Lab 3: Relational Algebra

Part 1 - Joins

Query 1: $T1 \bowtie_{T1.A=T2.A} T2$

This query performs an equi-join on T1 and T2, where T1's column A equals T2's column A.

Resulting schema:

T1.A	Q	R	T2.A	B	C

Resulting table:

T1.A	Q	R	T2.A	B	C
20	a	5	20	b	6
20	a	5	20	b	5

Query 2: $T1 \bowtie_{T1.Q=T2.B} T2$

This query performs an equi-join on T1 and T2, where T1's column Q equals T2's column B.

Resulting schema:

A	T1.Q	R	T2.A	B	C

Resulting table:

A	T1.Q	R	T2.A	B	C
25	b	8	20	b	6
25	b	8	20	b	5

Query 3: $T1 \bowtie T2$

This query is the Cartesian product of T1 and T2, with no join condition.

Resulting schema:

T1.A	Q	R	T2.A	B	C

Resulting table:

T1.A	Q	R	T2.A	B	C
20	a	5	20	b	6
20	a	5	45	c	3
20	a	5	20	b	5
25	b	8	20	b	6
25	b	8	45	c	3
25	b	8	20	b	5
35	a	6	20	b	6
35	a	6	45	c	3
35	a	6	20	b	5

Query 4: $T1 \bowtie_{T1.A=T2.A \wedge T1.R=T2.C} T2$

This query performs a multi-condition equi-join on T1 and T2, where T1's column A equals T2's column A and T1's column R equals T2's column C.

Resulting schema:

T1.A	Q	R	T2.A	B	C

Resulting table:

T1.A	Q	R	T2.A	B	C
20	a	5	20	b	5

Part 2 - Chess Queries

1. **Find the names of any player with an Elo rating of 2850 or higher.**
   $\Pi_{\text{Name}}(\sigma_{\text{Elo} \geq 2850}(\text{Players}))$
2. **Find the names of any player who has ever played a game as white.**
   $\Pi_{\text{Name}}(\text{Players} \bowtie \rho_{(\text{pID} \to \text{wpID})}(\text{Games}))$
3. **Find the names of any player who has ever won a game as white.**
   $\Pi_{\text{Name}}(\sigma_{\text{Result}='1-0'}(\text{Players} \bowtie \rho_{(\text{pID} \to \text{wpID})}(\text{Games})))$
4. **Find the names of any player who played any games in 2018.**
   $\Pi_{\text{Name}}((\text{Players} \bowtie \rho_{(\text{pID} \to \text{wpID})}(\sigma_{\text{eID}=2 \vee \text{eID}=3}(\text{Games}))) \cup (\text{Players} \bowtie \rho_{(\text{pID} \to \text{bpID})}(\sigma_{\text{eID}=2 \vee \text{eID}=3}(\text{Games}))))$
5. **Find the names and dates of any event in which Magnus Carlsen lost a game.**
   $\Pi_{\text{Name},\text{Year}}(\sigma_{(\text{wpID}=1 \wedge \text{Result}='0-1') \vee (\text{bpID}=1 \wedge \text{Result}='1-0')}(\text{Events} \bowtie \rho_{(\text{eID} \to \text{eID1})}(\text{Games} \bowtie \rho_{(\text{wpID} \to \text{pID}, \text{bpID} \to \text{pID1})}(\rho_{(\text{Name} \to \text{Name1}, \text{pID} \to \text{pID1})}(\sigma_{\text{Name}='\text{Magnus Carlsen}'}(\text{Players}))))))$
6. **Find the names of all opponents of Magnus Carlsen. An opponent is someone who he has played a game against.**
   $(\Pi_{\text{Name1}}(\rho_{(\text{Name} \to \text{Name1}, \text{pID} \to \text{pID1})}(\text{Players}) \bowtie \rho_{(\text{pID} \to \text{bpID})}(\sigma_{\text{wpID}=1}(\text{Games})))) \cup (\Pi_{\text{Name1}}(\rho_{(\text{Name} \to \text{Name1}, \text{pID} \to \text{pID1})}(\text{Players}) \bowtie \rho_{(\text{pID} \to \text{wpID})}(\sigma_{\text{bpID}=1}(\text{Games}))))$

Part 3 - LMS Queries

Part 3.1

Table:

Name (varchar(255))
Hermione
Harry

Find the names of students who have never received a "C" grade.

Part 3.2

Name (varchar(255))
Hermione

Find the names of all students born in the same year as Ron, excluding Ron.

Part 3.3

Empty set (no results)

Find the names of the courses in which all students are enrolled.

Part 4

$$\text{CoursesStartWithThree} \leftarrow \Pi_{cID}(\sigma_{cID \geq 3000 \wedge cID < 4000}(\text{Courses}))$$

$$\text{StudentsIDs} \leftarrow \Pi_{sID}(\text{CoursesStartWithThree} / \text{Enrolled})$$

$$\Pi_{Name}(\text{Students} \bowtie \text{StudentsIDs})$$