Owen Harvey

Assignment 6

Homework 5 – Relational Algebra

3/5/2024

Read 8.4.2 Aggregate Functions and Grouping to answer questions with aggregate functions.

8.1.) List the operations of relational algebra and the purpose of each.

- Selection σ: The select operation acts as a filter to select a tuples that satisfies a given condition.
- Project π: Keeps certain columns from a relation and discards the other columns to create a subset.
- Rename ρ: Rename the attributes of a relation, the relation's name, or both.
- Union ∪: Combines two relations to create a new relation that contains all the rows from both relations and removing any duplicates.
- Intersection ∩: Creates a new relation that contains only the rows that appear in both the input relations.
- Difference (minus) -: Creates a new relation that only contains the rows that appear in the first input relation but not in the second.
- Cartesian product x: Creates a new relation that contains every possible combination of rows from the two input relations.
- Join ⋈: Combines two relations based on a common attribute to create a new relation. The different types of joins contain different rules for combining rows.
- Division ÷: Used to find tuples that are associated with all tuples from another relation.
- Outer Join:
    - Left ⟕: Return all rows from the left table and the matched rows from the right table. If there is no match, Null values are returned for the columns from the right table.
    - Right ⟖: Returns all rows from the right table and the matched rows from the left table. If there is no match, Null values are returned for the columns from the left table.
    - Full ⟗: Returns all rows when there is a match in either the left or right table. If there is no match, Null values are returned for the columns from the other table.
- Outer Union ⋃: Combines two relations and keeps all tuples from both input relations including duplicates. Each tuple is only included once in the result even if it appears in both relations.
- Aggregate Functions $\mathcal{F}$: Used to perform calculations on a set of values and return a single value.
    - Sum: Calculates the sum of values in a column.
    - Avg: Calculates the average of values in a column.
    - Count: Counts the number of rows in a column.
    - Max: Returns the maximum value in a column.
    - Min: Returns the minimum value in a column.

8.16.) Specify the following queries on the COMPANY relational database schema shown in Figure 5.5 using the relational operators discussed in this chapter. Also show the result of each query as it would apply to the database state in Figure 5.6. (Write Relational Algebra)

b.) List the names of all employees who have a dependent with the same first name as themselves.

$$\pi_{Fname}\left(\sigma_{Department_{Name}} = Fname(Employee \bowtie Dependent)\right)$$

c.) Find the names of all employees who are directly supervised by 'Franklin Wong'.

$$\pi_{Fname, Lname}\left(\sigma_{Mgr_{ssn}} = 333445555(EMPLOYEE)\right)$$

f.) Retrieve the names of all employees who do not work on any project.

$$\pi_{Fname, Lname}\left(EMPLOYEE - (EMPLOYEE \bowtie WORKS_{ON})\right)$$

8.17.) Consider the AIRLINE relational database schema shown in Figure 5.8, which was described in Exercise 5.12. (Referencing figures on page 172). Specify the following queries in relational algebra:

a.) For each flight, list the flight number, the departure airport for the first leg of the flight, and the arrival airport for the last leg of the flight.

$$\pi_{\text{Flight\_number, Departure\_airport\_code, Arrival\_airport\_code}}\left(\left(\text{Flight} \bowtie_{\min(\text{Leg\_number})} \text{Flight\_leg}\right) \bowtie_{\max(\text{Leg\_number})} \text{Flight\_leg}\right)$$

b.) List the flight numbers and weekdays of all flights or flight legs that depart from Houston Intercontinental Airport (airport code 'iah') and arrive in Los Angeles International Airport (airport code 'lax').

$$\pi_{\text{Flight\_number, Weekdays}}\left(\sigma_{\text{Departure\_airport\_code='iah'} \wedge \text{Arrival\_airport\_code='lax'}}(\text{Flight\_leg})\right)$$

c.) List the flight number, departure airport code, scheduled departure time, arrival airport code, scheduled arrival time, and weekdays of all flights or flight legs that depart from some airport in the city of Houston and arrive at some airport in the city of Los Angeles. (Had to break into 2 parts because it ran off the page.)

$$\pi_{\text{Flight\_number, Departure\_airport\_code, Scheduled\_departure\_time, Arrival\_airport\_code, Scheduled\_arrival\_time, Weekdays}}\left(\sigma_{\text{City='Houston'} \wedge \text{City='Los Angeles'}}\left(\text{Airport} \bowtie_{\text{Departure\_airport\_code}}\left(\text{Airport} \bowtie_{\text{Arrival\_airport\_code}}\left(\text{Airport} \bowtie_{\text{Flight\_number}} \text{Flight\_leg}\right)\right)\right)\right)$$

d.) List all fare information for flight number 'co197'.

$$\sigma_{\text{Flight\_number='co197'}}(\text{Fare})$$

e.) Retrieve the number of available seats for flight number 'co197' on '2009-10-09'.

$$\pi_{\text{Number\_of\_available\_seats}}\left(\sigma_{\text{Flight\_number='co197'} \wedge \text{Date='2009-10-09'}}(\text{Leg\_instance})\right)$$