUIRED >

<!ELEMENT Branches (Branch*)>
  <!ELEMENT Branch EMPTY>
  <!ATTLIST Branch
    number ID #REQUIRED
    city CDATA #REQUIRED >

]>
```

b) <Question8>

```
<Employees>
  <Employee name="Andersson" branch="b3" salary="35000" />
  <Employee name="Jonsson" branch="b3" salary="25000" />
  <Employee name="Larsson" branch="b2" salary="32000" />
</Employees>
<Branches>
  <Branch number="b1" city="Stockholm" />
  <Branch number="b2" city="Paris" />
  <Branch number="b3" city="London" />
</Branches>
</Question8>
```

c) (Alternatives are acceptable. Two suggestions are given here.)

```
/Question8/Branches/Branch[@city="Paris"]

//Branch[@city="Paris"]
```

d) (Alternatives are acceptable.)

```
FOR $e IN /Question8/Employees/Employee[@salary>30000]
LET $place := $e/@branch => Branch/@city
RETURN <Result>{$e/name}: {$place}</Result>
```