Assignment-4(ADC)

1.
Query--------
```
WITH E1 as (
   select distinct s.a from w2 s inner join w2 s1 on s.a=s1.a and s.b<>s1.b)
 select * from E1
 union

 (select s.a from w2 s
 except (
   select distinct s.a from E1 inner join w2 s on s.a<>E1.a
 ));
```
RA----------

$E1= \pi_{s.a}(S \bowtie_{s.a=s1.a \wedge s.b<>s1.b} S1)$

$\pi_{*}(E1) \cup (\pi_{s.a}(S) - \pi_{s.a}(E1 \bowtie_{s.a<>E1.a} S1))$

--S,S1 are alias of table w2 or w1

2.

a)
Query--------
```
select distinct s.sid,s.sname from student s inner join buys b
      on s.sid=b.sid inner join cites c on b.bookno=c.bookno;
```
RA----------

$\pi_{s.sid,s.name}(S \bowtie_{s.sid=b.sid} B \bowtie_{b.bookno=c.bookno} C)$

--S,B,C are alias of tables Student,Buys,Cites
b)
Query--------
```
select distinct s1.sid,s1.sname from student s1 inner join student s2 on s1.sid=s2.sid
inner join major m1 on s1.sid=m1.sid inner join major m2 on s2.sid=m2.sid and
m1.major<>m2.major;
```
RA----------

$\pi_{s1.sid,s1.sname}(S1 \bowtie_{s1.sid=s2.sid} S2 \bowtie_{s1.sid=m1.sid} M1 \bowtie_{s2.sid=m2.sid \wedge m1.major<>m2.major} M2)$

--S1,S2,M1,M2 are alias of tables student S1,Student S2,Major M1,Major M2

c)
Query--------
```
select q.sid from
    ((select b.sid from buys b)
     except (select b1.sid from buys b1 inner join buys b2 on b1.sid=b2.sid and
b1.bookno<>b2.bookno))q;
```

RA----------

$Q=\pi_{b.sid}(B)- \pi_{b1.sid}(B1 \bowtie_{b1.sid=b2.sid \wedge b1.bookno<>b2.bookno} B2)$

$\pi_{q.sid}(Q)$

--B,B1,B2 are alias of tables buys B,buys B1,Buys B2

d)

Query--------

```
with q as (select b.bookno,b.title,b.price from book b inner join book b1 on not
b.price<=b1.price)

(select b.bookno,b.title from book b except
(select distinct q1.bookno,q1.title from q q1 inner join q q2 on not q1.price<=q2.price))

 except

 ((select distinct b1.bookno,b1.title from book b1 cross join book b2)
 except
 (select distinct b1.bookno,b1.title from book b1 inner join book b2 on not
b1.price<=b2.price));
```

RA----------

$Q=\pi_{b.bookno,b.title,b.price}(B \bowtie_{\neg b.price<=b1.price} B1)$

$(\pi_{b.bookno,b.title}(B)- \pi_{q1.bookno,q1.title}(Q1 \bowtie_{\neg q1.price=q2.price} Q2))-(\pi_{b1.bookno,b1.title}(B1XB2)- \pi_{b1.bookno,b1.title}(B1 \bowtie_{\neg b1.price=b2.price} B2))$

--B,B1,B2,Q1,Q2 are alias of tables book B, book B1,book B2, Q Q1,Q Q2

e)

Query--------

```
with q as ((select b.bookno from book b)
except
(select b2.bookno from buys b2 where b2.sid<>1001))

select q.bookno,b1.title from book b1 inner join q on b1.bookno=q.bookno;
```

RA----------

$Q=\pi_{b.bookno}(B)- \pi_{b2.bookno}(_{b2.sid<>1001}B2)$

$\pi_{q.bookno,b1.title}(B1 \bowtie_{b1.boono=q.bookno} Q)$

--B,B1,B2,Q are alias of tables book B,book B1,Buys B2, (bookno s from book) Q

f)
Query--------
```
select distinct s.sid,s.sname from student s inner join buys b1 on s.sid=b1.sid
inner join buys b2 on b1.sid=b2.sid inner join book b3 on b1.bookno=b3.bookno inner join
book b4 on b2.bookno=b4.bookno
and b1.bookno<>b2.bookno and b3.price<50 and b4.price<50;
```
RA----------

$\pi_{s.sid,s.sname}(S \bowtie_{s.sid=b1.sid} B1 \bowtie_{b1.sid=b2.sid} B2 \bowtie_{b1.bookno=b3.bookno} B3 \bowtie_{b2.bookno=b4.bookno \wedge b1.bookno<>b2.bookno \wedge b3.price<50 \wedge b4.price<50} B4)$

--S,B1,B2,B3,B4 are alias of tables student S,buys B1,buys B2,book B3,book B4

g)
Query--------
```
select q1.bookno from (select b.bookno from book b
except
select q2.bookno
from((select distinct b.bookno from buys b inner join student s on s.sid = b.sid)
        except(select distinct b.bookno from buys b inner join major m
                on b.sid=m.sid and m.major = 'CS'))q2)q1
```
RA----------

$Q2=\pi_{b.bookno}(B \bowtie_{s.sid=b.sid} S) - \pi_{b.bookno}(B \bowtie_{b.sid=m.sid \wedge m.major='CS'} M)$

$Q1=\pi_{b.bookno}(B) - \pi_{q2.bookno}(Q2)$

$\pi_{q1.bookno}(Q1)$

--B,S,M are alias of tables book B,student S,Major M

h)
Query--------
```
select bookno from book except
(select b.bookno from book b inner join cites c
 on c.bookno=b.bookno and b.price>50)
union
((select bookno from book) except(select citedbookno from cites));
```
RA----------

$\pi_{bookno}(Book) - (\pi_{b.bookno}(B \bowtie_{c.bookno=b.bookno \wedge b.price>50} C) \cup ((\pi_{bookno}(Book)) - (\pi_{citedbookno}(Cites))))$

--B,C are alias of tables book B,cites C

i)
Query--------
```
select distinct b1.sid from buys b1 inner join book b
on b1.bookno=b.bookno and b.price>=30;
```
RA----------

$\pi_{b1.sid}(B1 \bowtie_{b1.bookno=b.bookno \wedge b.price>=30} B)$

--B1,B are alias of tables buys B1,book B

j)
Query--------
select distinct q.sid,q.citedbookno from
((select * from buys b1 cross join (select b.bookno as citedbookno from book b)q1)
except
(select b1.sid,b1.bookno,c.citedbookno from buys b1 inner join cites c on
c.bookno=b1.bookno))q;
RA----------
$Q1=\pi_{citedbookno}(B)$
$Q=(\pi_{*}(B1XQ1))-(\pi_{b1.sid,b1.bookno,c.citedbookno}(B1\bowtie_{c.bookno=b1.bookno}C))$
$\pi_{q.sid,q.citedbookno}(Q)$

---citedbookno is alias of bookno from table B
--B1 is alias of buys B1
k)
Query--------
(select distinct b1.bookno,b2.bookno from book b1 inner join book b2 on
b1.bookno<>b2.bookno)
except
(select c.bookno,c.t1books from

(((select distinct q.t1books,t1.sid,t1.bookno from buys t1 inner join major m on t1.sid=m.sid
and m.major='CS'
cross join (select bookno as t1books from book)q)
except
(select distinct t1.bookno,t1.sid,q.t1books from buys t1 inner join major m on t1.sid=m.sid
and m.major='CS'
cross join (select bookno as t1books from book)q))
union
((select distinct t1.bookno,t1.sid,q.t1books from buys t1 inner join major m on t1.sid=m.sid
and m.major='CS'
cross join (select bookno as t1books from book)q)
except
(select distinct q.t1books,t1.sid,t1.bookno from buys t1 inner join major m on t1.sid=m.sid
and m.major='CS'
cross join (select bookno as t1books from book)q)))c);
RA----------
$Q=\pi_{t1books}(Book)$
$(\pi_{b1.bookno,b2.bookno}(B1\bowtie_{b1.bookno<>b2.bookno}B2))-(\pi_{c.bookno,c.t1books}(((\pi_{q.t1books,t1.sid,t1.bookno}(T1\bowtie_{t1.sid=m.sid\wedge m.major='CS'}M\ X\ Q)) - \pi_{t1.bookno,t1.sid,q.t1books}(T1\bowtie_{t1.sid=m.sid\wedge m.major='CS'}M\ X\ Q)))$
$U\ ((\pi_{t1.bookno,t1.sid,q.t1books}(T1\bowtie_{t1.sid=m.sid\wedge m.major='CS'}M\ X\ Q)) - (\pi_{q.t1books,t1.sid,t1.bookno}(T1\bowtie_{t1.sid=m.sid\wedge m.major='CS'}M\ X\ Q))))$

----t1books is the alias of bookno from book
--B1,B2,M,T1 are alias of book B1,book B2,major M,buys T1

l)

Query--------

```
select q1.s1,q1.s2 from
((select distinct s1.sid as s1,s2.sid as s2 from student s1 inner join student s2 on
s1.sid<>s2.sid cross join buys b)
 except
 select q2.s1,q2.s2
 from((select s1.sid as s1,s2.sid as s2,b.bookno from student s1 inner join student s2 on
s1.sid<>s2.sid
 inner join buys b on b.sid=s1.sid)
                  except (select s1.sid,s2.sid,b.bookno from student s1 inner join student s2 on
s1.sid<>s2.sid
                                    inner join buys b on b.sid=s2.sid and b.sid<>s1.sid ))q2)q1;
```

RA----------

$Q2=(\pi_{s1,s2,b.bookno}(S1\bowtie_{s1.sid<>s2.sid}S2\bowtie B_{b.sid=s1.sid}))-(\pi_{s1.sid,s2.sid,b.bookno}(S1\bowtie_{s1.sid<>s2.sid}S2\bowtie_{b.sid=s2.sid\wedge b.sid<>s1.sid}B))$

$Q1=\pi_{s1,s2}(S1\bowtie_{s1.sid<>s2.sid}S2\ XB)$

$\pi_{q1.s1,q1.s2}$

--s1,s2 in projection are alias names of s1.sid,s2.sid

--S1,S2,B are alias names of student S1,student S2,Buys B

m)

Query--------

```
select q1.bookno from
((select b1.bookno as bookno,b2.bookno as bookno1 from book b1 inner join book b2 on
b1.bookno<>b2.bookno
                  inner join cites c1 on b1.bookno=c1.citedbookno inner join cites c2 on
b2.bookno=c2.citedbookno)
except

 (select q2.* from
         ((select b1.bookno,b2.bookno from book b1 cross join book b2)
         except
 (select c1.bookno,c2.bookno from
                cites c inner join cites c1 on c1.bookno=c.citedbookno inner join
                                  cites c2 on c2.bookno=c.citedbookno
                                          ))q2))q1;
```

RA----------

$Q2=((\pi_{b1.bookno,b2.bookno}(B1XB2)-(\pi_{c1.bookno,c2.bookno}(C\bowtie_{c1.bookno=c.citedbookno}C1\bowtie_{c2.bookno=c.citedbookno}C2))$

$Q1=((\pi_{bookno,bookno1}(B1\bowtie_{b1.bookno<>b2.bookno}B2\bowtie_{b1.bookno=c1.citedbookno}C1\bowtie_{b2.bookno=c2.citedbookno}C2)-\pi_{q2.*})$

$\pi_{q1.bookno}$

--C,C1,C2,B1,B2 are alias names of cites C,cites C1,cites C2,book B1,book B2

--bookno,bookno1 in the projection are alias names of b1.bookno and b2.bookno from book b1,book b2

3.
a)
Query--------
```
select distinct m.sid, m.major
    from   major m inner join buys t on m.sid=t.sid
          inner join book b on t.bookno=b.bookno and b.price<20;
```
RA----------

$\pi_{m.sid,\ m.major}(M \bowtie_{m.sid=t.sid} T \bowtie_{t.bookno=b.bookno \wedge b.price<20} B)$

--M,T,B are alias names of major M,buys T,book B

b)
Query--------
```
(select distinct t.sid, b.bookno
    from   buys t inner join book b on t.bookno=b.bookno)
    except
        (select distinct t.sid, b.bookno
    from   buys t inner join book b on t.bookno=b.bookno inner join buys t1 on
              t1.sid = t.sid inner join book b1 on t1.bookno = b1.bookno and not
b.price<=b1.price);
```
RA----------

$(\pi_{t.sid,\ b.bookno}(T \bowtie_{t.bookno=b.bookno} B)) - (\pi_{t.sid,\ b.bookno}(T \bowtie_{t.bookno=b.bookno} B \bowtie_{t1.sid = t.sid} T1 \bowtie_{t1.bookno = b1.bookno \wedge \neg b.price<=b1.price} B1))$

--T,B,T1,B1 are alias names of buys T1,book B,buys T1,book B1
c)
Query--------
```
select distinct b.bookno, b.title
  from   book b inner join cites c on b.bookno= c.citedbookno
  and  20 <= b.price and b.price <= 40;
```
RA----------

$\pi_{b.bookno,\ b.title}(B \bowtie_{b.bookno= c.citedbookno \wedge 20 <= b.price \wedge b.price <= 40} C)$

--B,C are alias names of book B,cites C
d)
Query--------
```
select distinct s.sid, s.sname
  from   student s inner join major m on s.sid=m.sid inner join buys t on s.sid = t.sid inner
join cites c on
  t.bookno = c.citedbookno inner join book b1 on c.citedbookno = b1.bookno inner join
book b2 on c.bookno = b2.bookno
  and m.major = 'CS' and b1.price > b2.price;
```

RA----------

$\pi_{s.sid,\ s.sname}(S \bowtie_{s.sid=m.sid \wedge\ m.major = 'CS'} M \bowtie_{s.sid = t.sid} T \bowtie_{t.bookno = c.citedbookno} C \bowtie_{c.citedbookno = b1.bookno} B1 \bowtie_{c.bookno = b2.bookno \wedge\ b1.price > b2.price} B2)$

--S,M,T,C,B1,B2 are alias names of student S,major M,buys T,cites C,book B1,book B2

e)

Query--------

```
select distinct q.bookno,q.title from
((select distinct s.sid,b.bookno, b.title
  from   book b cross join student s inner join major m
  on s.sid=m.sid and  m.major = 'CS') except
            (select t.sid,b.bookno,b.title
                  from   buys t inner join book b
                        on t.bookno = b.bookno))q;
```

RA----------

$Q=((\ \pi_{s.sid,b.bookno,\ b.title}(BXS \bowtie_{s.sid=m.sid \wedge\ m.major = 'CS'} M))-(\ \pi_{t.sid,b.bookno,b.title}\ (T \bowtie_{t.bookno = b.bookno} B)))\ \pi_{q.bookno,q.title}$

--B,S,M,T are alias names of book B,student S,major M,buys T

f)

Query--------

```
(select b.bookno,b.title from book b)
except
        (select q.bookno,q.title
        from ((select b.bookno,b.title,s.sid from book b cross join student s inner join major
m1 on s.sid=m1.sid
                inner join major m2 on s.sid=m2.sid and m1.major = 'CS' and m2.major =
'Math' )

         except
         select b.bookno,b.title,s.sid from book b cross join student s inner join major m1 on
s.sid=m1.sid
                inner join major m2 on s.sid=m2.sid and m1.major = 'CS' and m2.major =
'Math' inner join buys t
         on t.sid = s.sid and t.bookno = b.bookno)q);
```

RA----------

$Q= ((\pi_{b.bookno,b.title,s.sid}(\ BXS \bowtie M1_{s.sid=m1.sid} \bowtie_{s.sid=m2.sid \text{ and } m1.major = 'CS' \text{ and } m2.major = 'Math'} M2)-\pi_{b.bookno,b.title,s.sid}(\ BXS \bowtie_{s.sid=m1.sid} M1 \bowtie_{s.sid=m2.sid \wedge\ m1.major = 'CS' \wedge\ m2.major = 'Math'} M2 \bowtie_{t.sid = s.sid \wedge\ t.bookno = b.bookno} T)$

$(\pi_{b.bookno,b.title}(B))-(\pi_{\ q.bookno,q.title}(Q))$

--B,S,M1,M2,T are alias names of book B,student S,major M1,major M2,buys T