EuropeanCountriesDB
Database for European Countries

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1 Introduction

1.1 Purpose of Application

The purpose of EuropeanCountriesDB is to build a database, which will contain data of touristic and general interest about European countries. Specifically, in addition to the characteristics of each country, the application will contain data on the epidemiological situation of each country from the disease Covid-19 or SARS-CoV-2. Also, it will contain ways that someone can visit a specific country as well as data on the most touristic cities of each country and by extension their tourist attractions.

1.2 Application Description

For EuropeanCountriesDB the data that will be stored are countries, data related to Covid-19, airports, railway stations, ports, tourist attractions and most touristic cities, while it will be used mainly by potential visitors to European countries.

1.3 Data Application Requirements

For EuropeanCountriesDB we expect to have data for 50 different countries. More specifically, data is expected on the daily cases and deaths of each country as well as the countries' weekly vaccinations regarding Covid-19, i.e. ~18000 registrations each year for cases and deaths and ~2400 each year for vaccinations. Also, we expect data for each country's airports, railway stations and ports, which ranges between 0-150 for airports, 0-20 for high-speed rail stations and 0-200 for each country's ports. We also expect data for each country's 5 to 10 most touristic cities and 200 to 1000 countries' most touristic attractions (museums and monuments), so about ~50000 entries in total for touristic attractions.

2 Categories of Users and their Requirements

Admin:

He is responsible for the complete management of the database. His rights include:

- Access to all the data .
- Add or remove records for any relationship in the database.
- Modify all values for record attributes.
- Add other users.
- Remove other users if necessary.

Manager of Health Organization for each country:

He is responsible for managing the statistics regarding Covid-19 for his country. His rights include:

- Access to data related to Covid-19.
- Modification of data (only for his country) on cases, deaths and vaccinations for Covid-19 in case of an entry error.
- Creation of new records (for own country only) for cases, deaths and vaccinations for Covid-19.

World Health Organization official:
He is responsible for monitoring the statistics regarding Covid-19 for all countries. His rights include:

- Access to data related to Covid-19.
- Amendment of data on cases, deaths and vaccinations for Covid-19 in case of an entry error.

Transport Manager of each country:
He is responsible for the management of his country's transport data. His rights include:

- Access to transport data.
- Create new records (only for own country or for railway lines that start/end in own country) in transport relations. E.g. the creation of a new airport or a new railway line.
- Modification of the records concerning the transports for his country. E.g. the passengers of an airport for this year.
- Deleting records related to transportation for his country such as a railway station that went out of service.

Official of the Ministry of Tourism of each country:

He is responsible for the management of the data concerning the data for tourism and for the tourist attractions of his country. His rights include:

- Access to data related to tourism.
- Create new records (for his country) for the most touristic cities and their attractions (in case there is a big change in the number of visitors to a city or another attraction is added).
- Modifying records related to his country's tourism data, such as the number of visitors to a city, the price of a museum ticket, and more.

Simple User:
They can search for any information they are interested in for all European countries. His rights include:
- Access to all database data.

- Creating comments in the event of an error being observed that will inform the person responsible for the specific data or the base administrator to change them.

3 Entity/Relationship Model

3.1 General description

The entities are European Country **,** Covid- **19 Cases , Covid-19 Vaccinations** , Airport **, Port** , the High Speed Railway Station **,** the City **with many visitors** , the Tourist Attraction **,** the Museum **and** the **Monument** .

Each country has N entries for daily Covid-19 statistics and N entries for weekly Covid-19 vaccination statistics. It also has N airports, N high-speed railway stations and N ports. A railway station may be connected to N other stations by railway lines. N most touristic cities belong to one country. Each of these cities has N attractions, divided into Museums and Monuments.

Cases:

- **The table European country is not in 3rd NF (we have a transition from country code to country name and from country name to capital city) but we do not split it into the extra table [Country Name, Country Code] as the countries are few and such a thing will simply reduce performance due to the extra connections that would have to be made).**
- The name of each tourist town is unique.
- As a country code we consider the ISO 3166-1 alpha-3 code.
- Attractions consist only of monuments and museums, although other types of attractions may also be included.
- In the Covid-19 vaccinations we include cases where citizens are fully vaccinated, i.e. they have been given the 2nd dose of the Pfizer, Moderna or Astra Zeneca vaccine and the single-dose Johnson & Johnson vaccine. We do not include vaccinations for the 3rd dose in our base.
- The entity City with many tourists has a mandatory participation in the European Country, because we consider that in wartime its ownership can change, e.g. Paris no longer belongs to France but to Germany.
- Two different cities cannot have a tourist attraction with the same name.
- At tourist attractions, the ticket is considered to be the general admission ticket.
- We consider the language of each country to be the language spoken by the majority of the population.
- The attributes (per year / latest) refer to the statistics published for the most recent year.
- In European countries we include the countries located on the European continent excluding Kazakhstan.
- We assume for the Monument entity that dates of the start_construction_year and end_construction_year attributes that are before Christ have a negative sign.
- Each city with a lot of tourists can have at most one airport, one port and one train station (there could be more ports but theoretically only one major port exists in each city and we're basically interested in those)

3.2 Entities

Entity Name	European_Country
Description	Basic Entity, the data for country elements is stored
Properties	Powerful Entity
Attributes	country_code
	country_name
	area
	language
	country_population
	currency
	capital_city

Entity Name	Covid19_Cases
Description	Entity that stores data on Covid-19 cases
Properties	secondary Entity
Attributes	date
	daily_cases#
	total_cases#
	daily_deaths#

Entity Name	Covid19_Vaccinations	
Description	Entity that stores data on vaccinations against Covid-19	
Properties	secondary Entity	
Attributes	Vaccination date	vac_year
		vac_week
	vaccinations_per_week#	
	vaccination_percentage	

Entity Name	City_Many_Visitors
Description	Entity that stores the data for the most touristic cities
Properties	Powerful Entity
Attributes	city_name
	city_population
	arrivals_per_year_latest#

Entity Name	Tourist_Attraction
Description	Entity that stores the data for elements of the attraction of a tourist city
Properties	Powerful Entity {Subclasses: Museum, Monument}
Attributes	attraction_name
	location
	ticket_price

Entity Name	Museum
Description	Entity that stores data about museums
Properties	Powerful Entity {Superclass: Tourist_Attraction}
Attributes	visitors_per_year_latest#
	exhibits#
	opening_year
	museum_type

Entity Name	Monument	
Description	Entity that stores the data for the monuments	
Properties	Powerful Entity {Superclass: Tourist_Attraction}	
Attributes	is_UNESCO	
	construction_period	start_construction_year
		end_construction_year

Entity Name	Airport
Description	Entity that stores the data for each country's airports
Properties	Powerful Entity
Attributes	airport_code
	airport_name
	airport_city
	airplanes_per_year_latest#
	passengers_per_year_latest#

Entity Name	Port
Description	Entity that stores the data for the ports of each country
Properties	Powerful Entity
Attributes	port_name
	port_location

Entity Name	High_Speed_Railway_Station
Description	Entity that stores the data for each country's high-speed rail stations
Properties	Powerful Entity
Attributes	station_city
	platforms#
	opening_year

3.3 Relationships

Association name	"Has"
Description	It connects every European country with Covid-19 cases
Properties	Has-A, Identifier, Binary
Reason for multitude	1:N
Participation	Total Participation of Covid-19 Cases
	Partial Participation of the European Country
Attributes	-

Association name	"Has"
Description	It connects every European country with Covid-19 vaccinations
Properties	Has-A, Identifier, Binary
Reason for multitude	1:N
Participation	Full Participation of Covid-19 Vaccinations
	Partial Participation of the European Country
Attributes	-

Association name	"Belong"
Description	It connects every European country with its airports
Properties	Has-A, Binary
Reason for multitude	1:N
Participation	Partial Participation of the Airport
	Partial Participation of the European Country
Attributes	-

Association name	"Belong"
Description	It connects every European country with its ports
Properties	Has-A, Binary
Reason for multitude	1:N
Participation	Partial Participation of the Port
	Partial Participation of the European Country
Attributes	-

Association name	"Belong"
Description	It connects every European country with its high-speed rail stations
Properties	Has-A, Binary
Reason for multitude	1:N
Participation	Partial Participation of High Speed Railway Station
	Partial Participation of the European Country
Attributes	-

Association name	"connects through line"
Description	It connects the high-speed railway stations of each European with other stations
Properties	Has-A, Retrospective
Reason for multitude	1:N
Participation	Full Participation of High Speed Railway Station
Attributes	Line name
	line length
	speed category

Association name	"Belong"
Description	It connects every European country with their cities with high traffic
Properties	Has-A, Binary
Reason for multitude	1:N
Participation	Full Participation of City with many visitors
	Partial Participation of the European Country
Attributes	-

Association name	"Has"
Description	It connects the cities with high traffic of each European country with the tourist attractions of each city
Properties	Has-A, Binary
Reason for multitude	1:N
Participation	Partial Participation of City with many visitors
	Partial Participation of Tourist Attraction
Attributes	-

Association name	"is a" (Subtypes)
Description	It links the tourist attractions of each city with high traffic with the Monuments subcategory
Properties	Is-A
Reason for multitude	1:1
Participation	Full Participation of Monument
	Full Participation of Tourist Attraction
Attributes	-

Association name	"is a" (Subtypes)
Description	It links the tourist attractions of each high-traffic city with the Museums subcategory
Properties	Is-A
Reason for multitude	1:1
Participation	Full Participation of the Museum
	Full Participation of Tourist Attraction
Attributes	-

Association name	"Has"
Description	It connects the most touristic cities with their ports
Properties	Has-A, Binary
Reason for multitude	1:1
Participation	Partial Participation of the Port
	Partial Participation of City with many visitors
Attributes	-

Association name	"Has"
Description	It connects the most touristic cities with their airports
Properties	Has-A, Binary
Reason for multitude	1:1
Participation	Partial Participation of the Airport
	Partial Participation of City with many visitors
Attributes	-

Association name	"Has"
Description	It connects the most touristic cities with their train stations
Properties	Has-A, Binary
Reason for multitude	1:1
Participation	Partial Participation of the Port
	Partial Participation of High Speed Railway Station
Attributes	-

3.4 Entity/Relationship Diagram

4 Relational Model

4.1 Definition Fields

Domain	Type
Integer	INT
Real	FLOAT
Airport_Code	CHAR(3)
Large Alphanumeric	VARCHAR(50)
Small Alphanumeric	VARCHAR(20)
Date	DATE
Year	YEAR
Speed Class	ENUM('less_200kmh', '200_230kmh', '240_260kmh', '270_300kmh', '310_320kmh')
Coordinates	POINT(lat, log)
Country_Code	VARCHAR(3)
Reasonable prices	TINYINT(1)
Museum type	ENUM('general', 'natural_history', 'natural_science', 'science_technology', 'history', 'art')

4.2 Relationships

Relationship Name	European_Country	
Attributes:		
Name	**Type**	
country_name	Large Alphanumeric	
currency	Large Alphanumeric	
area	Real	
language	Small Alphanumeric	
country_population	Integer	
country_code	Country_Code	
capital_city	Large Alphanumeric	
Integrity Constraints:		
Primary Key	country_code	
Foreign Keys	-	

Relationship Name	Covid19_Cases
Attributes:	
Name	**Type**
date	Date
num_daily_cases	Integer
num_total_cases	Integer
num_daily_deaths	Integer
country_code	Country_Code
Integrity Constraints:	
Primary Key	date - country_code
Foreign Keys	country_code ⮕ European_Country

Relationship Name	Covid19_Vaccinations
Attributes:	
Name	**Type**
num_vaccinations_per_week	Integer
vaccination_percentage	Real
vac_year	Year
vac_week	Integer
country_code	Country_Code
Integrity Constraints:	
Primary Key	vac_year - vac_week - country_code
Foreign Keys	country_code ⮕ European_country

Relationship Name	Airport
Attributes:	
Name	**Type**
airport_code	Airport_Code
airport_city	Large Alphanumeric
airport_name	Large Alphanumeric
num_airplanes_per_year_latest	Integer
num_passengers_per_year_latest	Integer
country_code	Country_Code
Integrity Constraints:	
Primary Key	airport_code
Foreign Keys	country_code ⮕ European_country

Relationship Name	Port	
Attributes:		
Name	**Type**	
port_name	Large Alphanumeric	
port_location	Large Alphanumeric	
country_code	Country_Code	
Integrity Constraints:		
Primary Key	port_name	
Foreign Keys	country_code ⍰ European_country	

Relationship Name	High_Speed_Railway_Station
Attributes:	
Name	**Type**
station_city	Large Alphanumeric
opening_year	Year
num_platforms	Integer
country_code	Country
Integrity Constraints:	
Primary Key	station_city
Foreign Keys	country_code ⍰ European_country

Relationship Name	Connects_Through_Line
Attributes:	
Name	**Type**
line_name	Large Alphanumeric
station_city	Large Alphanumeric
line_length	Real
speed_category	Speed Class
Integrity Constraints:	
Primary Key	line_name, station_city
Foreign Keys	station_city ⍰ High_Speed_Railway_Station

| Relationship Name	City_Many_Visitors
Attributes:	
Name	**Type**
city_name	Large Alphanumeric
city_population	Integer
num_arrivals_per_year_latest	Integer
country_code	Country_Code
station_city	Large Alphanumeric
port_name	Large Alphanumeric
airport_code	Airport_Code
Integrity Constraints:	
Primary Key	city_name
Foreign Keys	country_code ⮕ European_country station_city⮕High_Spedd_Railway_Station port_name⮕Port airport_code⮕Airport

Relationship Name	Tourist_Attraction
Attributes:	
Name	**Type**
attraction_name	Large Alphanumeric
location	Coordinates
ticket_price	Real
city_name	Large Alphanumeric
Integrity Constraints:	
Primary Key	attraction_name
Foreign Keys	city_name⮕ City_Many_Visitors

Relationship Name	Museum
Attributes:	
Name	**Type**
num_visitors_per_year_latest	Integer
num_exhibits	Integer
opening_year	Year
museum_type	Museum type
attraction_name	Large Alphanumeric
Integrity Constraints:	
Primary Key	attraction_name

Foreign Keys	attraction_name → Tourist_Attraction

Relationship Name	Monument	
Attributes:		
Name	**Type**	
is_UNESCO	Reasonable prices	
start_construction_year	Year	
end_construction_year	Year	
attraction_name	Large Alphanumeric	
Integrity Constraints:		
Primary Key	attraction_name	
Foreign Keys	attraction_name → Tourist_Attraction	

4.3 Relational Schema
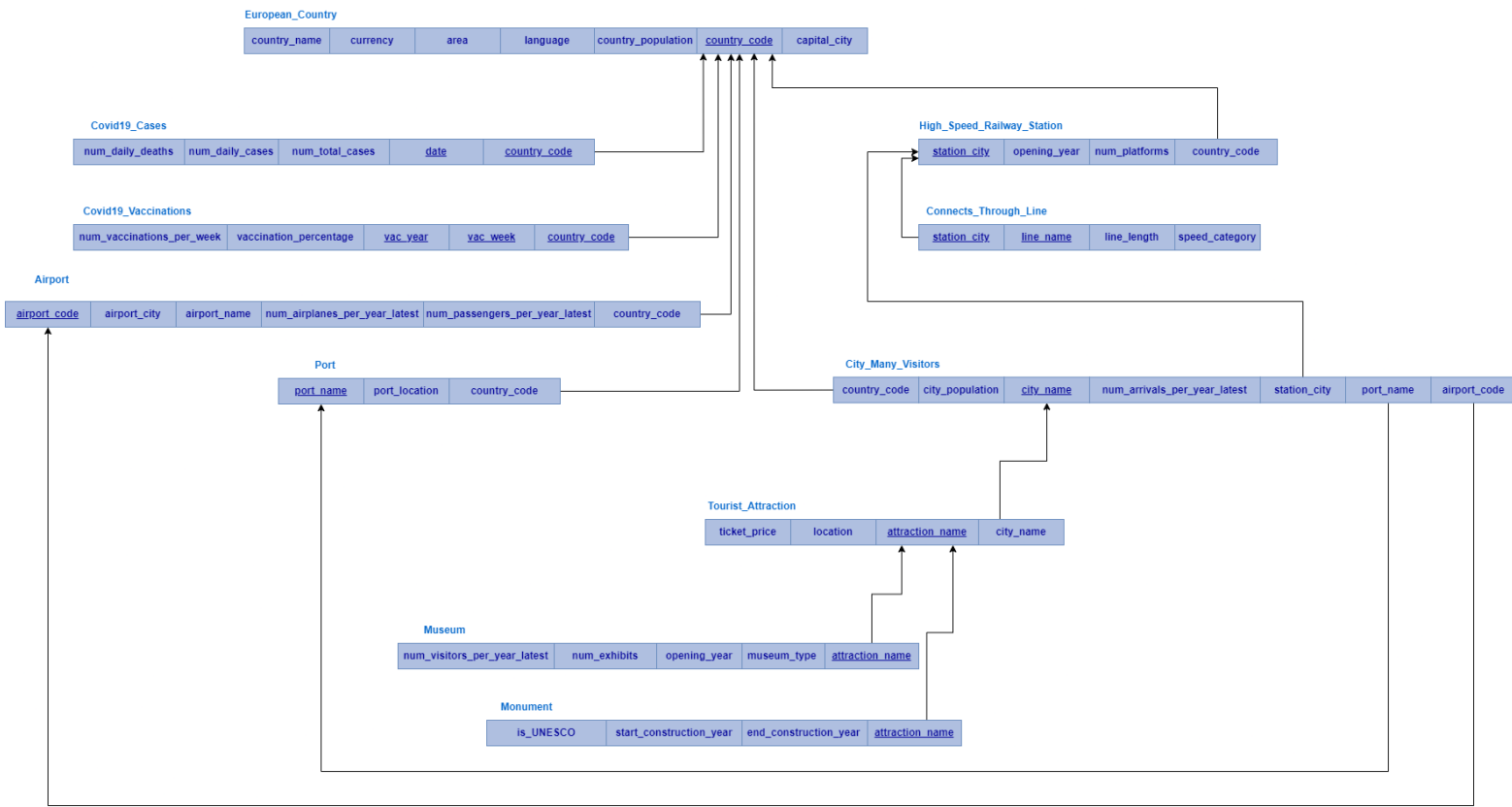
4.4 Views

A view that contains all the European countries together with their transportation information (airports, ports, railway stations).

$$\rho_{\text{TRANSPORTATION}} ((\text{Port}) \bowtie (\pi_{\text{station\_city,country\_code}} (\text{High\_Speed\_Railway\_Station}) \bowtie (\pi_{\text{airport\_city,airport\_name,country\_code}} (\text{Airport}) \bowtie \pi_{\text{country\_name,country\_code}} (\text{European\_Country}))))$$

A view containing all European countries along with their attractions and location.

$$\rho_{\text{ATTRACTION}} (\pi_{\text{country\_name,city\_name,attraction\_name,location}} (\pi_{\text{country\_name,country\_code}} (\text{European\_Country}) \bowtie (\pi_{\text{country\_code,city\_name}} (\text{City\_Many\_Visitors}) \bowtie \pi_{\text{city\_name,attraction\_name,location}} (\text{Tourist\_Attraction}))))$$

A view containing all European countries with Covid-19 data (vaccinations, vaccination rate, cases, deaths).

$$\rho_{\text{Covid19\_Information}} ($$
$$\pi_{\text{country\_name,country\_population,num\_daily\_deaths,num\_daily\_cases,num\_total\_cases,date,vaccination\_percentage}} (\pi$$
$$_{\text{country\_name ,country\_code,country\_population}} (\text{European\_Country}) \bowtie ((\text{Covid19\_Cases}) \bowtie \pi$$
$$_{\text{vaccination\_percentage,country\_code,vac\_year,vac\_week}} (\text{Covid19\_Vaccinations})))) $$

5   Examples

5.1   Examples of Tables

European_Country table :

country_name	currency	area	language	country_population	country_code	capital_city
Greece	Euro	131,940	Greek	10,760,136	GRC	Athens
France	Euro	547,030	French	63,248,000	FRA	Paris
Germany	Euro	357,021	German	81,440,000	DEU	Berlin
Italy	Euro	301,230	Italian	60,681,514	ITA	Rome
United Kingdom	British pound	244,820	English	62,300,000	GBR	London
Russia	Russian ruble	1,707,400	Russian	138,739,892	RUS	Moscow
Switzerland	Swiss franc	41,290	German	7,639,961	CHE	Bern
Monaco	Euro	1.95	French	30,539	MCO	Monaco
Serbia	Serbian dinar	77,474	Serbian	7,310,555	SRB	Belgrade
Cyprus	Euro	9,251	Greek	803,200	CYP	Nicosia

Estimated number of entries: ~50

Example for the **Covid19_Cases table:**

num_daily_deaths	num_daily_cases	num_total_cases	date	country_code
92	8,348	894,555	2021-11-24	GRC
98	30,454	7,450,691	2021-11-24	FRA
335	66,844	5,497,795	2021-11-24	DEU
83	10,044	4,942,135	2021-11-24	ITA
34	6,777	5,103,315	2021-11-24	ESP
0	437	131,028	2021-11-24	CYP

Estimated number of registrations: ~18000 (each year)

Example for the **Covid19_Vaccinations table:**

num_vaccinations_per_week	vaccination_percentage	vac_year	vac_week	country_code
52,820	61.5	2021	46	GRC
513,888	69.4	2021	46	FRA
319,039	68.1	2021	46	DEU
256,617	72.9	2021	46	ITA
48,754	74.2	2021	46	ESP
1,945	67.1	2021	46	CYP

Estimated number of entries: ~2600 (each year)

Example for Airport table :

airport_code	airport_city	airport_name	num_airplanes_per_year_latest	num_passengers_per_year_latest	country_code
ATH	Athens	Eleftherios Venizelos	10,022,240	131,803	GRC
ORY	Paris	Orly	10,797,105	86,424	FRA
BER	Berlin	Berlin Brandenburg	7,652,143	70,873	DEU
FCO	Rome	Leonardo Da Vinci-Fiumicino	9,830,957	103,496	ITA
BCN	Barcelona	Barcelona–El Prat	12,737,543	122,675	ESP
LCA	Larnaca	Larnaca International Airport – Glafcos Clerides	8,229,741	50,329	CYP

Estimated number of entries: ~3500

Example for the **Port table:**

port_name	port_location	country_code
Port of Rotterdam	Rotterdam	NLD
Port of Antwerp	Antwerp	BEL
Port of Hamburg	Hamburg	DEU
Port of Valencia	Valencia	ESP
Port of Genoa	Genoa	ITA
Port of Sines	Sines	PRT

Estimated number of entries: ~1500

Example for the **High_Speed_Railway_Station table:**

station_city	opening_year	num_platforms	country_code
Aigio	2020	3	GRC
Athens	2004	2	GRC
Thessaloniki	1969	6	GRC
Skopje	1940	2	MKD
Pristina	1936	2	UNK
Palermo	1886	10	ITA

Estimated number of entries: ~600

Example for the **Connects_Through_Line table:**

station_city	line_name	line_length	speed_category
Athens	Athens Airport-Patras railway	205.85 km	200_230kmh
Thessaloniki	Athens-Thessaloniki railway	304.23 km	200_230kmh
Skopje	Thessaloniki-Skopje railway	21.69 km	less_200kmh
Pristina	Skopje-Pristina railway	77,123 km	less_200kmh
Palermo	Palermo-Messina railway	194,326 km	less_200kmh
Paris	Paris-Est-Strasbourg-Ville railway	493 km	310_320kmh

Estimated number of entries: ~900

Example for the **City_Many_Visitors table :**

country_code	city_population	city_name	num_arrivals_per_year_latest	station_city	port_name	airport code
GRC	3,753,783	Athens	6,000,000	Athens	Port of Peraius	ATH
FRA	2,185,574	Paris	17,500,000	Paris	null	ORY
GBR	9,002,488	London	30,000,000	London	Port of London	LDN
ITA	2,873,104	Rome	8,500,000	Rome	null	FCO
ESP	3,266,126	Madrid	6,000,000	null	null	MAD
GRC	1,012,013	Thessaloniki	2,500,000	Thessaloniki	Port of Thessaloniki	SKG

Estimated number of entries: ~5000

Example for the **Tourist_Attraction table:**

ticket_price	location	attraction_name	city_name
€ 26.10	(48.85833, 2.294444)	Eiffel Tower	Paris
€ 16	(41.89028, 12.49222)	Colosseum	Rome
€ 20	(37.97194, 23.72667)	Acropolis of Athens	Athens
€ 0	(51.51944, 0.1269444)	British Museum	London
8.5 €	(48.8530, 2.3498)	Notre-Dame de Paris	Paris
€ 0	(41.00847, 28.98026)	Hagia Sophia	Istanbul

Estimated number of entries: ~50000

Example for the **Museum table:**

num_visitors_per_year_latest	num_exhibits	opening_year	museum_type	attraction_name
2,700,000	615,797	1793	history	Louvre Museum
1,275,400	8,000,000	1753	history	British Museum
1,666,286	4,250	2009	history	Acropolis Museum
500,000	50,000	1977	Art	Center Georges-Pompidou
2,680,000	8,000	1885	Art	Rijksmuseum
852,161	9,300	1819	Art	Prado Museum

Estimated number of entries: ~30000

Example for the **Monument table:**

is_Unesco	start_construction_year	end_contraction_year	attraction_name
1	532	537	Hagia Sophia
1	-447	-432	Acropolis of Athens
1	72	80	Colosseum
1	1887	1889	Eiffel Tower
1	1173	1372	Leaning Tower of Pisa
1	1163	1345	Notre Dame

Estimated number of entries: ~20000

5.2 Queries

For a traveler we assume that he wants to visit the oldest monument in Europe (the monument that finished its construction the earliest). We run the following query:

π Monument.attraction_name (Monument) - π Monument.attraction_name (σ Monument.end_construction_year >D.end_construction_year (Monument X ρ D (Monument)))

For a traveler we assume he wants to visit the most visited art museum in Europe. We run the following query:

π attraction_name (σ museum_type=art (museum_type **G** max(num_visitors_per_year_latest) as Highest visited art museum (Museum)))

Suppose a Greek epidemiologist wants to compare the epidemiological situation of Greece with countries with a similar population (± 10%) for today's date (26-11-2021). We run the following query:

A $\leftarrow$ π population (σ country_name=Greece (European_Country))

π country_name,population,num_daily_cases,date (σ population < 1.1 * A $\wedge$ population > 0.9 * A $\wedge$ date=2021-11-26 ((π country_code,country_name,population (European_Country)) $\bowtie$ (π country_code,num_daily_cases,date (Covid-19_cases)))

For a traveler we assume that he has a phobia of airplanes and wants to travel to some European country that has at least one port or train station. We run the following query:

A $\leftarrow$ country_code **G** count(*) as Ports (Port)

B $\leftarrow$ country_code **G** count(*) as Stations (High_Speed_Railway_Station)

C $\leftarrow$ (π country_code (σ Ports ≥ 1 (A)))U(π country_code (σ Stations ≥ 1 (B)))

π country_name ((European_Country) $\bowtie$ (C))