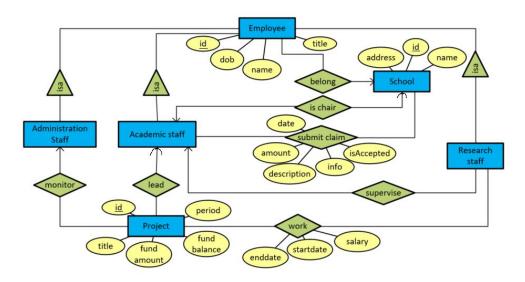
Solver: Thai Nguyen Hung

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1. (a)

(i)



(ii) Employee (id, dob, name, title)

School (id, name, address)

Emp belongTo School (emp\_id, school\_id)

AdministrationStaff (emp\_id)

AcademicStaff (emp id)

ResearchStaff (emp\_id)

ChairOfSchool (academic staff id, school id)

 $Submitted Claim \ ( \underline{\textbf{academic\_staff\_id, school\_id}}, \ date, \ amount, \ description, \ info, \ account, \ accou$ 

isAccepted)

Supervised (academic staff id, research staff id)

Project (<u>id</u>, period, title, fund\_amount, fund\_balance)

MonitorProject (admin\_staff\_id, project\_id)

LeadProject (academic staff id, project id)

WorkForProject (<u>research\_staff\_id, project\_id</u>, startdate, enddate, salary)

(b)

(i)  $R1 \coloneqq Customers \bowtie Accounts \bowtie Account\_Owners$ 

 $R2 := \Pi_{\text{name}} (\gamma_{\text{name, MAX(balance)} \rightarrow \text{maxbalance}} R1)$ 

(ii)  $R1 := Customers \bowtie Accounts \bowtie Account\_Owners$ 

 $R2 \coloneqq \delta(\Pi_{\text{name}}R1)$ 

 $R3 \coloneqq \delta \left( \Pi_{\text{name}} (\sigma_{\text{balance} > 0} R1) \right)$ 

R4 := R3 - R2

```
(iii) R1 :=
         Accounts \bowtie_{Accounts.number=Acc.num\ AND\ Accounts.balance>Acc.bal} \rho_{Acc(num,bal)}(Accounts)
         R2 := \Pi_{\text{balance}} \sigma_{\text{order} < 100} (\gamma_{\text{balance, COUNT(bal)} \rightarrow \text{order}} R1)
         R3 := \Pi_{\text{number}}(R2 \bowtie Accounts)
2. (a)
    C and E do not appear on the RHS of the FDs; thus, they must be included in the keys
    \{CE\}^+ = \{BCDE\},
                               \{ACE\}^+ = \{ABCDEF\},
                                                              \{BCE\}^+ = \{BCDE\},
    \{CDE\}^+ = \{BCDE\},\
                                 \{CEF\}^+ = \{ABCDEF\},\
                                                              \{BCDE\}^+ = \{BCDE\}
    So, keys of R: ACE, CEF
    FD C \to D violates BCNF definition. \{C\}^+ = \{BCD\}
    Decomposition of R: R1(B, C, D); R2(A, C, E, F)
    Keys of R1: C. R1 is in BCNF
    Keys of R2: ACE, CEF. There is a hidden FD AC \rightarrow F.
    FD AC \rightarrow F violates BCNF definition. \{AC\}^+ = \{ACF\}
    Decomposition of R2: R3(A, C, F); R4(A, C, E)
    Keys of R3: AC, E. R3 is in BCNF.
    Keys of R4: ACE, R4 is in BCNF.
    Conclusion: the decomposition of R is R1(B, C, D); R3(A, C, F); R4(A, C, E).
    Not all the FDs are reserved; e.g FD AD \rightarrow F is not reserved.
    (b)
    FD C \rightarrow D violates 3NF definition.
    Let S = \{C \rightarrow D, DF \rightarrow A, AD \rightarrow F, CD \rightarrow B, BCF \rightarrow A\}.
    We will determine the minimal basis of S.
    After the first step, S remains the same.
    After step 2, S becomes \{C \rightarrow D, DF \rightarrow A, AD \rightarrow F, CD \rightarrow B\}.
    After step 3, S = \{C \rightarrow D, DF \rightarrow A, AD \rightarrow F, C \rightarrow B\}
    Hence we ended up with the set S = \{C \rightarrow BD, DF \rightarrow A, AD \rightarrow F\}, which gives the 3NF
    decomposition of R as R1(B,C,D); R2(A,D,F); R3(A,C,E).
3. (a)
    SELECT temperature, heartRate
    FROM Tests, Patients
    WHERE Tests.pid = Patients.pid AND Patients.year < 1971
    (b)
    CREATE ASSERTION Q3b CHECK (
    NOT EXISTS (
      SELECT *
      FROM Wards INNER JOIN PatientInWard ON Wards.number = PatientInWard.wardNumber
      GROUP BY number
      HAVING COUNT(pid) > numBeds ) );
```

```
(c)
   CREATE VIEW FreeBeds AS
   SELECT number AS ward, COUNT(pid) - numBeds AS numBeds
   FROM Wards INNER JOIN PatientInWard ON Wards.number = PatientInWard.wardNumber
   GROUP BY number
   (d)
   CREATE TRIGGER Q3d
   BEFORE INSERT ON PatientInWard
   REFERENCING NEW ROW AS n
   FOR EACH ROW
   WHEN NOT EXISTS ( SELECT * FROM FreeBeds
                      WHERE ward = n.wardNumber AND numBeds > 0)
   INSERT INTO PatientInWard VALUES (n.pid, SELECT MIN(numBeds) FROM FreeBeds);
4. (a)
   (i)
   SELECT empid, name, salary
   FROM Employees
   ORDER BY name;
   (ii)
   CREATE PROCEDURE Merge (
          IN city1 CHAR(32),
          IN dept1 CHAR(32),
          IN city2 CHAR(32),
          IN dept2 CHAR(32),
          DECLARE dept1Size INTEGER,
          DECLARE dept2Size INTEGER,
          DECLARE dept1Head CHAR(32)
   )
   BEGIN
          UPDATE Employees SET dept = dept2, city = city2
                  WHERE dept = dept1 AND city = city1;
          SET dept1Size = ( SELECT COUNT(*) FROM Employees WHERE dept = dept1 );
          SET dept2Size = ( SELECT COUNT(*) FROM Employees WHERE dept = dept2 );
          SET dept1Head = ( SELECT departmentHead
                           FROM Departments WHERE dname = dept1);
          IF dept1Size > dept2Size THEN
                  UPDATE Departments SET departmentHead = dept1Head;
          DELETE FROM Departments WHERE dname = dept1;
   END;
```

## CEC 16<sup>th</sup> - Past Year Paper Solution *2015-2016 Sem1*CZ2007 - Introduction to Databases

(b)

- (i) 1. The DTD states <!ELEMENT A (B)> but there are multiple sections of B under A.2. The DTD states that attribute b2 of B is required but it is absent in the second section of B
- (ii) <!ELEMENT A (B)> needs to be changed to <!ELEMENT A (B+)> <!ATTLIST B b1 CDATA #REQUIRED b2 CDATA #REQUIRED> needs to be changed to <!ATTLIST B b1 CDATA #REQUIRED b2 CDATA #IMPLIED>

(c)

- (i) There is no visible result, as the target B has no text to show (actually none of the B has any text)
- (ii) Third Fourth