CS 486/586 Introduction to DBMS
Fall 2021

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Homework 1 – Basic SQL & Relational Algebra Queries
Due: Friday 10/8, 11:59pm, Canvas

Please note the following:
- do this assignment in groups of 2.
- ensure that each group member's name is listed on the assignment to ensure credit
- submit your assignment in PDF format
- turn in your completed assignment on Canvas, one submission per group
- Please create a Homework Team for you and your partner: how to sign up for a Canvas group

This assignment is based on the spy relational database. You can access the database via the web interface at: https://dbclass.cs.pdx.edu/. Additional information about accessing your database is here: 486/586 Database Access Info. When logging into the database, use the username/password that was given to you on Canvas.

The final page of the homework contains some useful PSQL commands. Take a look!

Part One (20 Points)
1) (5 pts) Describe the following tables: [agent, skill, skillrel, affiliation, affiliationrel, mission, securityclearance] from the spy database schema in the format shown below. Underline the attributes making up the primary key of each table and describe foreign keys in a separate line.

 TableName1(Attribute1, Attribute2, Attribute3,…)
 Attribute2 is a foreign key to Table3(Attribute2)
 Or: Attribute2 -> Table3(Attribute2)

Solution:
 1. Agent(agent_id, first, middle, last, address, city, country, salary, clearance_id)
 clearance_id -> securityclearance(sc_id)

 2. skill(skill_id, skill)

 3. skillrel(skill_id, agent_id)

skill_id -> skill(skill_id),
agent _id ->agent(agent_id)

4. affiliation (<u>aff id</u>, title, description)

5. affiliationrel(<u>aff id</u>, <u>agent id</u>, affiliation_strength)
aff_id -> affiliation(aff_id)
agent_id -> agent(agent_id)

6. mission(<u>mission id</u>, name, access_id, team_id, mission_status)
access_id -> securityclearance(sc_id)
team_id -> team(team_id)

7. securityclearance(<u>sc id</u>, sc_level, description)

For 2a through 2h, please give the answer – you do not have to write SQL queries to answer these questions, you only have to examine the schema of the spy database.

(3 points each)

2a)   How many security clearance levels can an agent have?
Solution: An agent can only have one security level

2b)   How many skills can an agent have?
Solution: An agent can have any number of skills

2c)   Can two affiliations have the same name? (Note: name refers to the attribute/column named 'title' in the relation affiliation)
Solution: Yes as long as their aff_id are different. Because, title attribute is not the key of that table. aff_id is the key in table affiliation

2d)   How many agents can be affiliated with a particular affiliation?
Solution: 34 unique aff_id have been listed in 954 rows. At the same time, 502 unique agent_id have been listed in 954 rows. These two have many to many relationships. Some affiliations have different number of agents and some other affiliations have totally different number of agents. So, Multiple agents can be affiliated with a particular affiliation

2e)   Can two agents have different affiliation strengths to the same affiliation?
Solution: Yes.

Part Two (15 points) 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

first five rows of the result for each query (or fewer if the result is smaller), and the total number of rows returned.

3.
(a) SELECT * FROM agent WHERE city = 'Warsaw' AND country = 'Poland';
Solution: This query is asking to display every attribute of each agent (or row) that matches the city "Warsaw" & country "Poland".
Total number of rows returned: 57 rows

```
[fall2021db78=> select * from agent where city = 'Warsaw' and country = 'Poland';
 agent_id |  first   | middle |    last    |    address      |  city  | country | salary | clearance_id
----------+----------+--------+------------+-----------------+--------+---------+--------+--------------
       27 | George   |        | McNamee    | 44 15th Avenue  | Warsaw | Poland  | 54453  |            2
       35 | Jonathan |        | Sheard     | 24 19th Avenue  | Warsaw | Poland  | 52297  |            2
       71 | Jim      |        | Atckinson  | 2 38th Avenue   | Warsaw | Poland  | 55779  |            3
       85 | Nick     |        | Coeckx     | 105 48th Avenue | Warsaw | Poland  | 57933  |            5
       99 | Charles  |        | Mou        |                 | Warsaw | Poland  | 71207  |            5
```

(b) SELECT salary FROM agent;
Solution: This query is asking to display the salary of all agents from the table "agent".
Total number of rows returned: 662 rows

```
 salary
--------
  50553
  50955
  55920
  66554
  76396
```

(c) SELECT DISTINCT salary FROM agent;
Solution: This query is asking to display the unique (or distinct or not duplicate) salary of all agents from the table "agent".
Total number of rows returned: 428 rows

```
 salary
--------
  54512
  78903
  56875
  58094
 263550
```

(d) SELECT agent_id, city, country, clearance_id FROM Agent WHERE salary > 100000 AND country != 'USA';
Solution: When an agent is not located in the country "USA" and making more than 100000 in salary, this query is asking to display the values of columns agent_id, city, and clearance_id of that agent from the table "agent".
Total number of rows returned: 1 rows

```
[fall2021db78=> select agent_id, city, country, clearance_id from agent where salary > 100000 and country != 'USA';
 agent_id |  city   | country | clearance_id
----------+---------+---------+--------------
      144 | Baghdad | Iraq    |            5
(1 row)
```

4.
(a) SELECT DISTINCT country FROM agent WHERE salary > 200000;
Solution: This query is listing the name of the country (duplicates allowed) when an agent makes more than 200000 in salary.
Total number of rows returned: 1 row

```
[fall2021db78=> select distinct country from agent where salary > 200000;
 country
---------
 USA
(1 row)
```

(b) SELECT DISTINCT country FROM agent
        WHERE agent.salary > 200000;
Solution: This query is listing the name of the country without duplicates when an agent makes more than 200000 in salary.
Total number of rows returned: 1 row

```
[fall2021db78=> select distinct country from agent where agent.salary>200000;
 country
---------
 USA
(1 row)
```

(c) SELECT DISTINCT country FROM agent A WHERE A.salary > 200000;
Solution: This query is creating an instance of table "agent" as "a" and fetching the distinct country name from that "a" when an agent makes more than 200000 in salary.
Total number of rows returned: 1 row

```
[fall2021db78=> select distinct country from agent a where a.salary>200000;
 country
---------
 USA
(1 row)
```

Part Three (50 points - 10 points each) 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. You should be able to write these SQL queries using only the features covered in the first lecture notes. Throughout this class (and in real life!) when writing queries, make sure you are using the data you are given. Eg. If you are asked to find all the agents who speak Hindi, your query should contain something along the lines of "language = Hindi" and not "lang_id = 19". **There are good reasons for this – ask on Slack if you're curious about what they are!**

5. What is the team ID and the meeting frequency for the team 'Cha Cha Cha'?
Solution: SELECT team_id, meeting_frequency FROM team WHERE name = 'Cha Cha Cha';
Number of rows returned: 1 row

```
[fall2021db78=> select team_id, meeting_frequency from team where name = 'Cha Cha Cha';
 team_id | meeting_frequency
---------+-------------------
      28 | weekly
(1 row)
```

6. Which countries have agents with Top Secret or Majestic clearance? (**Your query shouldn't depend on what clearance IDs are used for these clearance levels, just the names of the levels.**)
Solution:
SELECT DISTINCT A.country from agent A
INNER JOIN securityclearance S
ON A.clearance_id = S.sc_id
WHERE S.sc_level = 'Top Secret' OR S.sc_level = 'Majestic';

Number of rows returned: 20 rows

```
[fall2021db78=> SELECT DISTINCT A.country from agent A
[fall2021db78-> INNER JOIN securityclearance S
[fall2021db78-> ON A.clearance_id = S.sc_id
[fall2021db78-> WHERE S.sc_level = 'Top Secret' OR S.sc_level = 'Majestic';
   country
------------
 Iraq
 Turkey
 Spain
 England
 Italy
```

7. What are the first name, last name, and city of all agents in at least two affiliations? (You can do this without COUNT.)
Solution:
Hardcoded for two affiliations CIA & MI6:
select first, last, city, title from agent
join affiliationrel ON agent.agent_id = affiliationrel.agent_id
join affiliation ON affiliationrel.aff_id = affiliation.aff_id
where affiliation.title = 'CIA' OR affiliation.title = 'MI6';

```
fall2021db78=> select first, last, city, title from agent
fall2021db78-> join affiliationrel ON agent.agent_id = affiliationrel.agent_id
fall2021db78-> join affiliation ON affiliationrel.aff_id = affiliation.aff_id
fall2021db78-> where affiliation.title = 'CIA' OR affiliation.title = 'MI6';
    first     |     last     |     city      | title
--------------+--------------+---------------+-------
 Nick         | Steere       | San Francisco | CIA
 Nick         | Yan          | Seattle       | CIA
 Jim          | Atckinson    | Warsaw        | CIA
 David        | Kadam        | San Francisco | CIA
 Tom          | Lymar        | Paris         | CIA
 Nick         | Wu           | Warsaw        | MI6
```

Alternate solution to Question 7:
select a.first,a.last,a.city from agent a, affiliationrel af1, affiliationrel af2
where a.agent_id=af1.agent_id and af1.aff_id!=af2.aff_id
group by a.first,a.last,a.city;

8. List the name and status of all missions that have at least one agent with the skill
VooDoo/Blackmagic. Don't repeat missions in your result.
Solution:
SELECT DISTINCT name, mission_status FROM mission
INNER JOIN teamrel ON mission.team_id = teamrel.team_id
INNER JOIN skillrel ON teamrel.agent_id = skillrel.agent_id
INNER JOIN skill ON skillrel.skill_id = skill.skill_id
WHERE skill.skill = 'VooDoo/Blackmagic';

Number of rows returned: 180 rows

```
fall2021db78=> SELECT DISTINCT name, mission_status FROM mission
fall2021db78-> INNER JOIN teamrel ON mission.team_id = teamrel.team_id
fall2021db78-> INNER JOIN skillrel ON teamrel.agent_id = skillrel.agent_id
fall2021db78-> INNER JOIN skill ON skillrel.skill_id = skill.skill_id
fall2021db78-> WHERE skill.skill = 'VooDoo/Blackmagic';

        name          | mission_status
----------------------+----------------
 Narrow Ice           | ongoing
 Melian               | success
 Hammer of the Underw | ongoing
 Causeway             | success
 Galadrim             | success
 Aman                 | failed
```

9. Which pairs of agents have the same first and last names? (List each pair only
once.)
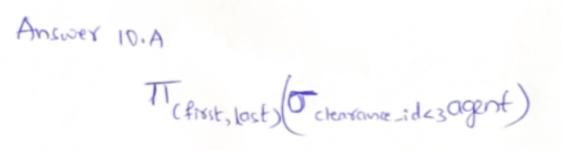**Solution:**
SELECT DISTINCT a1.first, a1.last FROM agent a1 ,agent a2
WHERE a1.first=a2.first AND a1.last = a2.last AND a1.agent_id != a2.agent_id;

```
fall2021db78=> SELECT DISTINCT a1.first, a1.last
fall2021db78-> from agent a1 ,agent a2
fall2021db78-> WHERE a1.first=a2.first
[fall2021db78-> AND a1.last = a2.last AND a1.agent_id != a2.agent_id;
 first  |   last
--------+----------
 Anri   | Lazaryan
 George | Carter
 John   | Miller
(3 rows)
```
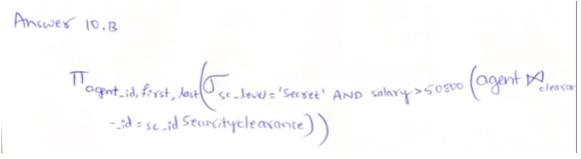
Part Four Relational Algebra (15 pts)
10. Write the following queries in Relational Algebra
    (a) Find the first and last names for all agents having clearance level less than 3.
Solution: Pi (first, last)((sigma clearance_id<3)agent)

Answer 10.A

$$\pi_{(first, last)}(\sigma_{clearance\_id<3}\ agent)$$

    (b) Find the unique agent id, first, and last names for agents who have Secret
    clearance and have a salary greater than $50,800.
Solution:
select distinct agent_id, first, last, salary, clearance_id from agent
join securityclearance on securityclearance.sc_id = agent.clearance_id
where agent.salary > 50800 and securityclearance.sc_level = 'Secret' ;

Answer 10.B

$$\pi_{agent\_id, first, last}(\sigma_{sc\_level='Secret'\ AND\ salary>50800}(agent \bowtie_{clearance\_id = sc\_id} Securityclearance))$$

    (c) Find the unique agent names of all agents in Spain and with the
    Communications skill.
Solution:
select agent.first, agent.last from agent
join skillrel on skillrel.agent_id=agent.agent_id
join skill on skill.skill_id=skillrel.skill_id
where agent.country='Spain' and skill.skill='Communications';

Answer 10.C

$$\Pi_{first, last} \left(\sigma_{country = 'Spain'} \text{ agent} \bowtie \left(\sigma_{skillsel.skill\_id = skill.skill\_id \text{ AND}} \atop skill.skill = 'Communications' \right) skill \right)$$

Useful PSQL Commands:

\dt - list all tables

\d schemaname.tablename - display info (schema) of a table

\? - help with 'backslash' commands

\q - quit psql

help - help with SQL commands (also can use help select for help on select)

Quotes:

In the syntax Type = "checking" AND Balance > 1000, why are there quotes around checking, but not around 1000 (or Type or Balance).

Type and Balance are attribute names, so do not need quotes. 1000 is an integer or numeric value and doesn't need quotes. But checking is a string, and strings do need quotes. The other error in that syntax is that postgres uses single quotes, rather than double quotes use single quotes in postgres, not double quotes.

Temp Tables:

Postgres allows you to create temporary tables from other tables if necessary – it may be of some use in sanity checking some of the SQL queries you write for your homework assignments.

As an example of how this is done, the syntax:

SELECT first, last INTO agentname FROM agent;

will create a permanent table that only contains the first and last attributes from the agent table. This table will need to be deleted when you are done with it, otherwise it will persist indefinitely. If you want to create a temp table instead, which will be deleted automatically by Postgres when you end your session, you can use the following syntax:

CREATE TEMP TABLE agentname AS SELECT first, last FROM agent;

Change Password:

ALTER USER username WITH PASSWORD 'newpasswordhere';