

Homework 1 – Basic SQL & Relational Algebra Queries

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Part One (20 Points)

Question-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)

Answer: -

Agent(agent_id, first, middle, last, address, city, country, salary, clearance_id)

Primary key: - agent_id

Foreign key: - clearance_id is a foreign key to securityclearance(sc_id)

Skill(skill_id, skill)

Primary key: - skill_id

Foreign key: - NA

Skillrel(skill_id, agent_id)

Primary key: - combination of skill_id and agent_id

Foreign key: -

- 1) agent_id is a foreign key to agent(agent_id)
- 2) skill_id is a foreign key to skill(skill_id)

Affiliation(aff_id, title, description)

Primary key: - aff_id

Foreign key: - NA

Affiliationrel(aff_id, agent_id, affiliation_strength)

Primary key: - combination of aff_id and agent_id

Foreign key: -

- 1) aff_id is a foreign key to affiliation(aff_id)
- 2) agent_id is a foreign key to agent(Agent_id)

Mission(mission_id, name, access_id, team_id, mission_status)

Primary key: - mission_id

Foreign key: -

- 1) access_id is a foreign key to securityclearance(sc_id)
- 2) team_id is a foreign key to team(team_id)

Securityclearance(sc_id , sc_level , description)

Primary key: - sc_id

Foreign key: - NA

Question-2) For 2a through 2e, 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?

2b) How many skills can an agent have?

2c) Can two affiliations have the same name? (Note: name refers to the attribute/column named 'title' in the relation affiliation)

2d) How many agents can be affiliated with a particular affiliation?

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

Answer: -

2(a): - Two. This is because, while there can be many security levels in general, an agent can only be assigned only one security clearance because of the foreign key constraint.

2(b): - Many. This is because there is no restriction on the skills that an agent can possess. This is confirmed by the fact that it is not a foreign key or primary key.

2(c): - Yes, title attribute can be same for two columns

2(d): - Many. This is because it is not a foreign key or primary key for the relations and thus, there are no restrictions.

2(e): - 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.

Question-3)

- (a) SELECT * FROM agent WHERE country = 'USA' and city = 'Washington DC';
- (b) SELECT salary FROM agent;
- (c) SELECT DISTINCT clearance_id FROM agent;
- (d) SELECT agent_id, city, country, clearance_id FROM Agent WHERE salary > 95000 AND country != 'USA';

Answer: -

a):- select * from agent where country='USA' and city='Washington DC';

In this query, we are finding out all the tuples (rows) from the agent who belong to the country USA and city of Washington DC

The screenshot for the query with results is given below: -

```
spr2022adb35=> 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)

b):- select salary from agent;

In this query, we are finding out all the salaries from agent table

The screenshot for the query along with the results is give below: -

```
OpenSSH SSH client
spr2022adb35=> select count(salary) from agent;
```

count
662

(1 row)

```
spr2022adb35=>
spr2022adb35=> select salary from agent limit 7;
```

salary
50553
50955
55920
66554
76396
51564
53357

(7 rows)

c):- select distinct clearance_id from agent;

Here, we are retrieving all the distinct clearance ids from the agent table .i.e. no duplicate values for clearance ids will be retrieved.

The screenshot for the query along with the result is given below: -

```
spr2022adb35=> select distinct(clearance_id) from agent;
clearance_id
-----
7
1
5
2
4
6
3
(7 rows)
```

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

Here we are retrieving agent_id, city, country and clearance_id from the agent table with the condition that all the tuples which are retrieved should have a salary of more than 95000 and should not belong to the country of USA.

The screenshot for the result of this query is given below: -

```
spr2022adb35=>
spr2022adb35=> SELECT agent_id, city, country, clearance_id FROM Agent WHERE salary > 95000 AND country != 'USA';
agent_id | city      | country | clearance_id
-----|-----|-----|-----
144      | Baghdad  | Iraq    | 5
154      | Jerusalem| Israel  | 2
173      | Sydney   | Australia| 3
482      | Warsaw   | Poland  | 1
854      | Baghdad  | Iraq    | 6
(5 rows)
```

Question-4).

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

Answer: -

a):- SELECT DISTINCT country FROM agent WHERE salary > 100000;

Here we are retrieving all the distinct country from the agent table with the condition that the salary for the agent should be more than 100000

The screenshot for the query along with its result is given below: -

```
spr2022adb35=> SELECT DISTINCT country FROM agent WHERE salary > 100000;
country
-----
Iraq
USA
(2 rows)
```

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

This is the exact same query as the one in the a) part. The only difference is that here the column salary is called with a different syntax which includes the name of the table including the column. This might not look like something which is effective here but in actual world databases where the retrieval is done using joins and multiple tables, it becomes very important to call the columns in conjunction with the names of the tables to which they belong.

The screenshot for the query along with its result is given below: -

```
spr2022adb35=> SELECT DISTINCT country FROM agent WHERE agent.salary > 100000;
country
-----
Iraq
USA
(2 rows)
```

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

This is also a way to call the tuples when we have used alias for the table name. This methodology is important and most frequently used when we join a table with itself.

The screenshot for the query along with its result is given below: -

```
spr2022adb35=> SELECT DISTINCT country FROM agent A WHERE A.salary > 100000;
country
-----
Iraq
USA
(2 rows)
```

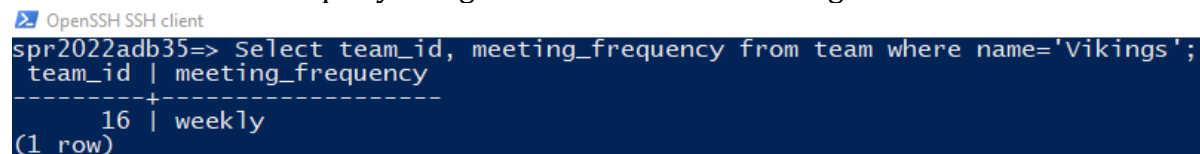
Part Three (50 points - 10 points each) Write a single SQL statement for each of the following queries. Show the first five rows of the result for each query (or fewer, if the result is smaller) and the number of rows returned. You should be able to write these SQL queries using only the features covered 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!**

Question-5). What is the team ID and the meeting frequency for the team ‘Vikings’?

Answer: - The query to be used for retrieving the meeting frequency with team id for ‘vikings’ Is given below: -

Select team_id, meeting_frequency from team where name='Vikings';

The screenshot of the query along with the desired result is given below: -



```
spr2022adb35=> Select team_id, meeting_frequency from team where name='Vikings';
team_id | meeting_frequency
-----+-----
      16 | weekly
(1 row)
```

Question-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: - The query to be used for retrieving the agents with top secret or majestic clearance is: -

Select distinct A.country from agent A, securityclearance S where A.clearance_id = S.sc_id and (S.sc_level = 'Top Secret' or S.sc_level='Majestic');

The screenshot of the query along with the desired result is given below: -

```
spr2022adb35=> Select distinct A.country from agent A, securityclearance S where A.clearance_id = S.sc_id and (S.sc_level = 'Top Secret' or S.sc_level='Majestic');
country
-----
Iraq
Turkey
Spain
England
Italy
Greece
Egypt
Australia
Russia
China
India
Luxembourg
France
USA
Israel
Brazil
Poland
Germany
Japan
Canada
(20 rows)
```

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

Answer: -

The query which will be used to retrieve the required results is given below: -

select distinct(first) , last , city from agent A, affiliationrel B, affiliationrel C where
A.agent_id = B.agent_id and B.agent_id = C.agent_id and B.aff_id<>C.aff_id;

```
Select OpenSSH SSH client
spr2022adb35=>
spr2022adb35=> Create temp Table result as select distinct(first) , last , city from agent A, affiliationrel B, affiliationrel C where A.agent_id = B.agent_id and B.agent_id = C.agent_id and
B.aff_id<>C.aff_id;
SELECT 307
spr2022adb35=>
spr2022adb35=>
spr2022adb35=>
spr2022adb35=>
spr2022adb35=> select count(*) from result;
count
-----
307
(1 row)
```

```
spr2022adb35=> select * from result limit 10;
first | last | city
-----+-----+-----
John | Muthusamy | Hong Kong
Andrew | Floyd | Baghdad
George | Wagner | Vancouver
Theo | Mateos | San Jose
Pete | Moret | Athens
Tom | Popp | Paris
Zdenka | Smith | San Francisco
Michael | McConnell | Miami
George | Miller | Istanbul
Bill | Fezzey | New York
(10 rows)
```

Question-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: -

The query which will be used to produce the required result is given below: -

```
select distinct m.name, m.mission_status from mission m, teamrel tr, skillrel sr, skill s
where m.team_id = tr.team_id and tr.agent_id = sr.agent_id and sr.skill_id = s.skill_id and
s.skill = 'VooDoo/Blackmagic'
```

The screenshot below depicting the result of the above query is: -

```
OpenSSH SSH client
spr2022adb35=> select distinct m.name, m.mission_status from mission m, teamrel tr, skillrel sr, skill s where m.team_id = tr.team_id and tr.agent_id = sr.agent_id and sr.skill_id = s.skill_id and s.skill = 'VooDoo/Blackmagic' limit 10;
name | mission_status
-----+-----
Narrow Ice | ongoing
Melian | success
Hammer of the Underw | ongoing
Causeway | success
Galadrim | success
Aman | failed
Widow | ongoing
The Wise | ongoing
Kharas | success
Tookland | success
(10 rows)

spr2022adb35=>
spr2022adb35=>
spr2022adb35=> select count(distinct m.name) from mission m, teamrel tr, skillrel sr, skill s where m.team_id = tr.team_id and tr.agent_id = sr.agent_id and sr.skill_id = s.skill_id and s.skill = 'VooDoo/Blackmagic' limit 10;
count
-----
180
(1 row)
```

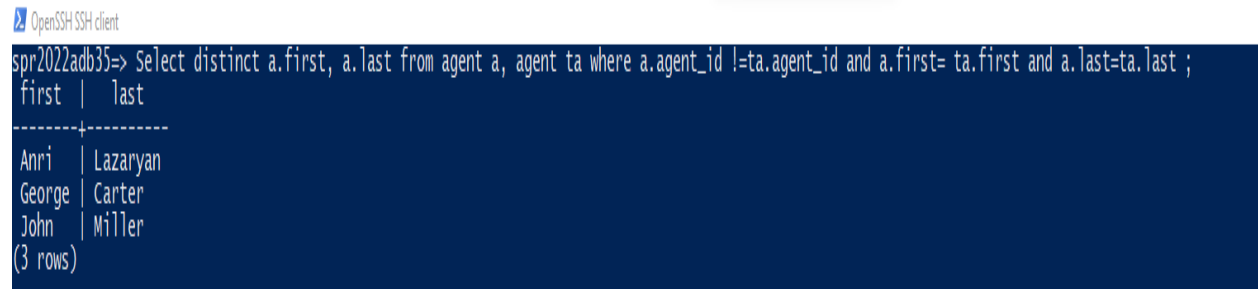

Question-9): - Which pairs of agents have the same first and last names? (List each pair only once.)

Answer: -

The query which will be used to produce the required result is given below: -

Select distinct a.first, a.last from agent a, agent ta where a.agent_id !=ta.agent_id and a.first=ta.first and a.last=ta.last ;

The screenshot of the result is given below: -



```
spr2022adb35> Select distinct a.first, a.last from agent a, agent ta where a.agent_id !=ta.agent_id and a.first= ta.first and a.last=ta.last ;
first | last
-----+-----
Anri   | Lazaryan
George | Carter
John   | Miller
(3 rows)
```

Part Four Relational Algebra (15 pts)

Question-10): - Write the following queries in Relational Algebra

- (a) Find the first and last names for all agents having clearance level more than 5.
- (b) Find the unique agent id, first, and last names for agents who have Secret clearance and have a salary greater than \$65,000.
- (c) Find the unique agent names of all agents in Spain and with the Communications skill.

Answer: -

10.a

Π first, last (σ securityclearance.sc_id > 5 AND agent.clearance_id = securityclearance.sc_id (agent x securityclearance));

10.b

Π first, last, agent_id (σ securityclearance.sc_id_level = 'secret' AND agent.clearance_id = securityclearance.sc_id AND agent.salary > 65000 (agent x securityclearance));

10.c

Π first, last (σ agent.country = 'spain' AND agent.agent_id = skillrel.agent_id AND skillrel.skill_id = skill.skill_id AND skill.skill = 'Communication' (agent x skillrel x skill));