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# **Assignment 11**

Hand in this assignment until Thursday, 20 July 2023, 12:00 at the latest.

### **E**xam-style Exercises

Exercises marked with (E) are similar in style to those you will find in the exam. You can use these to hone your expectations and gauge your skills.

#### Running out of ideas?

Are you hitting a roadblock? Are some of the exercises unclear? Do you just need that one hint to get the ball rolling? Refer to the #forum channel on our Discord server and check the tag for this assignment —maybe you'll find just the help you need.

#### Copy-Paste Symbols

This assignment focuses heavly on relational algebra. As such we have prepared a small relational-algebra-themed collection of our finest copy-pasteable Unicode symbols for you. ©



### Task 1: Relational Algebra Trivia

Please answer the following questions about relation algebra briefly.

- (a) Which are the **core** operators? Explain the term "relationally complete".
- (b) Briefly explain the difference between monotonic and non-monotonic operators.
- (c) Consider the relations R(A,B,C) and S(B,D). Rewrite the following expressions into equivalent expressions that use only core operators:
  - i.  $R \bowtie S$
  - ii.  $\pi_B(R) \cap \pi_B(S)$

# Task 2: Relational Flights (E)

Consider the following relations containing airline flight information:

<b>⊞</b> Air	craft			
aid	nar	ne	manufacturer	maximum_range
1234	A350-9	00ULR	Airbus	18000 km

<b>#</b> Pilots				
pid		name	salary	
5678	La	unchpad McQuack	\$330,000	

<b>⊞</b> Cer	<b>EE</b> Certified					
aid	pid					
1234	5678					

<b>■</b> Flights							
flno	origin	destination	distance	departure	arrival		
SQ 23	Singapore	New York	15349 km	2023-07-03 12:10	2023-07-03 18:50		

#### **Trivia**

The example is currently the longest commercial flight with a duration of about 19 hours! The departure and arrival times may look odd, but all is well because the timestamps are given in their respective local time zones, which are 12 hours apart.

Use relational algebra to formulate the following queries:

(a) Find the flno and the origin of all flights to Berlin.

- flno origin ...
- (b) Find the aid of all aircraft which can be used on non-stop flights from **Bonn** to **Madras**.



(c) Find the pid and name of all pilots certified for some **Boeing** aircraft.



(d) Find the names of all cities that lie on a round trip with exactly three flights.



Note

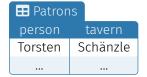
departure and arrival times do not have to be considered here.

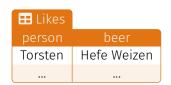
Task 3: Relational Tavern

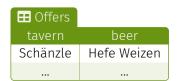
#### Caution

Though this task may be similar to task 2, some subtasks are non-monotonic in nature!

Consider the following relations containing information about taverns and their patrons:







Use relational algebra to formulate the following queries:

(a) (E) Which beers are mentioned in the database?



(b) (E) Which beers are not liked by any person?

beer ...

(c) Which patrons have not been to all taverns?

person ...

(d) (E) List all patrons which like none of the beers on offer.

- person
- (e) (E) Which patrons have been to any taverns that offer any of their favorite beers?
- person
- (f) Which patrons have been visiting **only** taverns that offer **any** of their favorite beers?
- person
- (g) Which patrons have been visiting any taverns that offer only their favorite beers?
- person
- (h) Which patrons have been visiting only taverns that offer only their favorite beers?

