

Assignment 2 – Relational Algebra and Simple SQL

Due Dates: October 17 (Relational Algebra); October 21 (SQL)

In this assignment you have to formulate a number of simple questions as queries in the relational algebra and SQL. Note that `borders` and `sea_connect` are assumed to be *symmetric* relations: e.g., if `borders(a,b)` is true, then also `borders(b,a)` is true.

Problem 1: Relational Algebra

Formulate the following questions as queries in the relational algebra:

1. List all city information for cities with a population greater than 1 million.
2. What are the `countryCodes` of countries that have cities with a population greater than 1 million?
3. List all African capital cities together with their city population and the country they are located in.
4. What countries have a border with another country?
5. What countries have at least two borders with another country?
6. What countries have no border with another country?
7. List all countries in Europe and Asia.
8. List all countries that are located in both Europe and Asia.
9. What countries are located on multiple continents?
10. Find the city (or cities) with the largest population.
11. What rivers flow in and out of the same lake?
12. What countries have all the religions that are in the `UDEF_RELIGION` relation?¹

¹This is a new table that holds the names of religions that a user is interested in.

```
CONTINENT(contName, area)
COUNTRY(countryCode, name, area, pop, GDP, capital → CITY)
CITY(cityId, pop, lat, long, country → COUNTRY)
LANGUAGE(language)
RELIGION(religion)
SEA(sea, depth)
LAKE(lake, area, depth, altitude)
RIVER(river, length)
ISLAND(island, area)
UDEF_RELIGION(religion → RELIGION)
```

```
country_language(country → COUNTRY, language → LANGUAGE)
country_religion(country → COUNTRY, religion → RELIGION)
country_continent(country → COUNTRY, continent → CONTINENT)
borders(country_a → COUNTRY, country_b → COUNTRY, length)
city_island(city → CITY, iname → ISLAND)
city_lake(city → CITY, lname → LAKE)
city_river(city → CITY, rname → RIVER)
city_sea(city → CITY, sname → SEA)
river_into_lake(rname → RIVER, lname → LAKE)
river_from_lake(rname → RIVER, lname → LAKE)
river_into_sea(rname → RIVER, sname → SEA)
sea_connect(sea_a → SEA, sea_b → SEA)
island_country(iname → ISLAND, country → COUNTRY)
```

Problem 2: SQL

Formulate the queries from Problem 1 in SQL.

(See the class page / mailing list for details on how to submit your answers.)