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CS 486/586 Introduction to DBMS
Summer 2022
Homework 1 – Basic SQL & Relational Algebra Queries

Part One

1) 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)

Answer:

- Table 1

  agent (<u>agent_id</u>, first, middle, last, address, city, country, salary, clearance_id)

  clearance_id is a FOREIGN KEY to securityclearance(sc_id)

- Table 2

  skill (<u>skill_id</u>, skill)

- Table 3

  skillrel (skill_id, agent_id)

  skill_id is a FOREIGN KEY to skill(skill_id)

  agent_id is a FOREIGN KEY to agent(agent_id)

- Table 4

  affiliation (<u>aff_id</u>, title, description)

- Table 5

  affiliationrel (aff_id, agent_id, affiliation_strength)

  aff_id is a FOREIGN KEY to affiliation (aff_id)

  agent_id is a FOREIGN KEY to agent(agent_id)

- Table 6

  mission (<u>mission_id</u>, name, access_id, team_id, mission_status)

  access_id is a FOREIGN KEY to securityclearance(sc_id)

  team_id is a FOREIGN KEY to team(team_id)

- Table 7

  securityclearance (<u>sc_id</u>, sc_level, description)

2a) How many security clearance levels can an agent have?
>   **Answer:**
>   An agent can have **one** security level

2b) How many skills can an agent have?
>   **Answer:**
>   An agent can have **many** number of skills

2c) Can two affiliations have the same name? (Note: name refers to the attribute/column named 'title' in the relation affiliation)
>   **Answer:**
>   **Yes**, two affiliations can have the same names.

2d) How many agents can be affiliated with a particular affiliation?
>   **Answer:**
>   **Multiple agents** can be affiliated with a particular affiliation.

2e) Can two agents have different affiliation strengths to the same affiliation?

>   **Answer:**

>   **Yes,** two agents can have different affiliation strengths to the same affiliation.

Part Two

 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 country = 'USA' and city ='Washington DC';

Answer:

```
su22adb20=> SELECT * FROM agent WHERE country = 'USA' and city = 'Washington DC';
 agent_id |    first     | middle |   last    |    address     |     city      | country | salary | clearance_id
----------+--------------+--------+-----------+----------------+---------------+---------+--------+--------------
      700 | Christopher  | R      | Boxer     | 112 HART       | Washington DC | USA     |  56224 |            4
      701 | Gordon       | N      | Cornyn    | 517 HART       | Washington DC | USA     | 259534 |            1
      731 | Johnny       | J      | Hatch     | 104 HART       | Washington DC | USA     |  52208 |            2
      753 | Jeff         | M      | Domenici  | 328 HART       | Washington DC | USA     | 164656 |            4
      771 | Thomas       | B      | Thomas    | 307 DIRKSEN    | Washington DC | USA     | 154114 |            2
      781 | James        | M      | Dodd      | 448 RUSSELL    | Washington DC | USA     | 224896 |            2
      791 | Judd         | J      | Jeffords  | 413 DIRKSEN    | Washington DC | USA     | 207326 |            2
(7 rows)
```

Total number of rows = 7 rows

(b) SELECT salary FROM agent;
Answer:

```
su22adb20=> SELECT salary FROM agent;
  57934
  89745
  67894
  89674
  71395
  55482
  56703
  54264
  56923
```

Total number of rows = 662 rows

(c) SELECT DISTINCT clearance_id FROM agent;
    Answer:

```
su22adb20=> SELECT DISTINCT clearance_id FROM agent;
 clearance_id
--------------
            7
            1
            5
            2
            4
            6
            3
(7 rows)
```

        Total number of rows = 7 rows

(d) SELECT agent_id, city, country, clearance_id FROM Agent WHERE salary > 95000 AND country != 'USA';

Answer:

```
su22adb20=> SELECT agent_id, city, country, clearance_id FROM Agent WHERE salary > 95000 AND
su22adb20-> country != 'USA';
 agent_id |   city     | country    | clearance_id
----------+------------+------------+--------------
      144 | Baghdad    | Iraq       |            5
      154 | Jerusalem  | Israel     |            2
      173 | Sydney     | Austrailia |            3
      482 | Warsaw     | Poland     |            1
      854 | Baghdad    | Iraq       |            6
(5 rows)
```

Total number of rows = 5 rows

4.
(a) SELECT DISTINCT country FROM agent WHERE salary > 100000;
Answer:

```
su22adb20=> SELECT DISTINCT country FROM agent WHERE salary > 100000;
 country
---------
 Iraq
 USA
(2 rows)
```

Total number of rows = 2 rows

(b) SELECT DISTINCT country FROM agent WHERE agent.salary > 100000;
Answer:

```
su22adb20=> SELECT DISTINCT country FROM agent
su22adb20-> WHERE agent.salary > 100000;
 country
---------
 Iraq
 USA
(2 rows)
```

Total number of rows = 2 rows

(c) SELECT DISTINCT country FROM agent A WHERE A.salary > 100000;

Answer:

```
su22adb20=> SELECT DISTINCT country FROM agent A WHERE A.salary > 100000;
 country
---------
 Iraq
 USA
(2 rows)
```

Total number of rows = 2 rows

Part Three

5. What is the team ID and the meeting frequency for the team 'Vikings'?

Answer:

SELECT team_id,meeting_frequency from team WHERE name = 'Vikings';

```
su22adb20=> SELECT team_id,meeting_frequency from team WHERE name='Vikings';
 team_id | meeting_frequency
---------+-------------------
      16 | weekly
(1 row)
```

Total number of rows = 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.**)

Answer:

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';

```
    country
-----------
 Iraq
 Turkey
 Spain
 England
 Italy
 Greece
 Egypt
```

Total number of rows = 20 rows

7. What are the first name, last name, and city of all agents in at least two affiliations? (You can do this without COUNT.)
Answer:

SELECT a.first, a.last, a.city from agent a, affiliationrel af, affiliationrel aff
WHERE a.agent_id = af.agent_id and af.aff_id!=aff.aff_id
group by a.first, a.last, a.city;

first	last	city
Ted	Suderburg	Paris
John	Muthusamy	Hong Kong
Andrew	Floyd	Baghdad
David	Parekh	Athens
George	Wagner	Vancouver
Theo	Mateos	San Jose
Christopher	Bond	Miami

Total number of rows = 502 rows

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.

Answer:

SELECT DISTINCT m.name,m.mission_status FROM mission m

INNER JOIN teamrel t ON m.team_id = t.team_id

INNER JOIN skillrel s ON t.agent_id = s.agent_id

INNER JOIN skill sk ON s.skill_id=sk.skill_id

WHERE sk.skill='VooDoo/Blackmagic';

```
su22adb20-> WHERE sk.skill='VooDoo/Blackmagic';
         name          | mission_status
-----------------------+----------------
 Narrow Ice            | ongoing
 Melian                | success
 Hammer of the Underw  | ongoing
 Causeway              | success
 Galadrim              | success
 Aman                  | failed
 Widow                 | ongoing
```

Total number of rows = 180 rows

9. Which pairs of agents have the same first and last names? (List each pair only once.)
Answer:

SELECT first, last, count (*) from agent
GROUP BY first, last having count (*)>=2;

```
su22adb20-> GROUP BY first, last having count (*)>=2;
 first  |   last    | count
--------+-----------+-------
 George | Carter    |     2
 Anri   | Lazaryan  |     2
 John   | Miller    |     2
(3 rows)
```

Total number of rows = 3 rows

Part Four Relational Algebra
10. Write the following queries in Relational Algebra
(a) Find the first and last names for all agents having clearance level more than 5.
Answer:

$$\pi_{(first,\ last)} \left(\left(\sigma_{clearance\_id>5} \right) agents \right)$$

(b) Find the unique agent id, first, and last names for agents who have Secret clearance and have a salary greater than $65,000.
Answer:

$$\pi_{(agent\_id,\ first,\ last)} \left(\sigma_{sc\_level='Secret'\ AND\ salary>65,000} \left(agent \bowtie_{clearance\_id=sc\_id} securityclearance \right) \right)$$

(c) Find the unique agent names of all agents in Spain and with the Communications skill.

Answer:

$$\pi_{(first,\ middle,\ last)} \left(\sigma_{country\ =\ 'Spain'}\ agents \bowtie \left(\sigma_{skillrel.skill\_id=skill.skill\_id\ AND\ s.skill='Communications'} skill \right) \right)$$