Classroom Exercise

1. The schema of a database containing university-type data is given below.

Primary key is bold for each relation.

STUDENT(**Sid**, Sname, Sex, Age, Year, GPA)
DEPT(**Dname**, Numphds)
PROF(**Pname**, Dname)
COURSE(**Cno**, Cname, Dname)
MAJOR(**Dname, Sid**)
SECTION(**Dname, Cno, Sectno**, Pname)
ENROLL(**Sid**, Grade, **Dname, Cno, Sectno**)

Write the following queries in SQL.

(i) Find the names of professors who work in departments that have fewer than 50 PhD students.

Solution:

```
SELECT   Pname
FROM     PROF, DEPT
WHERE    DEPT.Dname = PROF.Dname AND Numphds < 50;
```

(ii) Find the names and majors of students who have taken the 'Database System' course.

Solution:

```
SELECT  Sname, Dname
FROM    COURSE C, ENROLL E, MAJOR M, STUDENT S
WHERE   C.Cname = 'Database Systems'
AND     C.Dname = E.Dname
AND     C.Cno = E.Cno
AND     E.Sid = M.Sid
AND     E.Sid = S.Sid;
```

(iii) Find the ids, names, and GPAs of the students who have taken all courses from the 'Civil Engineering' department.

Solution:

```
SELECT    Sid, Sname, GPA
FROM      STUDENT S
WHERE     NOT EXISTS
          (SELECT C.CID
          FROM   COURSE C
          WHERE Dname = 'Civil Engineering'
          EXCEPT
          SELECT E.CID
          FROM ENROLL E
          WHERE Dname = 'Civil Engineering' AND E.Sid = S.Sid);
```

2. Suppose we are maintaining a database of articles published in our newspaper, the Straits Times. We have the following schema (where keys are underlined):

Article (issueID, articleID, author, title)

Citation (articleID, issueID, citedArticleID, citedIssueID)

WordAppears (wordID, issueID, articleID, position)

WordIs (wordID, wordText)

Issue (issueID, date, howManyDistributed)

Assume that dates can be compared using comparison operators (<, >, =). Assume that position is an index specifying where the word appears (1 = first word, 2 = second, etc.). Write the following query in SQL.

Find the documents in which the words "politician" and "corruption" appear.

Solution:

```
SELECT    DISTINCT wa1.issueID, wa1.articleID
FROM      WordAppears wa1, WordIs wi1, WordAppears wa2, WordIs wi2
WHERE     wa1.issueID = wa2.issueID AND wa1.articleID = wa2.articleID
          AND wa1.wordID = wi1.wordID AND wa2.wordID = wi2.wordID
          AND wi1.wordText = 'politician' AND wi2.wordText = 'corruption';
```

3. Consider the relation R(A,B,C,D) with candidate keys AC and D. What will be the output of the following query? Justify your answer.

```
SELECT A, B
FROM R
WHERE C > (SELECT D FROM R WHERE C = 3);
```

Solution:

This will be an error. The inner query is a row subquery and it can return multiple D's. Hence, there is a mismatch of operators.

Critical Thinking Exercise

4. Let R=(A, B, C), S=(C, D, E) be two relational schema. Let q and r be relations (i.e., tables) on schema R; and s be a relation (i.e., a table) on schema S. Convert the following relational algebra queries to SQL.

(i) $q - r$

(ii) $\Pi_{A, C}(r) \bowtie \Pi_{C, D}(s)$