

Midterm Solutions

Question 1.

- a. False. We don't always desire our DB to be in BCNF
- b. False. Weak entities do not have a key. They depend on other entities.
- c. True
- d. False. In any table, each attribute functionally depends on the key.
- e. True
- f. True
- g. True
- h. False. TRC and DRC are stronger than RA

Question 2

a.

- i) The ISA relationship must be **disjoint**.
B and C must have the same attributes.
- ii) The ISA relationship must be **total**.

b. The set of the common attributes of R1 and R2 (A, D) is a key for R2.
Proof:

- | | | |
|----|-------------------------|--|
| 1. | $A \rightarrow C$ | given |
| 2. | $A, D \rightarrow C, D$ | 1, augmentation |
| 3. | $A, D \rightarrow E$ | 2, $C, D \rightarrow E$, transitivity |

c.

- i) The company should be an attribute of the customer, assuming each customer works for a single company. We don't need to keep any information for each company.
- ii) The loan should be a separate entity set associated with a customer through a relationship .
Reasons:
 - A customer may have more than one loans.
 - A loan has additional information on its own.

Question 3

- a.
1. phn
 2. pname, address

b

Patient (phn, pname, address, illness, ward)

Test (testname, labtype, dname, specialization)

Test includes the Authorizes relationship set.

Doctor (dname, specialization)

Had (phn, testname, date, result)

c.

- The only table that is not in BCNF is the Patient table.
- FD illness \rightarrow ward violates BCNF.
- We split the table into

Patient (phn, pname, address, illness)

IllnessWard (illness, ward)

Question 4

a.

$$\pi_{sId} (\sigma_{hCity = \text{"Vancouver"}} (\text{Hotel})) - \pi_{hId} (\sigma_{year = 2005} (\text{Booking}))$$

NOTE: The following is WRONG:

$$\pi_{sId} (\sigma_{hCity = \text{"Vancouver"}} \wedge year \neq 2005 (\text{Booking} \bowtie \text{Hotel}))$$

Any hotel which has a booking for a year other than 2005 will be included in the result even if the same hotel HAS another booking for 2005!

b.

$$\pi_{gId, hId} (\sigma_{type = \text{"suite"}} (Booking \bowtie Room)) / \pi_{hId} (\sigma_{hCity = \text{"Vancouver"}} (Hotel))$$

NOTE: Again, the following is WRONG:

$$\pi_{gId} (\sigma_{type = \text{"suite"} \wedge hCity = \text{"Vancouver"}} (Booking \bowtie Room \bowtie Hotel))$$

This returns any guest who has booked a suite in some hotel in Vancouver.

c.

$$\{ t \mid \exists h \in Hotel (t.hId = h.hId \wedge t.hName = h.hName \wedge \\ \forall g \in Guest \exists b \in Booking (h.hId = b.hId \wedge g.gId = b.gId \wedge b.year = 2004)) \}$$