

Assignment 2

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September 22, 2022

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Problem 10.a

$$\pi_{B.bno, B.title}^{(B)} - \pi_{B_1.bno, B_1.title}^{(B_1 \bowtie_{B_1.bno=T_1.bno} (T_1 \bowtie_{T_1.bno=T_2.bno \wedge T_1.sid \neq T_2.sid} T_2))}$$

Problem 11.a

$$\pi_{hM.major, T.bno}^{(hM \bowtie_{T.sid=hM.sid} (T \bowtie_{T.bno=B.bno} B))} - \pi_{hM.major, T.bno}^{(hM \bowtie_{T.sid=hM.sid} (T \bowtie_{T.bno=B.bno} (B \bowtie_{hM.major=hM_1.major} (hM_1 \bowtie_{T_1.sid=hM_1.sid} (T_1 \bowtie_{T_1.bno=B_1.bno \wedge B_1.price > B_1.price} (B_1))))))}$$

Problem 12.a

Problem 13.a

Problem 14.a

Problem 19

$$\begin{aligned} & \pi_{c_1.bno1}(\pi_{c_1.bno1, c_1.bno2, c_2.bno1, c_2.bno2}(\sigma_{c_1.bno2=c_2.bno2}(cites_1 \times cites_2))) \\ & \cap \pi_{c_1.bno1, c_1.bno2, c_2.bno1, c_2.bno2}(\sigma_{c_1.bno1 \neq c_2.bno1}(cites_1 \times cites_2)) \\ & \cap \pi_{c_1.bno1, c_1.bno2, c_2.bno1, c_2.bno2}(\pi_{c_1.bno1, c_1.bno2, c_2.bno1, c_2.bno2}(cites_1 \times cites_2) - \\ & \pi_{c_1.bno1, c_1.bno2, c_2.bno1, c_2.bno2}(\pi_{c_1.bno1, c_1.bno2, c_2.bno1, c_2.bno2, c_3.bno1, c_3.bno2}(\sigma_{c_1.bno1=c_3.bno1}(cites_1 \times \\ & cites_2 \times cites_3))) \cap \\ & \pi_{c_1.bno1, c_1.bno2, c_2.bno1, c_2.bno2, c_3.bno1, c_3.bno2}(\pi_{c_1.bno1, c_1.bno2, c_2.bno1, c_2.bno2, c_3.bno1, c_3.bno2}() - \\ & \pi_{c_1.bno1, c_1.bno2, c_2.bno1, c_2.bno2, c_3.bno1, c_3.bno2}(\pi_{c_1.bno1, c_1.bno2, c_2.bno1, c_2.bno2, c_3.bno1, c_3.bno2, c_4.bno1, c_4.bno2}(\sigma_{c_2.bno1=c_4.bno1}(cites_1 \times \\ & cites_2 \times cites_3 \times cites_4))) \cap \pi_{c_1.bno1, c_1.bno2, c_2.bno1, c_2.bno2, c_3.bno1, c_3.bno2, c_4.bno1, c_4.bno2}(\sigma_{c_3.bno2=c_4.bno2}(cites_1 \times \\ & cites_2 \times cites_3 \times cites_4)))))) \cap \\ & \pi_{c_1.bno1, c_1.bno2, c_2.bno1, c_2.bno2}(\pi_{c_1.bno1, c_1.bno2, c_2.bno1, c_2.bno2}(cites_1 \times cites_2) - \\ & \pi_{c_1.bno1, c_1.bno2, c_2.bno1, c_2.bno2}(\pi_{c_1.bno1, c_1.bno2, c_2.bno1, c_2.bno2, c_3.bno1, c_3.bno2}(\sigma_{c_2.bno1=c_3.bno1}(cites_1 \times \\ & cites_2 \times cites_3))) \cap \\ & \pi_{c_1.bno1, c_1.bno2, c_2.bno1, c_2.bno2, c_3.bno1, c_3.bno2}(\pi_{c_1.bno1, c_1.bno2, c_2.bno1, c_2.bno2, c_3.bno1, c_3.bno2}() - \\ & \pi_{c_1.bno1, c_1.bno2, c_2.bno1, c_2.bno2, c_3.bno1, c_3.bno2}(\pi_{c_1.bno1, c_1.bno2, c_2.bno1, c_2.bno2, c_3.bno1, c_3.bno2, c_4.bno1, c_4.bno2}(\sigma_{c_1.bno1=c_4.bno1}(cites_1 \times \\ & cites_2 \times cites_3 \times cites_4))) \cap \\ & \pi_{c_1.bno1, c_1.bno2, c_2.bno1, c_2.bno2, c_3.bno1, c_3.bno2, c_4.bno1, c_4.bno2}(\sigma_{c_3.bno2=c_4.bno2}(cites_1 \times cites_2 \times cites_3 \times \\ & cites_4)))))) \neq \emptyset \end{aligned}$$

SQL

```
select q.c1b1 from (
  select c1.bno1 as c1b1, c1.bno2 as c1b2, c2.bno1 as c2b1, c2.bno2 as c2b2 from cites c1, cites c2 where c1.bno2 = c2.bno2
  INTERSECT
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select c1.bno1 as c1b1, c1.bno2 as c1b2, c2.bno1 as c2b1, c2.bno2 as c2b2 from cites c1, cites c2 where c1.bno1 <> c2.bno1
INTERSECT
select q1.c1b1, q1.c1b2, q1.c2b1, q1.c2b2 from (
select c1.bno1 as c1b1, c1.bno2 as c1b2, c2.bno1 as c2b1, c2.bno2 as c2b2 from cites c1, cites c2
EXCEPT
select q3.c1b1, q3.c1b2, q3.c2b1, q3.c2b2 from (
select c1.bno1 as c1b1, c1.bno2 as c1b2, c2.bno1 as c2b1, c2.bno2 as c2b2, c3.bno1 as c3b1, c3.bno2 as c3b2 from cites c1, cites c2, cites c3 where c1.bno1 = c3.bno1
INTERSECT
select q5.c1b1, q5.c1b2, q5.c2b1, q5.c2b2, q5.c3b1, q5.c3b2 from (
select c1.bno1 as c1b1, c1.bno2 as c1b2, c2.bno1 as c2b1, c2.bno2 as c2b2, c3.bno1 as c3b1, c3.bno2 as c3b2 from cites c1, cites c2, cites c3
EXCEPT
select q6.c1b1, q6.c1b2, q6.c2b1, q6.c2b2, q6.c3b1, q6.c3b2 from (
select c1.bno1 as c1b1, c1.bno2 as c1b2, c2.bno1 as c2b1, c2.bno2 as c2b2, c3.bno1 as c3b1, c3.bno2 as c3b2, c4.bno1 as c4b1, c4.bno2 as c4b2 from cites c1, cites c2, cites c3 where c1.bno1 = c4.bno1
INTERSECT
select c1.bno1 as c1b1, c1.bno2 as c1b2, c2.bno1 as c2b1, c2.bno2 as c2b2, c3.bno1 as c3b1, c3.bno2 as c3b2, c4.bno1 as c4b1, c4.bno2 as c4b2 from cites c1, cites c2, cites c3 where c1.bno1 = c4.bno1
) q6
) q5
) q3
) q1
INTERSECT
select q2.c1b1, q2.c1b2, q2.c2b1, q2.c2b2 from (
select c1.bno1 as c1b1, c1.bno2 as c1b2, c2.bno1 as c2b1, c2.bno2 as c2b2 from cites c1, cites c2
EXCEPT
select q4.c1b1, q4.c1b2, q4.c2b1, q4.c2b2 from (
select c1.bno1 as c1b1, c1.bno2 as c1b2, c2.bno1 as c2b1, c2.bno2 as c2b2, c3.bno1 as c3b1, c3.bno2 as c3b2 from cites c1, cites c2, cites c3 where c2.bno1 = c3.bno1
INTERSECT
select q8.c1b1, q8.c1b2, q8.c2b1, q8.c2b2, q8.c3b1, q8.c3b2 from (
select c1.bno1 as c1b1, c1.bno2 as c1b2, c2.bno1 as c2b1, c2.bno2 as c2b2, c3.bno1 as c3b1, c3.bno2 as c3b2 from cites c1, cites c2, cites c3
EXCEPT
select q7.c1b1, q7.c1b2, q7.c2b1, q7.c2b2, q7.c3b1, q7.c3b2 from (
select c1.bno1 as c1b1, c1.bno2 as c1b2, c2.bno1 as c2b1, c2.bno2 as c2b2, c3.bno1 as c3b1, c3.bno2 as c3b2, c4.bno1 as c4b1, c4.bno2 as c4b2 from cites c1, cites c2, cites c3 where c2.bno1 = c3.bno1
INTERSECT
select c1.bno1 as c1b1, c1.bno2 as c1b2, c2.bno1 as c2b1, c2.bno2 as c2b2, c3.bno1 as c3b1, c3.bno2 as c3b2, c4.bno1 as c4b1, c4.bno2 as c4b2 from cites c1, cites c2, cites c3 where c2.bno1 = c3.bno1
) q7
) q8
) q4
) q2
) q;

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Problem 20

$$\pi_{h.sid}(\pi_{h.sid,h.major}(\text{hasMajor}) - \pi_{h.sid,h.major}(\pi_{h.sid,h.major,b.sid,b.bno}(\sigma_{b.sid=h.sid}(\text{hasMajor} \times \text{buys}))) \cap \pi_{h.sid,h.major,b.sid,b.bno}(\pi_{h.sid,h.major,b.sid,b.bno}(\text{hasMajor} \times \text{buys}) - \pi_{h.sid,h.major,b.sid,b.bno}(\sigma_{h_1.sid < > h.sid \wedge b_1.sid = h_1.sid \wedge h_1.major = \text{Math}(\text{hasMajor} \times \text{buys} \times \text{hasMajor}_1 \times \text{buys}_1)))))) \neq \emptyset$$

SQL

```

select distinct q.sid from (
select h.sid, h.major from hasMajor h
EXCEPT
select q1.hsid, q1.major from (
select h.sid as hsid, h.major, b.sid as bsid, b.bno from hasMajor h, buys b where b.sid=h.sid
INTERSECT
select q2.hsid, q2.major, q2.bsid, q2.bno from (
select h.sid as hsid, h.major, b.sid as bsid, b.bno from hasMajor h, buys b
EXCEPT
select h.sid as hsid, h.major, b.sid as bsid, b.bno from hasMajor h, buys b, hasMajor h1, buys b1 where b1.sid=h1.sid and h1.major='Math' and b1.bno=b.bno
) q2
) q1
) q;

```

Problem 21

$$\pi_{m_1.major,m_2.major}(\pi_{m_1.major,m_2.major}(\sigma_{m_1.major \neq m_2.major}(\text{major}_1 \times \text{major}_2))) \cap \pi_{m_1.major,m_2.major}(\pi_{m_1.major,m_2.major}(\text{major}_1 \times \text{major}_2) - \pi_{m_1.major,m_2.major}(\pi_{m_1.major,m_2.major,h_1.major}(\sigma_{h_1.major=m_1.major}(\text{major}_1 \times \text{major}_2 \times \text{hasMajor}_1)))) \cap \pi_{m_1.major,m_2.major,h_1.major}(\sigma_{h_2.major=m_2.major \text{ and } h_1.sid=h_2.sid}(\pi_{h_1.major=m_1.major}(\text{major}_1 \times \text{major}_2 \times \text{hasMajor}_1 \times \text{hasMajor}_2)))))) \neq \emptyset$$

SQL

```

select q.m1, q.m2 from (
select m1.major as m1, m2.major as m2 from major m1, major m2 where m1.major <> m2.major
INTERSECT

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select m1.major as m1, m2.major as m2 from major m1, major m2
EXCEPT
select q1.m1, q1.m2 from (
  select m1.major as m1, m2.major as m2, h1.sid, h1.major from major m1, major m2, hasMajor h1 where h1.major=m1.major
  INTERSECT
  select m1.major as m1, m2.major as m2, h1.sid, h1.major from major m1, major m2, hasMajor h1, hasMajor h2 where h2.major=m2.major and h1.sid=h2.sid
) q1
) q;

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Problem 22

$$\pi_{h.sid}(\pi_{h.sid}(hasMajor) - \pi_{h.sid}(\sigma_{h.sid=s.sid}(hasMajor \times student))) = \emptyset$$

SQL

```

select h.sid from hasMajor h where true=all(
  select h.sid <> s.sid from student s
);

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