Homework 1 Solutions

Student Name

October 2025

Problem 1: Relational Algebra Expressions

1. Find the name of each employee who lives in city Miami.
Solution:

$$\pi_{\text{person\_name}}(\sigma_{\text{city='Miami'}}(\text{employee}))$$

2. Find the name of each employee whose salary is greater than 100,000.
Solution:

$$\pi_{\text{person\_name}}(\sigma_{\text{salary}>100000}(\text{employee} \bowtie \text{works}))$$

3. Find the name of each employee who lives in Miami and whose salary is greater than 100,000.
Solution:

$$\pi_{\text{person\_name}}(\sigma_{\text{city}='Miami' \wedge \text{salary}>100000}(\text{employee} \bowtie \text{works}))$$

4. Find the ID and name of each employee who does not work for BigBank.
Solution:

$$\pi_{\text{ID,person\_name}}(\sigma_{\text{companyname}\neq'BigBank'}(\text{employee} \bowtie \text{works}))$$

5. Find the ID and name of each employee who earns at least as much as every employee in the database.
Solution:

$$\pi_{\text{ID,person\_name}}(\text{employee} \bowtie \text{works} - \pi_{\text{employee1ID,personname1}}(\sigma_{\text{salary1}<\text{salary2}}(\rho_{\text{salary1,employee1ID,personname1}}(\text{works}) \times \rho_{\text{salary2}}(\text{works}))))$$

Problem 2: Schedule

1. Give the dependency graph for the schedule in the figure.
Solution: Draw nodes for each transaction (T_A, T_B, T_C). For each pair of conflicting actions (read/write), draw edges from one transaction to another if the first's action comes before the other's and both access the same object.
2. Is the schedule conflict-serializable?

Solution: Yes/No. (Requires analyzing the graph. Yes if acyclic, No if cycles)

3. If yes, serial equivalent; if not, explanation.

Solution: If the dependency graph is acyclic, list transactions in any topological order. If cyclic, explain which actions cause cycles.

Problem 3: Serializability True/False

1. A schedule with exactly one transaction is always conflict-equivalent to a serial schedule.

Solution: True

2. If each transaction preserves database consistency, every serializable schedule also preserves consistency.

Solution: True

3. A schedule is conflict serializable if and only if its dependency graph is acyclic.

Solution: True

4. All schedules that avoid cascading aborts are recoverable.

Solution: True

5. All schedules that avoid cascading aborts are conflict-serializable.

Solution: False

Problem 4: Two-Phase Locking (2PL)

1. Add lock/unlock instructions so transactions obey 2PL.

Solution: All locks must be acquired before any unlocks for each transaction. Example order: Lock-SA, Lock-XB, then UnlockA, UnlockB.

2. Can the execution result in deadlock?

Solution: Yes