MIS 6326 (Data Management)

Assignment 1: Chapter 3

Primary Due: 11 pm (Central Time) September 9, 2024
Secondary Due (15% penalty strictly enforced): 11 pm (Central Time) September 10, 2024

Please upload a readable *__single__* assignment file (e.g., a text file, a PDF file, or an MS Word file). After uploading the assignment file, you MUST validate it by checking what you uploaded. If you uploaded a wrong file, you can upload a correct one again before the assignment due date. At the time of grading, no credit will be given to a wrong assignment (e.g., an assignment file for a different class) or an unreadable file.
The assignment submitted via email will not be accepted.

Using the supplier-part database, answer each of the following relational algebra questions.
- This assignment does not require the use of SQL or any database software. The results must be manually generated.
- Note: See the textbook Chapter 3 and lecture PPT file for explanations and examples of relational algebra operations.

Supplier-Part-Project Database

S Table (for Suppliers)

SNO	SNAME	STATUS	CITY
S1	Smith	20	Irving
S2	Moore	10	Plano
S3	Brown	30	Plano
S4	Miller	20	Irving
S5	Peters	30	Temple

P Table (for Parts)

PNO	PNAME	COLOR	WEIGHT	CITY
P1	Nut	Red	12	Irving
P2	Bolt	Green	17	Plano
P3	Screw	Blue	17	Murphy
P4	Screw	Red	14	Irving
P5	Cam	Blue	12	Plano
P6	Cog	Red	19	Irving

J Table (for Projects)

JNO	JNAME	CITY
J1	Sorter	Plano
J2	Display	Waco
J3	OCR	Temple
J4	Console	Temple
J5	RAID	Irving
J6	EDS	Murphy
J7	Tape	Irving

SPJ Table

SNO	PNO	JNO	QTY
S1	P1	J1	200
S1	P1	J4	300
S2	P3	J1	400
S2	P3	J2	200
S2	P3	J3	200
S2	P3	J4	500
S2	P3	J5	600
S2	P3	J6	400
S2	P3	J7	800
S2	P5	J2	100
S3	P3	J1	500
S3	P4	J3	500
S4	P6	J3	300
S4	P6	J7	300
S5	P1	J2	200
S5	P2	J4	100
S5	P3	J4	200
S5	P4	J4	700
S5	P5	J4	400
S5	P5	J5	500
S5	P5	J7	700
S5	P6	J2	200
S5	P6	J4	500

(NOTE: QTY stands for quantity.)
SPJ table shows which supplier (SNO) supplied how many units (QTY) of what part (PNO) for which project (JNO).

Note 1: Short tutorials are attached in the end of this assignment. Before starting the assignment, please read them.

Note 2: As the answer of each question, write the result (i.e., table) of the operation. <u>Do not show the step-by-step process</u>; just the final result is sufficient as the answer.

1. Show the result of a project operation that lists the *SNAME*, *STATUS*, and *CITY* attributes of all suppliers.

2. Show the result of a restrict operation that lists suppliers in `Plano` and `Temple`.

3. Show the result of a project & restrict operation that lists the *SNAME*, *STATUS*, and *CITY* attributes of suppliers in `Plano` and `Temple`.

4. Show the result of the natural join that combines the suppliers (*S* table) and parts (*P* table).

5. Show the result of a one-sided outer join between the *P* (part) and *S* (supplier) tables using the common *CITY* column. Preserve the rows of the *P* table in the result.

6. Show the result of a one-sided outer join between the *P* (part) and *S* (supplier) tables using the common *CITY* column. Preserve the rows of the *S* table in the result.

7. Show the result of the full outer join between the *P* (part) and *S* (supplier) tables using the common *CITY* column.

8. Show *PNO*, *PNAME*, and *COLOR* of parts that supplier 'S3' did not supply,

9. Show *PNO*, *PNAME*, and *COLOR* of parts that were supplied to all projects in *J* table. (See textbook §3.4.7 for divide operator.)

10. Show the result of an aggregate operation on the *SPJ* table. The grouping column is *PNO* and the aggregate calculation is the sum of *QTY* values.

The following short *tutorial* complements the textbook's coverage on relational algebra operators (Textbook Chapter 3), because details of some operators are missing in the textbook.

A Short Tutorial on Join Operations

```
        Cross-join of T1 & T2

T1                    T2                    Result
----------            ----------            --------------------
C1[PK]  C2            C3[PK]  C2            C1   T1.C2   C3   T2.C2
----------            ----------            --------------------
1       x   ╲╲╲╲  a       x              1     x      a     x
2       y   ╳╳╳╳  b       x              1     x      b     x
3       x   ╳╳╳╳  c       y              1     x      c     y
4       z   ╱╱╱╱  d                      1     x      d
----------            ----------            2     y      a     x
                                            2     y      b     x
                                            2     y      c     y
                                            2     y      d
                                            3     x      a     x
                                            3     x      b     x
                                            3     x      c     y
                                            3     x      d
                                            4     z      a     x
                                            4     z      b     x
                                            4     z      c     y
                                            4     z      d
                                            --------------------
```

```
        Equi-join of T1 & T2 with T1.C2=T2.C2

T1                    T2                    Result
----------            ----------            --------------------
C1[PK]  C2            C3[PK]  C2            C1   T1.C2   C3   T2.C2
----------            ----------            --------------------
1       x   ╲   a       x              1     x      a     x
2       y   ╳   b       x              1     x      b     x
3       x   ╱   c       y              2     y      c     y
4       z       d                      3     x      a     x
----------            ----------            3     x      b     x
                                            --------------------
```

```
          Natural join of T1 & T2
          Using the Common Column "C2"

T1                    T2                    Result
----------            ----------            ----------
C1[PK]  C2            C3[PK]  C2            C1  C2  C3
----------            ----------            ----------
1       x             a       x            1    x    a
2       y             b       x            1    x    b
3       x             c       y            2    y    c
4       z             d                    3    x    a
---------             ----------           3    x    b
                                           ----------
```

(Note: The C2 column appears only once in the result.)

```
         Left outer join of T1 & T2 (preserving T1)
         with T1.C2=T2.C2
T1                    T2                    Result
----------            ----------            --------------------
C1[PK]  C2            C3[PK]  C2            C1   T1.C2  C3   T2.C2
----------            ----------            --------------------
1       x             a       x            1     x     a     x
2       y             b       x            1     x     b     x
3       x             c       y            2     y     c     y
4       z             d                    3     x     a     x
---------             ----------           3     x     b     x
                                           4     z
                                           --------------------
```
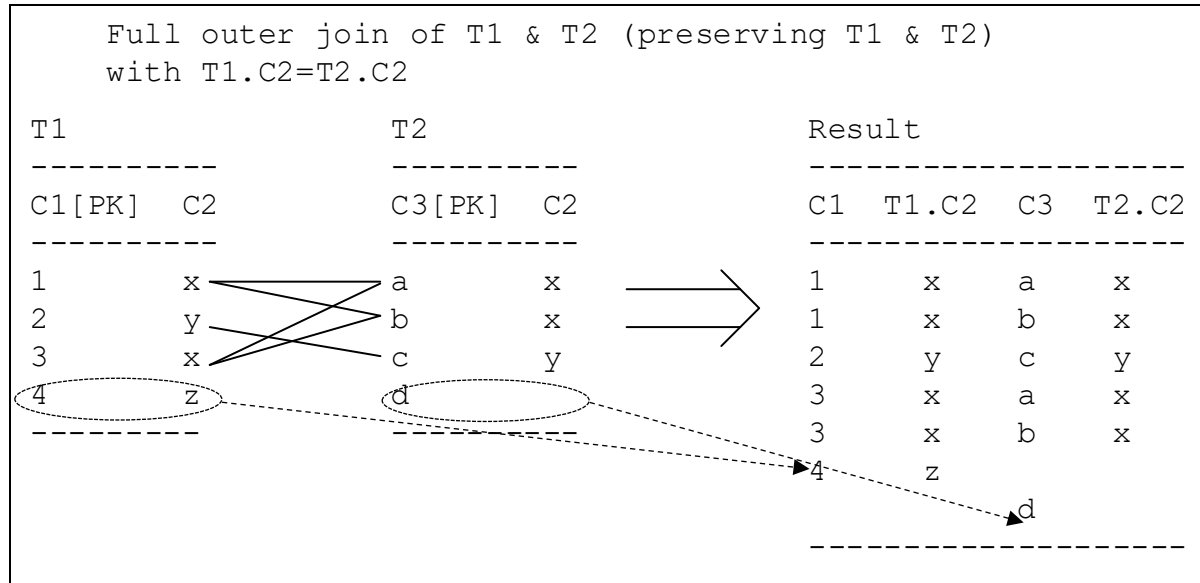
```
         Right outer join of T1 & T2 (preserving T2)
         with T1.C2=T2.C2
T1                    T2                    Result
----------            ----------            --------------------
C1[PK]  C2            C3[PK]  C2            C1   T1.C2  C3   T2.C2
----------            ----------            --------------------
1       x             a       x            1     x     a     x
2       y             b       x            1     x     b     x
3       x             c       y            2     y     c     y
4       z             d                    3     x     a     x
---------             ----------           3     x     b     x
                                                             d
                                           --------------------
```
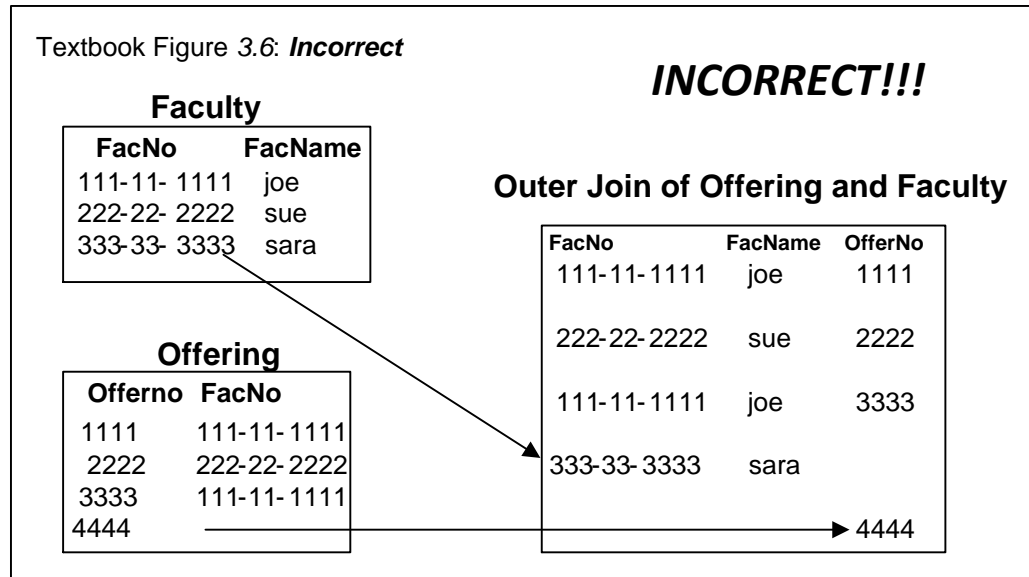
4

```
     Full outer join of T1 & T2 (preserving T1 & T2)
     with T1.C2=T2.C2

T1                    T2                    Result
----------            ----------            --------------------
C1[PK]  C2            C3[PK]  C2            C1   T1.C2   C3   T2.C2
----------            ----------            --------------------
1       x             a       x            1    x       a    x
2       y             b       x            1    x       b    x
3       x             c       y            2    y       c    y
4       z             d                    3    x       a    x
----------            ----------            3    x       b    x
                                           4    z
                                                             d
                                           --------------------
```

Textbook Figure *3.6*: **Incorrect**

INCORRECT!!!

Faculty

FacNo	FacName
111-11- 1111	joe
222-22- 2222	sue
333-33- 3333	sara

Outer Join of Offering and Faculty

FacNo	FacName	OfferNo
111-11- 1111	joe	1111
222-22- 2222	sue	2222
111-11- 1111	joe	3333
333-33- 3333	sara	
		4444

Offering

Offerno	FacNo
1111	111-11- 1111
2222	222-22- 2222
3333	111-11- 1111
4444	

The above Figure 3.6 of the textbook is incorrect.

The following is the corrected figure.
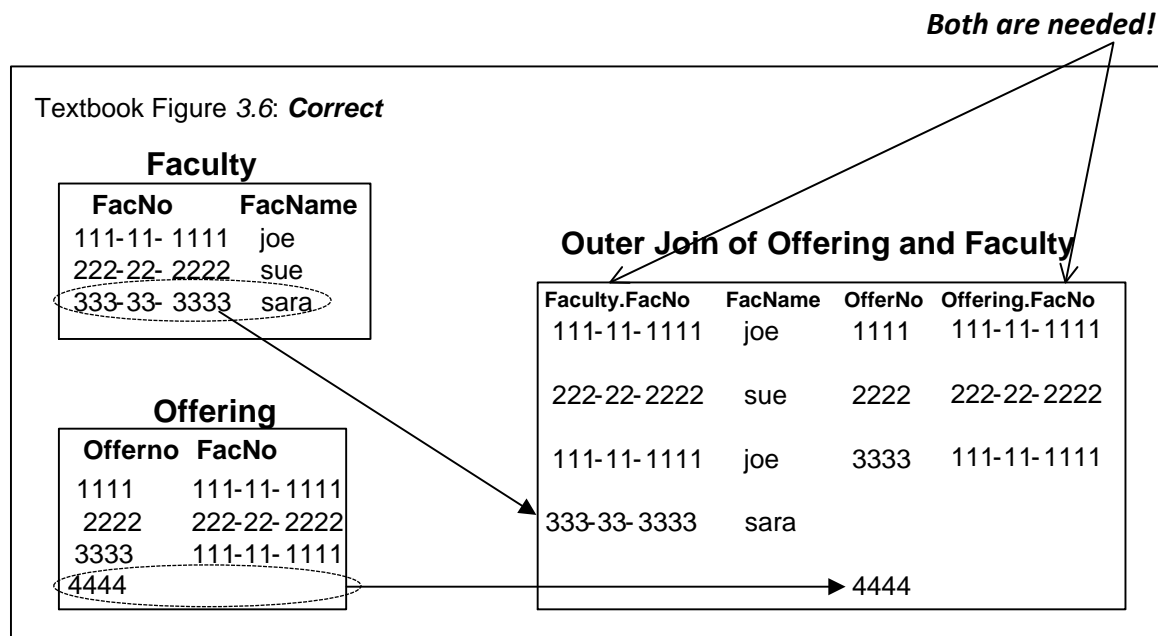
Both are needed!

Textbook Figure *3.6*: **Correct**

Faculty

FacNo	FacName
111-11- 1111	joe
222-22- 2222	sue
333-33- 3333	sara

Outer Join of Offering and Faculty

Faculty.FacNo	FacName	OfferNo	Offering.FacNo
111-11- 1111	joe	1111	111-11- 1111
222-22- 2222	sue	2222	222-22- 2222
111-11- 1111	joe	3333	111-11- 1111
333-33- 3333	sara		
		4444	

Offering

Offerno	FacNo
1111	111-11- 1111
2222	222-22- 2222
3333	111-11- 1111
4444	

6

The following short *tutorial* complements the textbook's coverage on relational algebra operators (Textbook Chapter 3), because details of aggregation operations are missing in the textbook.

A Short Tutorial on Aggregation Operations

Faculty Table

FacSSN	FacLastName	FacDept	FacRank	FacSalary	FacSupervisor	FacHireDate
098-76-5432	VINCE	MS	ASST	$35,000.00	654-32-1098	10-Apr-1997
543-21-0987	EMMANUEL	MS	PROF	$120,000.00		15-Apr-1998
654-32-1098	FIBON	MS	ASSC	$70,000.00	543-21-0987	01-May-1996
765-43-2109	MACON	FIN	PROF	$65,000.00		11-Apr-1999
876-54-3210	COLAN	MS	ASST	$40,000.00	654-32-1098	01-Mar-2001
987-65-4321	MILLS	FIN	ASSC	$75,000.00	765-43-2109	15-Mar-2002

Example 1. Show the result of a summarize operation on the Faculty table. The grouping column is FacDept and the aggregate calculation is COUNT. (That is, for each faculty department, count the number of faculty members.)

Ans: First, break the table into groups (i.e., smaller tables) such that each group contains a same FacDept value.

Group of 'MS' Dept Faculty

FacSSN	FacLastName	FacDept	FacRank	FacSalary	FacSupervisor	FacHireDate
098-76-5432	VINCE	MS	ASST	$35,000.00	654-32-1098	10-Apr-1997
543-21-0987	EMMANUEL	MS	PROF	$120,000.00		15-Apr-1998
654-32-1098	FIBON	MS	ASSC	$70,000.00	543-21-0987	01-May-1996
876-54-3210	COLAN	MS	ASST	$40,000.00	654-32-1098	01-Mar-2001

Group of 'FIN' Dept Faculty

FacSSN	FacLastName	FacDept	FacRank	FacSalary	FacSupervisor	FacHireDate
765-43-2109	MACON	FIN	PROF	$65,000.00		11-Apr-1999
987-65-4321	MILLS	FIN	ASSC	$75,000.00	765-43-2109	15-Mar-2002

Second, count the number of rows in each group: 4 for the group of 'MS' faculty dept faculty and 2 for the 'FIN' dept faculty.

Thus, the answer should be:

FacDept	COUNT
MS	4
FIN	2

Example 2. Show the result of a summarize operation on the Faculty table. The grouping column is FacDept and the aggregate calculations are MAX and MIN. (That is, for each faculty department, find the highest and the lowest faculty salary figures.)

Ans: First, break the table into groups (i.e., smaller tables) such that each group contains a same FacDept value.

Group of 'MS' Dept Faculty

FacSSN	FacLastName	FacDept	FacRank	FacSalary	FacSupervisor	FacHireDate
098-76-5432	VINCE	MS	ASST	$35,000.00	654-32-1098	10-Apr-1997
543-21-0987	EMMANUEL	MS	PROF	$120,000.00		15-Apr-1998
654-32-1098	FIBON	MS	ASSC	$70,000.00	543-21-0987	01-May-1996
876-54-3210	COLAN	MS	ASST	$40,000.00	654-32-1098	01-Mar-2001

Group of 'FIN' Dept Faculty

FacSSN	FacLastName	FacDept	FacRank	FacSalary	FacSupervisor	FacHireDate
765-43-2109	MACON	FIN	PROF	$65,000.00		11-Apr-1999
987-65-4321	MILLS	FIN	ASSC	$75,000.00	765-43-2109	15-Mar-2002

Second, find the maximal and minimal FacSalary values in each group: $120,000 and $35,000 for the MS dept faculty group; $75,000 and $65,000 for the FIN dept faculty group.

Thus, the answer should be:

FacDept	MAX	MIN
MS	$120,000	$35,000
FIN	$75,000	$65,000

Example 3. Show the result of a summarize operation on the Faculty table. The grouping column is FacDept and the aggregate calculation is AVG. (That is, for each faculty department, calculate the average salary figure.)

Ans: First, break the table into groups (i.e., smaller tables) such that each group contains a same FacDept value.

Group of 'MS' Dept Faculty

FacSSN	FacLastName	FacDept	FacRank	FacSalary	FacSupervisor	FacHireDate
098-76-5432	VINCE	MS	ASST	$35,000.00	654-32-1098	10-Apr-1997
543-21-0987	EMMANUEL	MS	PROF	$120,000.00		15-Apr-1998
654-32-1098	FIBON	MS	ASSC	$70,000.00	543-21-0987	01-May-1996
876-54-3210	COLAN	MS	ASST	$40,000.00	654-32-1098	01-Mar-2001

Group of 'FIN' Dept Faculty

FacSSN	FacLastName	FacDept	FacRank	FacSalary	FacSupervisor	FacHireDate
765-43-2109	MACON	FIN	PROF	$65,000.00		11-Apr-1999
987-65-4321	MILLS	FIN	ASSC	$75,000.00	765-43-2109	15-Mar-2002

Second, calculate the average FacSalary value in each group: $66,250 for the group of 'MS' faculty dept faculty and $70,000 for the 'FIN' dept faculty.

Thus, the answer should be:

FacDept	AVERAGE
MS	$66,250
FIN	$70,000

Example 4. Show the result of a summarize operation on the Faculty table. The grouping column is FacDept and the aggregate calculation is SUM. (That is, for each faculty department, calculate the total salary figure.)

Ans: First break the table into groups (i.e., smaller tables) such that each group contains a same FacDept value.

Group of 'MS' Dept Faculty

FacSSN	FacLastName	FacDept	FacRank	FacSalary	FacSupervisor	FacHireDate
098-76-5432	VINCE	MS	ASST	$35,000.00	654-32-1098	10-Apr-1997
543-21-0987	EMMANUEL	MS	PROF	$120,000.00		15-Apr-1998
654-32-1098	FIBON	MS	ASSC	$70,000.00	543-21-0987	01-May-1996
876-54-3210	COLAN	MS	ASST	$40,000.00	654-32-1098	01-Mar-2001

Group of 'FIN' Dept Faculty

FacSSN	FacLastName	FacDept	FacRank	FacSalary	FacSupervisor	FacHireDate
765-43-2109	MACON	FIN	PROF	$65,000.00		11-Apr-1999
987-65-4321	MILLS	FIN	ASSC	$75,000.00	765-43-2109	15-Mar-2002

Second, add up the FacSalary values in each group: $265,000 for the group of 'MS' faculty dept faculty and $140,000 for the 'FIN' dept faculty.

Thus, the answer should be:

FacDept	SUM
MS	$265,000
FIN	$140,000