COMP 3005 Database Systems
Winter Term 2012 Midterm Test Solution Sketches

1. (a)

$$\forall xyzuv(Studies(x,y,z) \wedge Studies(x,u,v) \ \rightarrow \ y = u \wedge z = v)$$

(b)

$$\forall xyz\exists u\exists v(People(x,y,z) \ \rightarrow \ Studies(z,u,v)$$

or

$$\forall xyz(People(x,y,z) \ \rightarrow \ \exists u\exists v Studies(z,u,v)$$

(c)

$$V(x)\colon \ \exists yzuv(People(x,y,z) \wedge People(x,u,v) \wedge z \neq v)$$

also possible

$$V(x)\colon \ \exists yzv(People(x,y,z) \wedge People(x,y,v) \wedge z \neq v)$$

(d)

$$Viol(x)\colon \ \ \exists yzuv(Studies(x,y,z) \wedge Studies(x,u,v) \wedge y \neq u)$$

or

$$Viol(x,z)\colon \ \ \exists yuv(Studies(x,y,z) \wedge Studies(x,u,v) \wedge y \neq u)$$

(e)

$$Viol(x,z)\colon \ \ \exists y(People(x,y,z) \wedge \neg\exists uv Studies(z,u,v)$$

Contents: $\{\langle mary, law\rangle, \langle mary, medicine\rangle$

(f)

- Relevant: Insertion and deletions of tuples in *People*, changes of names or degrees in tuples in *People*
- Irrelevant: Changes of age in tuples in *People*; any update on *Studies*

Notice that these are not specific to any concrete instance

(g)

- Relevant: Insertion of tuples in *People*; deletions of tuples from *Studies*, etc.
- Irrelevant: Deletions of tuples from tuples in *People*; insertion of tuples into *Studies*, etc.

(h)

$$\forall xyz(People(x,y,z) \wedge z = astronaut \rightarrow y < 40)$$

(or logically equivalent variations of this)

(i)

SQO is the optimization (speeding up of the computation) of query answering by using semantic information as represented by integrity constraints.

In this example, before computing people and costs for astronauts, we discard all the people over 40.

2. (a)

RA: (variations on)

1. $R_1 = \sigma_{Drinker=john}(Likes)$
2. $R_2 = R_1 \bowtie_{Beer} Serves$
3. $R_3 = \Pi_{Bar}(R_2)$
4. $R_4 = \sigma_{Drinker=john}(Frequents)$
5. $R_5 = R_4 \bowtie_{Bar} R_3$
6. $R_6 = \Pi_{Bar}(R_5)$

RC: $Ans(y)$: $\exists z(Frequents(john, y) \wedge Serves(y, z) \wedge Likes(john, z))$

(b)

RA: (variations on)

1. $R_1 = Serves \bowtie_{Beer} Likes$
2. $R_2 = R_1 \bowtie_{Drinker,Bar} Frequents$
3. $R_3 = \Pi_{Drinker}(R_2)$
4. $R_4 = \Pi_{Drinker}(Likes)$
5. $R_5 = \Pi_{Drinker}(Frequents)$ (having just this one was also O.K.)
6. $R_6 = R_4 \cup R_5$
7. $R_7 = R_6 \setminus R_3$