1. Consider the existing relations, show the result
   a. $T_2 \cup T_3$;
      No result coz not the same arity
   b. $T_2 \cap T_3$;
      No result coz not the same arity
   c. $T_2 - T_3$;
      No result coz not the same arity
   d. $T_2 \times T_3$

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2. Consider the existing relations, show the result
   a. $T_1 \bowtie_{T_1.P=T_2.A} T_2$

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   b. $T_1 \bowtie_{T_1.Q=T_2.B} T_2$

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   c. $T_1 \bowtie_{T_1.P=T_2.A} T_2$

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   d. $T_1 \bowtie_{T_1.Q=T_2.B} T_2$

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3. SQL:
   a. copies of the book titled The Lost Tribe are owned by the library branch whose name is "Sharpstown"?
      SELECT No_Of_Copies
      FROM BOOK, BOOK_COPIES, LIBRARY_BRANCH
      WHERE Title='The Lost Tribe' AND BranchName='Sharpstown'
   b. copies of the book titled The Lost Tribe are owned by each library branch?
      SELECT BranchId, NoOfCopies
      FROM BOOK, BOOK_COPIES
      WHERE Title='The Lost Tribe'
      GROUP BY BranchId
   c. Retrieve the names of all borrowers who do not have any books checked out.
      SELECT Name
      FROM BORROWER B
      WHERE NOT EXIST ( SELECT *
                     FROM BOOK_LOANS L
                     WHERE B.CardNo = L.CardNo )
   d. For each book that is loaned out from the "Sharpstown" branch and whose DueDate is today, retrieve the book title, the borrower's name, and the borrower's address.
      SELECT B.Title, R.Name, R.Address
      FROM BOOK B, BORROWER R, BOOK_LOANS BL, LIBRARY_BRANCH LB
      WHERE LB.BranchName='Sharpstown' AND LB.BranchId=BL.BranchId AND BL.DueDate='today' AND BL.CardNo=R.CardNo AND BL.BookId=B.BookId
   e. For each library branch, retrieve the branch name and the total number of books loaned out from that branch.
      SELECT L.BranchName, COUNT(*)
      FROM BOOK_COPIES B, LIBRARY_BRANCH L
      WHERE B.BranchId = L.BranchId
      GROUP BY L.BranchName
   f. Retrieve the names, addresses, and number of books checked out for all borrowers who have more than five books checked out.
SELECT B.CardNo, B.Name, B.Address, COUNT(*)
FROM BORROWER B, BOOK_LOANS L
WHERE B.CardNo = L.CardNo
GROUP BY B.CardNo
HAVING COUNT(*) > 5

For each book authored (or co-authored) by "Stephen King", retrieve the title and the number of
copies owned by the library branch whose name is "Central".
SELECT Title, NoOfCopies
FROM ( ( (BOOK_AUTHORS NATURAL JOIN BOOK) NATURAL JOIN BOOK_COPIES)
NATURAL JOIN LIBRARY_BRANCH)
WHERE Author_Name = 'Stephen King' and BranchName = 'Central'

4. Tuple relational calculus

c. Retrieve the names of all borrowers who do not have any books checked out.
   \{b.Name | Borrower (b) and (not(\exists l)(Book_Loan(l) AND b.CardNo = l.CardNo))\}
d. For each book that is loaned out from the "Sharpstown" branch and whose DueDate is today,
   retrieve the book title, the borrower's name, and the borrower's address.
   \{a.Title, b.Name, b.Address | Book(a) Borrower(b) AND (\exists c)(Book_Loan(c)
   (\exists d)(Library.Branch(d) AND d.BranchName='Sharpstown' AND d.BranchId=c.BranchId

e. For each library branch, retrieve the branch name and the total number of books loaned out from
that branch.
   \{l.BranchName, count(b) | Book_Copies(b) Library.Branch(l) AND b.BranchId=l.BranchId\}
f. Retrieve the names, addresses, and number of books checked out for all borrowers who have
more than five books checked out.
   \{b.CardNo, b.Name, b.Address, count(a) | Book_Loan(a) Borrower(b) AND b.CardNo=a.CardNo
   AND count(b)>5\}

5. Relational Algebra (P=Project, S=Select)
a. copies of the book titled The Lost Tribe are owned by the library branch whose name is
   "Sharpstown"?
   P No_Of_Copies ((S Title='The Lost Tribe' (BOOK) \x\ BOOK_COPIES) \x ( S BranchName='Sharpstown' (LIBRARY-BRANCH) )
b. copies of the book titled The Lost Tribe are owned by each library branch?
   P BranchId, No_Of_Copies ( (S Title='The Lost Tribe' (BOOK) \x BOOK_COPIES)
c. Retrieve the names of all borrowers who do not have any books checked out.
   NO_CHECKOUT_B <-- P CardNo (BORROWER) - P CardNo (BOOK_LOANS)
   RESULT <-- P Name (BORROWER * NO_CHECKOUT_B)
d. For each book that is loaned out from the "Sharpstown" branch and whose DueDate is today,
   retrieve the book title, the borrower's name, and the borrower's address.
   S <-- P BranchId ( S BranchName='Sharpstown' (LIBRARY-BRANCH) )
   B_FROM_S <-- P BookId, CardNo ( (S DueDate='today' (BOOK_LOANS) ) * S )
e. For each library branch, retrieve the branch name and the total number of books loaned out from that branch.
   \[ R(\text{BranchId, Total}) \leftarrow \text{BranchId FCOUNT(BookId, CardNo)} \ (\text{BOOK_LOANS}) \]
   \[ \text{RESULT } \leftarrow \text{P BranchName, Total (R * LIBRARY_BRANCH)} \]

f. Retrieve the names, addresses, and number of books checked out for all borrowers who have more than five books checked out.
   \[ B(\text{CardNo, TotalCheckout}) \leftarrow \text{CardNo FCOUNT(BookId)} \ (\text{BOOK_LOANS}) \]
   \[ B5 \leftarrow \text{S TotalCheckout > 5 (B)} \]
   \[ \text{RESULT } \leftarrow \text{P Name, Address, TotalCheckout (B5 * BORROWER)} \]

g. For each book authored (or co-authored) by "Stephen King", retrieve the title and the number of copies owned by the library branch whose name is "Central".
   \[ SK(\text{BookId, Title}) \leftarrow \text{(sAuthorName='Stephen King' (BOOK_AUTHORS)) * BOOK} \]
   \[ CENTRAL(\text{BranchId}) \leftarrow \text{sBranchName='Central' (LIBRARY_BRANCH)} \]
   \[ \text{RESULT } \leftarrow \text{P Title, NoOfCopies (SK * BOOKCOPIES * CENTRAL)} \]

6. SQL
   a. Insert <'ProductA', 'A', 'Bellaire', 2> into PROJECT
      
      \[
      \text{INSERT INTO PROJECT VALUES ('ProductA', 4, 'Bellaire', 2)}
      \]
   b. Insert <'112234455', NULL, '40.0'> into WORKS_ON
      
      \[
      \text{INSERT INTO WORKS_ON VALUES ('112234455', NULL, '40.0')}
      \]
   c. Delete the EMPLOYEE tuple with SSN='9988776655'
      
      \[
      \text{DELETE FROM EMPLOYEE WHERE SSN='9988776655'}
      \]
   d. Delete the PROJECT tuple with PNAME='ProductY'
      
      \[
      \text{DELETE FROM PROJECT WHERE PNAME='ProductY'}
      \]
   e. Modify the SUPERSSN attribute of EMPLOYEE tuple with SSN='3344556677' to '3456734567'
      
      \[
      \text{UPDATE EMPLOYEE SET SUPERSSN = '3456734567' WHERE SSN='3344556677'}
      \]
   f. Modify the HOURS attribute of WORKS_ON tuple with SSN = '98769876' and PNO=10 to '5.0'
      
      \[
      \text{UPDATE WORKS_ON SET HOURS = '5.0' WHERE ESSN='98769876' AND PNO=10}
      \]