GIS Visualization Homework 1

Homework1(1). Line segment length algorithm

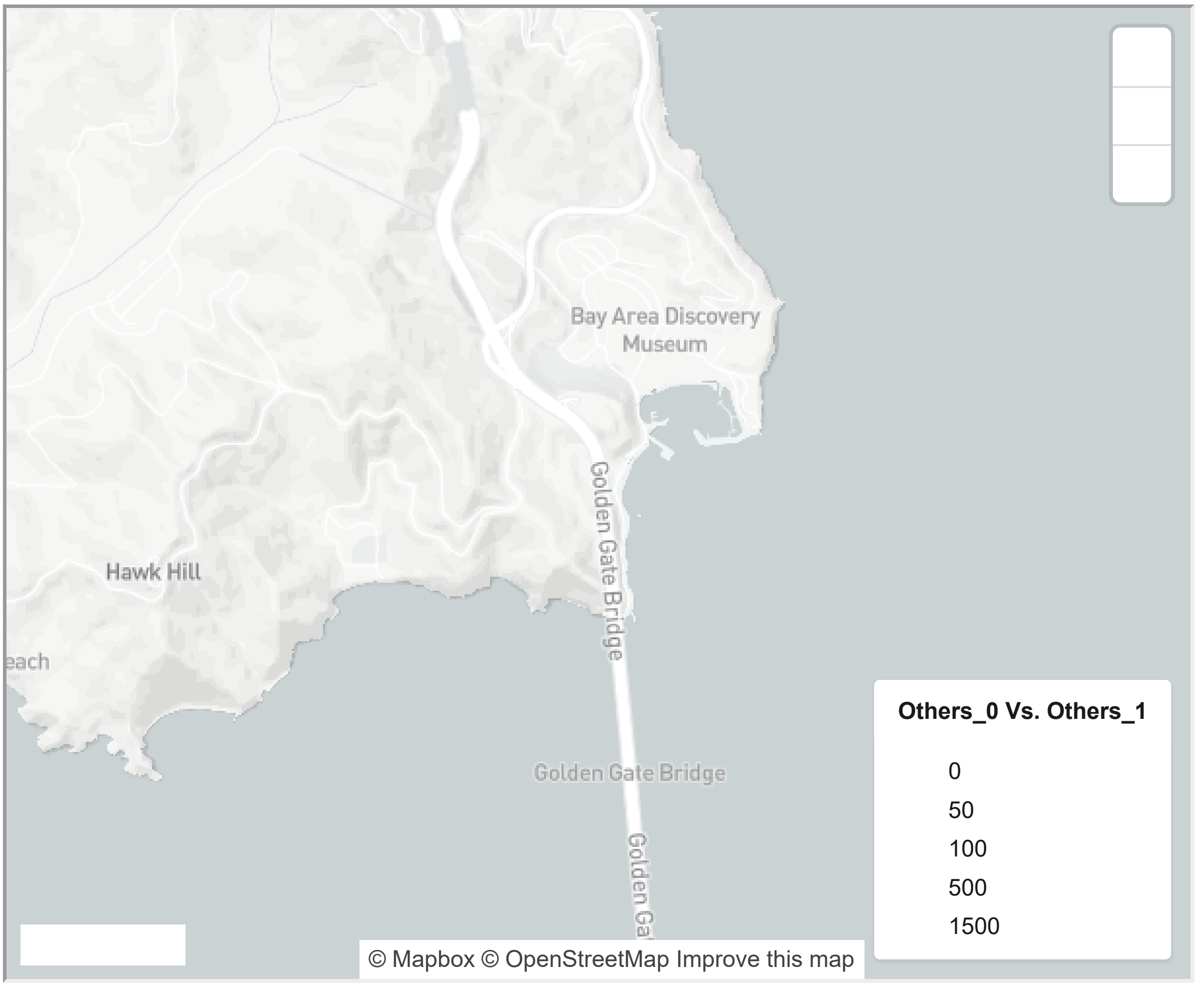
In [19]:

```
# My access token for Mapbox
token ='pk.eyJ1IjoiMzA1NzU4MDI2OCIsImEiOiJja3R3dTU4Ym8ybmoyMnhwbWZ1ZnZ5c3BwIn0.n0dPOKbtOp

import os
import pandas as pd
import json
from typing import Union
from mapboxgl.viz import *
from mapboxgl.utils import *
# python geoprocessing package
from shapely.geometry import LineString
# My function package
from Function import *
# For mathematical calculation
import math
import geopandas
```

In [20]:

```
# Line=[[80, 50], [150, 30]]
# list2geojson("Data/MapLine.geojson",[LineString(Line)], [500],[5])
'''
list2geojson(write_geojson_path,lst,*others)
:param write_geojson_path: geojson file path to write
:param lst:List to be converted
:param others:Additional information. 'sample' and 'weight' for particular.
'''
def CalculateLength(Polyline):
    '''
    Calculate the length of the line segment
    :param Polyline: List type, [[x1,y1],[x2,y2],...]
    :return: Returns the length of a numeric line segment
    '''
    dis=0
    for i in range(len(Polyline)-1):
        dis+=math.sqrt((Polyline[i+1][0]-Polyline[i][0])*(Polyline[i+1][0]-Polyline[i][0
    return dis

# Test the function
# print('Calculated length of the line segment: ',CalculateLength(Line))

# Call the function package to execute
data=geopandas.read_file('Data/MapLine.geojson')
print('Length of the line segment:',data.geometry[0].length)

# If the range of the line segment is within geographic coordinates, display it on the ma
OnMap=False
Line=data.geometry[0].coords
for i in range (len(Line)):
    if (Line[i][0]<180 or Line[i][0]>-180) and (Line[i][1]<90 or Line[i][1]>-90):
        OnMap=True

# Draw on the map to present the line
if OnMap:
    print('\nBecause the range of the line segment is within geographic coordinates, pres
    # make viz with GeoJSON source. others_0 stands for 'sample', others_1 stands for 'we
    viz = LinestringViz('/files/Data/MapLine.geojson',
                        access_token=token,
                        color_property='others_0',
                        color_stops=create_color_stops([0, 50, 100, 500, 1500], colors='E
                        line_width_property='others_1',
                        line_width_stops=create_numeric_stops([0, 1, 2, 3, 4, 5], 0, 10),
                        #
                        width='610px',
                        opacity=0.8,
                        center=(-122.48, 37.83),
                        zoom=13,
                        below_layer='waterway-label')
    viz.show()
```

```
Length of the line segment: 0.018435172501924724

Because the range of the line segment is within geographic coordinates, present it on the
map:
```



Homework1(2). Statistical Charts

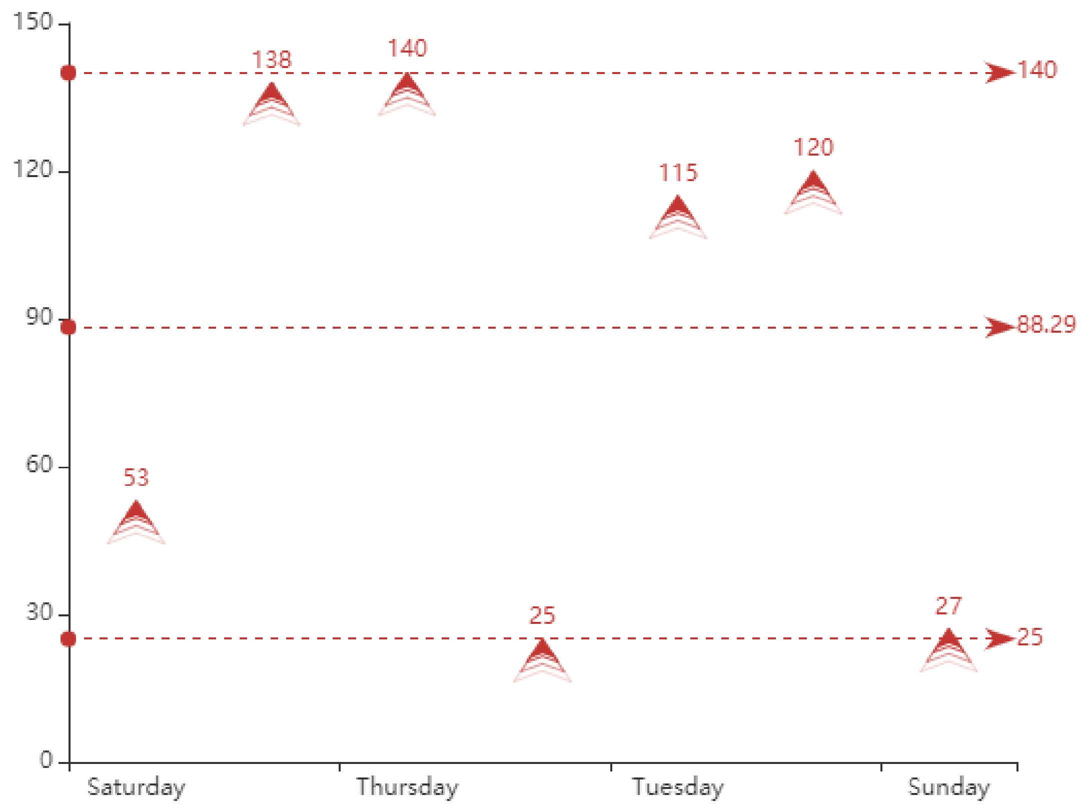
1) Scatter Chart

In [21]:

```
from pyecharts import options as opts
from pyecharts.charts import *
from pyecharts.globals import ThemeType,SymbolType
from pyecharts.commons.utils import JsCode
from pyecharts.faker import Faker
import random
'''
Raw Data: [x,y] for every point. Using Faker to generate.
Statistics: Maximum, Minimum and Average.
'''
# Since statistical calculations are very basic, I think there should be no need to use r
(
    # Set width for convenience of printing.
    EffectScatter(init_opts=opts.InitOpts(width="610px"))
    # Generate random points.
    .add_xaxis(Faker.week_en)
    .add_yaxis("", Faker.values(), symbol=SymbolType.ARROW)
    # Setting title.
    .set_global_opts(title_opts=opts.TitleOpts(title="EffectScatter-Symbol"))
    # Setting markline for statistics.
    .set_series_opts(
         markline_opts=opts.MarkLineOpts(
            data=[
                opts.MarkLineItem(type_="min", name="Minimum"),
                opts.MarkLineItem(type_="max", name="Maximum"),
                opts.MarkLineItem(type_="average", name="Average"),
            ]
        ))
    .render_notebook()
)
```

Out[21]:

EffectScatter-Symbol

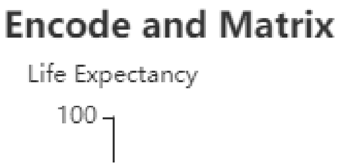


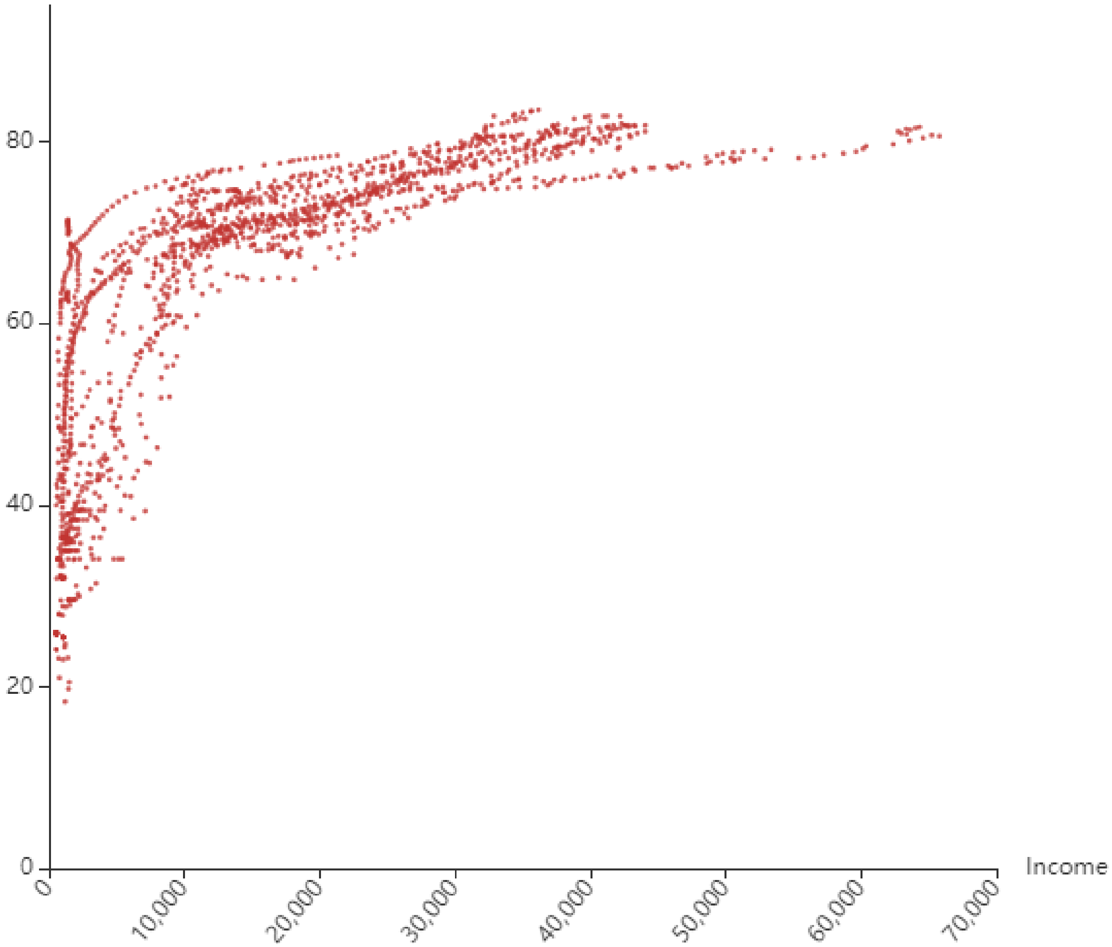
2) Professional Scatter

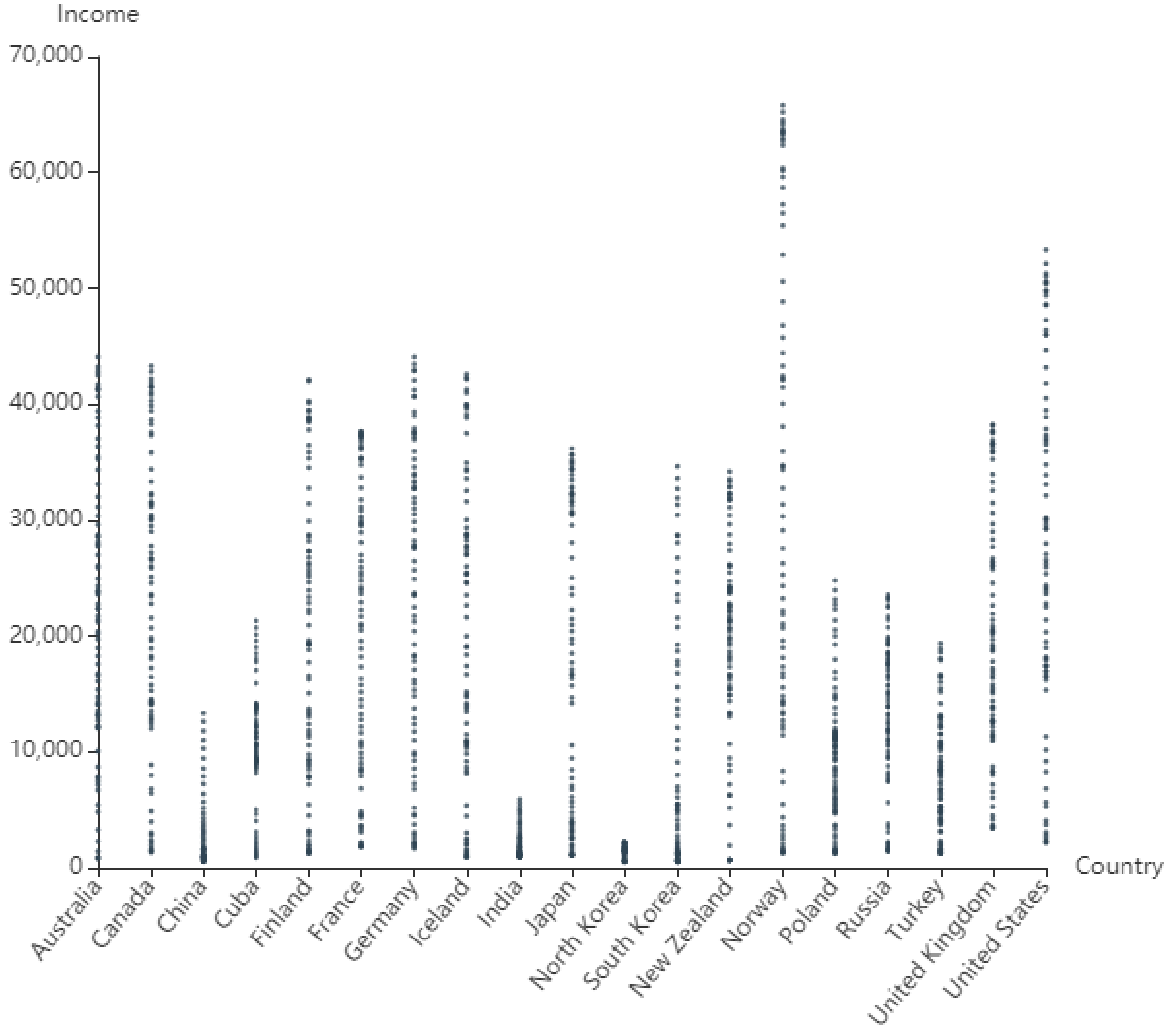
In [22]:

```
'''
Raw Data: ["Income","Life Expectancy","Population","Country","Year"]
'''
# Loading data from json file.
with open("Data/life-expectancy-table.json", "r", encoding="utf-8") as f:
    j = json.load(f)

# The first segment, represents the relationship between income and life expectancy
l1_1 = (
    Scatter()
    .add_dataset(
        dimensions=[
            "Income",
            "Life Expectancy",
            "Population",
            "Country",
            # Using ordinal type instead of numerical to represent year.
            {"name": "Year", "type": "ordinal"},
        ],
        source=j,
    )
    .add_yaxis(
        series_name="",
        y_axis=[],
        symbol_size=2.5,
        # For grid index.
        xaxis_index=0,
        yaxis_index=0,
        # Tooltip means to display when the mouse is hovering.
        encode={"x": "Income", "y": "Life Expectancy", "tooltip": [0, 1, 2, 3, 4]},
        label_opts=opts.LabelOpts(is_show=False),
    )
    .set_global_opts(
        xaxis_opts=opts.AxisOpts(
            type_="value",
            # Grid index.
            grid_index=0,
            name="Income",
            # Rotate xaxis label.
            axislabel_opts=opts.LabelOpts(rotate=50, interval=0),
        ),
        yaxis_opts=opts.AxisOpts(type_="value", grid_index=0, name="Life Expectancy"),
        title_opts=opts.TitleOpts(title="Encode and Matrix"),
    )
)

# The second segment, represents the relationship between Country and Income
l1_2 = (
    Scatter()
    .add_dataset()
    .add_yaxis(
        series_name="",
        y_axis=[],
        symbol_size=2.5,
        xaxis_index=1,
        yaxis_index=1,
        encode={"x": "Country", "y": "Income", "tooltip": [0, 1, 2, 3, 4]},
        label_opts=opts.LabelOpts(is_show=False),
    )
    .set_global_opts(
        xaxis_opts=opts.AxisOpts(
            type_="category",
            grid_index=1,
            name="Country",
            boundary_gap=False,
            axislabel_opts=opts.LabelOpts(rotate=50, interval=0),
        ),
        yaxis_opts=opts.AxisOpts(type_="value", grid_index=1, name="Income"),
    )
)

# The third segment, represents the relationship between Income and Population
l2_1 = (
    Scatter()
    .add_dataset()
    .add_yaxis(
        series_name="",
        y_axis=[],
        symbol_size=2.5,
        xaxis_index=2,
        yaxis_index=2,
        encode={"x": "Income", "y": "Population", "tooltip": [0, 1, 2, 3, 4]},
        label_opts=opts.LabelOpts(is_show=False),
    )
    .set_global_opts(
        xaxis_opts=opts.AxisOpts(
            type_="value",
            grid_index=2,
            name="Income",
            axislabel_opts=opts.LabelOpts(rotate=50, interval=0),
        ),
        yaxis_opts=opts.AxisOpts(type_="value", grid_index=2, name="Population"),
    )
)

# The fourth segment, represents the relationship between Life Expectancy and Population
l2_2 = (
    Scatter()
    .add_dataset()
    .add_yaxis(
        series_name="",
        y_axis=[],
        symbol_size=2.5,
        xaxis_index=3,
        yaxis_index=3,
        encode={"x": "Life Expectancy", "y": "Population", "tooltip": [0, 1, 2, 3, 4]},
        label_opts=opts.LabelOpts(is_show=False),
    )
    .set_global_opts(
        xaxis_opts=opts.AxisOpts(
            type_="value",
            grid_index=3,
            name="Life Expectancy",
            axislabel_opts=opts.LabelOpts(rotate=50, interval=0),
        ),
        yaxis_opts=opts.AxisOpts(type_="value", grid_index=3, name="Population"),
    )
)
# Use the grid component to render four scatter plots at the same time
(
    Grid(init_opts=opts.InitOpts(width="610px", height="2200px"))
    .add(
        chart=l1_1,
        # Percentage distance from the four sides
        grid_opts=opts.GridOpts(pos_right="10%", pos_bottom="76%"),
        grid_index=0,
    )
    .add(
        chart=l1_2,
        grid_opts=opts.GridOpts(pos_right="10%", pos_bottom="53%", pos_top="28%"),
        grid_index=1,
    )
    .add(
        chart=l2_1,
        grid_opts=opts.GridOpts(pos_right="10%", pos_bottom="27%", pos_top="53%"),
        grid_index=2,
    )
    .add(
        chart=l2_2, grid_opts=opts.GridOpts(pos_right="10%", pos_bottom="3%", pos_top="7
    )
    .render_notebook()
)
```

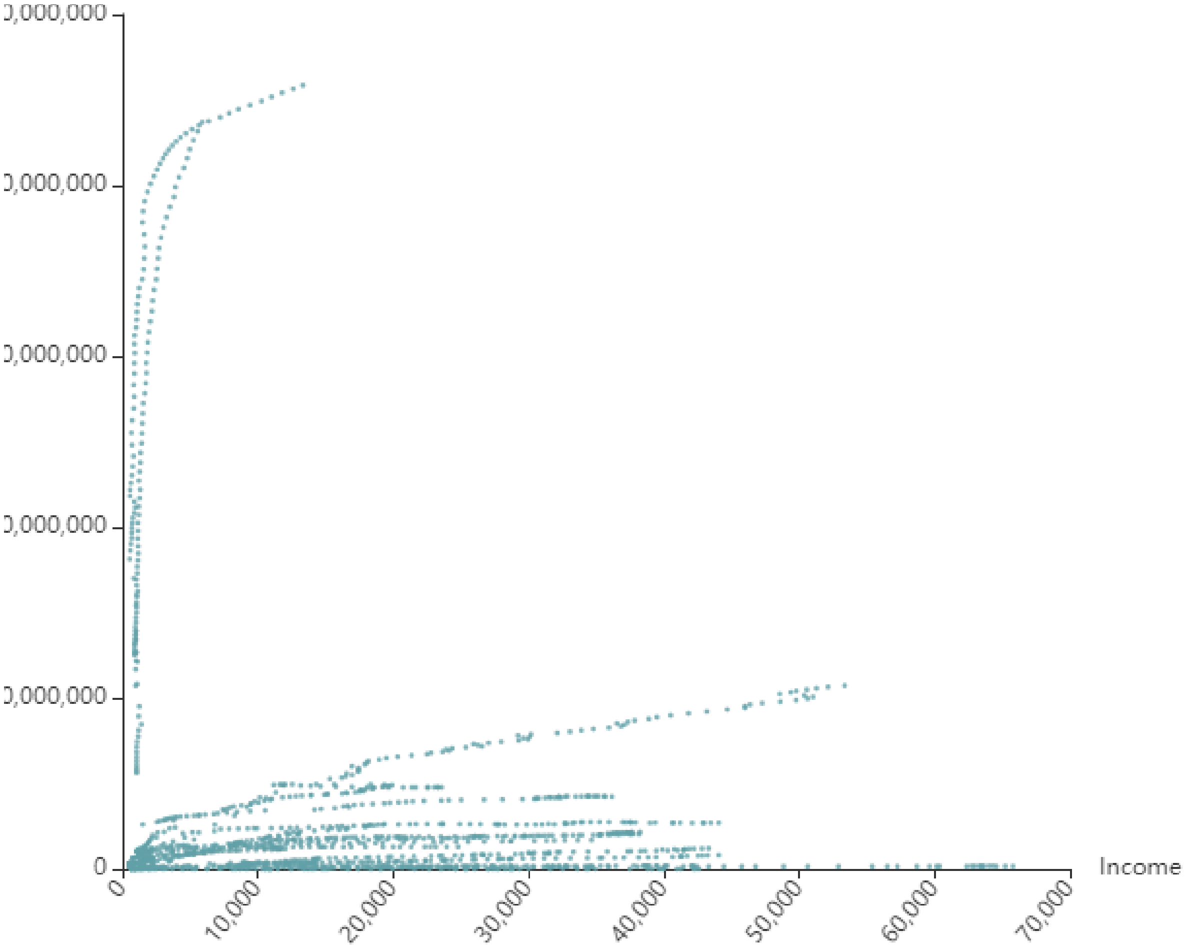
Out[22]:



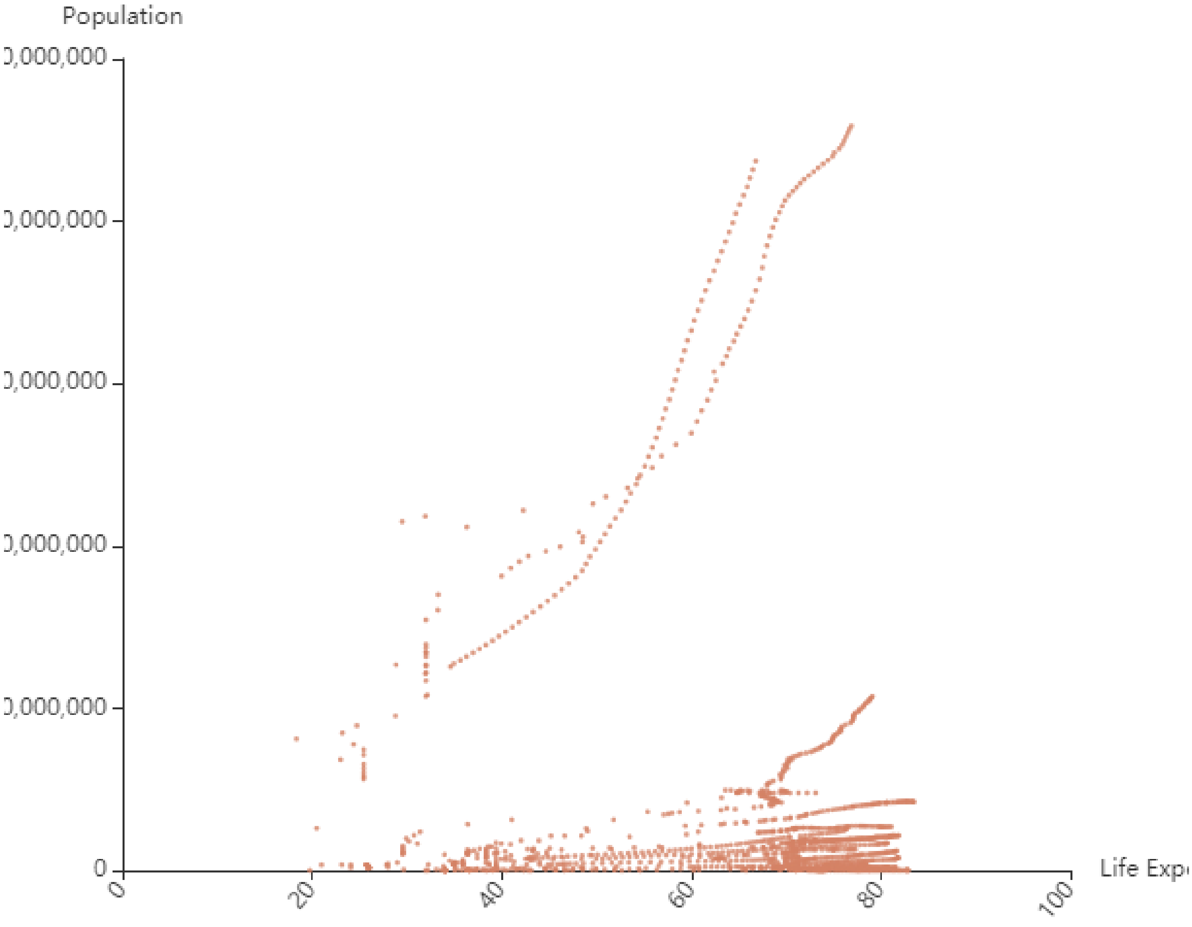

0
20
40
60
80
0
10,000
20,000
30,000
40,000
50,000
60,000
70,000
Income


Income
0
10,000
20,000
30,000
40,000
50,000
60,000
70,000
Country
Australia
Canada
China
Cuba
Finland
France
Germany
Iceland
India
Japan
North Korea
South Korea
New Zealand
Norway
Poland
Russia
Turkey
United Kingdom
United States

Population



,000,000
,000,000
,000,000
,000,000
,000,000
0
0
10,000
20,000
30,000
40,000
50,000
60,000
70,000
Income



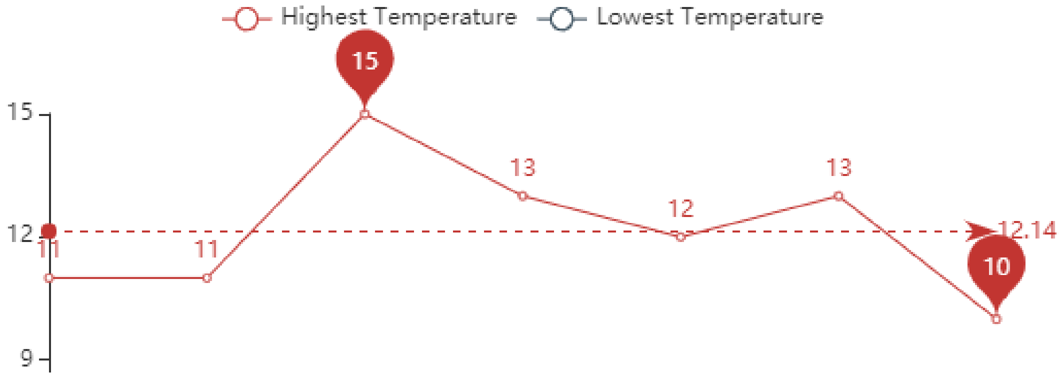
Population
,000,000
,000,000
,000,000
,000,000
,000,000
0
0
20
40
60
80
100
Life Exp

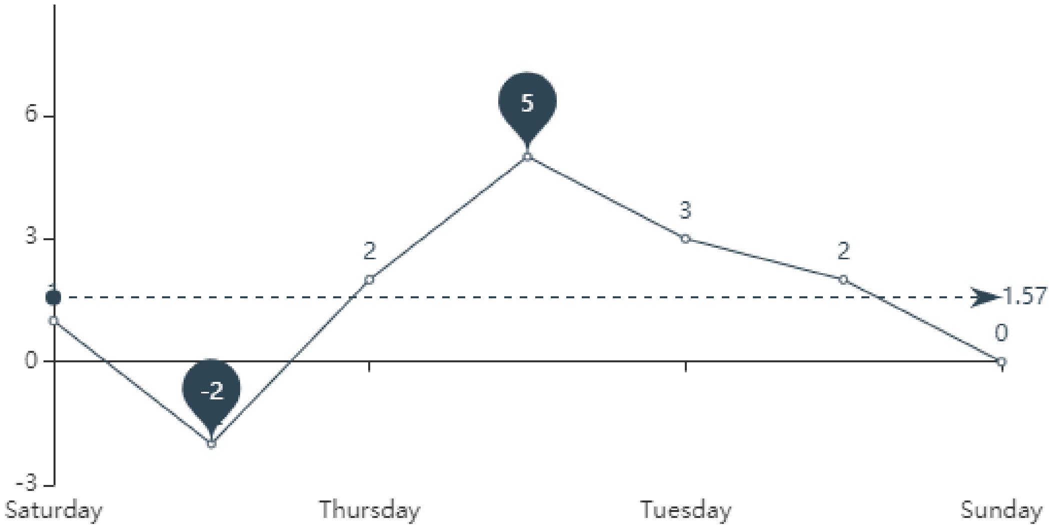
3) Line Chart

In [23]:

```
'''
Raw Data: [x,y1,y2] for every point. Represents the highest and lowest temperature in a w
Statistics: Maximum, Minimum and Average.
'''
week_name_list = Faker.week_en
high_temperature = [11, 11, 15, 13, 12, 13, 10]
low_temperature = [1, -2, 2, 5, 3, 2, 0]

(
    # Set width for convenience of printing.
    Line(init_opts=opts.InitOpts(width="610px"))
    # Add point data.
    .add_xaxis(xaxis_data=week_name_list)
    # Highest temperature data.
    .add_yaxis(
        series_name="Highest Temperature",
        y_axis=high_temperature,
        # Markpoint for Maximum and minimum.
        markpoint_opts=opts.MarkPointOpts(
            data=[
                opts.MarkPointItem(type_="max", name="Maximum"),
                opts.MarkPointItem(type_="min", name="Minimum"),
            ]
        ),
        # Markline for average.
        markline_opts=opts.MarkLineOpts(
            data=[opts.MarkLineItem(type_="average", name="Average")]
        ),
    )
    # Lowest temperature data.
    .add_yaxis(
        series_name="Lowest Temperature",
        y_axis=low_temperature,
        # Markpoint for Maximum and minimum.
        markpoint_opts=opts.MarkPointOpts(
            data=[
                opts.MarkPointItem(type_="max", name="Maximum"),
                opts.MarkPointItem(type_="min", name="Minimum")
            ]
        ),
        # Markline for average.
        markline_opts=opts.MarkLineOpts(
            data=[
                opts.MarkLineItem(type_="average", name="Average")
            ]
        ),
    )
    # Snap the initial value to the y axis.
    .set_global_opts(
        xaxis_opts=opts.AxisOpts(type_="category", boundary_gap=False),
    )
    .render_notebook()
)
```

Out[23]:





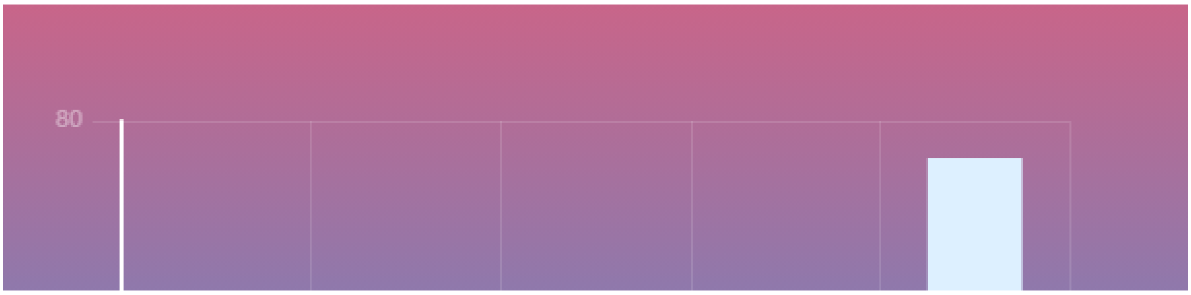
4) Bar Chart

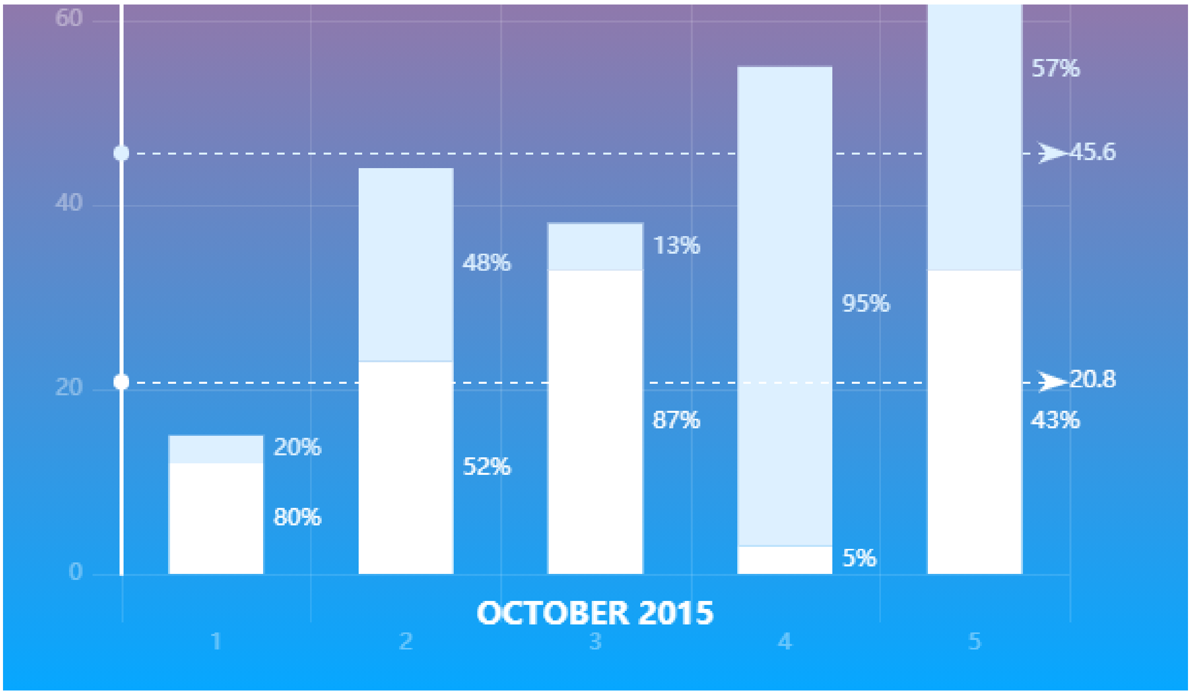
In [24]:

```
'''
Raw Data: [x,y1,y2] for every point. Represents the ratio of two items.
Statistics: Average.
'''
# Set background style.
background_color_js = (
    "new echarts.graphic.LinearGradient(0, 0, 0, 1, "
    "[{offset: 0, color: '#c86589'}, {offset: 1, color: '#06a7ff'}], false)"
)

# Data
list2 = [     {"value": 12, "percent": 12 / (12 + 3)},
    {"value": 23, "percent": 23 / (23 + 21)},
    {"value": 33, "percent": 33 / (33 + 5)},
    {"value": 3, "percent": 3 / (3 + 52)},
    {"value": 33, "percent": 33 / (33 + 43)},
]
list3 = [
    {"value": 3, "percent": 3 / (12 + 3)},
    {"value": 21, "percent": 21 / (23 + 21)},
    {"value": 5, "percent": 5 / (33 + 5)},
    {"value": 52, "percent": 52 / (3 + 52)},
    {"value": 43, "percent": 43 / (33 + 43)},
]

# Initiate with fixed width and color scheme.
Stackbar=Bar(init_opts=opts.InitOpts(width='610px',bg_color=JsCode(background_color_js))

# Add xaxis and double yaxis. Category_gap for the width of the bar.
Stackbar.add_xaxis([1, 2, 3, 4, 5])
Stackbar.add_yaxis("product1", list2, stack="stack1", category_gap="50%",color='#DDF0FF',
            markline_opts=opts.MarkLineOpts(
            data=[
                opts.MarkLineItem(type_="average", name="Average")
            ]
        ),)
Stackbar.add_yaxis("product2", list3, stack="stack1", category_gap="50%",color='white',
            markline_opts=opts.MarkLineOpts(
            data=[
                opts.MarkLineItem(type_="average", name="Average")
            ]
        ),)

# Options for label position and string formmat.
```

```
Stackbar.set_series_opts(
        label_opts=opts.LabelOpts(
            position="right",
            formatter=JsCode(
                "function(x){return Number(x.data.percent * 100).toFixed() + '%';}"
            ),
        )
    )

# Options for title and the style of axie.
Stackbar.set_global_opts(
        title_opts=opts.TitleOpts(
            title="OCTOBER 2015",
            pos_bottom="5%",
            pos_left="center",
            title_textstyle_opts=opts.TextStyleOpts(color="#fff", font_size=16),
        ),
        xaxis_opts=opts.AxisOpts(
            # Margin for the offset from xaxis.
            axislabel_opts=opts.LabelOpts(margin=30, color="#ffffff63"),
            # Hide the original xaxis.
            axisline_opts=opts.AxisLineOpts(is_show=False),
            # Set the tick style.
            axistick_opts=opts.AxisTickOpts(
                is_show=True,
                length=25,
                linestyle_opts=opts.LineStyleOpts(color="#ffffff1f"),
            ),
            # Set the grid style.
            splitline_opts=opts.SplitLineOpts(
                is_show=True, linestyle_opts=opts.LineStyleOpts(color="#ffffff1f")
            ),
        ),
        yaxis_opts=opts.AxisOpts(
            # Label style.
            axislabel_opts=opts.LabelOpts(margin=20, color="#ffffff63"),
            # Line style.
            axisline_opts=opts.AxisLineOpts(
                linestyle_opts=opts.LineStyleOpts(width=2, color="#fff")
            ),
            # Tick style.
            axistick_opts=opts.AxisTickOpts(
                is_show=True,
                length=15,
                linestyle_opts=opts.LineStyleOpts(color="#ffffff1f"),
            ),
            # Grid style.
            splitline_opts=opts.SplitLineOpts(
                is_show=True, linestyle_opts=opts.LineStyleOpts(color="#ffffff1f")
            ),

        ),
        # Hide the label.
        legend_opts=opts.LegendOpts(is_show=False),
)
# Present on notebook
Stackbar.render_notebook()
```

Out[24]:



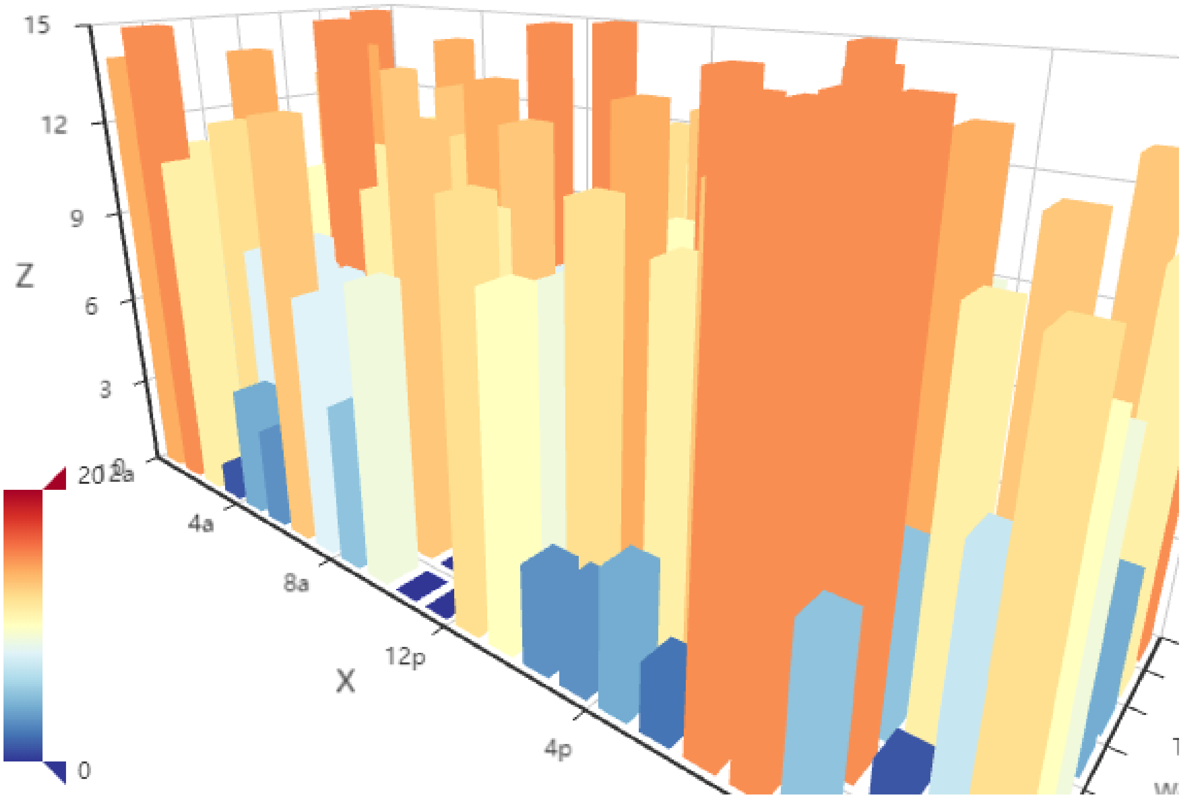


5) 3D Bar Chart

In [25]:

```
'''
Raw Data: [x,y,z] for every point. Respectively represent hour, week, and value.
'''
# Clear dataset
data=[]

# Generate random data
for i in range(24):
    for j in range(7):
        t=random.randint(0,15)
        data.append([i,j,t])

# Render the graph directly
(Bar3D(init_opts=opts.InitOpts(width='610px'))
    .add(
        series_name='',
        data=data,
        # Using faker go generate label.
        xaxis3d_opts=opts.Axis3DOpts(type_="category", data=Faker.clock),
        yaxis3d_opts=opts.Axis3DOpts(type_="category", data=Faker.week_en),
        zaxis3d_opts=opts.Axis3DOpts(type_="value"),
    )
    .set_global_opts(
        # Setting color bar.
        visualmap_opts=opts.VisualMapOpts(
            max_=20,
            range_color=[
                "#313695",
                "#4575b4",
                "#74add1",
                "#abd9e9",
                "#e0f3f8",
                "#ffffbf",
                "#fee090",
                "#fdae61",
                "#f46d43",
                "#d73027",
                "#a50026",
            ],
        )
    ).render_notebook()
)
```

Out[25]:

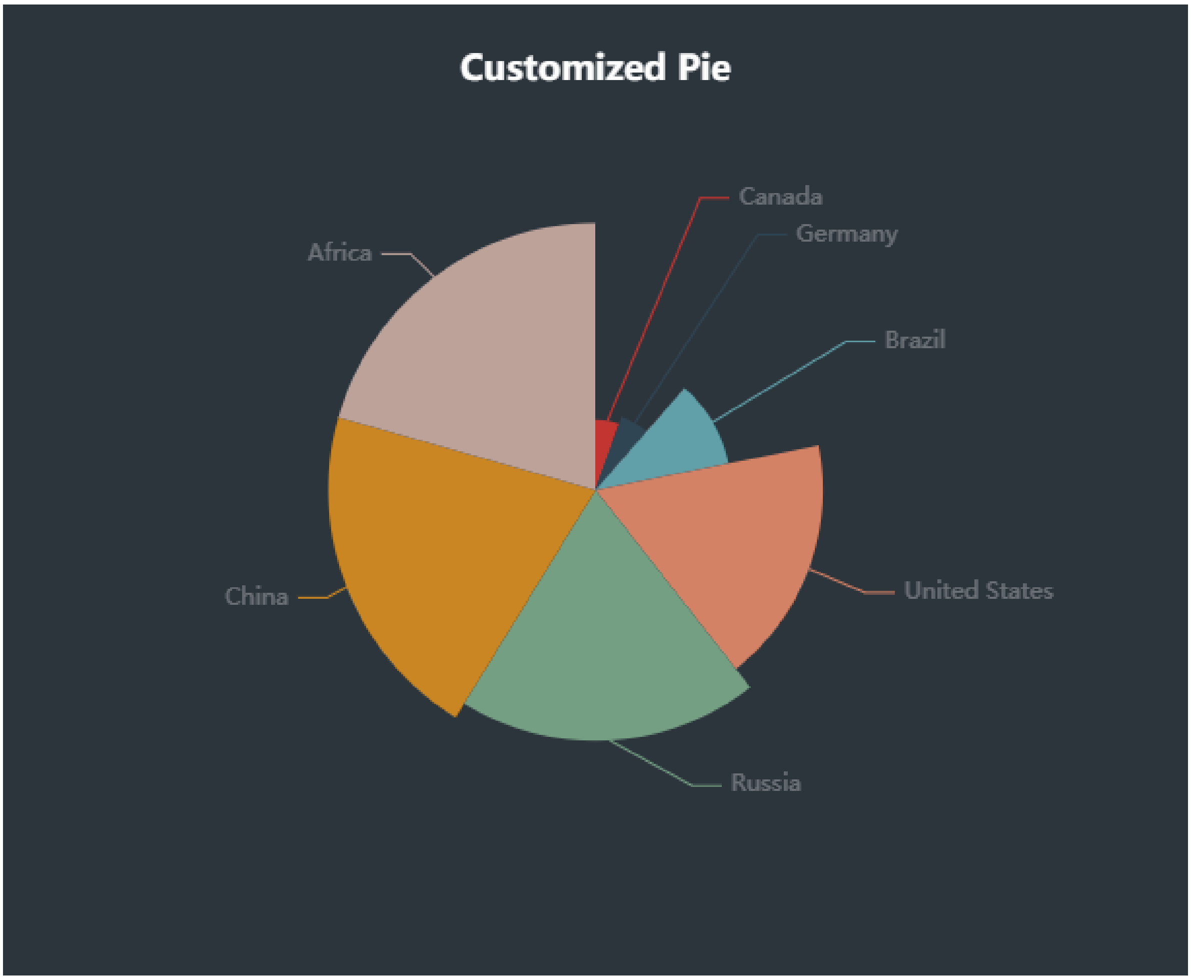


6) Pie Chart

In [26]:

```
'''
Raw Data: [x,y] for every segment.
Statistics: Maximum, Minimum.
'''
x_data = Faker.country
y_data = Faker.values()

# Rank the content.
data_pair = [list(z) for z in zip(x_data, y_data)]
data_pair.sort(key=lambda x: x[1])

(
    # Initiate settings.
    Pie(init_opts=opts.InitOpts(width="610px",bg_color="#2c343c"))
    # Add data.
    .add(
        series_name="Country",
        data_pair=data_pair,
        rosetype="radius",
        # Zoom chart
        radius="55%",
    )
    # Set title and legend.
    .set_global_opts(
        title_opts=opts.TitleOpts(
            title="Customized Pie",
            pos_left="center",
            pos_top="20",
            title_textstyle_opts=opts.TextStyleOpts(color="#fff"),
        ),
        legend_opts=opts.LegendOpts(is_show=False),
    )
    # Set mouse hover operation.
    .set_series_opts(
        tooltip_opts=opts.TooltipOpts(
            trigger="item", formatter="{a} <br/>{b}: {c} ({d}%)"
        ),
        label_opts=opts.LabelOpts(color="rgba(255, 255, 255, 0.3)"),
    )
    .render_notebook()
)
```

Out[26]:

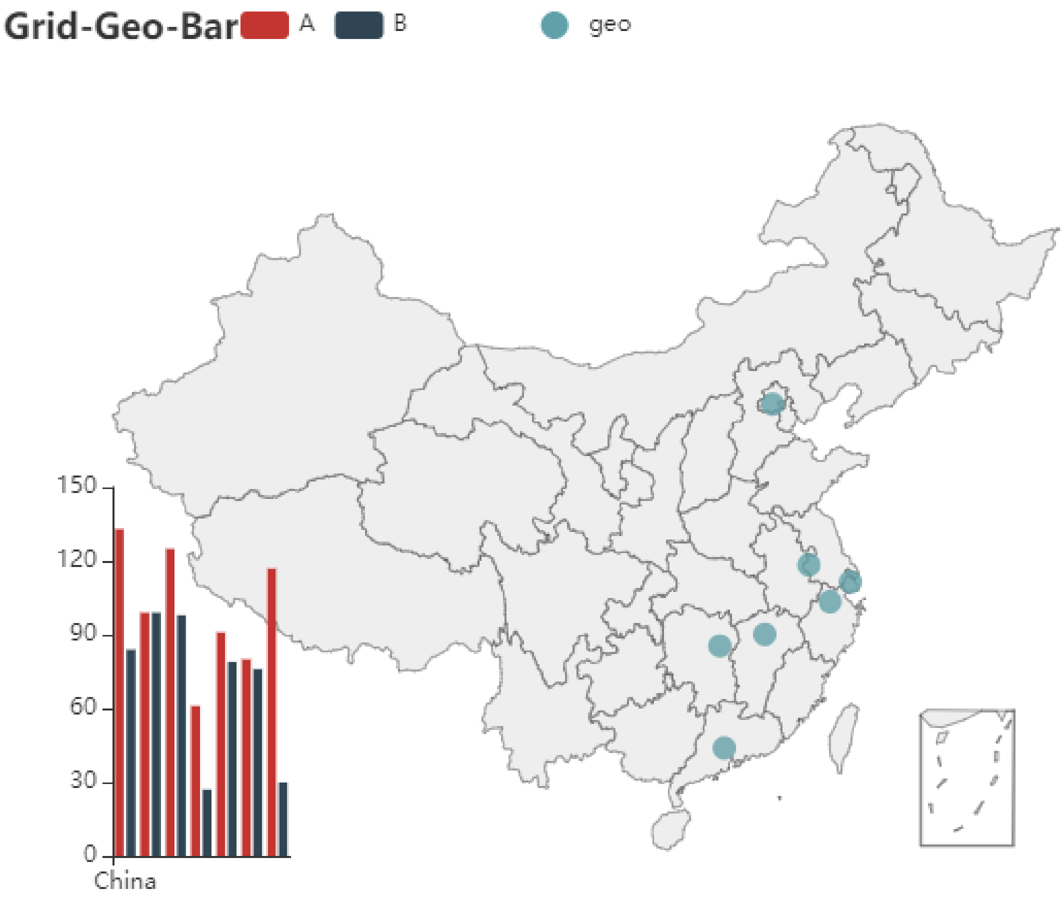


7) Mixed Chart

In [27]:

```
'''
Raw Data: [x,y1,y2] for bar chart, [x,y] for map.
'''
# Using faker to generate bar
bar = (
    Bar()
    .add_xaxis(Faker.country)
    .add_yaxis("A", Faker.values())
    .add_yaxis("B", Faker.values())
    .set_global_opts(legend_opts=opts.LegendOpts(pos_left="20%"))
    .set_series_opts(label_opts=opts.LabelOpts(is_show=False))
)

# Initiate map
geo = (
    Geo()
    .add_schema(maptype="china")
    .add("geo", [list(z) for z in zip(Faker.provinces, Faker.values())])
    .set_series_opts(label_opts=opts.LabelOpts(is_show=False))
    .set_global_opts(
        visualmap_opts=opts.VisualMapOpts(),
        title_opts=opts.TitleOpts(title="Grid-Geo-Bar"),
    )
)
# Connect above two graphs
(
    Grid(init_opts=opts.InitOpts(width='610px'))
    .add(bar, grid_opts=opts.GridOpts(pos_top="50%", pos_right="75%"))
    .add(geo, grid_opts=opts.GridOpts(pos_left="60%"))
    .render_notebook()
)
```

Out[27]:



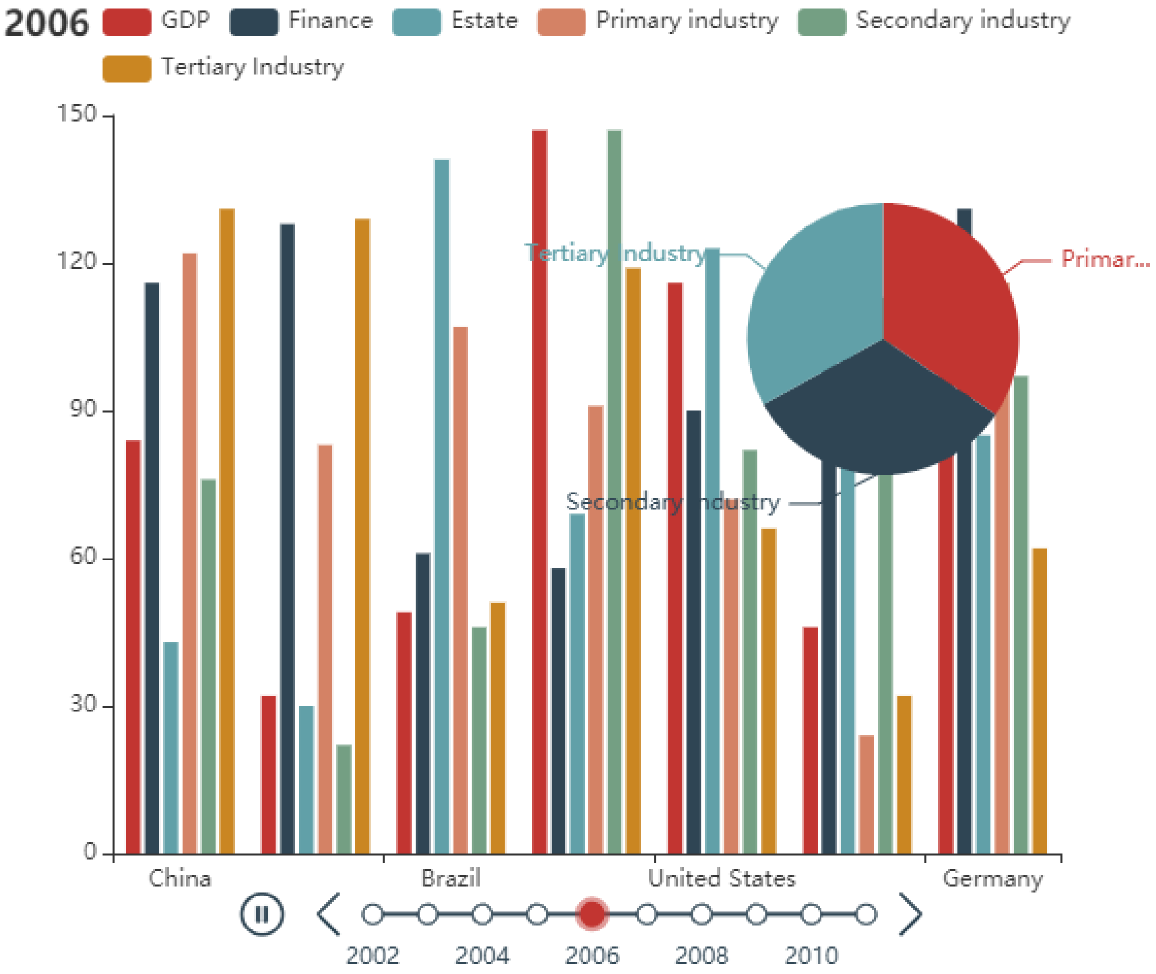
8) Dynamic Timeline Chart

In [28]:

```
'''
Raw Data: ["country","gdp","Primary industry","Secondary industry","Tertiary Industry","E
'''
total_data={}
# Using Faker to generate data
name_list=Faker.country
data_gdp={}
data_pi={}
data_si={}
data_ti={}
data_estate={}
data_financial={}
for year in range(2002, 2012):
    data_gdp[year]=Faker.values()
    data_pi[year]=Faker.values()
    data_si[year]=Faker.values()
    data_ti[year]=Faker.values()
    data_estate[year]=Faker.values()
    data_financial[year]=Faker.values()
```

```
# Format data function
def format_data(data: dict) -> dict:
    for year in range(2002, 2012):
        max_data, sum_data = 0, 0
        temp = data[year]
        max_data = max(temp)
        for i in range(len(temp)):
            sum_data += temp[i]
            data[year][i] = {"name": name_list[i], "value": temp[i]}
        data[str(year) + "max"] = int(max_data / 100) * 100
        data[str(year) + "sum"] = sum_data
    return data

# GDP
total_data["dataGDP"] = format_data(data=data_gdp)
# Primary industry
total_data["dataPI"] = format_data(data=data_pi)
# Secondary industry
total_data["dataSI"] = format_data(data=data_si)
# Tertiary Industry
total_data["dataTI"] = format_data(data=data_ti)
# Estate
total_data["dataEstate"] = format_data(data=data_estate)
# Finance
total_data["dataFinancial"] = format_data(data=data_financial)

#####################################################################################
# 2002 - 2011 years’ data
def get_year_overlap_chart(year: int) -> Bar:
    bar = (
        Bar()
        .add_xaxis(name_list)
        .add_yaxis("GDP",total_data["dataGDP"][year])
        .add_yaxis(
            "Finance",
            total_data["dataFinancial"][year]
        )
        .add_yaxis(
            "Estate",
            total_data["dataEstate"][year]
        )
        .add_yaxis(
            "Primary industry",
            total_data["dataPI"][year]
        )
        .add_yaxis(
           "Secondary industry",
            total_data["dataSI"][year]
        )
        .add_yaxis(
            "Tertiary Industry",
            total_data["dataTI"][year]
        )
        .set_series_opts(
            label_opts=opts.LabelOpts(is_show=False)
        )
        .set_global_opts(
            title_opts=opts.TitleOpts(
                title="{}".format(year)
            ),
            tooltip_opts=opts.TooltipOpts(
                is_show=True, trigger="axis", axis_pointer_type="shadow"
            ),
        )
    )
    pie = (
        Pie()
        .add(
            series_name="GDP_Percent",
            data_pair=[
                ["Primary industry", total_data["dataPI"]["{}sum".format(year)]],
                ["Secondary industry", total_data["dataSI"]["{}sum".format(year)]],
                ["Tertiary Industry", total_data["dataTI"]["{}sum".format(year)]],
            ],
            center=["75%", "35%"],
            radius="28%",
        )
        .set_series_opts(tooltip_opts=opts.TooltipOpts(is_show=True, trigger="item"))
    )
    return bar.overlap(pie)


# Graph to generate timeline
timeline = Timeline(init_opts=opts.InitOpts(width="610px", height="500px"))

# Add data to timeline
for y in range(2002, 2012):
    timeline.add(get_year_overlap_chart(year=y), time_point=str(y))

# Autoplay Setting
timeline.add_schema(is_auto_play=True, play_interval=1000)

# Present on notebook
timeline.render_notebook()
```

Out[28]:



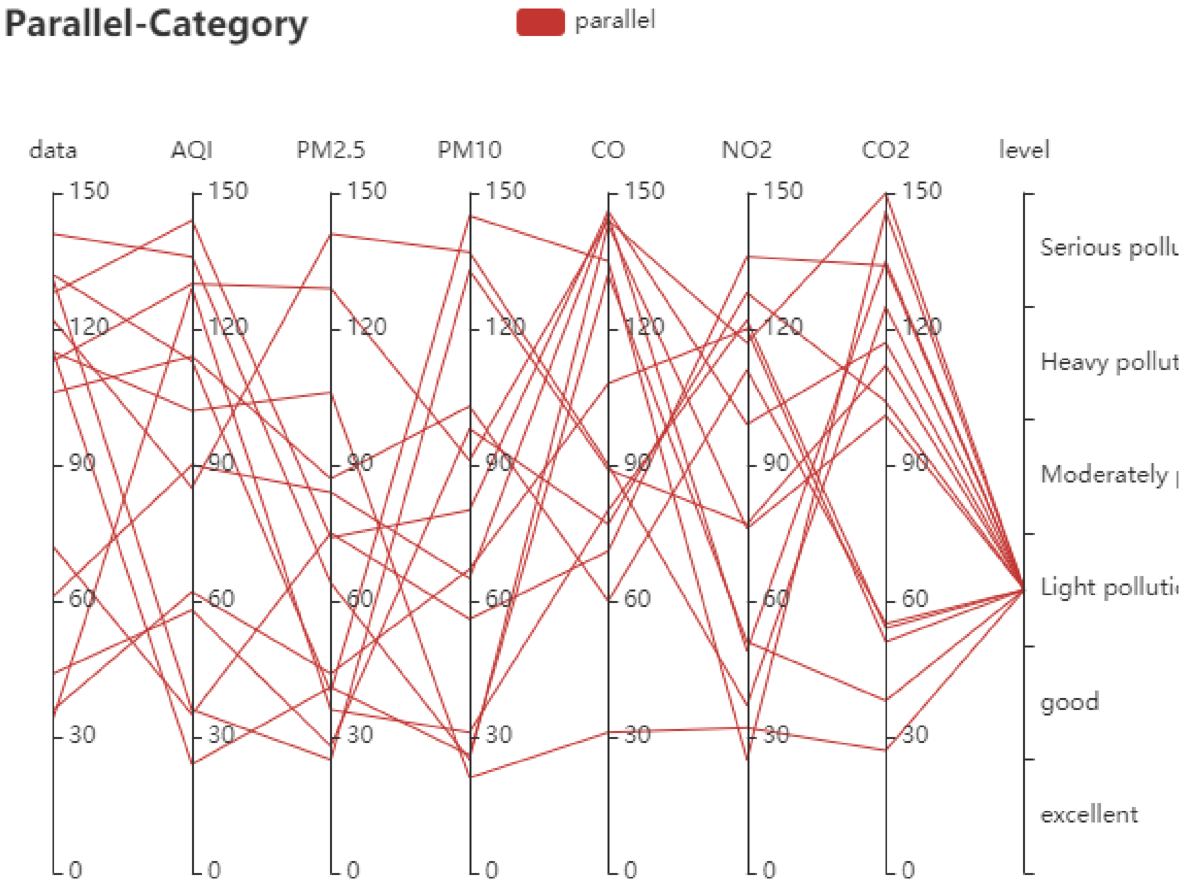
9) Parallel Chart

In [29]:

```
'''
Raw Data: ["data","AQI","PM2.5","PM10","CO","NO2","CO2"]
'''
```

```
# Generte Fake values
data=[]
for i in range(14):
    data.append(Faker.values()+['Light pollution'])
(
    Parallel(init_opts=opts.InitOpts(width='610px'))
    .add_schema(
        [
            opts.ParallelAxisOpts(dim=0, name="data"),
            opts.ParallelAxisOpts(dim=1, name="AQI"),
            opts.ParallelAxisOpts(dim=2, name="PM2.5"),
            opts.ParallelAxisOpts(dim=3, name="PM10"),
            opts.ParallelAxisOpts(dim=4, name="CO"),
            opts.ParallelAxisOpts(dim=5, name="NO2"),
            opts.ParallelAxisOpts(dim=6, name="CO2"),
            opts.ParallelAxisOpts(
                dim=7,
                name="level",
                type_="category",
                data=["excellent", "good", "Light pollution",
                      "Moderately polluted", "Heavy pollution", "Serious pollution"],
            ),
        ]
    )
    .add("parallel", data)
    .set_global_opts(title_opts=opts.TitleOpts(title="Parallel-Category"))
    .render_notebook()
)
```

Out[29]:



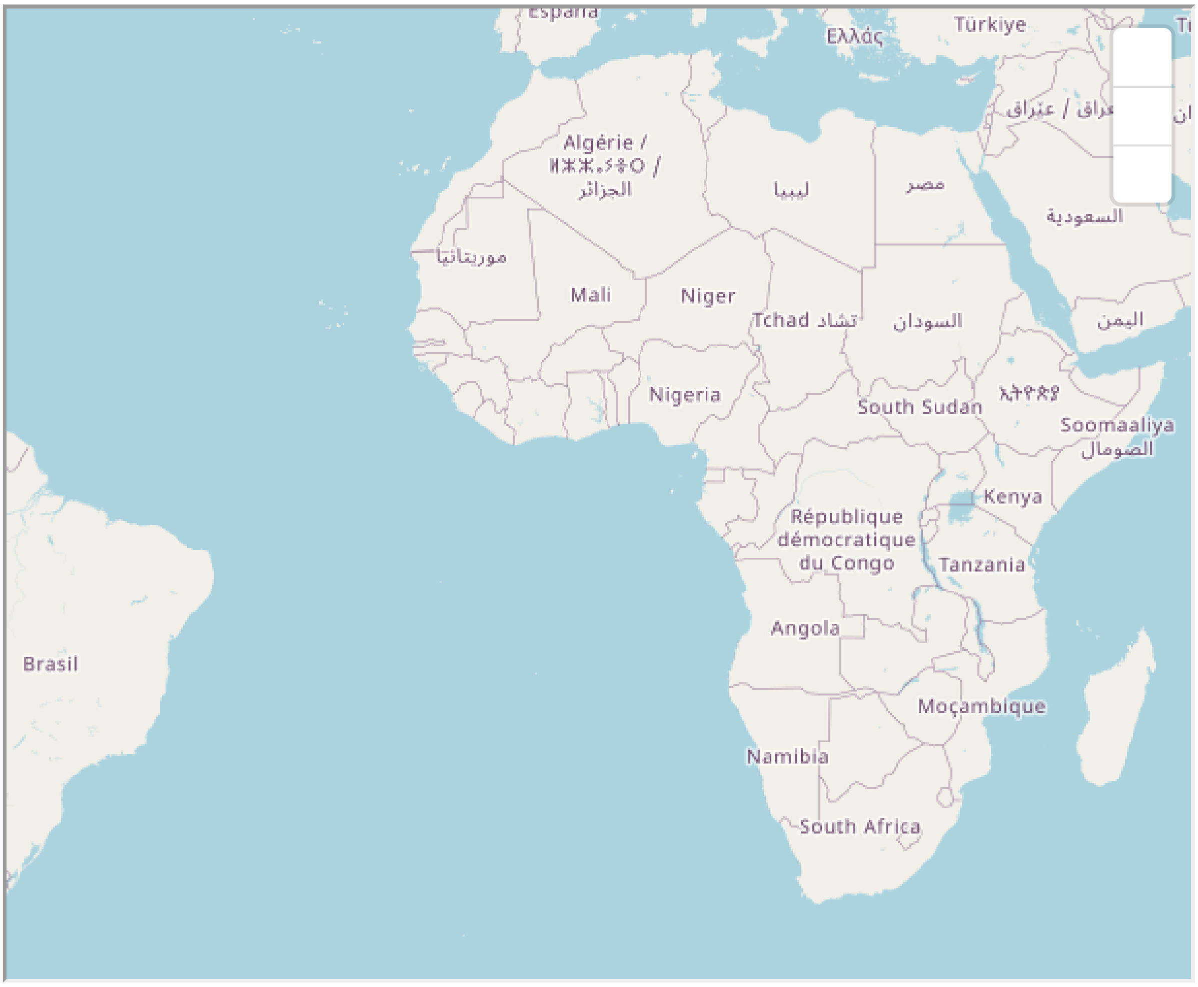
Homework1(3). Advanced Features

1) Draw a map

Create a map with raster tiles from OpenStreetMap.org

In [30]:

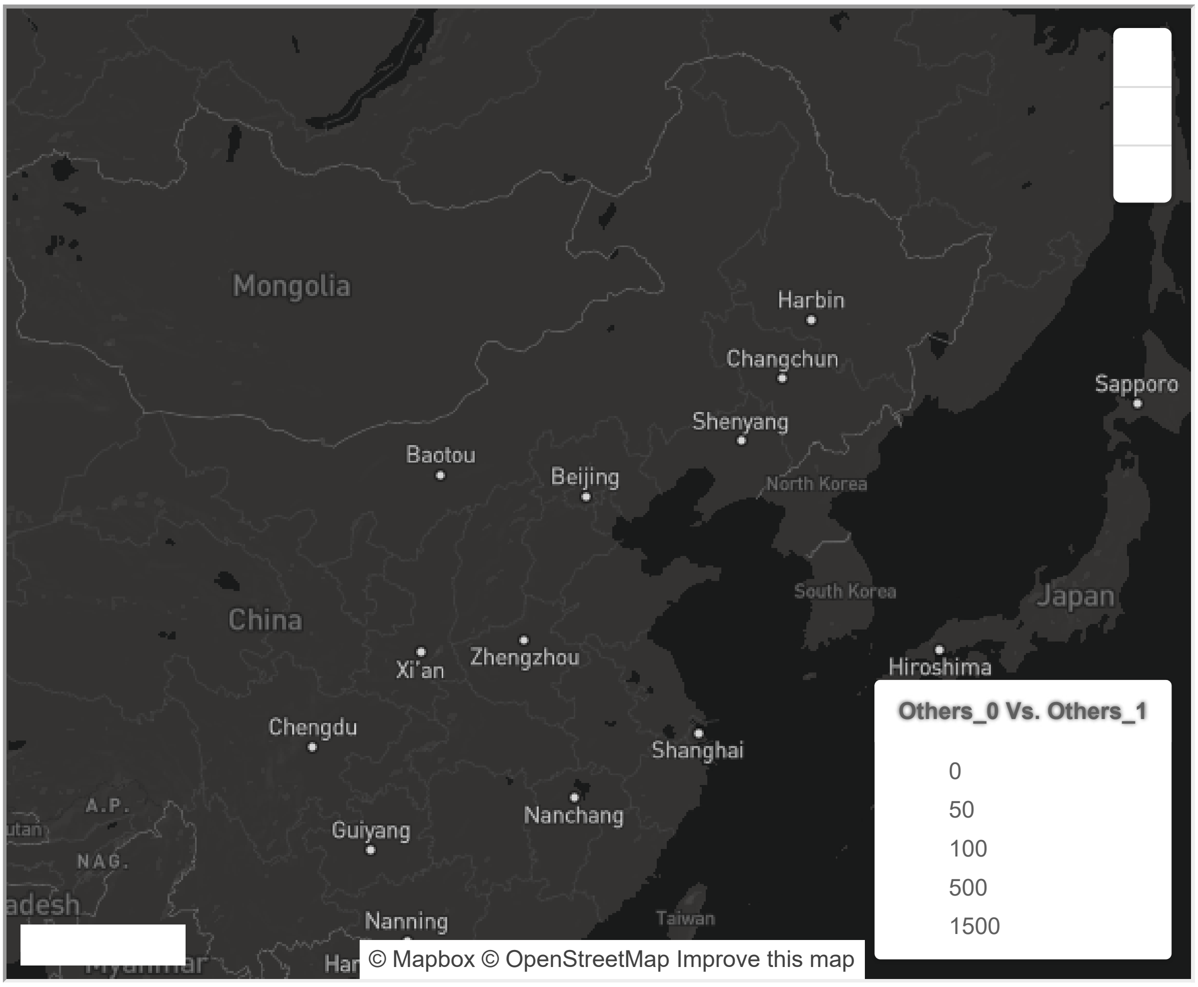
```
tiles_url = 'https://a.tile.openstreetmap.org/{z}/{x}/{y}.png'

# Create an empty style
style = {'version': 8, 'sources': {}, 'layers': []}

viz = RasterTilesViz(tiles_url,
                     access_token=token,
                     tiles_size=256,
                     height='500px',
                     #
                     width='610px',
                     zoom=2,
                     style=style)
viz.show()
```



Update scale to match Mapbox Dark-v9 style

In [31]:

```
viz = LinestringViz('/files/MapLine.geojson',
                        access_token=token,
                        color_property='others_0',
                        color_stops=create_color_stops([0, 50, 100, 500, 1500], colors='
                        line_width_property='others_1',
                        line_width_stops=create_numeric_stops([0, 1, 2, 3, 4, 5], 0, 10),
                        opacity=0.8,
                        center=(117, 40),
                        #
                        width='610px',
                        zoom=3,
                        below_layer='waterway-label')

# Map settings
viz.style='mapbox://styles/mapbox/dark-v9?optimize=true'
viz.height = '500px'

# Legend settings
viz.legend_gradient = False
viz.legend_fill = '#343332'
viz.legend_header_fill = '#343332'
viz.legend_text_color = 'hsl(0, 0%, 70%)'
viz.legend_key_borders_on = False
viz.legend_title_halo_color = 'hsla(0, 0%, 10%, 0.75)'

# Render map
viz.show()
```



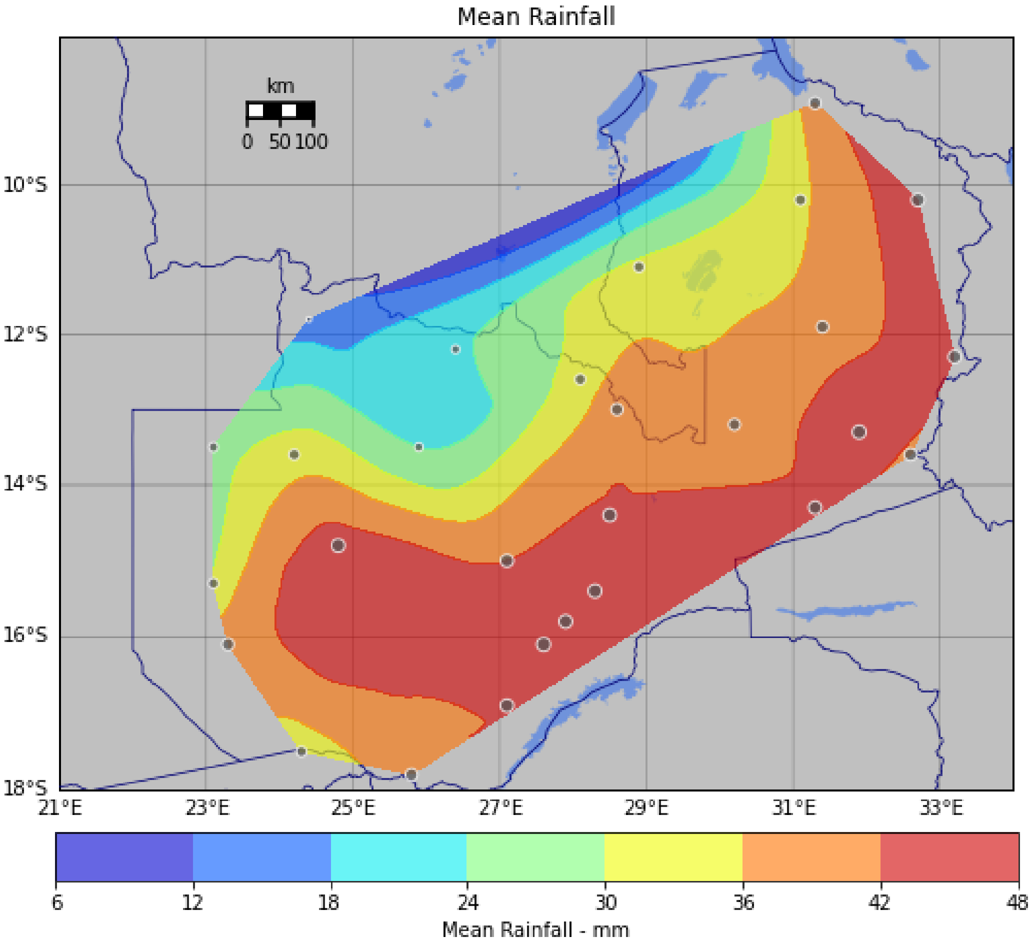
2) Gray map tracking contour

Plot the average precipitation contour

In [32]:

```
import numpy as np
import pandas as pd
# from matplotlib.mlab import griddata
from mpl_toolkits.basemap import Basemap
import matplotlib.pyplot as plt
from matplotlib.colors import Normalize
from scipy.interpolate import griddata as gd

# Set up a basic picture drawing board
fig = plt.figure(figsize=(10, 8))
ax = fig.add_subplot(111, fc='w', frame_on=False)

# Extract data
data = pd.read_csv('Data/datam.txt', delim_whitespace=True)
norm = Normalize()
```

```python
#Set the map boundary value
lllon = 21
lllat = -18
urlon = 34
urlat = -8

#Initialize the map
m = Basemap(
    projection = 'merc',
    llcrnrlon = lllon, llcrnrlat = lllat, urcrnrlon = urlon, urcrnrlat = urlat,
    resolution='h')

# Convert latitude and longitude points to map mapping points
data['projected_lon'], data['projected_lat'] = m(*(data.Lon.values, data.Lat.values))

# Generate raster data of latitude and longitude
numcols, numrows = 1000, 1000
xi = np.linspace(data['projected_lon'].min(), data['projected_lon'].max(), numcols)
yi = np.linspace(data['projected_lat'].min(), data['projected_lat'].max(), numrows)
xi, yi = np.meshgrid(xi, yi)

# Interpolation
x, y, z = data['projected_lon'].values, data['projected_lat'].values, data.Z.values
zi = gd(
    (data[['projected_lon', 'projected_lat']]),
    data.Z.values,
    (xi, yi),
    method='cubic')

# Set map details
m.drawmapboundary(fill_color = 'white')
m.fillcontinents(color='#C0C0C0', lake_color='#7093DB')
m.drawcountries(
    linewidth=.75, linestyle='solid', color='#000073',
    antialiased=True,
    ax=ax, zorder=3)

m.drawparallels(
    np.arange(lllat, urlat, 2.),
    color = 'black', linewidth = 0.5,
    labels=[True, False, False, False])
m.drawmeridians(
    np.arange(lllon, urlon, 2.),
    color = '0.25', linewidth = 0.5,
    labels=[False, False, False, True])

# Isosurface drawing
con = m.contourf(xi, yi, zi, zorder=4, alpha=0.6, cmap='jet')
# Insert survey point
m.scatter(
    data['projected_lon'],
    data['projected_lat'],
    color='#545454',
    edgecolor='#ffffff',
    alpha=.75,
    s=50 * norm(data['Z']),
    cmap='jet',
    ax=ax,
    vmin=zi.min(), vmax=zi.max(), zorder=4)

# Insert color label, name and range
cbar = plt.colorbar(con,orientation='horizontal', fraction=.057, pad=0.05)
cbar.set_label("Mean Rainfall - mm")

m.drawmapscale(
    24., -9., 28., -13,
    100,
    units='km', fontsize=10,
    yoffset=None,
    barstyle='fancy', labelstyle='simple',
    fillcolor1='w', fillcolor2='#000000',
    fontcolor='#000000',
    zorder=5)

plt.title("Mean Rainfall")
plt.show()
```

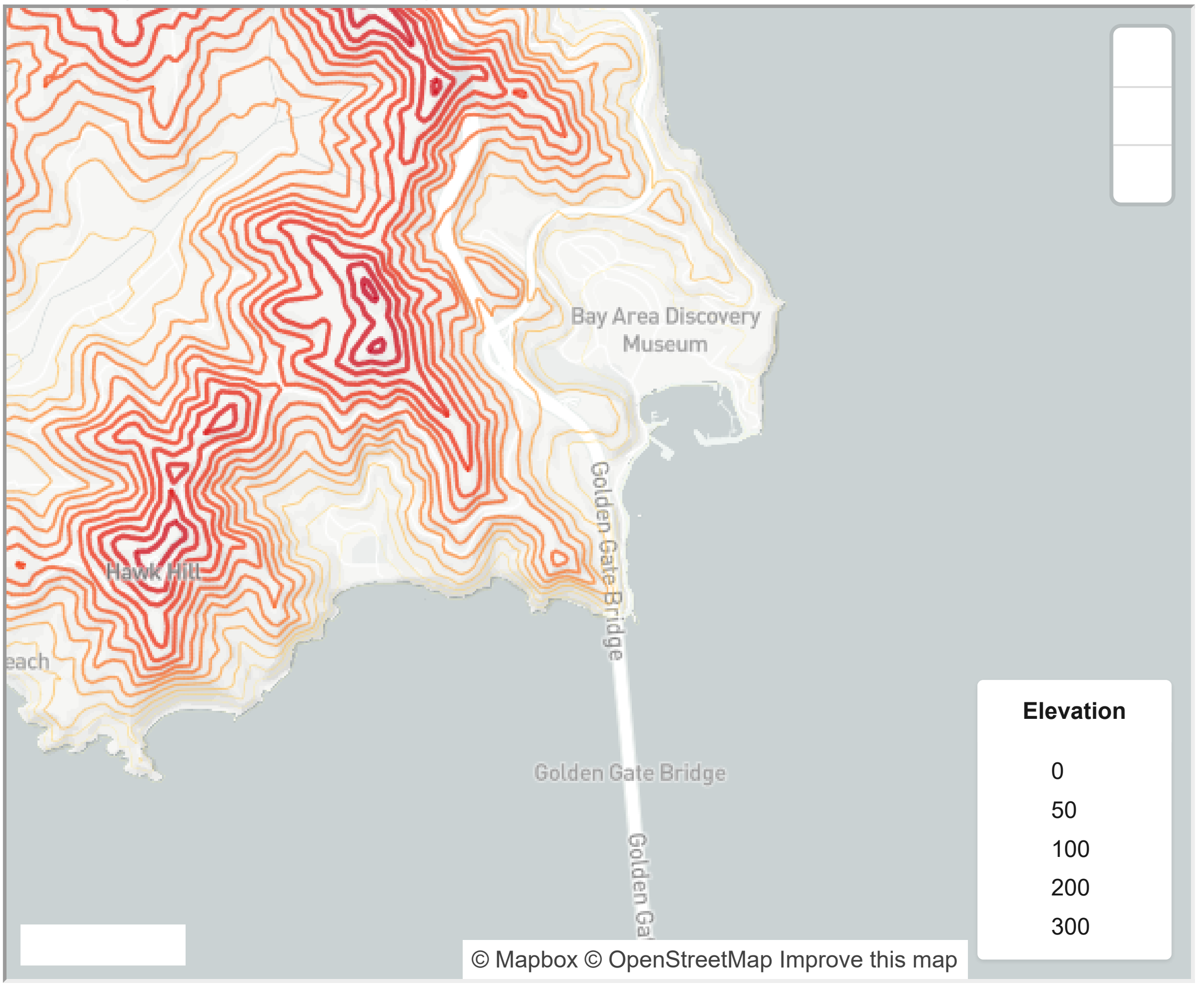


Contour drawing in mapbox

In [33]:

```
# JSON join-data object
data = [{"elevation": x} for x in range(0, 21000, 10)]
viz = LinestringViz(data,
                    access_token=token,
                    vector_url='mapbox://mapbox.mapbox-terrain-v2',
                    vector_layer_name='contour',
                    vector_join_property='ele',
                    data_join_property='elevation',
                    color_property='elevation',
                    color_stops=create_color_stops([0, 50, 100, 200, 300], colors='YlOrRd
                    line_width_stops=create_numeric_stops([0, 50, 100, 200, 300], 0.1, 4)
                    line_width_property='elevation',
                    line_width_function_type='interpolate',
                    line_width_default='1',
                    #
                    width='610px',
                    opacity=0.8,
                    center=(-122.48, 37.83),
                    zoom=13,
                    below_layer='waterway-label')
viz.show()
```

```
d:\cty\mypython\lib\site-packages\IPython\core\display.py:724: UserWarning: Consider usin
g IPython.display.IFrame instead
  warnings.warn("Consider using IPython.display.IFrame instead")
```



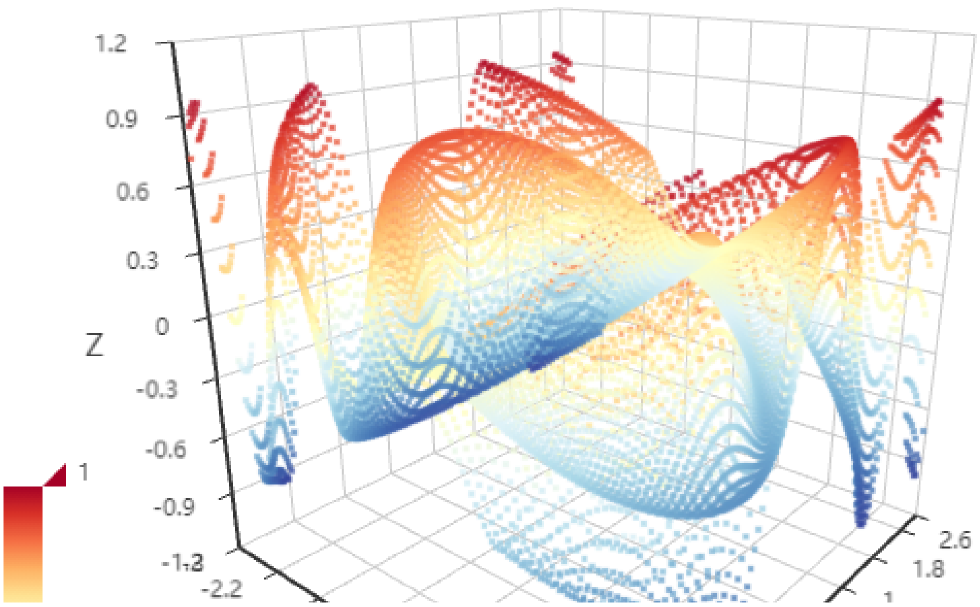
3) 3D isosurface rendering

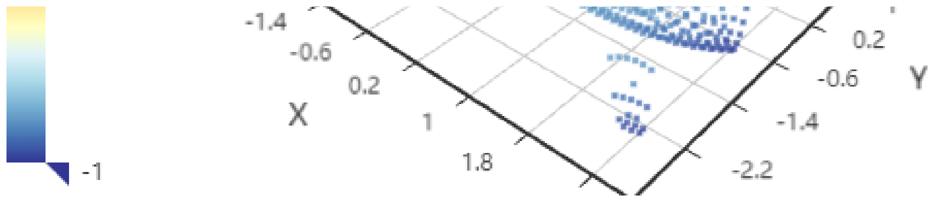
In [34]:

```
def float_range(start: int, end: int, step: Union[int, float], round_number: int = 2):
    """
    Floating point range
    :param start: Starting value
    :param end: End value
    :param step: Step size
    :param round_number: Precision
    :return: list type
    """
    temp = []
    while True:
        if start < end:
            temp.append(round(start, round_number))
            start += step
        else:
            break
    return temp


def surface3d_data():
    for t0 in float_range(-3, 3, 0.05):
        y = t0
        for t1 in float_range(-3, 3, 0.05):
            x = t1
            z = math.sin(x ** 2 + y ** 2) * x / 3.14
            yield [x, y, z]

# config
```

```
(
    Scatter3D(
        init_opts=opts.InitOpts(width="610px")
    )  # bg_color="black"
    .add(
        series_name="",
        data=list(surface3d_data()),
        grid3d_opts=opts.Grid3DOpts(width=100, height=100, depth=100),
    )
    .set_global_opts(
        visualmap_opts=[
            opts.VisualMapOpts(
            dimension=2,
            max_=1,
            min_=-1,
            range_color=[
                "#313695",
                "#4575b4",
                "#74add1",
                "#abd9e9",
                "#e0f3f8",
                "#ffffbf",
                "#fee090",
                "#fdae61",
                "#f46d43",
                "#d73027",
                "#a50026",
            ],
        ),
        opts.VisualMapOpts(
                type_="size",
                pos_bottom="100",
                range_size=3,
               is_show=False
            ),

        ]

    )
    .render_notebook()
)
```

Out[34]:

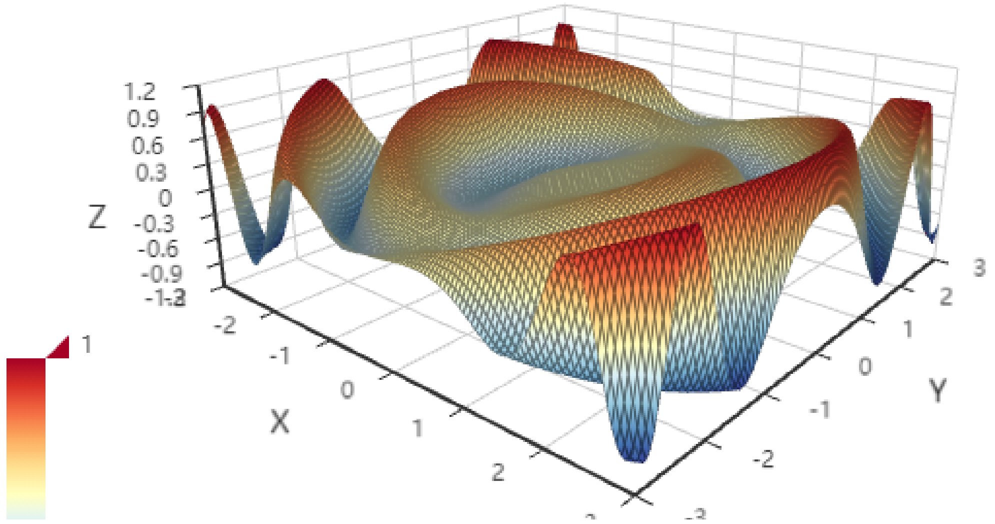




In [35]:

```
(
    Surface3D(init_opts=opts.InitOpts(width="610px"))
    .add(
        series_name="",
        shading="color",
        data=list(surface3d_data()),
        xaxis3d_opts=opts.Axis3DOpts(type_="value"),
        yaxis3d_opts=opts.Axis3DOpts(type_="value"),
        grid3d_opts=opts.Grid3DOpts(width=100, height=40, depth=100),
    )
    .set_global_opts(
        visualmap_opts=opts.VisualMapOpts(
            dimension=2,
            max_=1,
            min_=-1,
            range_color=[
                "#313695",
                "#4575b4",
                "#74add1",
                "#abd9e9",
                "#e0f3f8",
                "#ffffbf",
                "#fee090",
                "#fdae61",
                "#f46d43",
                "#d73027",
                "#a50026",
            ],
        )
    )
    .render_notebook()
)
```

Out[35]:



```
In [ ]:
```

```
In [ ]:
```