COVID-19 Data Visualization WEB project

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Part 1. Overview

Data visualization is the art of providing insights with the aid of some type of visual representation, such as charts, graphs, or more complex forms of visualizations like dashboards.

This project aims to visualize COVID-19 data, with `Spring Boot` as the back-end development framework and `Vue`, `jQuery`, `Bootstrap`, `eCharts` and other libraries as the front-end.

This project supports the following:

- Tracking the latest COVID-19 data automatically. By setting the **scheduled task**, the crawler is automatically performed every 5 minutes.
- Two data modes: **Local File Data** and **Online Data**.
- Data multi-access: **WHO Data Souce** and **OWID Data Souce**.
- Search function: Search the specific countries (**fuzzy matching**) in table-view, display the results and roll back the unsearched state.
- Sort function: Each field of data can be sorted in table-view, in ascending or descending order.
- Map visualization: An **interactive world map** is used to present data.
- A variety of visual data statistics: There are **twelve different charts**, including three bar charts, three line charts and three pie charts. Moreover, each each is **interactive**, **animated**, and can be set with **flexible parameters** to adjust the data to be displayed. There are charts that show **trends** in time series data, which can be **fast-forward**, **paused** or **rewind** using the timeline bar.
- Data save: Table data can be saved in **CSV**, **SQL**, **TXT**, **JSON**, and **XLS** formats. All graphs saving is also supported for all charts.

Part 2. Quick Start

1. Requirements

   Install some software to start the Front-end, such as `Webstorm`, `python -m http.server`, etc.

   Install `Java` to start the Back-end.

2. Run the Back-end

   ```
   cd Back-End
   java -jar COVID-19-0.0.1-SNAPSHOT.jar
   ```

   When you see info like below means it starts successfully:

   ```
     .   ____          _            __ _ _
    /\\ / ___'_ __ _ _(_)_ __  __ _ \ \ \ \
   ( ( )\___ | '_ | '_| | '_ \/ _` | \ \ \ \
    \\/  ___)| |_)| | | | | || (_| |  ) ) ) )
     '  |____| .__|_| |_|_| |_\__, | / / / /
    =========|_|==============|___/=/_/_/_/
   ```

```
 :: Spring Boot ::                (v2.6.1)

2021-12-21 13:54:33.188  INFO 17728 --- [           main]
cs209.covid19.Covid19Application         : Starting Covid19Application
v0.0.1-SNAPSHOT using Java 1.8.0_312 on DESKTOP-I76CLVT with PID 17728
(C:\Users\Bugmaker\Desktop\COVID19-数据可视化\Back-End\COVID-19-0.0.1-
SNAPSHOT.jar started by Bugmaker in C:\Users\Bugmaker\Desktop\COVID19-数据可视
化\Back-End)
2021-12-21 13:54:33.188  INFO 17728 --- [           main]
cs209.covid19.Covid19Application         : No active profile set, falling
back to default profiles: default
2021-12-21 13:54:33.726  INFO 17728 --- [           main]
o.s.b.w.embedded.tomcat.TomcatWebServer  : Tomcat initialized with port(s):
8080 (http)
2021-12-21 13:54:33.734  INFO 17728 --- [           main]
o.apache.catalina.core.StandardService   : Starting service [Tomcat]
2021-12-21 13:54:33.734  INFO 17728 --- [           main]
org.apache.catalina.core.StandardEngine  : Starting Servlet engine: [Apache
Tomcat/9.0.55]
2021-12-21 13:54:33.770  INFO 17728 --- [           main] o.a.c.c.C.
[Tomcat].[localhost].[/]       : Initializing Spring embedded
WebApplicationContext
2021-12-21 13:54:33.771  INFO 17728 --- [           main]
w.s.c.ServletWebServerApplicationContext : Root WebApplicationContext:
initialization completed in 551 ms
2021-12-21 13:54:34.335  INFO 17728 --- [           main]
o.s.b.w.embedded.tomcat.TomcatWebServer  : Tomcat started on port(s): 8080
(http) with context path ''
2021-12-21 13:54:34.344  INFO 17728 --- [           main]
cs209.covid19.Covid19Application         : Started Covid19Application in
1.442 seconds (JVM running for 50.321)
```

3. Run the Front-end

```
python -m http.server
```

When you see info like below means it starts successfully:

```
Serving HTTP on :: port 8000 (http://[::]:8000/) ...
```

4. Open the browser

```
http://localhost:8000/
```

Part 3. The structure

Part 3.1 Back-end structure

```
└─src
    ├─main
    |  ├─java
    |  |  └─cs209
    |  |      └─covid19
    |  |          |  Covid19Application.java
    |  |          |
```

```
|   |           ├─controller
|   |           |      OWIDDataController.java
|   |           |      WHODataController.java
|   |           |
|   |           ├─pojo
|   |           |      OWIDData.java
|   |           |      WHOData.java
|   |           |
|   |           └─utils
|   |                   LocalDataUtil.java
|   |                   OnlineDataUtil.java
|   |
|   └─resources
|       |  application.properties
|       |
|       ├─static
|       |      owid-covid-data.csv
|       |      WHO-COVID-19-global-data.csv
|       |
|       └─templates
└─test
    └─java
        └─cs209
            └─covid19
                    Covid19ApplicationTests.java
```

1. **Covid19Application.java**

   The startup of Spring boot framework.

2. **OWIDData.java**

```
    private String isoCode;

    private String continent;

    private String location;

    private int totalCases;

    private int newCases;

    private int totalDeaths;

    private int newDeaths;
```

3. **WHOData.java**

```
    private String countryCode;

    private String country;

    private String WHORegion;

    private int newCases;

    private int cumulativeCases;

    private int newDeaths;

    private int cumulativeDeaths;
```

4. **OWIDDataController.java**

   The OWID data controller in MVC framework, contains interfaces to get different OWID data (JSON).

```
    // get the latest local Data from source <Our World In Data>.
    @CrossOrigin
    @RequestMapping("latestLocalData")
    public ArrayList<OWIDData> getLatestLocalData();
```

```
    // get the latest update date of local data from source <Our World In
Data>.
    @CrossOrigin
    @RequestMapping("latestLocalDate")
    public LocalDate getLatestLocalDate();
```

```
    // get the latest local OWID data by specific location.
    @CrossOrigin
    @RequestMapping("latestLocalDataByLocation/{searchCountryName}")
    public ArrayList<OWIDData>
getLatestLocalDataByLocation(@PathVariable("searchCountryName") String
location);
```

```
    // get the ordered <dataArrayList> data.
    @CrossOrigin
    @RequestMapping("getOrderedLocalDataList/{attr}/{reverseOrder}")
    public ArrayList<OWIDData> getOrderedLocalDataList(@RequestBody
ArrayList<OWIDData> dataArrayList, @PathVariable String attr, @PathVariable
int reverseOrder);
```

```
    // get the map data from local OWID.
    @CrossOrigin
    @RequestMapping("getMapLocalData")
    public ArrayList<Object> getMapLocalData();
```

```
    // get the local OWID data for specific month.
    @CrossOrigin
    @RequestMapping("getLocalDataForOneMonth/{date}")
    public ArrayList<ArrayList<Object>>
getLocalDataForOneMonth(@PathVariable String date);
```

```
    // get the total deaths for specific month and locations.
    @CrossOrigin
    @RequestMapping("getLocalDataTotalDeathsForOneMonthByLocations/{date}")
    public ArrayList<ArrayList<Object>>
getLocalDataTotalDeathsForOneMonthByLocations(@PathVariable String date,
@RequestBody ArrayList<String> locations);
```

```
    // get the latest new cases and new deaths from local OWID data for
specific locations.
    @CrossOrigin
    @RequestMapping("getLatestNewCasesNewDeathsLocalDataForLocations")
    public ArrayList<ArrayList<Object>>
getLatestNewCasesNewDeathsLocalDataForLocations(@RequestBody
ArrayList<String> locations);
```

```
    // get the latest total cases data (in Pie chart needed format) in local
OWID.
    @CrossOrigin
    @RequestMapping("getLocalDataPieTotalCasesData")
    public HashMap<String, Object>
getLocalDataPieTotalCasesData(@RequestBody ArrayList<String> locations);
```

```
    // get the latest total deaths data (in Pie chart needed format) in
local OWID.
    @CrossOrigin
    @RequestMapping("getLocalDataPieTotalDeathsData")
    public HashMap<String, Object>
getLocalDataPieTotalDeathsData(@RequestBody ArrayList<String> locations);
```

The remaining methods are similar to above, replacing **local OWID data** with **online OWIDdata**.

5. **WHODataController.java**

   The methods are similar to **OWIDDataController.java**, replacing **OWID Data** with **WHO data**.

6. **LocalDataUtil.java**

   The data util class to get and process data from **local data file**.

```
// the resouce of local OWID data file.
private static final ClassPathResource OWIDDataFileResource = new
ClassPathResource("static/owid-covid-data.csv");
```

```
// the resouce of local WHO data file.
private static final ClassPathResource WHODataFileResource = new
ClassPathResource("static/WHO-COVID-19-global-data.csv");
```

```
// the stored OWID data using HashMap structure.
private static final HashMap<LocalDate, ArrayList<OWIDData>> localOWIDData =
new HashMap<>();
```

```
// the stored WHO data using HashMap structure.
private static final HashMap<LocalDate, ArrayList<WHOData>> localWHOData =
new HashMap<>();
```

```
// load the OWID data from local data file.
public static void loadOWIDData();
```

```
// get the latest updated date of local OWID data.
public static LocalDate getOWIDDataLatestDate();
```

```
// get the latest updated data of local OWID data.
public static ArrayList<OWIDData> getLatestOWIDData();
```

```
// get the latest OWID data for specific location.
public static ArrayList<OWIDData> getLatestOWIDDataByLocation(String
location);
```

```
// get the ordered <arrayList> data.
public static ArrayList<OWIDData> getOrderedOWIDDataList(ArrayList<OWIDData>
arrayList, String orderAttr, int reverseOrder);
```

```
// get the OWID data in world map needed format.
public static ArrayList<Object> getMapOWIDData();
```

```
// get the total deaths OWID data for specific locations and month.
public static ArrayList<ArrayList<Object>>
getOWIDDataTotalDeathsForOneMonthByLocations(LocalDate localDate,
ArrayList<String> locations);
```

```
// get the OWID data for specific month.
public static ArrayList<ArrayList<Object>> getOWIDDataForOneMonth(LocalDate
localDate);
```

```
// get the total cases data in pie chart needed format for specific
locations.
public static HashMap<String, Object>
getOWIDDataPieTotalCasesData(ArrayList<String> locations);
```

```
// get the total deaths data in pie chart needed format for specific
locations.
public static HashMap<String, Object>
getOWIDDataPieTotalDeathsData(ArrayList<String> locations);
```

```
// get the new cases and new deaths data in pie chart needed format for
specific locations.
public static ArrayList<ArrayList<Object>>
getLatestNewCasesNewDeathsOWIDDataForLocations(ArrayList<String> locations);
```

The remaining methods are similar to above, replacing **local OWID data souce** with **Local WHO data souce**.

7. **OnlineDataUtil.java**

   The data util class to get and process data from **realtime online data**. The methods are similar to **LocalDataUtil.java**, replacing the **local data souce** with **online data souce**.

Part 3.2 Front-end structure

```
|  index.html
|  world.json
|
├─bootstrap
|  ├─css
|  |      bootstrap-theme.css
|  |      bootstrap-theme.css.map
|  |      bootstrap-theme.min.css
|  |      bootstrap-theme.min.css.map
|  |      bootstrap.css
|  |      bootstrap.css.map
|  |      bootstrap.min.css
|  |      bootstrap.min.css.map
|  |
|  ├─fonts
|  |      glyphicons-halflings-regular.eot
|  |      glyphicons-halflings-regular.svg
|  |      glyphicons-halflings-regular.ttf
|  |      glyphicons-halflings-regular.woff
|  |      glyphicons-halflings-regular.woff2
|  |
|  └─js
|          bootstrap.js
|          bootstrap.min.js
|          npm.js
|
└─js
        axios.min.js
        echarts.min.js
        jquery-3.6.0.min.js
        jquery.base64.js
        lodash.min.js
        tableExport.min.js
        vue.min.js
        world.js
```

Javascript method:

```
// update the covid data in vue.
updateCOVIDData: function ();

// search the country and update the table data.
```

```
searchCountry: function ();

// change the data source.
changeDataSource: function (source);

// sort the table data based on attr.
sortTable: function (attr);

// change the page to show different content.
changePage: function (index);

// different page render function.
page1Render: function ();
page2Render: function ();
page3Render: function ();
page4Render: function ();

// diffrent graph in pages render function.
page2Graph1Render: function ();
page2Graph2Render: function ();
page2Graph3Render: function ();
page3Graph1Render: function ();
page3Graph2Render: function ();
page3Graph3Render: function ();
page4Graph1Render: function ();
page4Graph2Render: function ();
page4Graph3Render: function ();

// update the data in graph to show.
page2Graph2ModifyCountryList: function (flag);
page2Graph3ModifyCountryList: function (flag);
page3Graph1ModifyCountryList: function (flag);
page3Graph2ModifyCountryList: function (flag);
page4Graph1ModifyCountryList: function (flag);
page4Graph2ModifyCountryList: function (flag);

// export the table data in different type format.
exportTable: function (type);
```

Part 4. The demonstartion

Part 4.1 The table-view page:

COVID-19 疫情数据可视化

当前数据源：本地-OWID　数据源

表格数据　地图可视化　柱状图　折线图　饼图

国家：请输入国家名称(英文)　数据更新时间：2021-12-14　Export to

ISO代码	所属大陆	国家	总确诊	新增确诊	总死亡	新增死亡
AFG	Asia	Afghanistan	157660	12	7329	1
ALB	Europe	Albania	204301	376	3144	4
DZA	Africa	Algeria	213288	230	6155	4
AND	Europe	Andorra	20136	696	134	1
AGO	Africa	Angola	65431	27	1737	0
ATG	North America	Antigua and Barbuda	4177	15	117	0
ARG	South America	Argentina	5366522	8067	116826	55
ARM	Asia	Armenia	342765	161	7845	26
ABW	North America	Aruba	0	0	0	0
AUS	Oceania	Australia	235547	2809	2117	4
AUT	Europe	Austria	1235063	2859	13282	64
AZE	Asia	Azerbaijan	605920	922	8123	19
BHS	North America	Bahamas	22907	0	708	0
BHR	Asia	Bahrain	278149	84	1394	0
BGD	Asia	Bangladesh	1580005	295	28034	3
BRB	North America	Barbados	26949	135	253	0
BLR	Europe	Belarus	676512	778	5305	19
BEL	Europe	Belgium	1968269	9076	27685	54
BLZ	North America	Belize	31152	119	586	0
BEN	Africa	Benin	24897	0	161	0
BTN	Asia	Bhutan	2649	0	3	0
BOL	South America	Bolivia	554999	1891	19330	13
BIH	Europe	Bosnia and Herzegovina	282587	684	13028	29
BWA	Africa	Botswana	197644	1554	2424	3
BRA	South America	Brazil	22195775	18716	616970	513
BRN	Asia	Brunei	15363	1	98	0

Part 4.2 Seach function:

国家：ch　数据更新时间：2021-12-14　Export to

ISO代码	所属大陆	国家	总确诊	新增确诊	总死亡	新增死亡
TCD	Africa	Chad	5703	0	181	0
CHL	South America	Chile	1785124	959	38723	7
CHN	Asia	China	100002	69	4636	0
CZE	Europe	Czechia	2350338	11936	34697	146
LIE	Europe	Liechtenstein	5512	111	68	1
SYC	Africa	Seychelles	23920	19	129	0

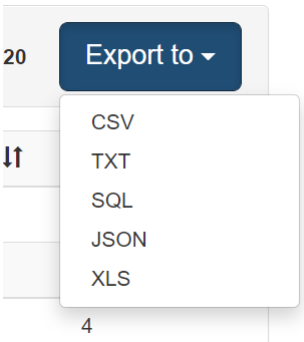
Part 4.3 Sort by total cases:

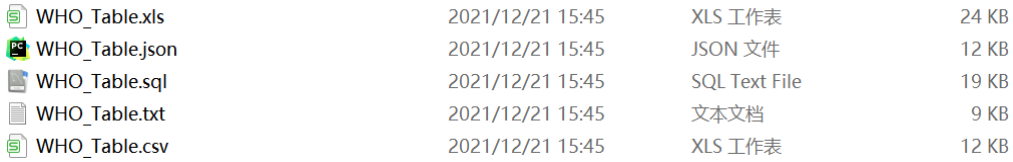
国家: 请输入国家名称(英文)　　数据更新时间：2021-12-14　　Export to

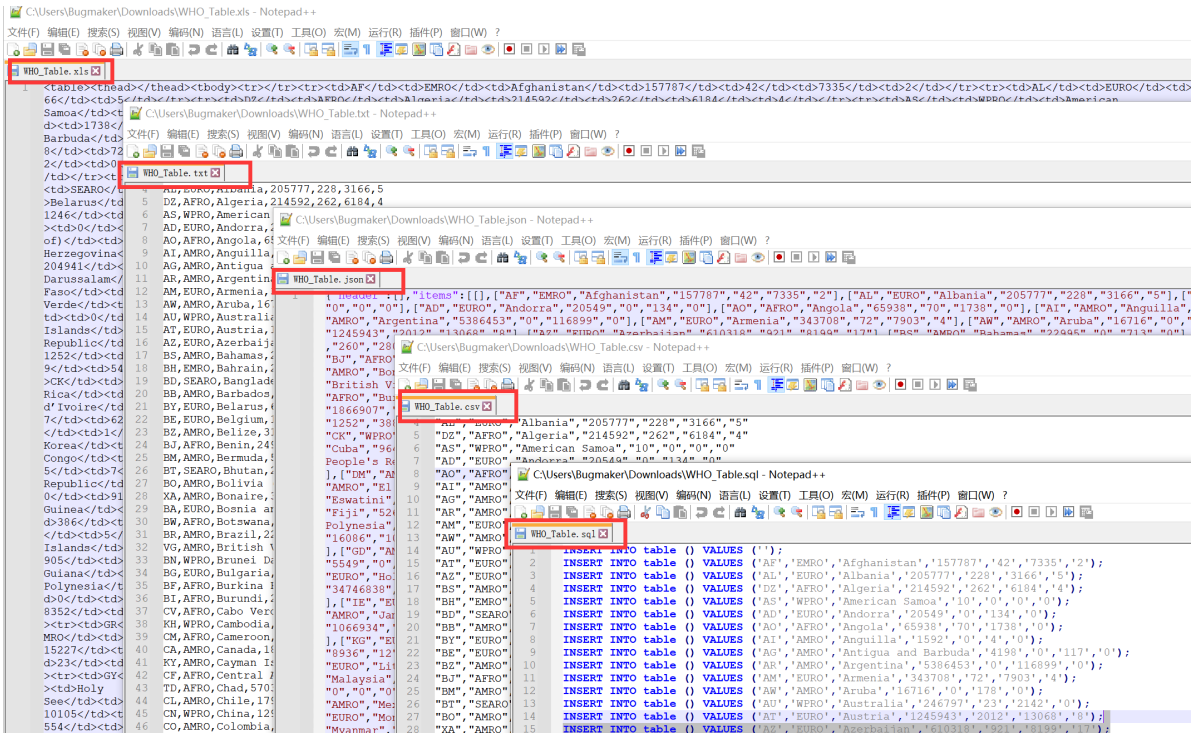
ISO代码	所属大陆	国家	总确诊	新增确诊	总死亡	新增死亡
USA	North America	United States	50233338	113749	800343	1629
IND	Asia	India	34710628	6984	476135	247
BRA	South America	Brazil	22195775	18716	616970	513
GBR	Europe	United Kingdom	10995311	60067	147085	150
RUS	Europe	Russia	9899139	27910	286023	1114
TUR	Asia	Turkey	9082422	21477	79503	181
FRA	Europe	France	8438360	63416	121817	158
DEU	Europe	Germany	6633666	52233	106685	454
IRN	Asia	Iran	6160303	2784	130831	67
ARG	South America	Argentina	5366522	8067	116826	55
ESP	Europe	Spain	5366128	26136	88542	58
ITA	Europe	Italy	5258886	20665	135049	120
COL	South America	Colombia	5097680	1859	129205	42
IDN	Asia	Indonesia	4259439	190	143960	12
MEX	North America	Mexico	3918987	771	296721	49
POL	Europe	Poland	3857085	17460	89045	537
UKR	Europe	Ukraine	3746106	7716	97328	418
ZAF	Africa	South Africa	3204642	23857	90172	24
NLD	Europe	Netherlands	2949045	12875	20671	75
PHL	Asia	Philippines	2836868	65	50351	10

Part 4.4 Change to online WHO data souce:

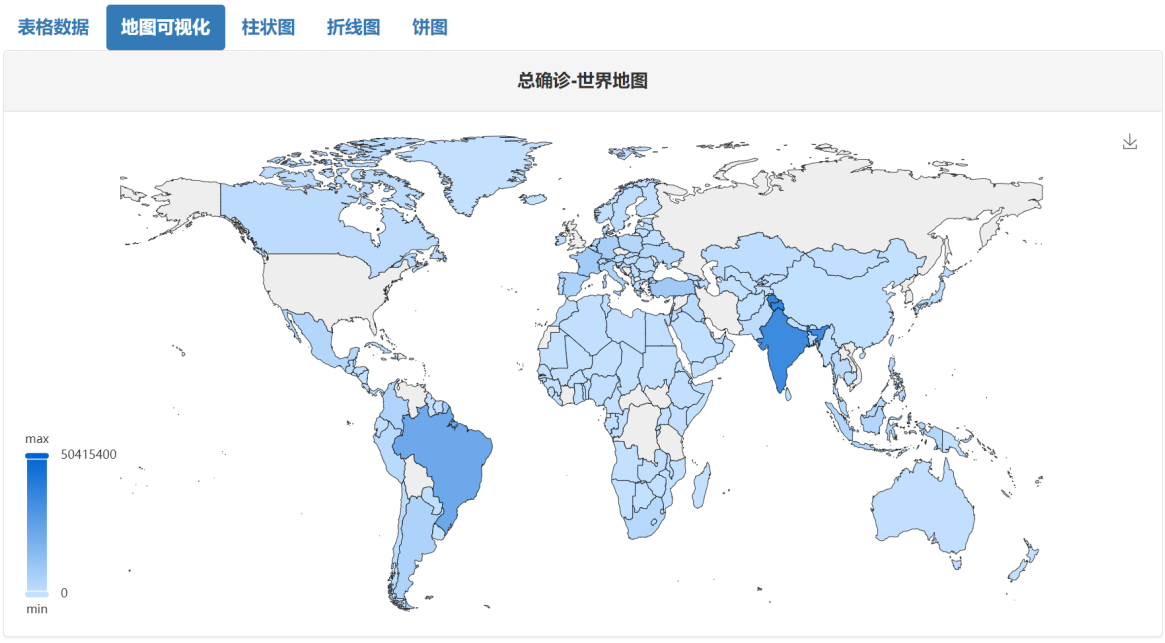
Part 4.5 Save the table data in different format:







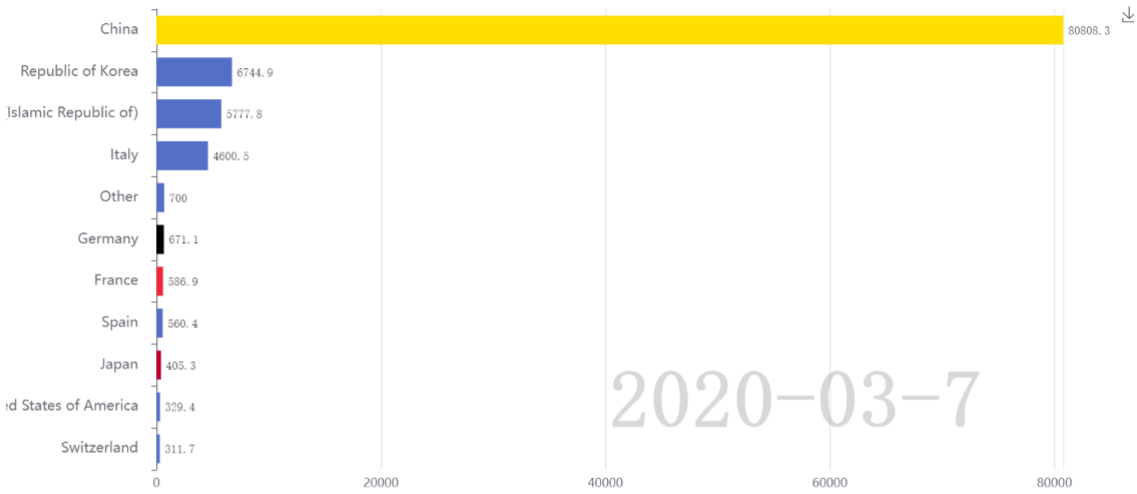
Part 4.6 Fancy graphs:



表格数据 地图可视化 柱状图 折线图 饼图

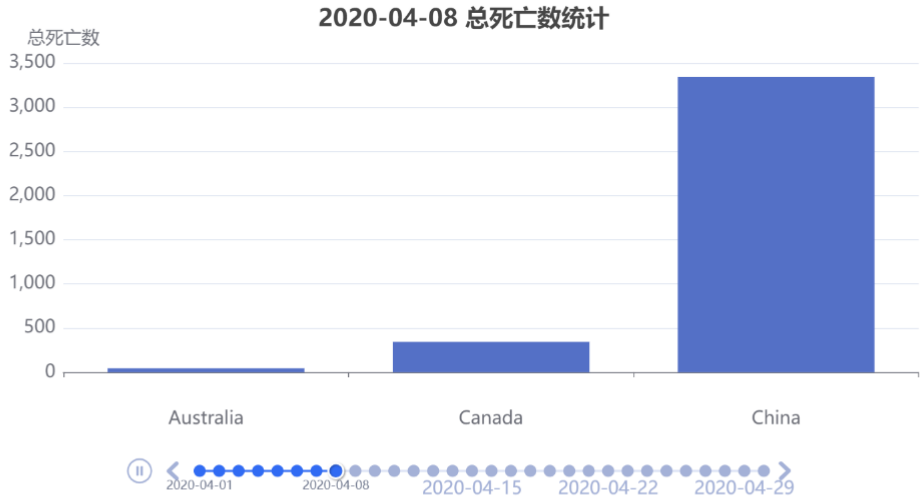
总确诊-动态排序柱状图

日期: 2020年03月 确定



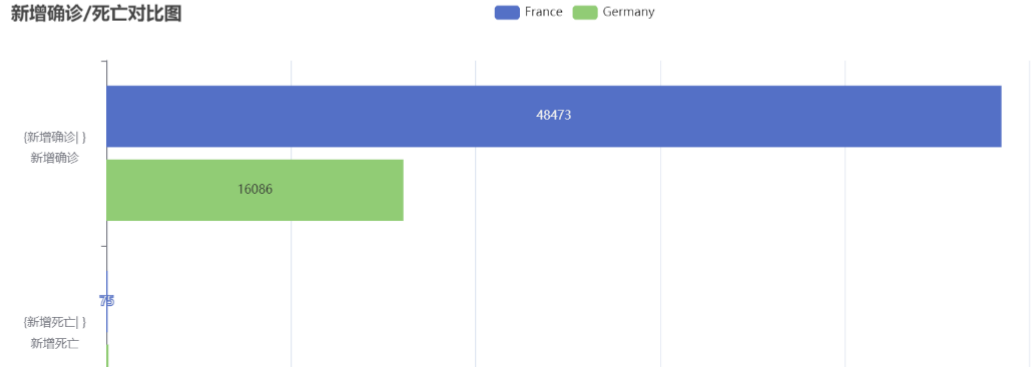
总死亡-时序柱状图

国家列表: Australia,Canada,China 更改国家: 请输入国家名称(英文) 添加 删除 日期: 2020年04月 确定



新增确诊/死亡-水平对比柱状图

国家列表: France,Germany,Russia 更改国家: 请输入国家名称(英文) 添加 删除 确定



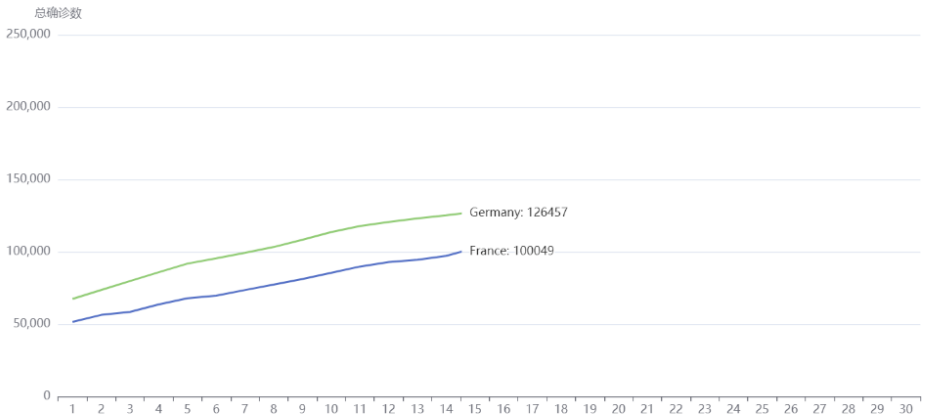
当前数据源：在线-WHO 数据源

表格数据 地图可视化 柱状图 **折线图** 饼图

总确诊-动态排序折线图

国家列表： France,Germany,Iran,Arger 更改国家： 请输入国家名称(英文) 添加 删除 日期： 2020年04月 确定

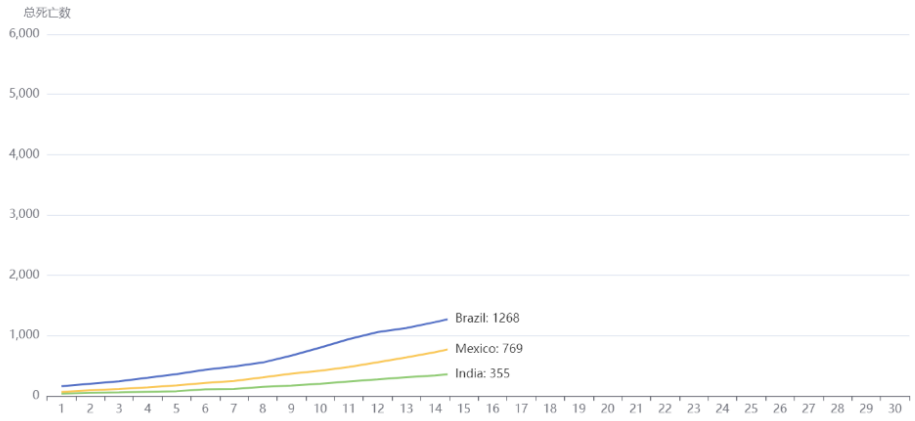
2020-04总确诊数



总死亡-动态排序折线图

国家列表： Brazil,India,Mexico,Russia, 更改国家： 请输入国家名称(英文) 添加 删除 日期： 2020年04月 确定

2020-04总死亡数

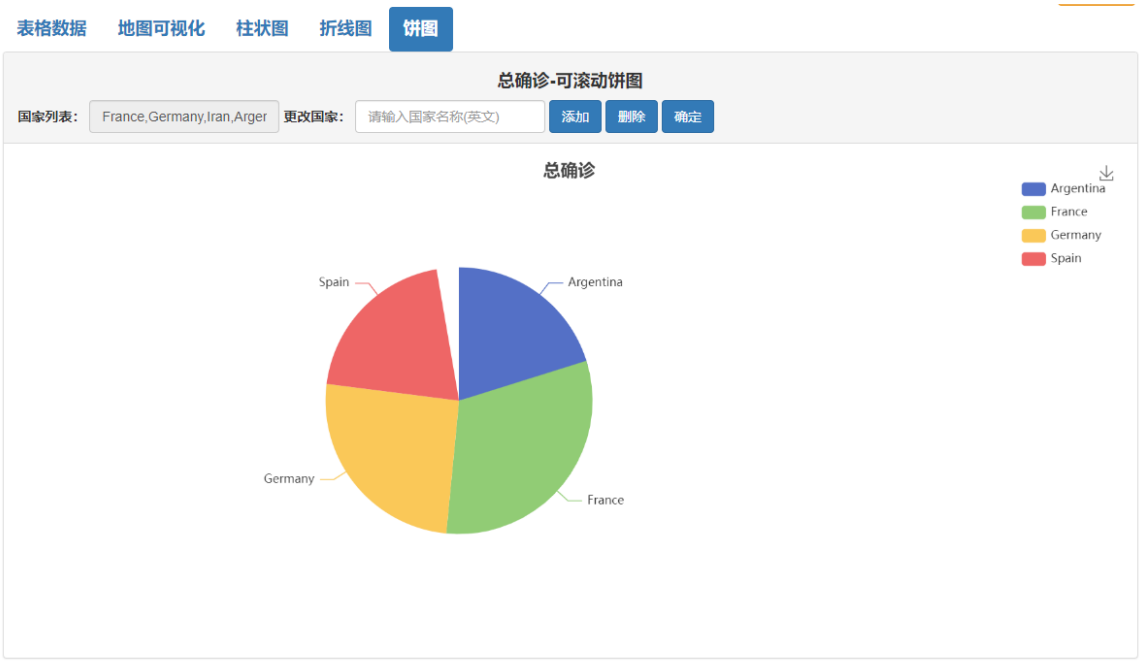


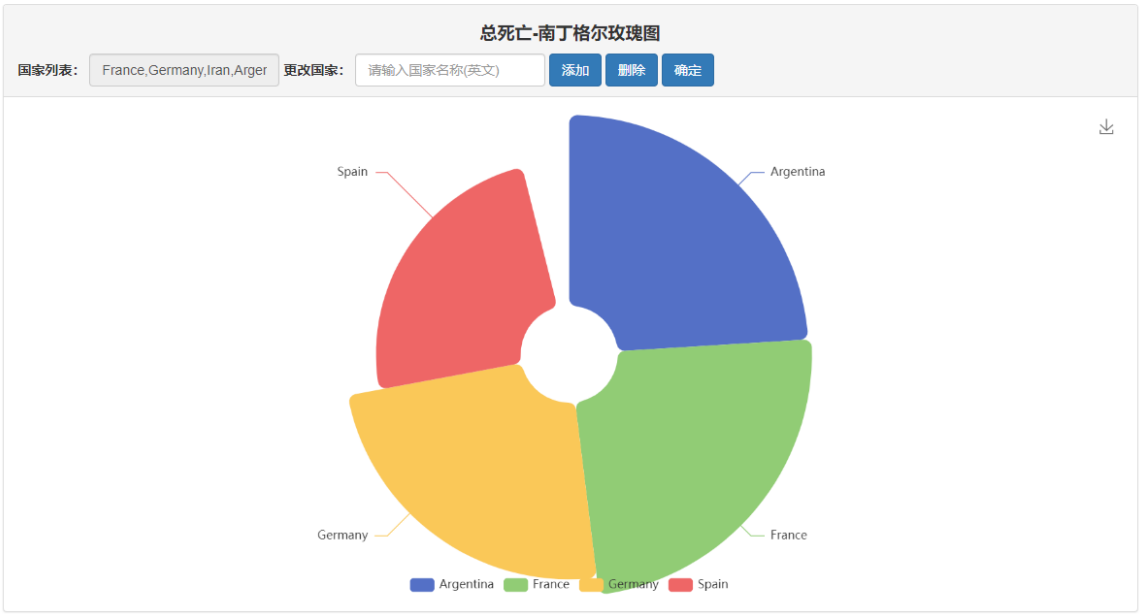
新增确诊/死亡-渐变折线图

国家： China 确定

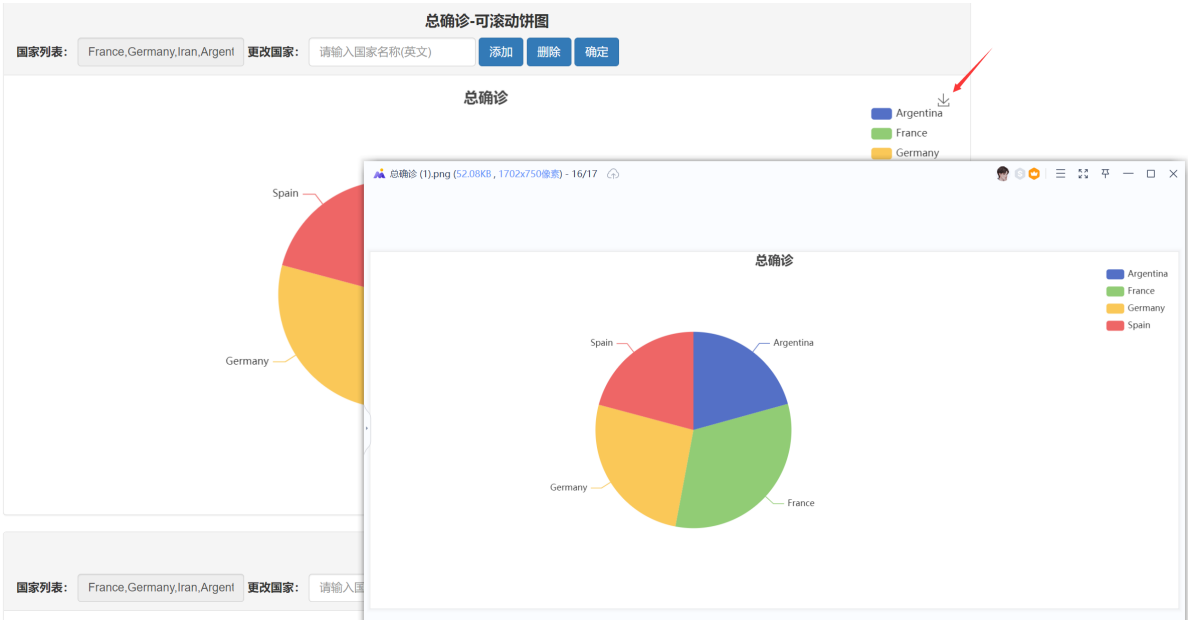
新增确诊

新增死亡





Part 4.7 Save the graph:


总确诊-可滚动饼图
国家列表：
France,Germany,Iran,Argent
更改国家：
请输入国家名称(英文)
添加
删除
确定
总确诊
Argentina
France
Germany
Spain
Spain
Germany

总确诊 (1).png (52.08KB , 1702x750像素) - 16/17
总确诊
Argentina
France
Germany
Spain
Spain
Argentina
Germany
France

国家列表：
France,Germany,Iran,Argent
更改国家：