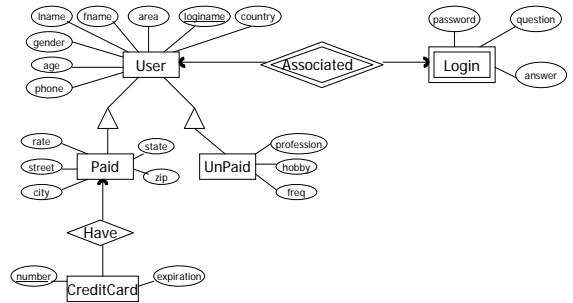


Solution to Midterm 1

IST 210 Spring 2006

Problem 1 (a)



Problem 1 (b)

- User(loginame, lname, fname, gender, age, area, phone, country)
 - Login(loginame, password, question, answer)
 - Paid(loginame, rate, street, city, state, zip)
 - UnPaid(loginame, profession, hobby, freq)
 - CreditCard(number, expiration)
 - Have(loginame, number)
- Assumptions:
1. the loginame for users is unique;
 2. the credit number for credit cards is unique;
 3. a paid user can have several credit cards.

Problem 2 (a)

- A+ = ABCD
 - B+ = BCD
 - C+ = C
 - D+ = D
 - AB+ = ABCD
 - AC+ = ABCD
 - AD+ = ABCD
 - BC+ = BCD
 - BD+ = BCD
 - CD+ = CD
 - ABC+ = ABCD
 - ABD+ = ABCD
 - ACD+ = ABCD
 - BCD+ = BCD
 - ABCD+ = ABCD
- Key: A

Problem 2 (b)

- A -> C (from A+)
- A -> D (from A+)
- B -> D (from B+)
- Nothing new (from other closures)

Problem 2 (c)

- B -> C or BC -> D
- B or BC is not superkey since A is the key

Problem 2 (d)

- If you pick $B \rightarrow C$, then R is decomposed into $R_1(B,C,D)$ and $R_2(A,B)$
- If you pick $BC \rightarrow D$, then R is decomposed into $R_1(B,C,D)$ and $R_2(A,B,C)$
- However, R_2 is still not in BCNF because the key for R_2 is A, but R_2 has FD: $B \rightarrow C$ where B is not a super key in R_2
- Continue to decompose R_2 into:
 - $R_2(B,C)$ and $R_3(A, B)$
- So R is decomposed into:
 - $R_1(B,C,D)$, $R_2(B,C)$ and $R_3(A,B)$

Problem 3 (a)

- False
- Because BCNF relations are contained in 3NF relations

Problem 3 (b)

- False
- Because X may be a superkey

Problem 3 (c)

- False
- $X \rightarrow Y$ can not imply $X \rightarrow Z$

Problem 3 (d)

- True
- Although $BD \rightarrow A$ violates BCNF, A is a prime because AD is a key. So the relation R is in 3NF

Problem 3 (e)

- True
- Because R is in BCNF, all the FDs are determined by keys or superkeys. So all the information are determined by keys or superkeys.

Problem 4 (a)

- CREATE TABLE Terrorists(lastname varchar(10), firstname varchar(10), phone char(20), cellphone char(20), citizenship varchar(10), affiliation varchar(20), age int);
- We assume phone number and cellphone number are 20-digit

Problem 4 (b)

- SELECT lastname, firstname, cellphone FROM Terrorists WHERE affiliation='Al-Qaida' AND citizenship='UK';

Problem 4 (c)

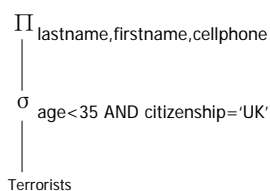
- SELECT affiliation, MIN(age) FROM Terrorists GROUP BY affiliation;

Problem 4 (d)

- SELECT * FROM Terrorists WHERE lastname LIKE 'Bin%';

Problem 5 (a)

- Tree format



Problem 5 (a)

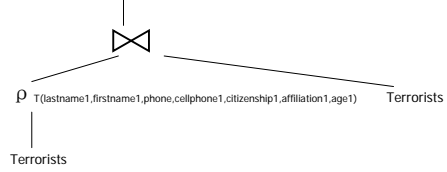
- Line format

- R(lastname, firstname, cellphone)
= $\Pi_{\text{lastname,firstname,cellphone}} (\sigma_{\text{age}<35 \text{ AND } \text{citizenship}='UK'} (\text{Terrorists}))$

Problem 5 (b)

- Tree format

- $\sigma_{\text{lastname1} \neq \text{lastname OR firstame1} \neq \text{firstame}}$



Problem 5 (b)

- Line format

- $R(\text{lastname,firstname,phone,cellphone, citizenship,affiliation,age})$

$$= \sigma_{\text{lastname1} \neq \text{lastname OR firstame1} \neq \text{firstame}} (\rho_{T(\text{lastname1, firstame1, phone, cellphone1, citizenship1, affiliation1, age1})} \bowtie \text{Terrorists})$$

- Note: we need to naturally join the two Terrorists tables based on phone