

Consider the following schema:Customers (cid, cname, city)Products (pid, pname, city, quantity, price)Agents (aid, aname, city)Orders (ordno, cid, aid, pid, month, quantity, total)**Answer the following queries using Tuple Relational Calculus (TRC) AND Relational Algebra (RA):**

1. Find all orders with quantity equal to 1000 or more.

TRC: $\{O \mid O \in Orders \wedge (O.quantity \geq 1000)\}$ RA: $\sigma_{quantity \geq 1000} Orders$

2. Find all (ordno, cid) pairs for order with a total value less than \$5000.

TRC: $\{O \mid \exists O1 \in Orders (O.ordno = O1.ordno \wedge O.cid = O1.cid \wedge O1.total < \$5000)\}$ RA: $\pi_{ordno, cid} \sigma_{total < \$5000} Orders$

3. Find all (ordno, cname) pairs for orders in March.

TRC: $\{R \mid \exists O \in Orders (R.ordno = O.ordno \wedge O.month = March \wedge \exists C \in Customers (C.cid = O.cid \wedge R.cname = C.cname))\}$ RA: $\pi_{ordno, cname} \sigma_{month=March} (Orders \bowtie Customers)$

4. Find all product names of products in Berkeley ordered in March.

TRC: $\{P \mid \exists P1 \in Products (P.pname = P1.pname \wedge P1.city = Berkeley \wedge \exists O \in Orders (P1.pid = O.pid \wedge O.month = March))\}$ RA: $\pi_{pname} \left(\left(\sigma_{city=Berkeley} Products \right) \bowtie_{pid=pid} \left(\sigma_{month=March} Orders \right) \right)$

5. Find all (cid, aid, pid) triples for customer, agent, product combinations that are all in the same city.

TRC: $\{R \mid \exists C \in Customers (R.cid = C.cid \wedge \exists A \in Agents (R.aid = A.aid \wedge \exists P \in Products (R.pid = P.pid \wedge C.city = A.city \wedge A.city = P.city)))\}$ RA: $\pi_{cid, aid, pid} (Customers \bowtie Agents \bowtie Products)$

6. Find pids of products ordered through agent 3 but not through agent 6.

TRC: $\{O \mid \exists O1 \in Orders (O.pid = O1.pid \wedge O1.aid = 3) \wedge \neg \exists O2 \in Orders (O1.pid = O2.pid \wedge O2.aid = 6)\}$ OR Another Valid TRC: $\{O \mid \exists O1 \in Orders (O.pid = O1.pid \wedge O1.aid = 3) \wedge \forall O2 \in Orders (O1.pid \not\leftrightarrow O2.pid \vee O2.aid \not\leftrightarrow 6)\}$ RA: $\pi_{pid} (\sigma_{aid=3} Orders) - \pi_{pid} (\sigma_{aid=6} Orders)$

7. Get names of agents who place orders for all products ordered by customer 2

TRC: $\{A \mid \exists A1 \in Agents (A.aname = A1.aname \wedge \forall O1 \in Order (O1.cid = 2 \Rightarrow \exists O2 \in Order (O2.pid = O1.pid \wedge O2.aid = A1.aid)))\}$ RA: $\pi_{aname} \left(\left(\pi_{aid, pid} Orders \right) / \left(\pi_{pid} \sigma_{cid=2} Orders \right) \right) \bowtie Agents$