ELEN 6889 Large-scale Stream Processing

Real-Time Weather Condition Analysis

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I. Problem Definition
II. Data Processing
III. Visualization
IV. Results Demo
V. Future Work

I. **Problem Definition**
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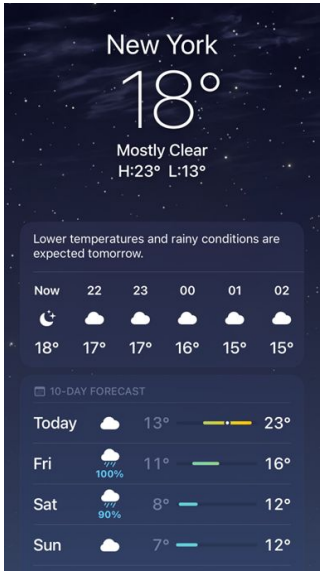
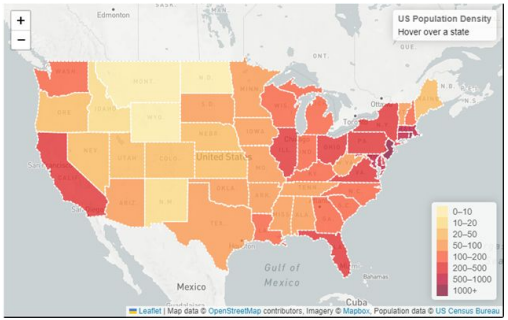
Problem

- Idea:
  - Obtain local weather information via devices
  - Cannot search easily from different places
- What we want:
  - A heat map showing weather condition nationally
  - Updating frequently & simple to use





Problem

- How we implement:
  - Access weather data via NOAA
  - Process Data
  - Apply Django to visualize
- The outcomes:
  - A heat map with all the states in America
  - Weather condition displayed on the map

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Data Processing

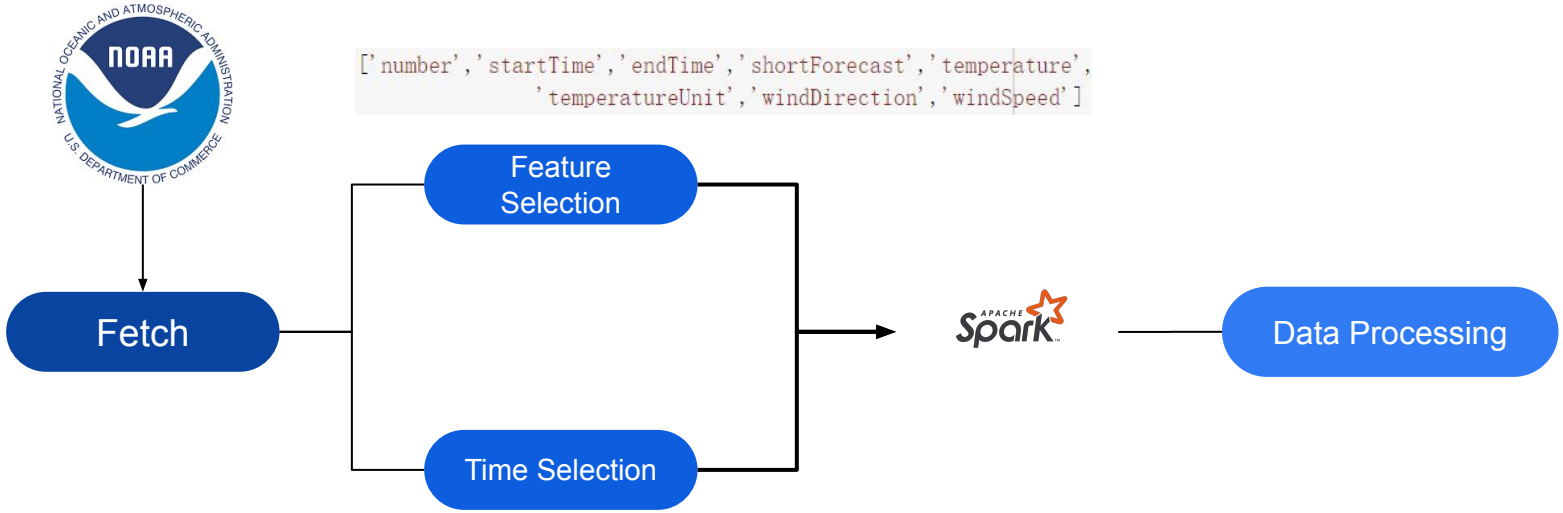
Raw Data:

1. 13 rows containing various weather information;
2. Forecast for the next seven days, one hour apart;
3. Confused data types and data structures not suitable for streaming


```
[{'detailedForecast': '',
  'endTime': '2022-05-06T00:00:00-04:00',
  'icon': 'https://api.weather.gov/icons/land/night/bkn?size=small',
  'isDaytime': False,
  'name': '',
  'number': 1,
  'shortForecast': 'Mostly Cloudy',
  'startTime': '2022-05-05T23:00:00-04:00',
  'temperature': 62,
  'temperatureTrend': None,
  'temperatureUnit': 'F',
  'windDirection': 'S',
  'windSpeed': '6 mph'},
 {'detailedForecast': '',
  'endTime': '2022-05-06T01:00:00-04:00',
  'icon': 'https://api.weather.gov/icons/land/night/bkn?size=small',
  'isDaytime': False,
  'name': '',
  'number': 2,
  'shortForecast': 'Mostly Cloudy',
  'startTime': '2022-05-06T00:00:00-04:00',
  'temperature': 59,
  'temperatureTrend': None,
```

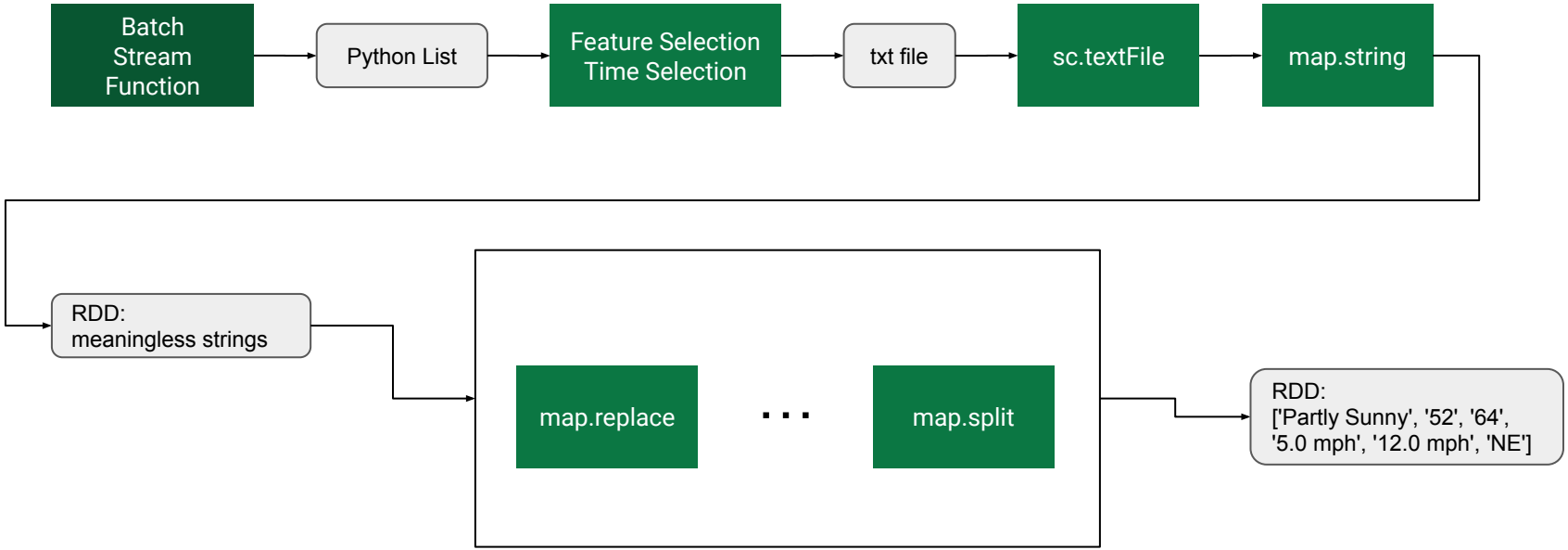
Data Processing

Data Preprocessing Procedure:



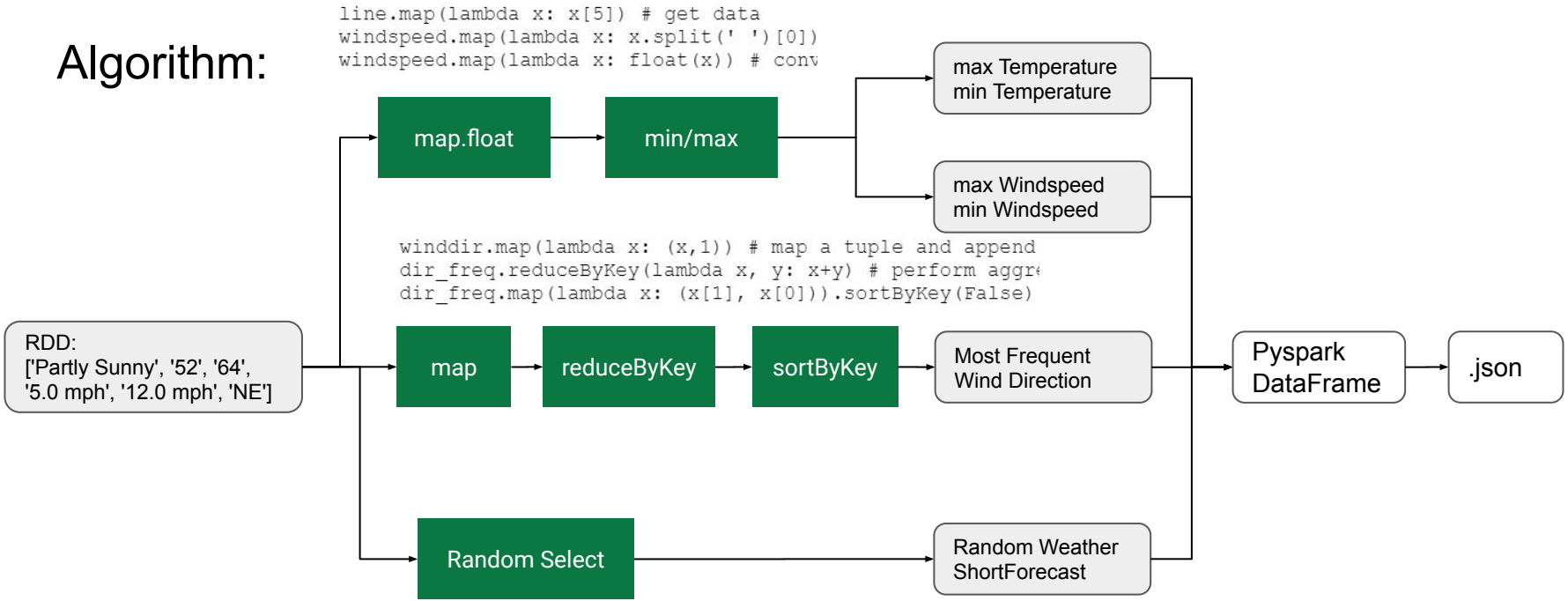
Data Processing

Data Processing:



Data Processing

Algorithm:



Data Processing

‘.json’ file modification:

We have extracted the ‘us-state.js’ and transform it to ‘.json’ format like this:


```
[{"type":"Feature","id":"01","properties":{"name":"Alabama","density":94.65},"geometry":{"type":"Polygon"
{"type":"Feature","id":"04","properties":{"name":"Arizona","density":57.05},"geometry":{"type":"Polygon",
{"type":"Feature","id":"05","properties":{"name":"Arkansas","density":56.43},"geometry":{"type":"Polygon"
{"type":"Feature","id":"06","properties":{"name":"California","density":241.7},"geometry":{"type":"Polygo
{"type":"Feature","id":"08","properties":{"name":"Colorado","density":49.33},"geometry":{"type":"Polygon"
{"type":"Feature","id":"09","properties":{"name":"Connecticut","density":739.1},"geometry":{"type":"Polyg
{"type":"Feature","id":"10","properties":{"name":"Delaware","density":464.3},"geometry":{"type":"Polygon"
{"type":"Feature","id":"11","properties":{"name":"District of Columbia","density":10065},"geometry":{"typ
{"type":"Feature","id":"12","properties":{"name":"Florida","density":353.4},"geometry":{"type":"Polygon",
{"type":"Feature","id":"13","properties":{"name":"Georgia","density":169.5},"geometry":{"type":"Polygon",
{"type":"Feature","id":"15","properties":{"name":"Hawaii","density":214.1},"geometry":{"type":"MultiPolyg
{"type":"Feature","id":"16","properties":{"name":"Idaho","density":19.15},"geometry":{"type":"Polygon","c
```

Data Processing

‘.json’ file modification:

Add the weather condition in a {key:value} format:


```
[{"Weather":"Mostly Clear","MinTemperature":67.0,"MaxTemperature":89.0,"MinWindSpeed":0.0
{"Weather":"Sunny","MinTemperature":66.0,"MaxTemperature":92.0,"MinWindSpeed":0.0,"MaxWin
{"Weather":"Partly Sunny","MinTemperature":64.0,"MaxTemperature":73.0,"MinWindSpeed":5.0,
{"Weather":"Sunny","MinTemperature":52.0,"MaxTemperature":88.0,"MinWindSpeed":3.0,"MaxWin
{"Weather":"Partly Sunny","MinTemperature":39.0,"MaxTemperature":48.0,"MinWindSpeed":5.0,
{"Weather":"Chance Rain Showers","MinTemperature":49.0,"MaxTemperature":63.0,"MinWindSpee
{"Weather":"Slight Chance Rain Showers","MinTemperature":55.0,"MaxTemperature":71.0,"MinW
{"Weather":"Scattered Showers And Thunderstorms","MinTemperature":56.0,"MaxTemperature":7
{"Weather":"Areas Of Fog","MinTemperature":67.0,"MaxTemperature":89.0,"MinWindSpeed":0.0,
{"Weather":"Mostly Sunny","MinTemperature":64.0,"MaxTemperature":84.0,"MinWindSpeed":0.0,
```

Data Processing

‘.json’ file modification:

Update json function:

```
# -- coding: utf-8 -#
import json
import re

with open("weather_condition.json", "r", encoding="utf-8") as f:
    load_dict_wea = json.load(f)


states_list = ['Alabama','Arizona','Arkansas','California','Colorado','Co
weather_list = load_dict_wea
#weather_list.append(load_dict_wea)
print(weather_list)

with open("us-states.json", "r", encoding="utf-8") as f:
    load_dict = json.load(f)
    print(load_dict)

n = len(load_dict)
print(range(0,n))

for i in range(0,n):
    if states_list[i]==load_dict[i]['properties']['name']:
        load_dict[i]['properties'].update(weather_list[i])

with open("updated_weather.json", "w", encoding="utf-8") as f:
    json.dump(load_dict, f)
```

Transform ‘.json’ to ‘.js’:

```
with open('updated_weather.json', 'r') as file:
    res = []
    res = file.readlines()
with open('updated_weather.js', "w") as resfile:
    resfile.write('var testData2 = {"type":"FeatureCollection","features":')
    for r in res:
        resfile.write('\n' + r + ','+'\n')
        resfile.write('\n};')
```

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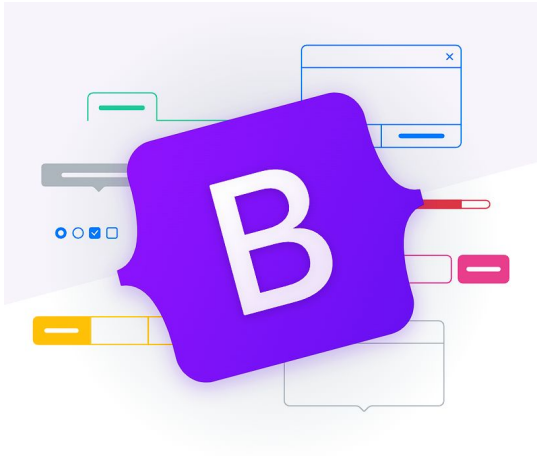
Frontend Part



We use Django to build our web server and use Bootstrap&CSS to decorate our web

Frontend Part - django

urls.py

```
urlpatterns = [
    path('', views.results),
    path('<str:state_name>weather', views.state_weather)
]
```

views.py

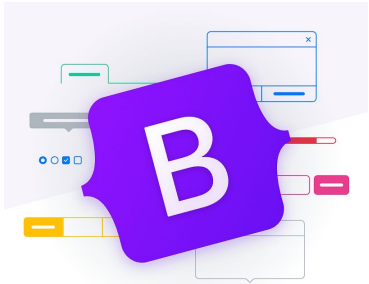
```
def state_weather(request, state_name):
    context = {}
    context['state_weather'] = {
        "name": str(state_name)
    }

    return render(request,"weather.html", context)
```

./templates/index.html

```
location.href = `${t_s_name}weather`;
```

Frontend Part - Bootstrap



Headings

Example heading New

Example heading New

Example heading New

Example heading New

Example heading New

Example heading New

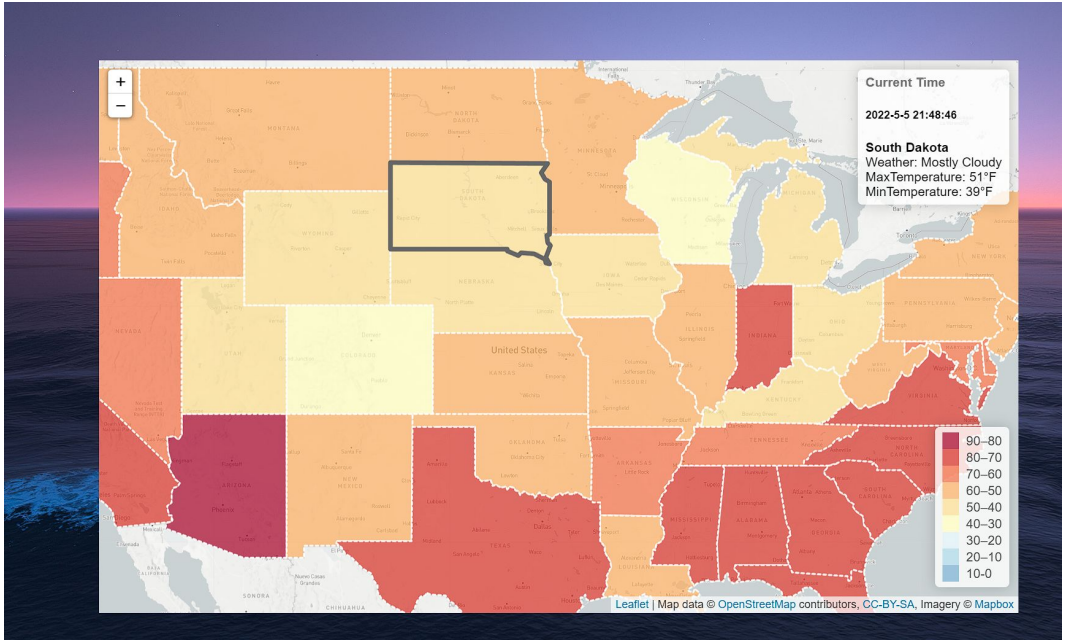
Copy

```
<h1>Example heading <span class="badge bg-secondary">New</span></h1>
<h2>Example heading <span class="badge bg-secondary">New</span></h2>
<h3>Example heading <span class="badge bg-secondary">New</span></h3>
<h4>Example heading <span class="badge bg-secondary">New</span></h4>
<h5>Example heading <span class="badge bg-secondary">New</span></h5>
<h6>Example heading <span class="badge bg-secondary">New</span></h6>
```

Frontend Part

Leaflet is the leading open-source JavaScript library for mobile-friendly interactive maps. Weighing just about 39 KB of JS, it has all the mapping features most developers ever need. Using mapbox’s api.

Frontend Part



GeoJSON data

```
{
    "type": "Feature",
    "properties": {
        "name": "Alabama",
        "density": 94.65
    },
    "geometry": ...
    ...
}
```

Frontend Part

Detail information will be showed if user click on the map.
These information include max&min temperature, max&min windspeed and wind direction.

Frontend Part

auto refresh data

```
auto_refresh = function() {
    initialization();
    layer_flag = 1;
    setTimeout(auto_refresh, refresh_seconds * 200);
    reload_js("{% static "updated_weather.js" %}");
}
```

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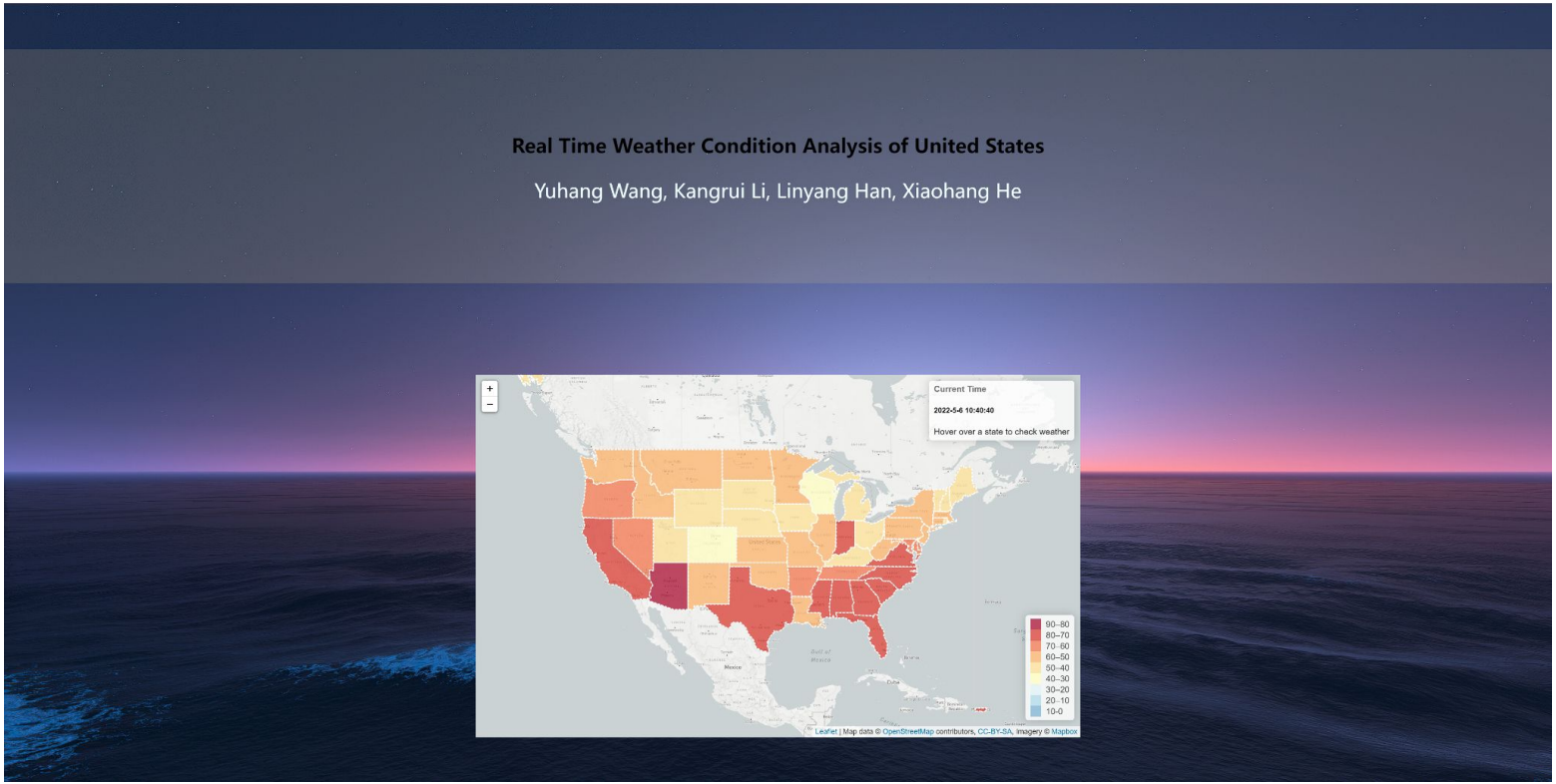
demo


Real Time Weather Condition Analysis of United States
Yuhang Wang, Kangrui Li, Linyang Han, Xiaohang He
Current Time
2022-5-6 10:40:40
Hover over a state to check weather
90–80
80–70
70–60
60–50
50–40
40–30
30–20
20–10
10-0
Leaflet | Map data © OpenStreetMap contributors, CC-BY-SA, Imagery © Mapbox

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Future Work

- Expand the dataset to cover weather data in every city
- Apply streaming optimization to improve the streaming process and process data more efficiently
- Try to find a better weather data source to implement this system

Reference

https://pypi.org/project/noaa-sdk/

https://leafletjs.com/examples/choropleth/

https://spark.apache.org/docs/latest/rdd-programming-guide.html#rdd-operations

Thank you for your listening!