Homework #1
CS 486/586
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Part 1 (25 pts)

Exercise 1

Describe what is meant by the ACID properties of many relational databases. For each ACID property, describe an example transaction/interaction that adheres to that property, and a different counter example of a transaction/interaction that doesn't.

ACID stands for Atomicity, Consistency, Isolation, and Durability

1. **Atomicity** requires that every transaction that alters the database does so in its entirety, and can't be only partially completed.

   Positive example: A sale at a shop should always be atomic. Failing to receive goods after payment is a ripoff; taking goods without paying is theft.

   Negative example: Taking a class is not an atomic transaction. I slowly accumulate knowledge over the quarter and if I quit halfway through I have gained partial knowledge from the class.

2. **Consistency** requires that, given the defined constraints on a database, no operation can result in the database being in violation of any of those constraints.

   Positive example: Any game like chess needs to remain in a consistent state that follows from movement rules. For example a single bishop can never move from one square to another square that's a different color.

   Negative example: A mathematics that allows division by zero will allow an inconsistent state, for example you could prove that 1 = 2.

3. **Isolation** requires that no two transactions can appear to be running at the same time; there can be no interference or race conditions between parallel transactions on the db.

   Positive example: A call-waiting system will allow someone to take a call, put them on hold while receiving the second call, and switch between the two. Neither incoming caller can hear the conversation belonging to the other caller.

   Negative example: Two runners in an olympic track race are not running separate timed trials. They can obstruct and impede one another.

4. **Durability** requires that any update made to the database persists in storage and isn't reverted if the user process terminates.

   Positive example: A court stenographer records into a physical record all the events and arguments of a court case, synchronously with the arguments in the case.

   Negative example: Most text editors let you change a file in process memory but the changes will not persist if the process crashes, before the changes can be subsequently saved to disk.

Exercise 2

In the format of TableName1(Attr1, Attr2...), describe a schema for a karate studio, including the classes they offer, their instructors, their students, which classes each instructor can teach, and which instructor is each student's primary mentor.
Instructors can teach multiple classes.

Classes can be taught by multiple instructors.
Students have one mentor, who is an instructor.
Underline the attributes making up the primary key of each table. Describe foreign keys in a separate line, like: Attribute2 is a foreign key to Table3(Attribute2)

Instructor(id, name)

Class(name, description)

Student(id, name, mentor)

- mentor is a foreign key to Instructor(id)

InstructorTeachesClass(instructor_id, class_id)

- instructor_id is a foreign key to Instructor(id)
- class_name is a foreign key to Class(name)

StudentTakesClass(student_id, class_name)

- student_id is a foreign key to Student(id)
- class_name is a foreign key to Class(name)

Part 2 (25 pts)

Exercise 3

Give the english request that could have resulted in each of the SQL queries below. Don't just paraphrase the SQL into words. Also include the total number of rows returned.

a) `SELECT * FROM spy.Agent A WHERE A.Last = 'Miller' or A.First = 'Tim';`

"Which agents have either first name Tim or last name Miller?"

25 rows returned.

b) `SELECT DISTINCT A.country FROM spy.Agent A WHERE A.salary < 50100;`

"Which countries are the country of origin of at least one agent earning a salary below 50100?"

2 rows returned.

c) `SELECT DISTINCT affiliation_strength FROM spy.affiliationrel;`

"What values of affiliation-strength are each held by at least one agent?"

3 rows returned.

d) `SELECT * FROM spy.skill where skill like '%ntel%';`

"Which skills (with their complete records) have names containing the substring 'ntel'?"

5 rows returned.

e) `SELECT DISTINCT A.Country FROM Agent A, SkillRel SR, Skill S WHERE A.agent_id = SR.agent_id AND SR.skill_id = S.skill_id AND S.skill = 'Computer Hacker';`

"Which countries are the country of origin of at least one agent that has the 'Computer hacker' skill?"

12 rows returned.

Part 3 (50 pts)

Write a single SQL statement for each of the following queries. Show the first five rows of the result for each query (or fewer, if the result is smaller) and the number of rows returned.

Exercise 4

What are names of agents who live in Poland and make between 90000 and 100000?

```
SELECT first, last
FROM spy.agent
WHERE country = 'Poland'
    AND salary >= 90000
    AND salary <= 100000;
```

Result: (4 rows)

first_name	last_name
Ethan	Taylor
Chris	Selsor
George	Reed
George	Cahill

Exercise 5

What are the names of ongoing, Top Secret missions? Don't specify the sc_id numeric value.

```
SELECT M.name
FROM spy.mission M, spy.securityclearance SC
WHERE M.access_id = SC.sc_id
    AND SC.sc_level = 'Top Secret'
    AND M.mission_status='ongoing';
```

Result: (22 rows)

mission_name
Silpion
Wandlimb
Annatar
Old World
Gimli

Exercise 6

What are the mission names of ongoing, Top Secret missions, and the teams conducting them?

```
SELECT M.name mission_name, T.name team_name
FROM spy.mission M, spy.team T, spy.securityclearance SC
WHERE M.access_id = SC.sc_id
  AND SC.sc_level = 'Top Secret'
  AND M.mission_status='ongoing'
  AND T.team_id=M.team_id;
```

Result: (22 rows)

mission_name	team_name
Silpion	ShowBiz
Wandlimb	Terminator
Annatar	Blaster
Old World	Swing Voters
Gimli	Blackout

Exercise 7

What are the agent names who are on ongoing, Top Secret missions (and their team and mission names, ordered by mission_name)?

```
  SELECT M.name mission_name, T.name team_name, A.first || ' ' || A.last agent_name
FROM spy.mission M, spy.team T, spy.securityclearance SC, spy.agent A, spy.teamrel TR
WHERE M.access_id = SC.sc_id
  AND SC.sc_level = 'Top Secret'
  AND M.mission_status='ongoing'
  AND T.team_id=M.team_id
  AND TR.agent_id = A.agent_id
  AND TR.team_id = T.team_id
ORDER BY mission_name;
```

Result: (207 rows)

mission_name	team_name	agent_name
Annatar	Blaster	Ethan Petallas
Annatar	Blaster	Ethan Watt
Annatar	Blaster	Jason Urry
Annatar	Blaster	Craig Burr
Annatar	Blaster	Calin Cenan

Exercise 8

What are the agent names and the agents' security levels who are on ongoing, Top Secret missions (and their team and mission names, ordered by mission_name)? (Note, not their clearance_id, but their security clearance level in text).

```
SELECT M.name mission_name, T.name team_name,
    A.first || ' ' || A.last agent_name, SCL.sc_level security_level
FROM spy.mission M, spy.team T, spy.securityclearance SC,
    spy.securityclearance SCL, spy.agent A, spy.teamrel TR
WHERE M.access_id = SC.sc_id
  AND SC.sc_level = 'Top Secret'
  AND M.mission_status='ongoing'
  AND T.team_id=M.team_id
  AND TR.agent_id = A.agent_id
  AND TR.team_id = T.team_id
    AND SCL.sc_id = A.clearance_id
ORDER BY mission_name;
```

Result: (207 rows)

mission_name	team_name	agent_name	security_level
Annatar	Blaster	Ethan Petallas	Secret
Annatar	Blaster	Ethan Watt	Secret
Annatar	Blaster	Jason Urry	Majestic
Annatar	Blaster	Craig Burr	Magellon
Annatar	Blaster	Calin Cenan	Secret