

**CS5097/5098 - Database Systems and Big Data**  
**Assignment 3 – Transaction Management and MYSQL Spatial Extensions**  
**Hand-In Deadline: 13 midnight Monday December 2021**

This exercise is part of the formal assessment of the course, and the work done **must be by your own**. You are reminded to read the section on Cheating and Plagiarism in your student handbook. Marks for each question are shown in brackets.

1. Consider the following Student table in a University Student Records database.

student			
StudentId	fName	lName	discipline
432987	Peter	Gates	Computing
452318	Mark	Best	Mathematics
485496	Joanne	Perry	Psychology
421267	David	Murray	Mathematics
489023	Jane	Johnson	Computing
458623	Nick	Williams	Psychology
415634	Mary	Cummins	Mathematics

Every year when new students join the University, the admissions office produces a report consisting of two parts as shown below:

Grand Total = 7

Discipline-wise Totals

Discipline	Number of Students
Computing	2
Mathematics	3
Psychology	2

Assume that admissions office created the following transaction to create the required report:

```
COMMIT;  
SET TRANSACTION ISOLATION LEVEL READ COMMITTED;  
START TRANSACTION;  
SELECT COUNT(*) AS 'Number of Students'  
FROM student;  
SELECT discipline AS Discipline, COUNT(*) AS 'Number of Students'  
FROM student  
GROUP BY discipline;  
COMMIT;
```

Assume that when the above transaction has completed executing the first SELECT query that computes the grand total, two new students, who were allowed to late register, added themselves to the Student table, each running an insert query on the Student table:

```
INSERT INTO student VALUES(465891,'John','Jobs', 'Computing');  
INSERT INTO student VALUES(434567,'Linda','Ford', 'Psychology');
```

Assume that the second SELECT query that computes discipline-wise totals in the transaction initiated by the admissions office runs after the new students added themselves. The scenarios of different transactions running on the Student table is shown below:

Time Step	Transaction by the Admissions Office	John Jobs's Transaction	Linda Ford's Transaction
T1	COMMIT; SET TRANSACTION ISOLATION LEVEL READ COMMITTED; START TRANSACTION; SELECT COUNT(*) AS 'Number of Students' FROM student;		
T2		INSERT INTO student VALUES(465891,'John','Jobs', 'Computing');	INSERT INTO student VALUES(434567,'Linda','Ford', 'Psychology');
T3	SELECT discipline AS Discipline, COUNT(*) AS 'Number of Students' FROM student GROUP BY discipline; COMMIT;		

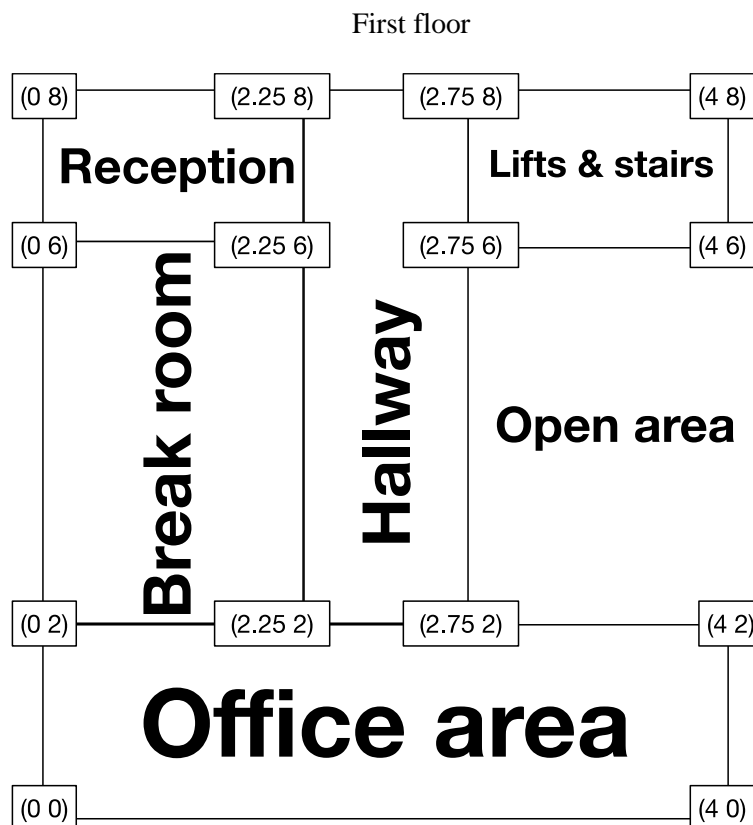
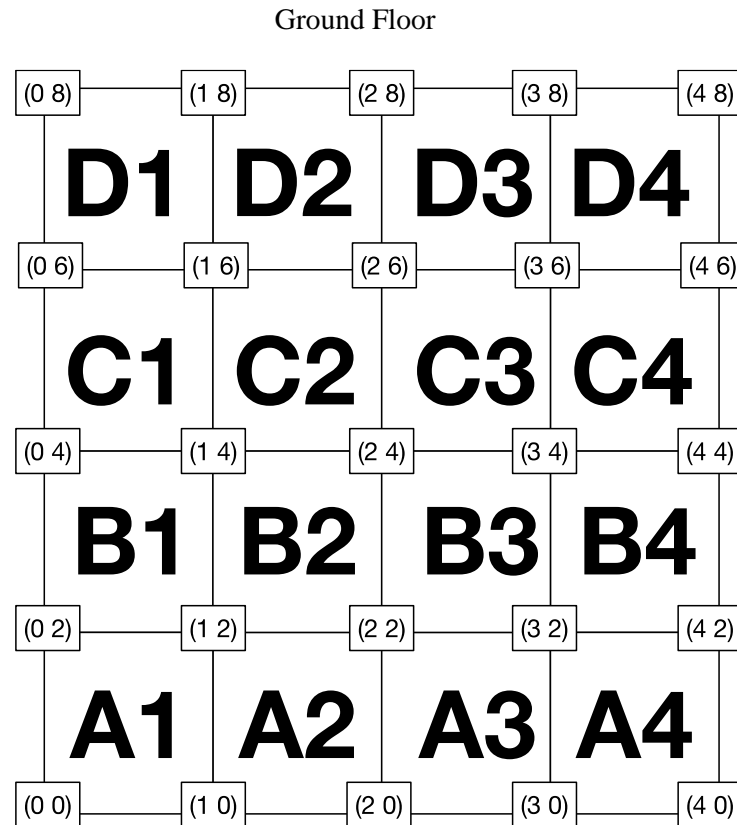
- Explain the problem with the above described scenario involving multiple transactions running concurrently on the Student table. (4)
- Explain how you would solve the problem from (i) using your knowledge of transaction management. (4)

2. Consider the following transaction scenario where  $T_i$ s are transactions accessing several data items  $X_i$ s:

Transaction	Data Items Locked by Transaction	Data Items Transaction is Waiting for
T1	X2	X1, X3
T2	X3, X10	X7, X8
T3	X8	X4, X5
T4	X7	X1
T5	X1, X5	X3
T6	X4, X9	X6
T7	X6	X5

- Produce a wait-for-graph for the above transaction scenario. (5)
- Using the wait-for-graph from part (i), determine whether the transactions are in a deadlock and explain how you detected deadlock. That is, you need to identify all the cycles in the WFG. (3)
- Explain how you would resolve the deadlock if it is detected in part(ii). (2)

3. Consider the floor plans for a two-storey office block as shown below:



The ground floor of the office block has a car park with 12 spaces, each labelled with a name e.g. A1, A2, A3 etc. The first floor has a section for the lift & stairs, reception, break room and office area, with a hallway that runs through the top of the first floor and connects the north side (where the reception, lift and stairs area are) to the south (where there is a shared office area). In both the ground and first floor, the coordinates for each section of the layout are included in the floor plans. For example, on the ground floor, the coordinates for the parking space labelled C3 is defined with the

coordinates ((2 4, 3 4, 3 6, 2 6, 2 4)). The first floor of the office block contains a section labelled as Open area. On the ground floor, this area has no roof, meaning that if you stand in the area labelled Hallway on the first floor and face east, you can see a section of the ground floor beneath.

- i. Your first task is to create a spatial database using the coordinates for each area on both floors. Implement your design as a MySQL database using the spatial datatypes available with MySQL. Refer to Exercise 6 of practical 9 as required. Once you have created your database, export it as an SQL script using the export tab on phpMyAdmin. Copy and paste the contents of this script into your submission document for this assignment. (5)
- ii. Your second task is to write an SQL query to list the parking spaces on the ground floor directly beneath the Office area on the first floor. Write this query in SQL script and include it in your submission document. (3)
- iii. Your third task is to write an SQL query to list the parking slots which are visible from standing in the Hallway on the first floor and facing east. State any assumptions you make. Write this query in SQL script and include it in your submission document. (4)

Please submit your solutions document as a pdf file and name it with your name and student id appended to Assignment-CA3 (e.g. Assignment-CA3\_JoePublic\_999999.pdf). Upload the pdf file to MyAberdeen by selecting the CA3 Submission link in the Assessment section.

Please follow all the submission instructions to help us mark your coursework efficiently.