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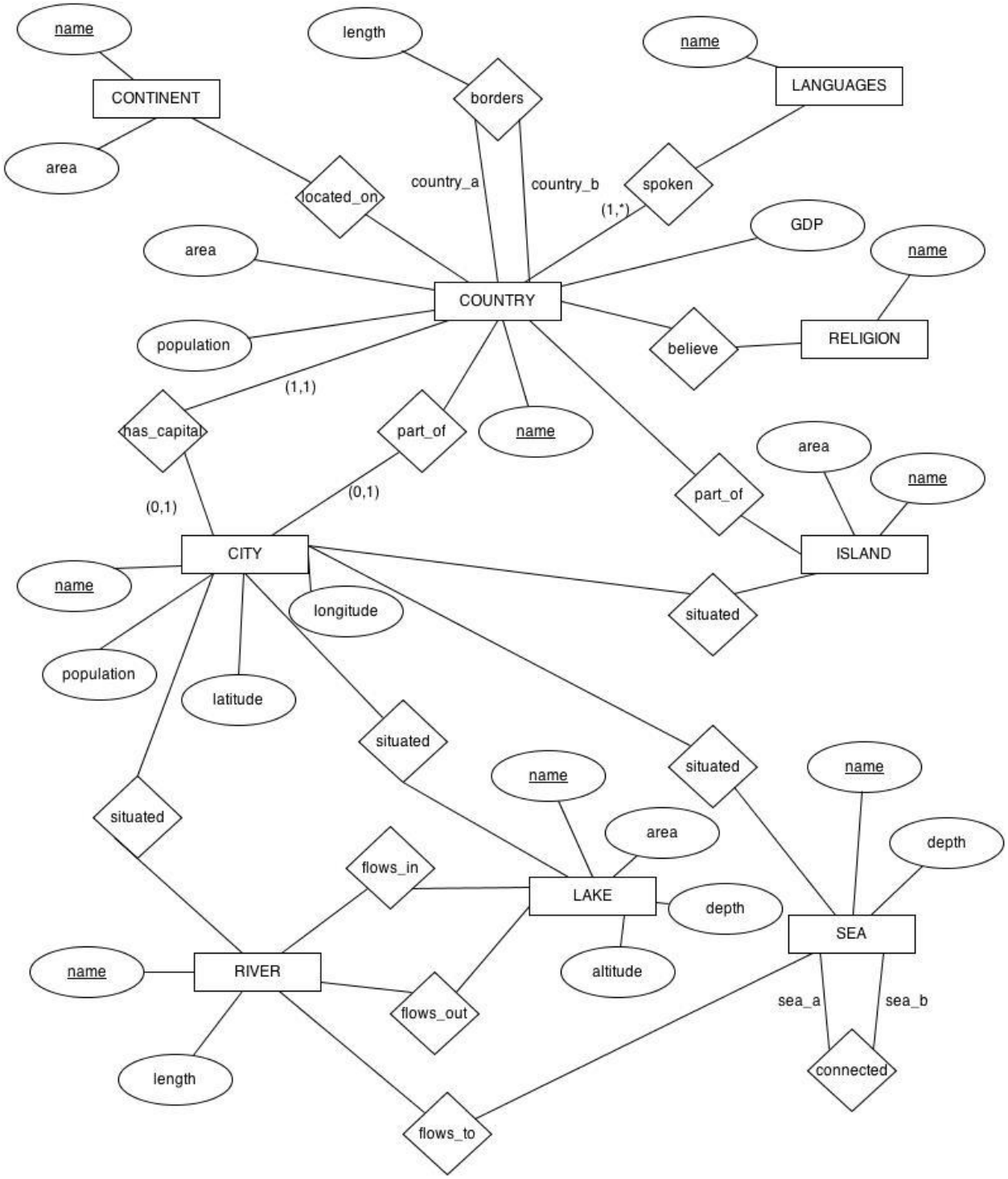
Homework 1

Problem 1

a) ER Diagram



b) Constraints that we are unable to capture using the standard ER modeling constructs:

1. The sum of all the population of the cities should not be greater than the population of the country
2. The sum of the area of the land located on the continent(s) and island(s) should not exceed the area of the country

c)

COUNTRY(name, population, area, GDP, capital_city_name → CITY)

CITY(name, population, longitude, latitude, country_name → COUNTRY)

CONTINENT(name, area)

RELIGION(name)

LANGUAGES(name)

ISLAND(name, area)

SEA(name, depth)

LAKE(name, area, depth, altitude)

RIVER(name, length)

country_spoken_languages(cname → COUNTRY, lname → LANGUAGES)

country_believe_religion(cname →COUNTRY, rname → RELIGION)

country_located_on_continent(country_name → COUNTRY, continent_name → CONTINENT)

country_borders_country(cname_a → COUNTRY, cname_b → COUNTRY, length)

island_part_of_country(iname → ISLAND, cname → COUNTRY)

city_situated_island(cname → CITY, iname → ISLAND)

city_situated_sea(cname → CITY, sname → SEA)

city_situated_lake(cname → CITY, lname → LAKE)

city_situated_river(cname → CITY, rname → RIVER)

sea_connected_sea(sea_name_a → SEA, sea_name_b → SEA)

river_flows_in_lake(rname → RIVER, lname → LAKE)

river_flows_out_lake(rname → RIVER, lname → LAKE)

river_flows_to_sea(rname → RIVER, sname → SEA)

county_has_capital_city and city_part_of_country relationships are not needed in the tables because we assume that a country is only able to have one capital and that a city is part of only one country. Therefore, the foreign keys can be placed in the COUNTRY and CITY tables shown from the relational schema above.

Problem 2

a) The country's population and GDP as well as the city's population change regularly over time. The sea's depth, river's length, and lake's area and depth can also change over time. In order to modify the ER diagram to include the time-dependent information, we can add a TIME entity with a primary key of year (or time). Then, we change the attributes to relationships between the entities and TIME. The relational schema would have a relation between the primary key of an entity, like country name, and time and measurement of the attribute, like population. This way, the new relationship would have the time dependent attribute (like population) as an attribute.

b) The changes made to the ER diagram would be to first take out the GDP attribute from COUNTRY. Then, add a TIME entity with a primary key of either year or time. Put a relationship between COUNTRY and TIME and name it country_gdp_during with an attribute name GDP.

The changes made to the relational schema would be:

COUNTRY(<u>name</u>, population, area, capital_city_name → CITY)

country_gdp_during(<u>cname</u> → COUNTRY, <u>t</u> → TIME, GDP)

TIME(<u>t</u>)