This assignment verifies that you understand how shared and exclusive locks work. Suppose that Session 1, Session 2, and Session 3 are sessions connected concurrently to the same database instance. Suppose further that X, Y, and Z are data objects that can be locked with a shared and exclusive lock.

Before you address each of the scenarios below, let us take a look at two examples.

*Example 1:* If Session 1 has a shared lock on X, and Session 2 has a shared lock on Y, what would happen if Session 3 attempts to procure a shared lock on X? The answer is that Session 3 would be granted the shared lock, because by the nature of a shared lock, it is acceptable for both Session 1 and Session 3 to have a shared lock on the same data item at the same time.

*Example 2:* If Session 1 has an exclusive lock on X, and Session 2 has an exclusive lock on Y, what would happen if Session 3 attempts to procure a shared lock on X? The answer is that Session 3 would need to wait until Session 1 releases the lock on X, because by the nature of an exclusive lock, only one session at a time may have the lock. Therefore Session 3 cannot be granted the lock at the same time Session 1 has the lock, and Session 3 will need to wait until Session 1 releases the lock.

Now that we have taken a look at a couple of examples, it is your turn to describe what will happen in each scenario below. For each scenario, indicate, for each session, whether it procures the requested lock, waits, or deadlocks. Make sure to explain your reasoning.

Scenario 1: Session 1 has an exclusive lock on X and Session 2 attempts to procure an exclusive lock on X.  
**Since Session 1 already has procured an exclusive lock on X Session 2 will have to wait until Session 1 releases the lock because an exclusive lock only allows a single session at a time.**

Scenario 2: Session 1 has a shared lock on X and a shared lock on Y, and Session 2 attempts to procure a shared lock on Y.

**Session 2 will be able to procure the shared lock on Y even though Session 1 also has a shared lock on Y because shared locks allow read-only access to the data at the same time.**

Scenario 3: Session 1 has an exclusive lock on X and attempts to procure an exclusive lock on Y. Session 2 has an exclusive lock on Y and attempts to procure an exclusive lock on Z. Session 3 has an exclusive lock on Z and attempts to procure an exclusive lock on X.

**Session 1 has an exclusive lock on X, therefore Session 3 cannot have access to it and waits until Session 1 releases the exclusive lock. Also Session 1 has to wait while Session 2 has a lock on Y. Session 3 has an exclusive lock on Z therefore Session 2 must wait until it is released. Each of the 3 sessions is locking a resource and waiting for another resource to become unlocked, however, they are in a deadlock situation and will not be able to get out of it unless one of the sessions is chosen as a victim and has it’s transaction rolled back so the others can execute.**

Scenario 4: Session 1 has a shared lock on X and Session 2 attempts to procure a shared lock on X.

**Both Session 1 and Session 2 will be able to access the shared lock at the same time and will not have to wait.**

Scenario 5: Session 1 has an exclusive lock on X and Session 2 attempts to procure a shared lock on X.

**Since Session 1 has the exclusive lock on X Session 2 will have to wait until it is released before a shared lock can be procured.**

Scenario 6: Session 1 has a shared lock on X and attempts to procure a shared lock on Y. Session 2 has a shared lock on Y and attempts to procure a shared lock on Z. Session 3 has a shared lock on Z and attempts to procure an exclusive lock on X.

**Session 1 and Session 2 can both have the shared lock on Y. Session 2 and Session 3 can both have the shared lock on Z. Session 3 will not be able to attain the exclusive lock on X and will have to wait until Session 1 has released the shared lock.**

Scenario 7: Session 1 has a shared lock on X and Session 2 attempts to procure an exclusive lock on X.  
**Session 2 will not be able to get the exclusive lock and has to wait until Session 1 releases its shared lock.**

Scenario 8: Session 1 has a shared lock on X, Session 2 has a shared lock on X, and Session 3 attempts to procure a shared lock on X.

**All three sessions will be able to procure the shared lock on X at the same time without any deadlocks or waiting.**

Scenario 9: Session 1 has an exclusive lock on X and attempts to procure an exclusive lock on Y. Session 2 has an exclusive lock on Y and attempts to procure an exclusive lock on X.

**This is a deadlock scenario since both Session 1 and Session 2 have an exclusive lock on an object that the other one is waiting for, this is also known as “the deadly embrace.”**

Scenario 10: Session 1 has an exclusive lock on X and a shared lock on Y, and Session 2 attempts to procure an exclusive lock on Y.

**Since Session 1 already has a shared lock on Y Session 2 will have to wait and will not be granted the exclusive lock.**

Scenario 11: Session 1 has a shared lock on X and a shared lock on Y. Session 2 has a shared lock on Y and attempts to procure an exclusive lock on X.

**Session 1 and Session 2 can both access object Y since they are using a shared lock, however Session 2 will be forced to wait before attaining an exclusive lock on X since Session 1 already has a shared lock on it.**

Scenario 12: Session 1 has a shared lock on X and attempts to procure an exclusive lock on Y. Session 2 has a shared lock on Y and attempts to procure an exclusive lock on Z. Session 3 has a shared lock on Z and attempts to procure an exclusive lock on X.

**Session 1 will have to wait on the exclusive lock on Y since Session 2 already has a shared lock on it. Session 2 has to wait on Session 3 to release its shared lock on object Z. Session 3 has to wait on Session 1 to release its lock on X. Since all three sessions have an exclusive lock on an object that another one is waiting for this si resulting in a deadlock.**



Your submission will be evaluated according to the following grading rubric.

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|  | **Grade** | **Qualities Demonstrated by the Assignment Submission** | **Grade Assigned** |
| **Content (70%)**  **Measures the quality of the content in the assignment** | A+ ➔ 100 | The content demonstrates exceptional understanding of all relevant subject matter and its inter-relationships. All major relevant issues are thoroughly covered, and all content is very focused and on-topic. There is no known way to improve the content, and there are absolutely no technical or coverage errors present. |  |
| A ➔ 96 | The content demonstrates exceptional understanding of all relevant subject matter and its inter-relationships. All major relevant issues are thoroughly covered, and all content is very focused and on-topic. At most one insignificant technical or coverage error may be present |
| A- ➔ 92 | The content demonstrates deep understanding of all relevant subject matter and its inter-relationships. All major relevant issues are covered, and all content is on-topic. |
| B+ ➔ 88 | The content demonstrates understanding of all relevant subject matter and its inter-relationships. Almost all major relevant issues are covered, and the content is at least reasonably on-topic. |
| B ➔ 85 | The content demonstrates understanding of most relevant subject matter and its inter-relationships. Almost all major relevant issues are covered, and all content is at least reasonably on-topic. |
| B- ➔ 82 | The content demonstrates moderate understanding of much relevant subject matter and its inter-relationships. There is reasonable coverage of major relevant issues, and the content is at least reasonably on-topic. |
| C+ ➔ 78 | The content demonstrates some understanding of relevant subject matter and its inter-relationships. Some major relevant issues are covered, and at least some content is on-topic. |
| C ➔ 75 | The content demonstrates understanding of a small portion of the relevant subject matter and its inter-relationships. Some major relevant issues are covered, and at least a small portion of the content is on-topic. |
| C- ➔ 72 | The content demonstrates little understanding of and insight into the relevant subject matter and its inter-relationships. A small portion of the major relevant issues are covered. The focus of the content may be off topic or on insubstantial or secondary topics |
| D ➔ 67 | The content demonstrates almost no understanding of or insight into the relevant subject matter and its inter-relationships. Almost none of the major relevant issues are covered, and the content may be almost entirely off-topic. |
| F ➔ 0 | The content demonstrates no understanding of or insight into the relevant subject matter and its inter-relationships. No major relevant issues are covered, and the content is entirely off-topic. |
| **Exposition (30%)**  **Measures how well the content is expressed** | A+ ➔ 100 | The presentation of all ideas and designs is exceptionally clear and persuasive; the entire submission is exceptionally organized. There is no known way to improve the clarity or organization of the submission. |  |
| A ➔ 96 | The presentation of all ideas and designs is exceptionally clear and persuasive; the entire submission is exceptionally organized. There may be at most one insignificant way to improve the clarity or organization of the submission. |
| A- ➔ 92 | The presentation of all ideas and designs is very clear and persuasive; the entire submission is very organized. |
| B+ ➔ 88 | The presentation of all ideas and designs is clear and persuasive; the entire submission is organized. |
| B ➔ 85 | The presentation of most ideas and designs is clear and persuasive; most of the submission is organized. |
| B- ➔ 82 | The presentation of most ideas and designs is generally clear; most of the submission is reasonably organized. |
| C+ ➔ 78 | Some parts of the submission are hard to understand; some parts are disorganized. |
| C ➔ 75 | About half of the submission is hard to understand; about half is disorganized. |
| C- ➔ 72 | Most parts of the submission are hard to understand; most parts are disorganized. |
| D ➔ 67 | Almost all of the submission is hard to understand and disorganized. |
| F ➔ 0 | The entire submission is hard to understand and disorganized. |