ADC Assignment2

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Question 1

$\{(b.bno, b.title) \mid Book(b) \wedge$
$(\exists s \in (Student(s) \wedge Buys(s.sid, b.bno)) \wedge$
$\forall s1 \forall s2(Student(s1) \wedge Student(s2) \wedge Buys(s1.sid, b.bno) \wedge Buys(s2.sid, b.bno))) \rightarrow (s1 = s2))\}$

Question 2

$\{(m.major, b.bno) \mid ((Major(m) \wedge Book(b) \wedge$
$(hasMajor(hm) \wedge (hm.major = m.major)) \rightarrow (Buys(t) \wedge hasMajor(t.sid)) \rightarrow Buys(b.bno)) \wedge$
$(\neg \exists t \neg b1(Buys(t) \wedge Book(b1) \wedge t.bno = b1.bno \wedge \exists hm \in hasMajor(t.sid, m.major) \wedge b1.price < b.price)\}$

Question 3a

$\{(b.bno, b.title) \mid \exists bs(Buys(bs) \wedge Student(s) \wedge bs.sid = s.sid) \rightarrow (b.bno = bs.bno))$
$\wedge \forall s_1 \forall hm(Student(s_1) \wedge hasMajor(hm) \wedge hm.sid = s_1.sid \wedge hm.sid = bs.sid \wedge hm.major =' Chemistry')$
$\rightarrow ((s_1.sid \neq s.sid) \wedge s.birthyear > s_1.birthyear)\}$

Question 3b

$\{(b.bno, b.title) \mid Book(b) \wedge some(\{(b.bno = bs.bno) \mid Buys(bs) \wedge Student(s) \wedge bs.sid = s.sid$
$\wedge all(\{(s.sid \neq s_1.sid \wedge s.birthyear > s_1.birthyear) \mid Student(s_1) \wedge hasMajor(hm)$
$\wedge hm.sid = s_1.sid \wedge hm.major =' Chemistry' \wedge hm.sid = bs.sid\})\})\}$

Question 4

$student\_cs = \{(s.sid, b.bno, b.price) \mid Student(s) \wedge Buys(bs) \wedge Book(b) \wedge hasMajor(hm) \wedge s.sid = bs.sid$
$\wedge bs.bno = b.bno \wedge hm.sid = s.sid \wedge hm.major =' CS'\}$

$\{(tt.sid, tt.bno) \mid student\_cs(tt) \wedge$
$\neg \exists(\{true \mid Book(b) \wedge b.price <= tt.price \wedge \neg \exists(\{true \mid student\_cs(tt1) \wedge b.bno = tt1.bno \wedge tt1.sid = tt.sid\})\})\}$

Question 5

$student\_bought\_books\_all\_combi\_gt\_30 = \{(s.sid, s.sname, b.bno, b.price) \mid Student(s) \wedge Book(b) \wedge b.price > 30\}$

$student\_bought\_books\_gt\_30 = \{(s.sid, s.sname, b.bno, b.price) \mid Student(s) \wedge Buys(bs) \wedge Book(b) \wedge bs.sid = s.sid \wedge b.bno = bs.bno \wedge b.price > 30\}$

$student\_bought\_books\_gt\_30 = \{(s.sid, s.sname, b.bno, b.price) \mid student\_bought\_books\_all\_combi\_gt\_30(T1) \wedge \neg\exists T2(student\_bought\_books\_gt\_30(T2) \wedge T1.sid = T2.sid) \rightarrow (T1.bno = T2.bno)\}$

$\{(T3.sid, T3.sname) \mid student\_bought\_books\_gt\_30(T3) \wedge \forall T1 \forall T2(student\_bought\_books\_gt\_30(T1) \wedge (student\_bought\_books\_gt\_30(T2) \wedge T1.sid = T2.sid \wedge T1.bno < T2.bno \wedge T3.sid = T2.sid)) \rightarrow (false)\}$

Question 10

$student\_books = \pi_{sid,bno,title}(Student \bowtie Buys \bowtie Book)$

$\pi_{bno,title}(\pi_{sid,bno,title}(T1) - pi_{sid,bno,title}(T1 \bowtie_{(T1.bno=T2.bno) \wedge (T1.sid <> T2.sid)} T2))$

Note : (T1 : $student\_books$, T2 : $student\_books$)

Question 14

$major\_books = \pi_{major,bno}(Book \bowtie Buys \bowtie hasMajor \bowtie Major)$
$major\_books\_not\_cheapest = \pi_{major,bno}(Book \bowtie_{b1.price<price} Book_1 \bowtie Buys \bowtie hasMajor \bowtie Major)$

$major\_books$ - $major\_books\_not\_cheapest$

Question 12

$chem\_student\_books = \pi_{sid,birthyear,bookno}(\sigma_{major='Chemistry'}(Student \bowtie hasMajor \bowtie Buys \bowtie Book)$

$\pi_{bno,title}(Student \bowtie Buys \bowtie Book \bowtie_{birthyear>chem\_student\_books.birthyear} chem\_student\_books) - \pi_{bno,title}(Student \bowtie Buys \bowtie Book \bowtie chem\_student\_books)$

Question 13

$student\_bought\_books = \pi_{sid,bno,price}(\sigma_{major='CS'}(Student \bowtie Buys \bowtie Book \bowtie hasMajor))$

$student\_bought\_books\_all\_combi = \pi_{sid,bno,price}(Student \times Book)$

$diff = \pi_{sid,bno,price}(SB\_Combi) - \pi_{sid,bno,price}(student\_bought\_books)$

$\pi_{sid,bno}(student\_bought\_books) - \pi_{sid,bno}(SB\_Combi \bowtie_{(SB\_Combi.price>=diff.price)\wedge(SB\_Combi.sid=diff.sid)} diff)$

Question 14

$student\_bought\_books\_all\_combi\_gt\_30 = \pi_{sid,sname,bno,price}(\sigma_{price>30}(Student \times Book)$

$student\_bought\_books\_gt\_30 = \pi_{sid,sname,bno,price}(\sigma_{price>30}(Student \bowtie Buys \bowtie Book)$

$student\_missed\_books\_gt\_30 = \pi_{sid,sname,bno,price}(\pi_{sid,sname,bno,price}(X) - \pi_{sid,sname,bno,price}(Y))$

$\pi_{sid,sname}(Y) - \pi_{sid,sname}(Z_1 \bowtie_{(Z_1.sid=Z_2.sid)\wedge(Z_1.bno<Z_2.bno)} Z_2)$

Note : (X:student_bought_books_all_combi_gt_30 , Y:student_bought_books_gt_30, Z:student_missed_books_gt_30)

Question 19

$(\pi_{c.bno}(C) - \pi_{c1.bno1}(C1 \bowtie_{c1.bno2=c2.bno2} B \bowtie_{c1.bno=b.bno\wedge c2.bno=b.bno})$
Note : (C1 : Cites relation, C2: Cites relation, B = Books)

Question 20

$B = \pi_{T.bno,T.sid}(\sigma_{hm.major=Math}(S \bowtie_{s.sid=hm.sid} H \bowtie_{hm.sid=T.sid} T))$
$D = \pi_{sid}(H \bowtie_{hm.sid=T.sid} T)$
$\pi_{sid}(S) \subseteq \pi_{sid}(B \bowtie_{B.bno=D.bno} D)$
Note : (S:Student, H:hasMajor, T:buys)

Question 21

$H = \pi_{h1.major1,h2.major2}(H_1 \times H_2)$
$H \subseteq \pi_{h.major1,h.major2}(\sigma_{hm1.sid \neq hm2.sid} H_1 \bowtie_{h1.major=h.major1} H \bowtie_{h2.major=h.major2} H_2)$ Note : (H1 : hasMajor relation,H2 : hasMajor)

Question 22

$$\pi_{sid}(hasMajor \bowtie Student) = \pi_{sid}(Student \bowtie hasMajor) = \pi_{sid}(hasMajor)$$