Consider the following database schema loosely based on the CIA World Factbook.\(^1\)


- This table represents countries consisting of their codes (e.g., “US”), names (e.g., “United States of America”), gross domestic products per capita (e.g., “46,900” dollars per person), and inflation rates (e.g., “3.8” percent).
- *code* is the primary key

**Province**(*name*: string, *country*: string, *area*: float)

- This table represents provinces (states in the US) consisting of their names, countries, and areas.
- *name* and *country* together form the primary key
- *country* is a foreign key to Country.code

**City**(*name*: string, *province*: string, *country*: string, *population*: int)

- This table represents cities consisting of their names, provinces, countries, and population.
- *name, province, and country* together form the primary key
- *province* and *country* together are a foreign key to Province.(name,country)

Answer the following questions using this database schema. Please submit your answers as a single PDF document to the blackboard system.

1. Describe the following query using plain English and write an equivalent query using relational algebra.

   
   ```sql
   SELECT *
   FROM Country
   WHERE inflation < 2.0 AND gdp > 20000;
   ```

2. Describe the following relational algebra query using plain English and write an equivalent SQL query for it.

   \[
   \sigma_{\text{inflation} > 2.0} (\pi_{\text{code}, \text{inflation}, \text{area}} (\text{Country} \bowtie_{\text{code} = \text{country}} \text{Province}))
   \]

\(^1\)https://www.cia.gov/library/publications/the-world-factbook/index.html
3. Describe the following query using plain English and write an equivalent query using relational algebra.

```
SELECT DISTINCT P.name, P.area
WHERE Province P, City C
WHERE C.province = P.name AND
    C.population > 1000;
```

4. Rewrite the previous query using the “JOIN ON” syntax.

5. Write an SQL query to find provinces with an area less than 100 and that contain a city with a population over 1,000,000.

6. Write an SQL query to find the GDP of the country with the smallest inflation.

7. Write an SQL query that lists countries whose GDP is above the average GDP of all countries.

8. Write an SQL query that finds the GDP, inflation, and total population of each country. Let a country’s population be the total population of all cities in that country.