Art of Data Visualization

이진호, 이해진, 이동구

Project Proposal

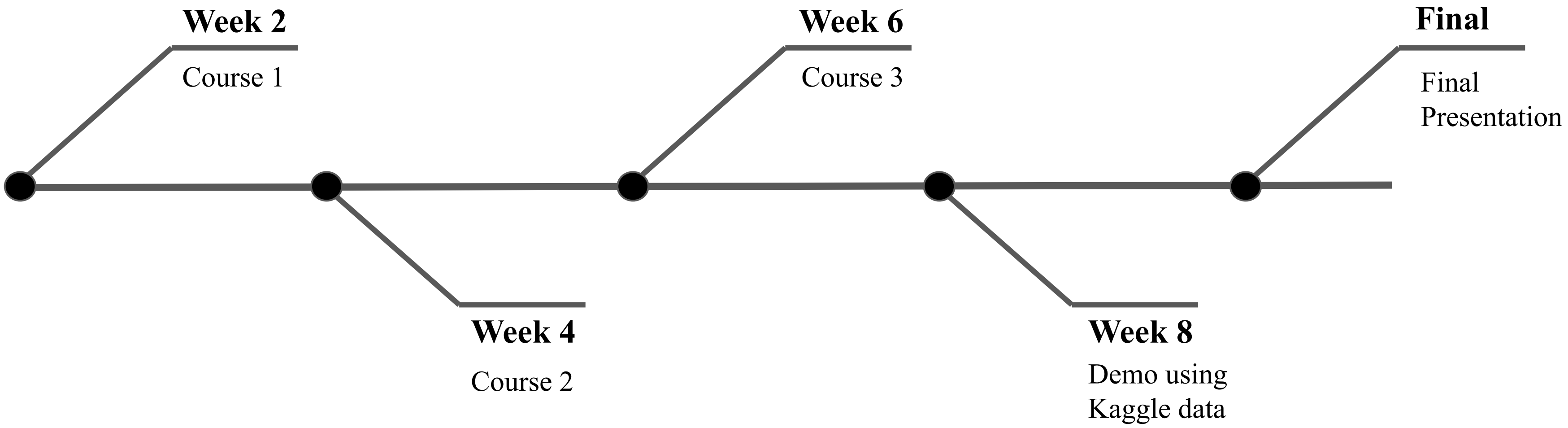
Topic Data Visualization

Description Coursera 와 Kaggle 에 있는 Data Visualization 관련 수업과 자료들을 빠르게 학습하며 파이썬의 여러가지 라이브러리들을어떻게 효율적으로 다루어 시각화 자료를 만드는지 배우는 기회를 가져보려고 합니다.

Expected Duration 8 weeks

Team Member 이진호, 이해진, 이동구

Timeline



Week 2

Course 1

Week 4

Course 2

Week 6

Course 3

Week 8

Demo using
Kaggle data

Final

Final
Presentation

Data Visualization with Python

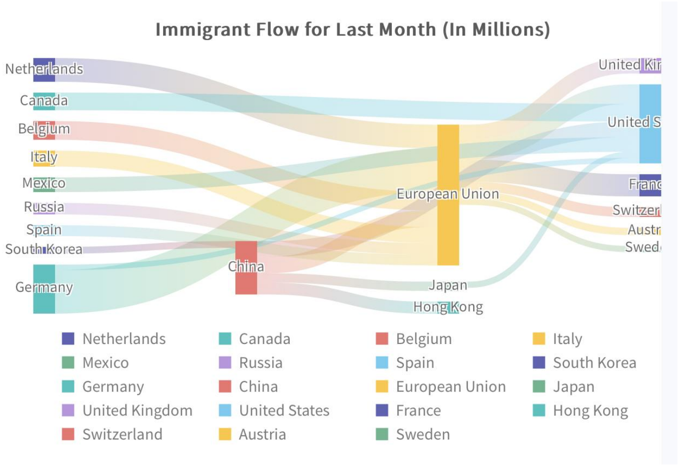
- Visualization of geospatial data
- Maps with markers
- Choropleth Maps
- Plotly & Dash introduction

Advanced Visualization - Sankey Chart

- Sankey charts are like flow diagrams wherein the width represents the quantity of the flow.

- Sankey charts are immensely useful when we are supposed to represent large amount of data with lots of inter correlation amongst the values (nodes).

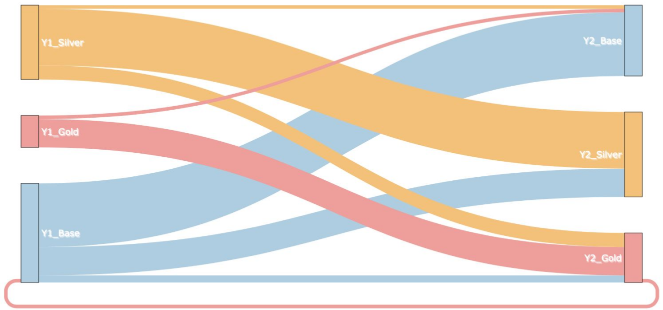
- Sankey charts are usually used for visualization of material, cost or energy flows.

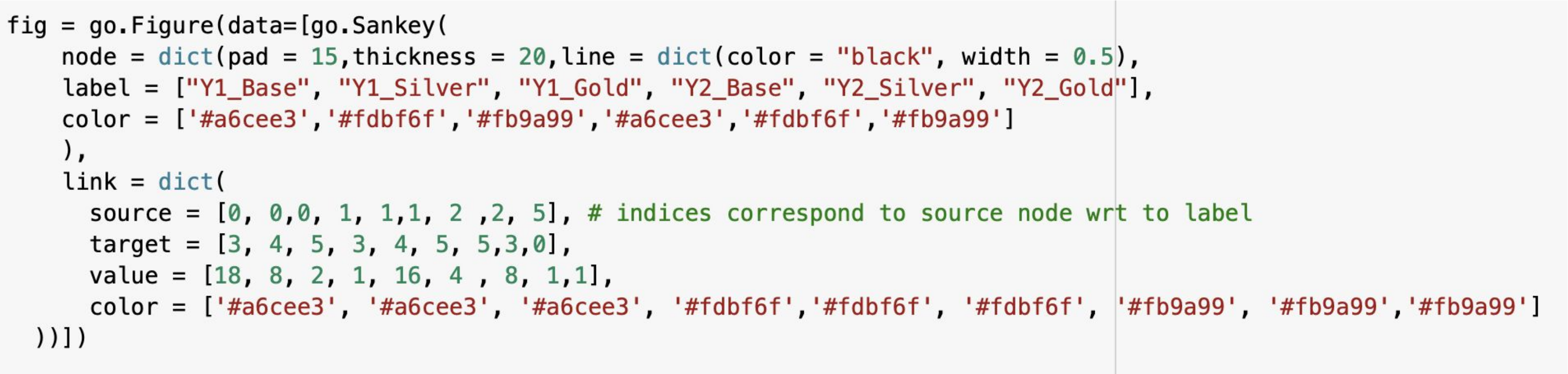


Immigrant Flow for Last Month (In Millions)

Demo 1

- It show the flow of customers from Base,Silver and Gold tiers in the first year and the second year.





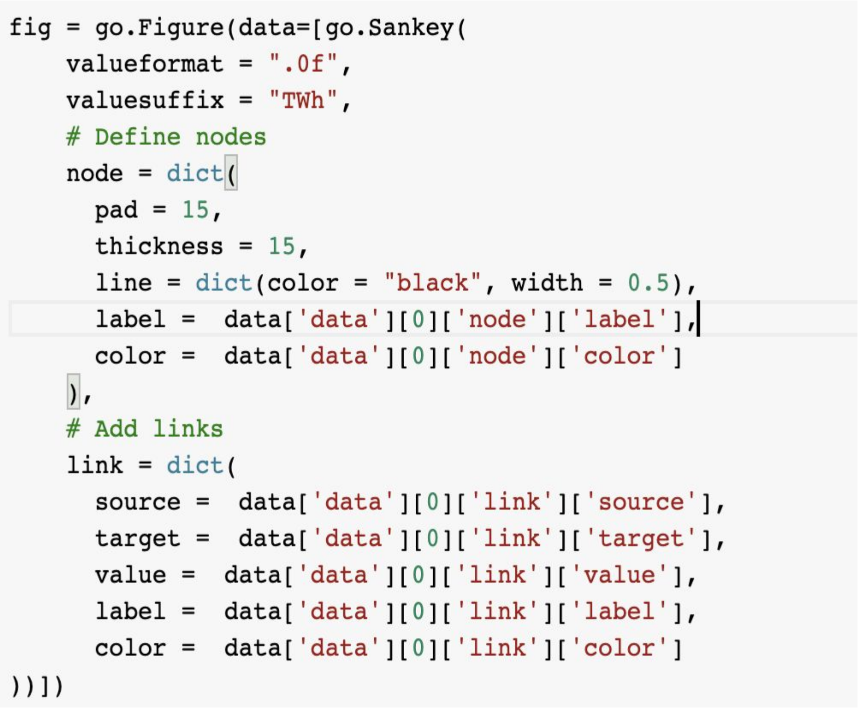
```
fig = go.Figure(data=[go.Sankey(
    node = dict(pad = 15,thickness = 20,line = dict(color = "black", width = 0.5),
    label = ["Y1_Base", "Y1_Silver", "Y1_Gold", "Y2_Base", "Y2_Silver", "Y2_Gold"],
    color = ['#a6cee3','#fdbf6f','#fb9a99','#a6cee3','#fdbf6f','#fb9a99']
    ),
    link = dict(
      source = [0, 0,0, 1, 1,1, 2 ,2, 5], # indices correspond to source node wrt to label
      target = [3, 4, 5, 3, 4, 5, 5,3,0],
      value = [18, 8, 2, 1, 16, 4 , 8, 1,1],
      color = ['#a6cee3', '#a6cee3', '#a6cee3', '#fdbf6f','#fdbf6f', '#fdbf6f', '#fb9a99', '#fb9a99','#fb9a99']
  ))])
```

Demo 2

- Data: Energy Conversion - JSON format

  https://raw.githubusercontent.com/plotly/plotly.js/master/test/image/mocks/sankey_energy.json

- JSON: Follows object literal grammar
- For Object-Structured data



```
fig = go.Figure(data=[go.Sankey(
    valueformat = ".0f",
    valuesuffix = "TWh",
    # Define nodes
    node = dict(
      pad = 15,
      thickness = 15,
      line = dict(color = "black", width = 0.5),
      label =  data['data'][0]['node']['label'],
      color =  data['data'][0]['node']['color']
    ),
    # Add links
    link = dict(
      source =  data['data'][0]['link']['source'],
      target =  data['data'][0]['link']['target'],
      value =  data['data'][0]['link']['value'],
      label =  data['data'][0]['link']['label'],
      color =  data['data'][0]['link']['color']
))])
```

Advanced Visualization - amChart

- amCharts is a set of programming libraries and tools for all your data visualization needs on the web.

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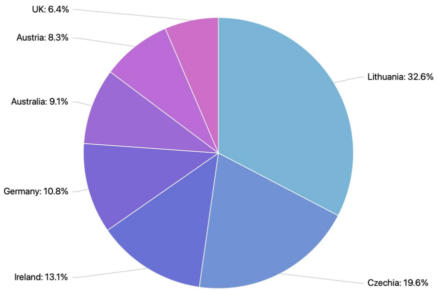
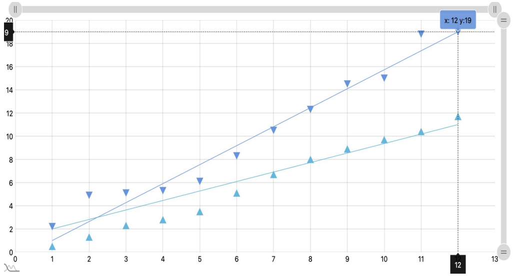
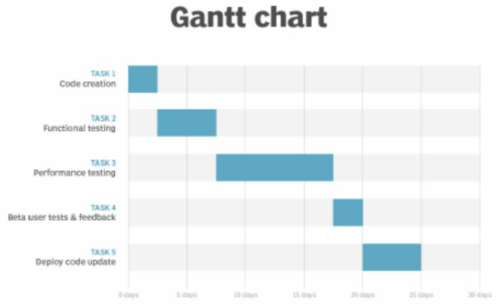
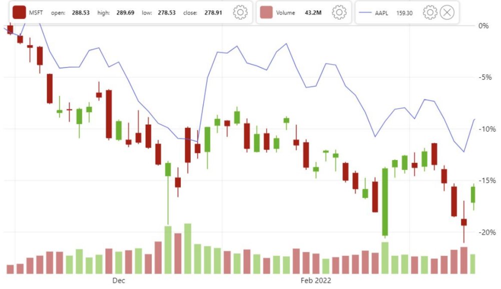








Data

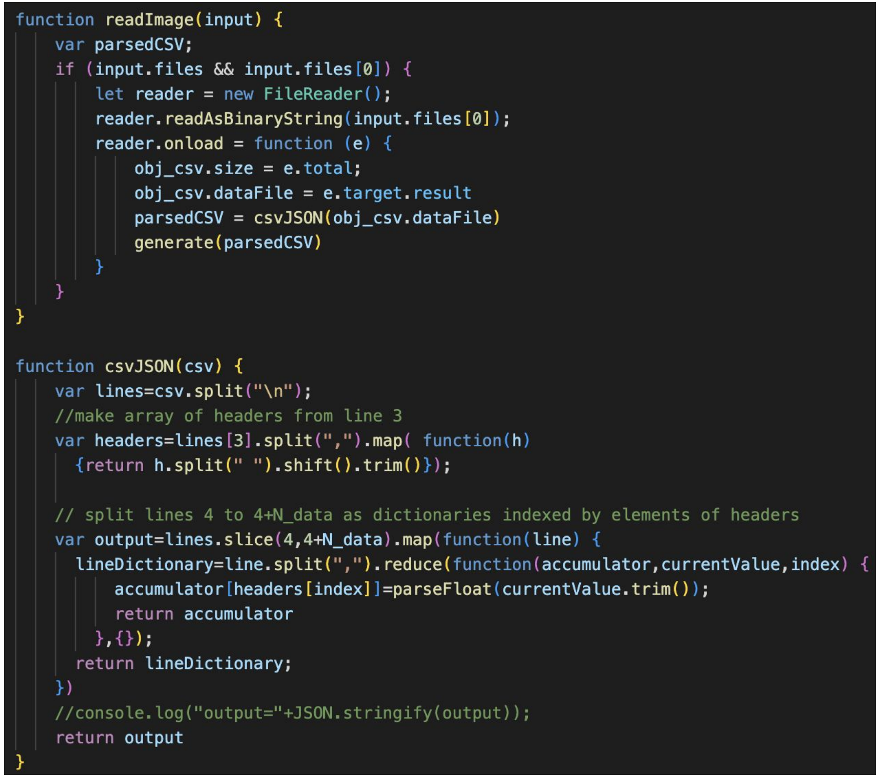
Crop harvest data

Columns: Distance, VRYieldVolume, Wetmass, Moisture

Change of these values over time

Normalized by column

Code : Preprocessing



```
function readImage(input) {
    var parsedCSV;
    if (input.files && input.files[0]) {
        let reader = new FileReader();
        reader.readAsBinaryString(input.files[0]);
        reader.onload = function (e) {
            obj_csv.size = e.total;
            obj_csv.dataFile = e.target.result
            parsedCSV = csvJSON(obj_csv.dataFile)
            generate(parsedCSV)
        }
    }
}

function csvJSON(csv) {
    var lines=csv.split("\n");
    //make array of headers from line 3
    var headers=lines[3].split(",").map( function(h)
      {return h.split(" ").shift().trim()});

    // split lines 4 to 4+N_data as dictionaries indexed by elements of headers
    var output=lines.slice(4,4+N_data).map(function(line) {
      lineDictionary=line.split(",").reduce(function(accumulator,currentValue,index) {
        accumulator[headers[index]]=parseFloat(currentValue.trim());
        return accumulator
      },{});
      return lineDictionary;
    })
    //console.log("output="+JSON.stringify(output));
    return output
}
```

readImage()

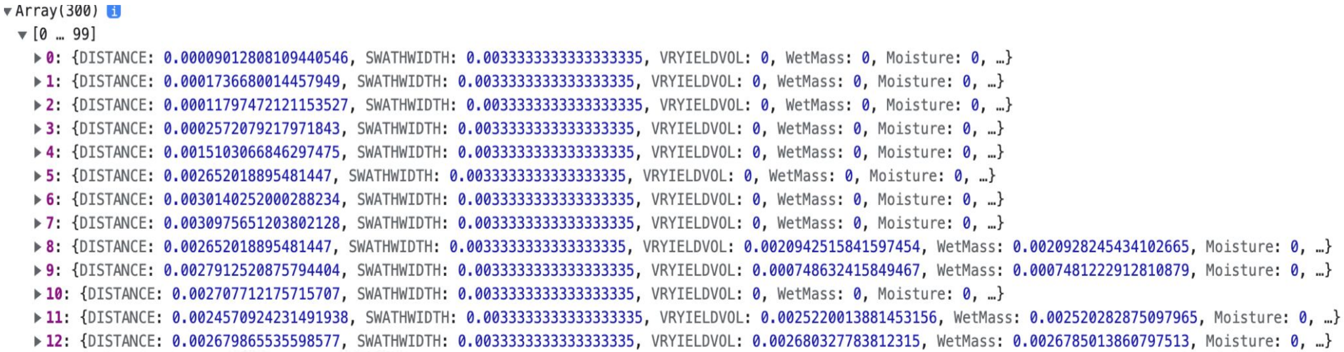
trigger function

onload event -> parse and preprocess the csv file

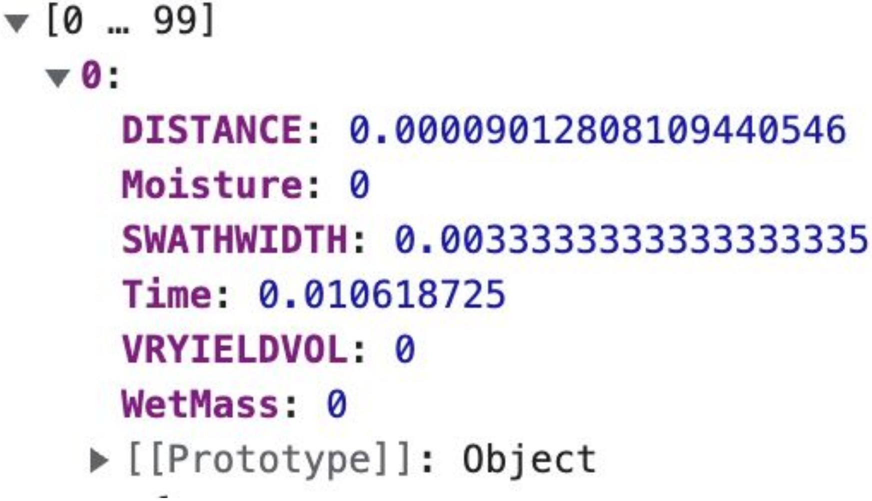
csvJSON()

Convert csv file to JSON object

Csv to JSON

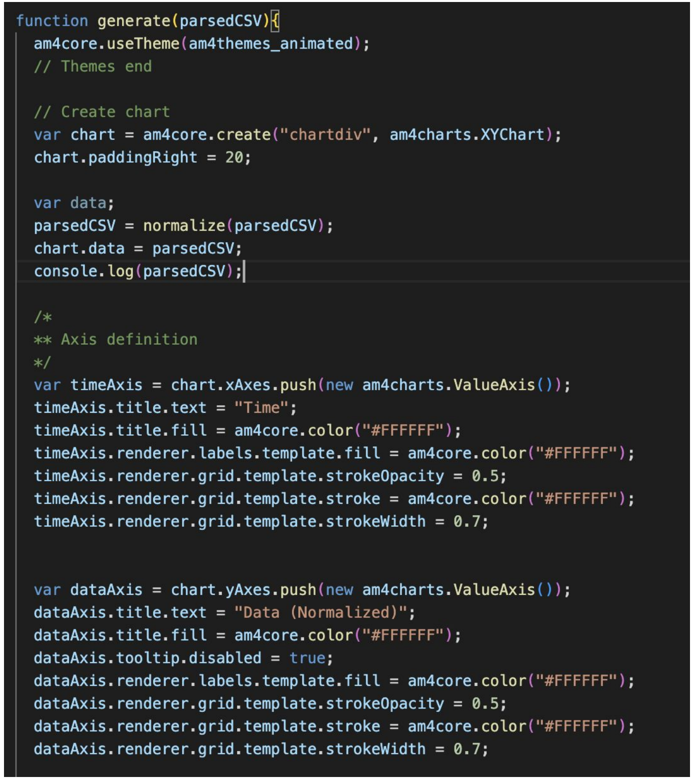


```
▼ Array(300)
  ▼ [0 … 99]
    ▶ 0: {DISTANCE: 0.000090128081094405546, SWATHWIDTH: 0.0033333333333333335, VRYIELDVOL: 0, WetMass: 0, Moisture: 0, …}
    ▶ 1: {DISTANCE: 0.0001736680014457949, SWATHWIDTH: 0.0033333333333333335, VRYIELDVOL: 0, WetMass: 0, Moisture: 0, …}
    ▶ 2: {DISTANCE: 0.00011797472121153527, SWATHWIDTH: 0.0033333333333333335, VRYIELDVOL: 0, WetMass: 0, Moisture: 0, …}
    ▶ 3: {DISTANCE: 0.0002572079217971843, SWATHWIDTH: 0.0033333333333333335, VRYIELDVOL: 0, WetMass: 0, Moisture: 0, …}
    ▶ 4: {DISTANCE: 0.0015103066846297475, SWATHWIDTH: 0.0033333333333333335, VRYIELDVOL: 0, WetMass: 0, Moisture: 0, …}
    ▶ 5: {DISTANCE: 0.002652018895481447, SWATHWIDTH: 0.0033333333333333335, VRYIELDVOL: 0, WetMass: 0, Moisture: 0, …}
    ▶ 6: {DISTANCE: 0.0030140252000288234, SWATHWIDTH: 0.0033333333333333335, VRYIELDVOL: 0, WetMass: 0, Moisture: 0, …}
    ▶ 7: {DISTANCE: 0.0030975651203802128, SWATHWIDTH: 0.0033333333333333335, VRYIELDVOL: 0, WetMass: 0, Moisture: 0, …}
    ▶ 8: {DISTANCE: 0.002652018895481447, SWATHWIDTH: 0.0033333333333333335, VRYIELDVOL: 0.0020942515841597454, WetMass: 0.0020928245434102665, Moisture: 0, …}
    ▶ 9: {DISTANCE: 0.0027912520875794404, SWATHWIDTH: 0.0033333333333333335, VRYIELDVOL: 0.0007486324158494467, WetMass: 0.0007481222912810879, Moisture: 0, …}
    ▶ 10: {DISTANCE: 0.002707712175715707, SWATHWIDTH: 0.0033333333333333335, VRYIELDVOL: 0, WetMass: 0, Moisture: 0, …}
    ▶ 11: {DISTANCE: 0.0024570924231491938, SWATHWIDTH: 0.0033333333333333335, VRYIELDVOL: 0.0025220013881453156, WetMass: 0.002520282875097965, Moisture: 0, …}
    ▶ 12: {DISTANCE: 0.002679865535598577, SWATHWIDTH: 0.0033333333333333335, VRYIELDVOL: 0.002680327783812315, WetMass: 0.0026785013860797513, Moisture: 0, …}
```



```
▼ [0 … 99]
  ▼ 0:
      DISTANCE: 0.000090128081094405546
      Moisture: 0
      SWATHWIDTH: 0.0033333333333333335
      Time: 0.010618725
      VRYIELDVOL: 0
      WetMass: 0
    ▶ [[Prototype]]: Object
```

Axis and Series Configuration



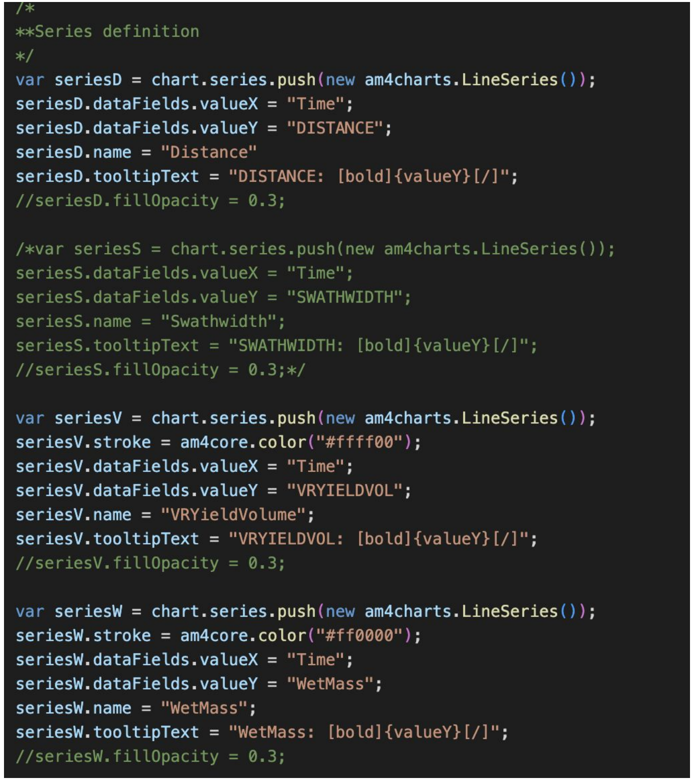
```
function generate(parsedCSV){
    am4core.useTheme(am4themes_animated);
    // Themes end

    // Create chart
    var chart = am4core.create("chartdiv", am4charts.XYChart);
    chart.paddingRight = 20;

    var data;
    parsedCSV = normalize(parsedCSV);
    chart.data = parsedCSV;
    console.log(parsedCSV);

    /*
    ** Axis definition
    */
    var timeAxis = chart.xAxes.push(new am4charts.ValueAxis());
    timeAxis.title.text = "Time";
    timeAxis.title.fill = am4core.color("#FFFFFF");
    timeAxis.renderer.labels.template.fill = am4core.color("#FFFFFF");
    timeAxis.renderer.grid.template.strokeOpacity = 0.5;
    timeAxis.renderer.grid.template.stroke = am4core.color("#FFFFFF");
    timeAxis.renderer.grid.template.strokeWidth = 0.7;


    var dataAxis = chart.yAxes.push(new am4charts.ValueAxis());
    dataAxis.title.text = "Data (Normalized)";
    dataAxis.title.fill = am4core.color("#FFFFFF");
    dataAxis.tooltip.disabled = true;
    dataAxis.renderer.labels.template.fill = am4core.color("#FFFFFF");
    dataAxis.renderer.grid.template.strokeOpacity = 0.5;
    dataAxis.renderer.grid.template.stroke = am4core.color("#FFFFFF");
    dataAxis.renderer.grid.template.strokeWidth = 0.7;
```



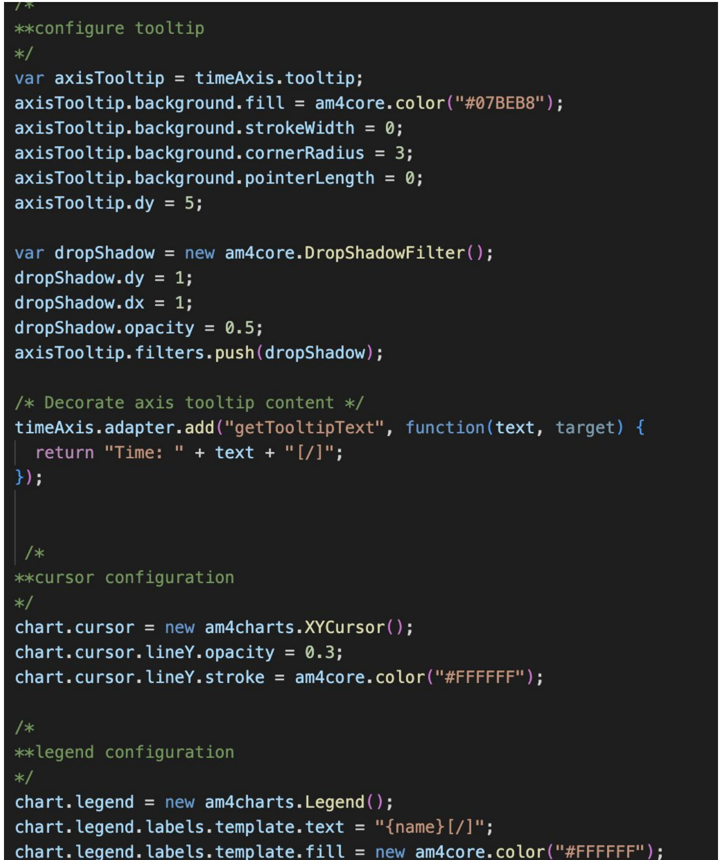
```
/*
**Series definition
*/
var seriesD = chart.series.push(new am4charts.LineSeries());
seriesD.dataFields.valueX = "Time";
seriesD.dataFields.valueY = "DISTANCE";
seriesD.name = "Distance"
seriesD.tooltipText = "DISTANCE: [bold]{valueY}[/]";
//seriesD.fillOpacity = 0.3;

/*var seriesS = chart.series.push(new am4charts.LineSeries());
seriesS.dataFields.valueX = "Time";
seriesS.dataFields.valueY = "SWATHWIDTH";
seriesS.name = "Swathwidth";
seriesS.tooltipText = "SWATHWIDTH: [bold]{valueY}[/]";
//seriesS.fillOpacity = 0.3;*/

var seriesV = chart.series.push(new am4charts.LineSeries());
seriesV.stroke = am4core.color("#ffff00");
seriesV.dataFields.valueX = "Time";
seriesV.dataFields.valueY = "VRYIELDVOL";
seriesV.name = "VRYieldVolume";
seriesV.tooltipText = "VRYIELDVOL: [bold]{valueY}[/]";
//seriesV.fillOpacity = 0.3;

var seriesW = chart.series.push(new am4charts.LineSeries());
seriesW.stroke = am4core.color("#ff0000");
seriesW.dataFields.valueX = "Time";
seriesW.dataFields.valueY = "WetMass";
seriesW.name = "WetMass";
seriesW.tooltipText = "WetMass: [bold]{valueY}[/]";
//seriesW.fillOpacity = 0.3;
```

Tooltips Configuration



```
/*
**configure tooltip
*/
var axisTooltip = timeAxis.tooltip;
axisTooltip.background.fill = am4core.color("#07BEB8");
axisTooltip.background.strokeWidth = 0;
axisTooltip.background.cornerRadius = 3;
axisTooltip.background.pointerLength = 0;
axisTooltip.dy = 5;

var dropShadow = new am4core.DropShadowFilter();
dropShadow.dy = 1;
dropShadow.dx = 1;
dropShadow.opacity = 0.5;
axisTooltip.filters.push(dropShadow);

/* Decorate axis tooltip content */
timeAxis.adapter.add("getTooltipText", function(text, target) {
  return "Time: " + text + "[/]";
});



 /*
**cursor configuration
*/
chart.cursor = new am4charts.XYCursor();
chart.cursor.lineY.opacity = 0.3;
chart.cursor.lineY.stroke = am4core.color("#FFFFFF");

/*
**legend configuration
*/
chart.legend = new am4charts.Legend();
chart.legend.labels.template.text = "{name}[/]";
chart.legend.labels.template.fill = new am4core.color("#FFFFFF");
```

timeAxis.tooltip

DropShadowFilter

XYcursor()

legend

Advanced Visualization - Chart.js

- js. is an free JavaScript library for making HTML-based charts. It is one of the simplest visualization libraries for JavaScript.

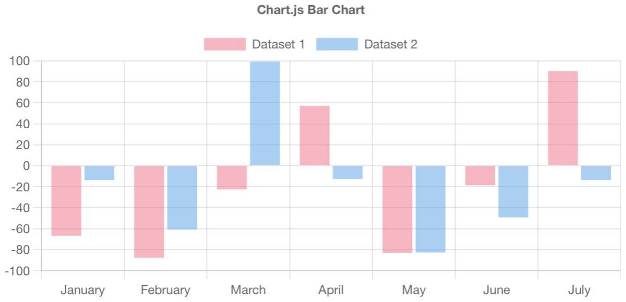
- It is a open source library, which supports 8 different chart types: bar, line, area, pie, bubble, radar, polar and scatter.

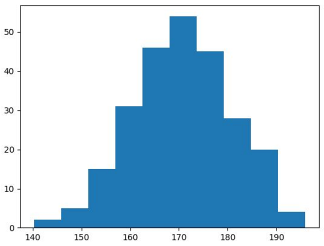
- From scale tracking to animation, it makes graph looks more distinct and better.

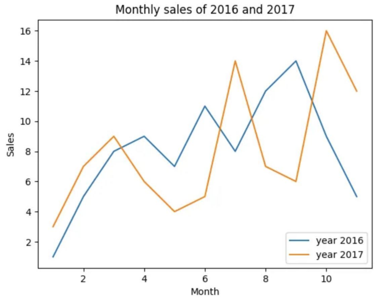
ON
OFF
60
40
20
0
1
2
5
10
20
50
100
A
B
C
D
E
F
G

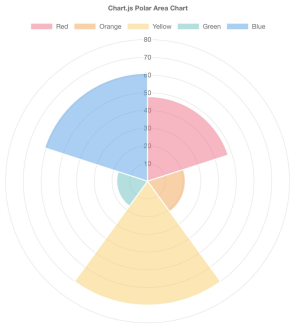
Chart.js

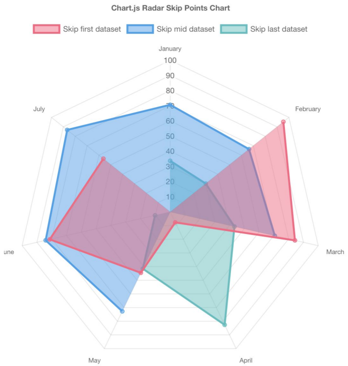
matplotlib

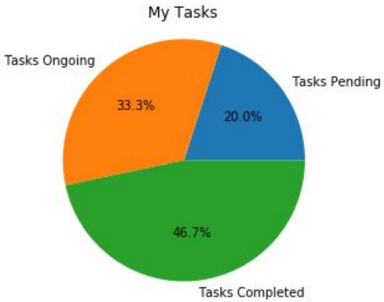




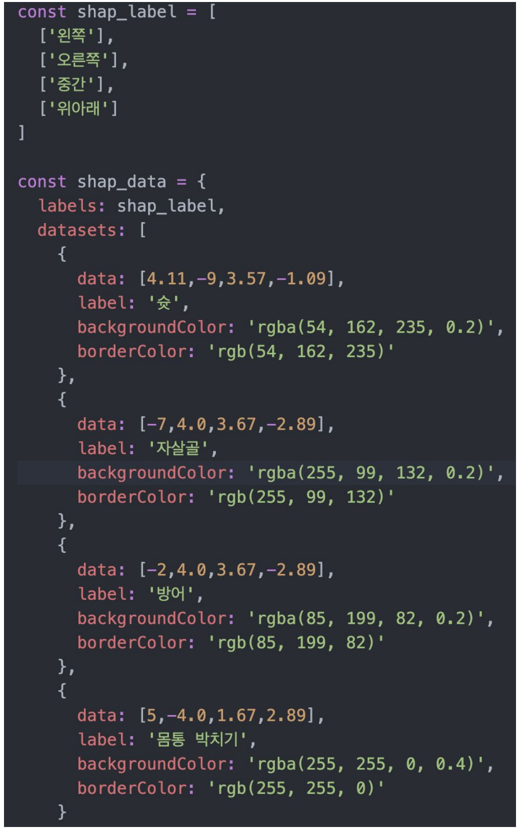






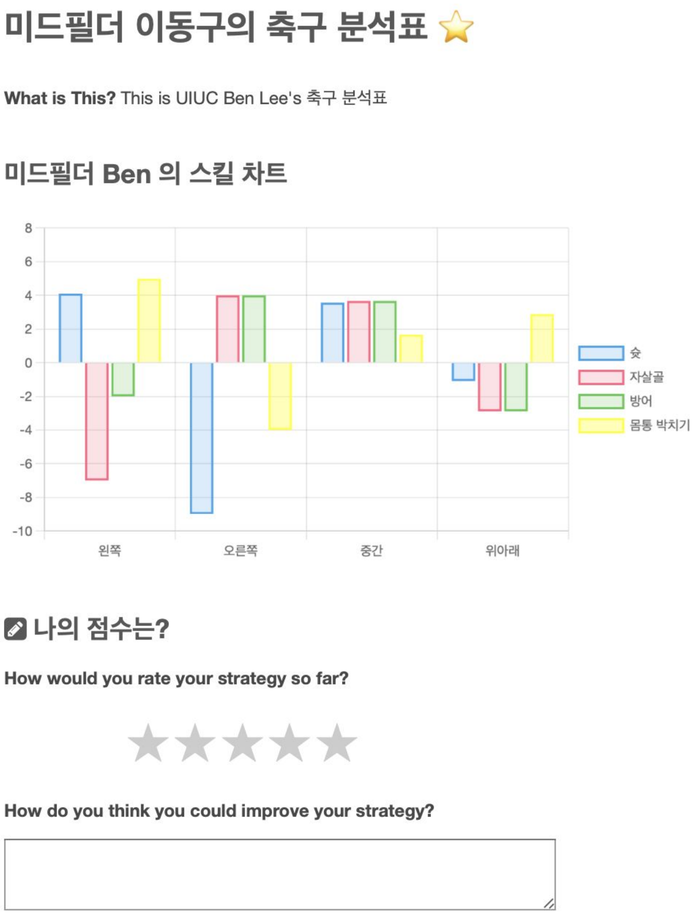


Demo 1



```
const shap_label = [
  ['왼쪽'],
  ['오른쪽'],
  ['중간'],
  ['위아래']
]

const shap_data = {
  labels: shap_label,
  datasets: [
    {
      data: [4.11,-9,3.57,-1.09],
      label: '슛',
      backgroundColor: 'rgba(54, 162, 235, 0.2)',
      borderColor: 'rgb(54, 162, 235)'
    },
    {
      data: [-7,4.0,3.67,-2.89],
      label: '자살골',
      backgroundColor: 'rgba(255, 99, 132, 0.2)',
      borderColor: 'rgb(255, 99, 132)'
    },
    {
      data: [-2,4.0,3.67,-2.89],
      label: '방어',
      backgroundColor: 'rgba(85, 199, 82, 0.2)',
      borderColor: 'rgb(85, 199, 82)'
    },
    {
      data: [5,-4.0,1.67,2.89],
      label: '몸통 박치기',
      backgroundColor: 'rgba(255, 255, 0, 0.4)',
      borderColor: 'rgb(255, 255, 0)'
    }
```



미드필더 이동구의 축구 분석표 ⭐

What is This? This is UIUC Ben Lee's 축구 분석표

미드필더 Ben 의 스킬 차트

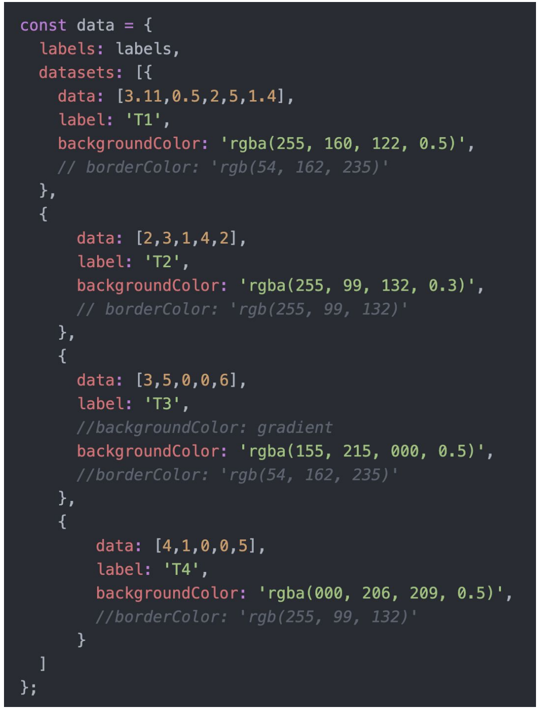
📝 나의 점수는?

How would you rate your strategy so far?

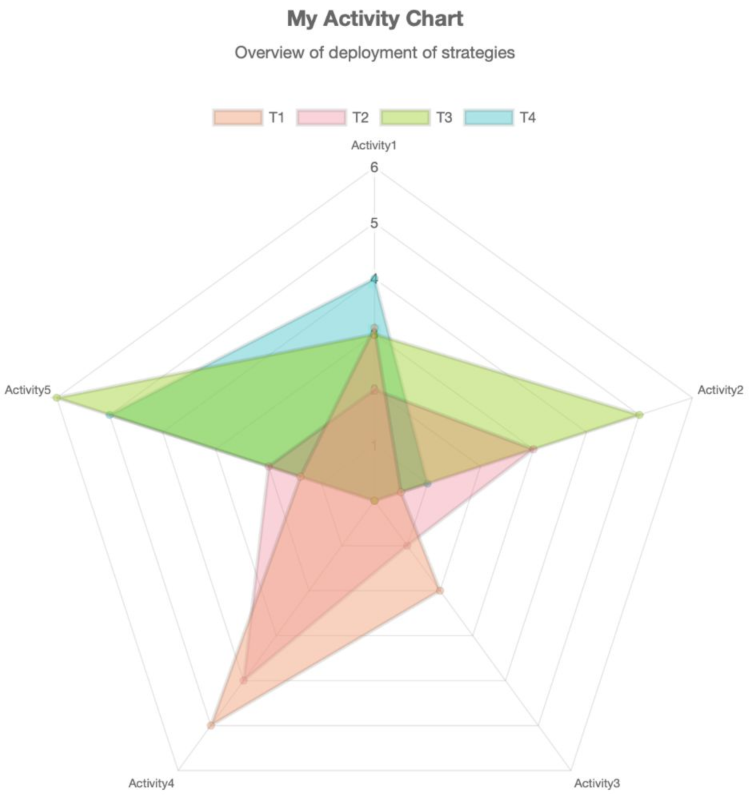
★★★★★

How do you think you could improve your strategy?

Demo 2



```
const data = {
  labels: labels,
  datasets: [{
    data: [3.11,0.5,2,5,1.4],
    label: 'T1',
    backgroundColor: 'rgba(255, 160, 122, 0.5)',
    // borderColor: 'rgb(54, 162, 235)'
  },
  {
      data: [2,3,1,4,2],
      label: 'T2',
      backgroundColor: 'rgba(255, 99, 132, 0.3)',
      // borderColor: 'rgb(255, 99, 132)'
    },
    {
      data: [3,5,0,0,6],
      label: 'T3',
      //backgroundColor: gradient
      backgroundColor: 'rgba(155, 215, 000, 0.5)',
      //borderColor: 'rgb(54, 162, 235)'
    },
    {
        data: [4,1,0,0,5],
        label: 'T4',
        backgroundColor: 'rgba(000, 206, 209, 0.5)',
        //borderColor: 'rgb(255, 99, 132)'
      }
  ]
};
```



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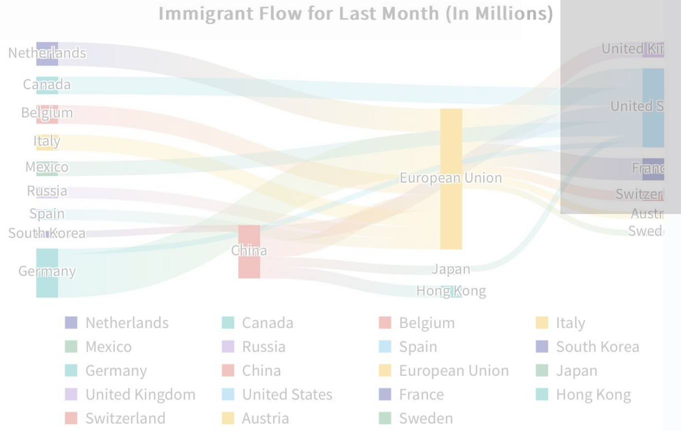
3. Chart.js



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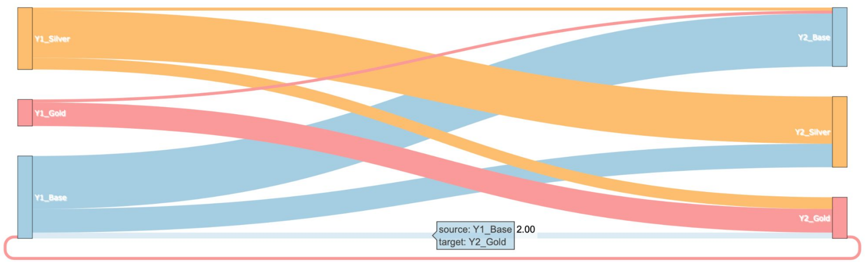

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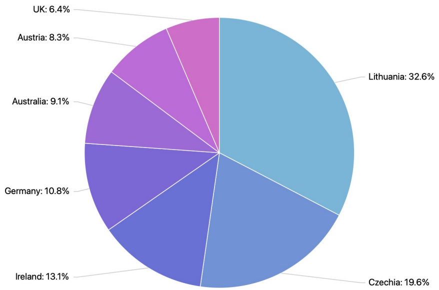
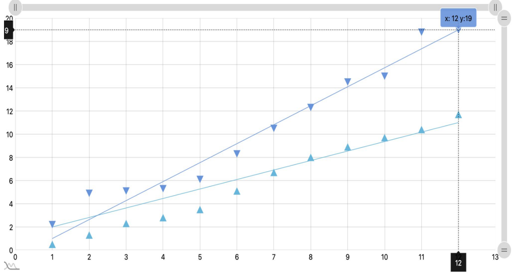
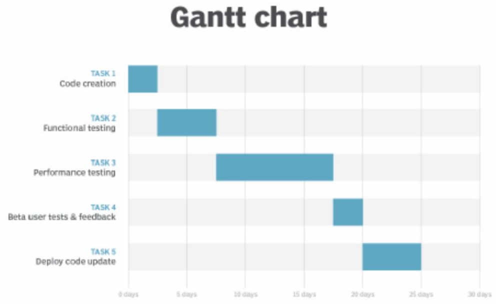
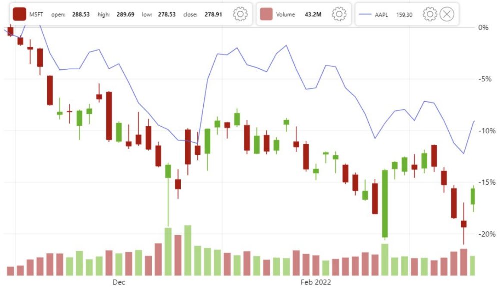
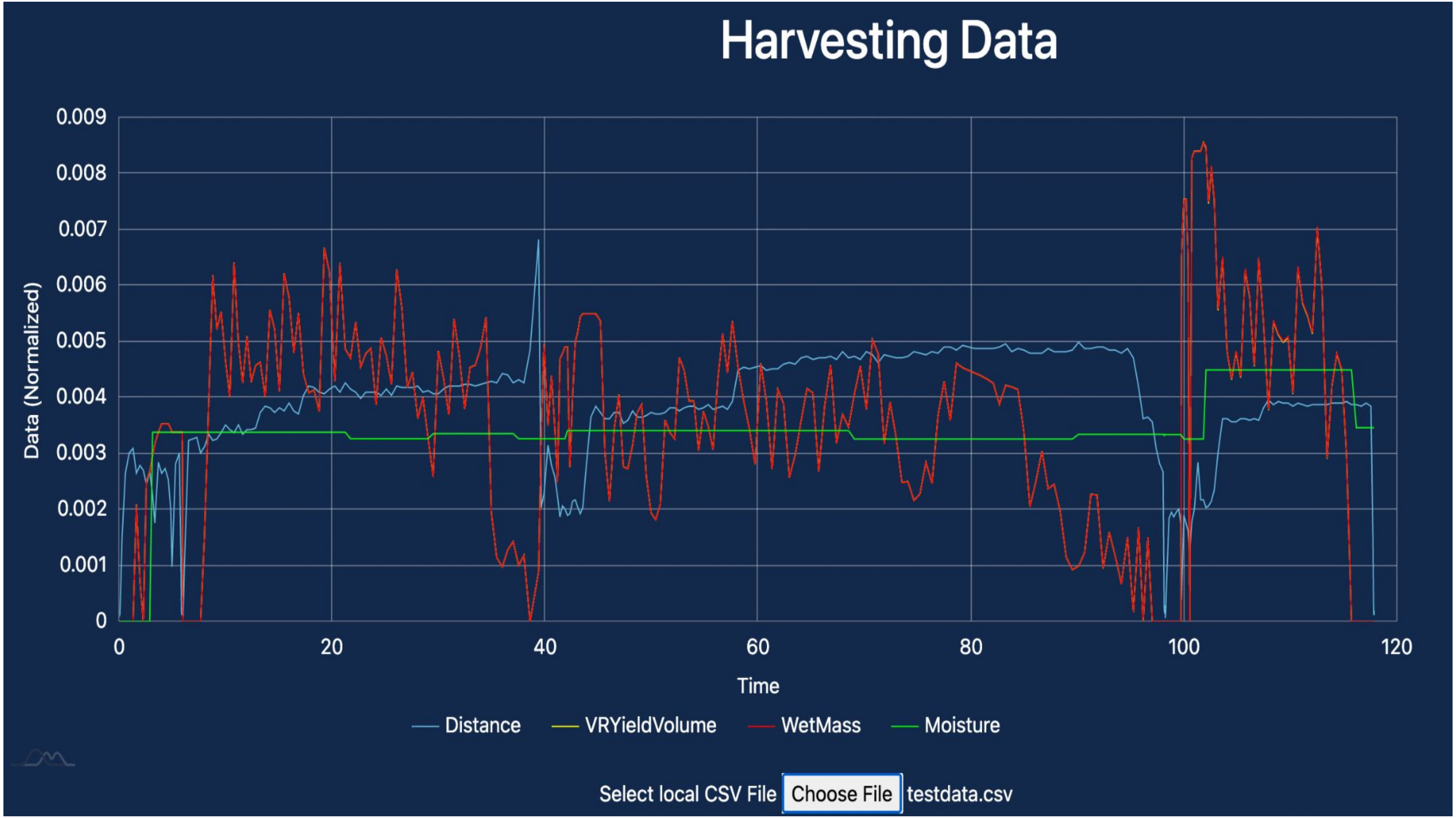










Harvesting Data

Select local CSV File testdata.csv

Advanced Visualization - Chart.js

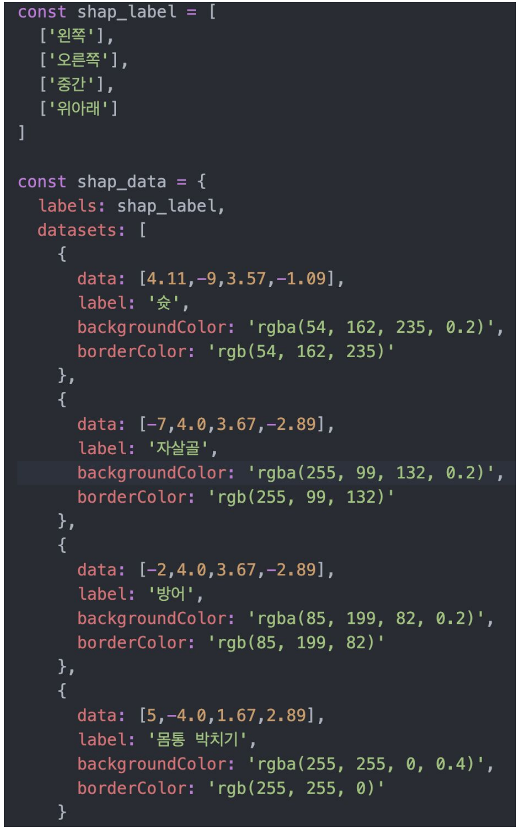
- js. is an free JavaScript library for making HTML-based charts. It is one of the simplest visualization libraries for JavaScript.

- It is a open source library, which supports 8 different chart types: bar, line, area, pie, bubble, radar, polar and scatter.

- From scale tracking to animation, it makes graph looks more distinct and better.

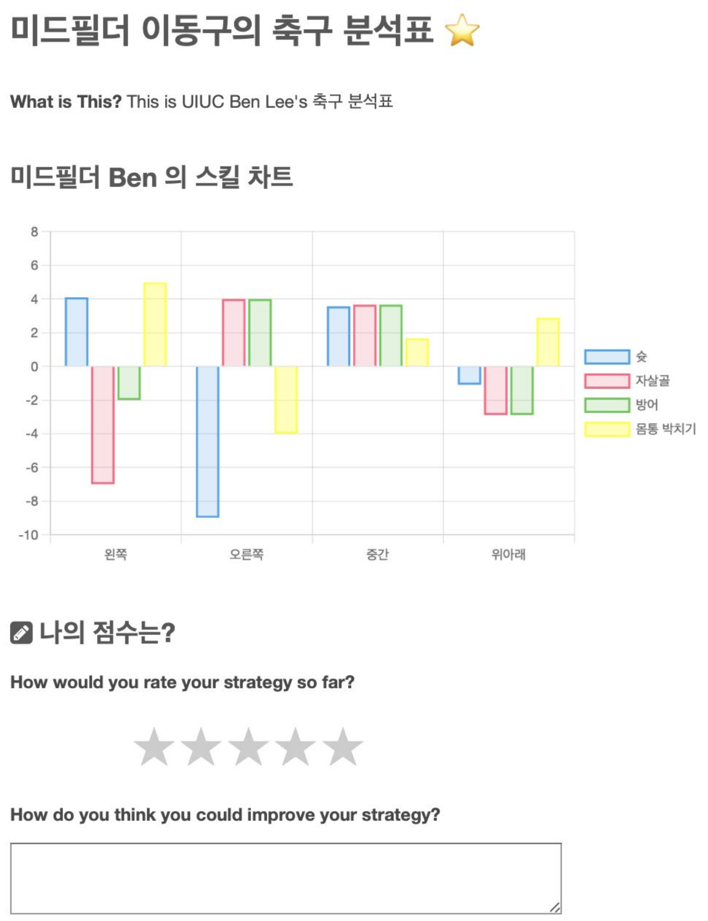
ON
OFF
60
40
20
0
A
B
C
D
E
F
G
1
2
5
10
20
50
100

Demo



```
const shap_label = [
  ['왼쪽'],
  ['오른쪽'],
  ['중간'],
  ['위아래']
]

const shap_data = {
  labels: shap_label,
  datasets: [
    {
      data: [4.11,-9,3.57,-1.09],
      label: '슛',
      backgroundColor: 'rgba(54, 162, 235, 0.2)',
      borderColor: 'rgb(54, 162, 235)'
    },
    {
      data: [-7,4.0,3.67,-2.89],
      label: '자살골',
      backgroundColor: 'rgba(255, 99, 132, 0.2)',
      borderColor: 'rgb(255, 99, 132)'
    },
    {
      data: [-2,4.0,3.67,-2.89],
      label: '방어',
      backgroundColor: 'rgba(85, 199, 82, 0.2)',
      borderColor: 'rgb(85, 199, 82)'
    },
    {
      data: [5,-4.0,1.67,2.89],
      label: '몸통 박치기',
      backgroundColor: 'rgba(255, 255, 0, 0.4)',
      borderColor: 'rgb(255, 255, 0)'
    }
```



미드필더 이동구의 축구 분석표 ⭐

What is This? This is UIUC Ben Lee's 축구 분석표

미드필더 Ben 의 스킬 차트

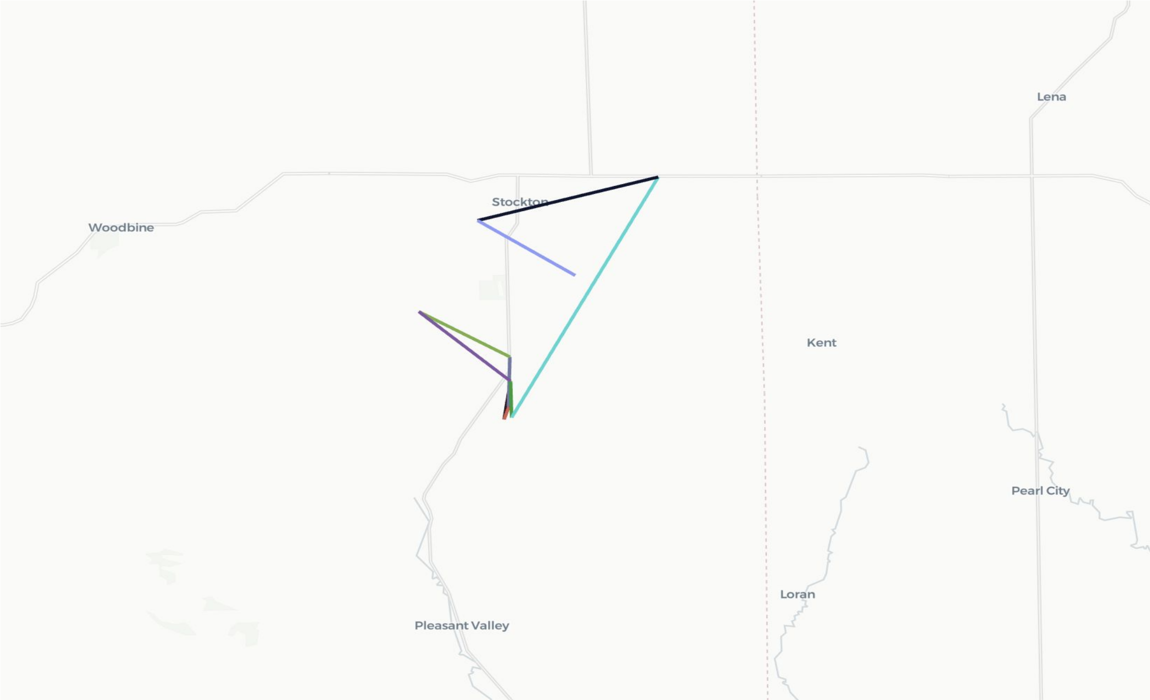
✎ 나의 점수는?

How would you rate your strategy so far?

★★★★★

How do you think you could improve your strategy?

Advanced Visualization - Trips Layer/Path Layer


Lena
Stockton
Woodbine
Kent
Pearl City
Loran
Pleasant Valley