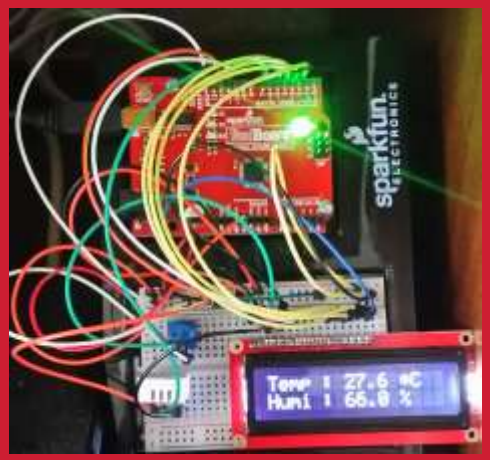
Arduino-IOT

[wk07]

Data Visualization I - plotly.js charts



Visualization of Signals using Arduino, Node.js & storing signals in MongoDB & mining data using Python

Drone-IoT-Comsi, INJE University

2nd semester, 2021

Email : chaos21c@gmail.com

My ID

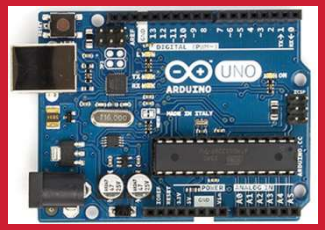
ID를 확인하고 github에 repo 만들기

AA01	김준수	AA13	조재윤
AA02	김현서	AA14	고태승
AA03	박영훈	AA15	이한글
AA04	박윤호	AA16	장세진
AA05	성은지	AA17	장태호
AA06	손윤우	AA18	정지원
AA07	오세윤	AA19	진우태
AA08	우승철	AA20	황혁준
AA09	윤현석	AA21	장이제
AA10	이예주	AA22	박상현
AA11	강지환	AA23	정은성
AA12	성인제	AA24	김경영

위의 id를 이용해서 github에 repo를 만드시오.

Option: 아두이노응용 실습 과제 – **AAnn**

Public, **README.md check**



[Review]

- [wk06]
  - Arduino sensors + Node.js
  - Complete your project
  - Upload folder: aann-rpt06
  - Use repo “aann” in github

wk06 : Practice : aann-rpt06

- [Target of this week]
  - Complete your works
  - Save your outcomes and upload outputs in github repo.

제출폴더명 : **aann-rpt06**

- 압축할 파일들

① AAnn_tmp36_message.png

② AAnn_tmp36_IOT_data.png

③ AAnn_cds_tmp36_serial.png

④ AAnn_cds_tmp36_lcd.png

⑤ AAnn_cds_tmp36_IOT.png

⑥ AAnn_cds_tmp36_WEB.png

⑦ AAnn_multi_signals_node.png

⑧ AAnn_multi_signals_WEB.png

⑨ All *.ino

⑩ All *.js

⑪ NO node_modules folder

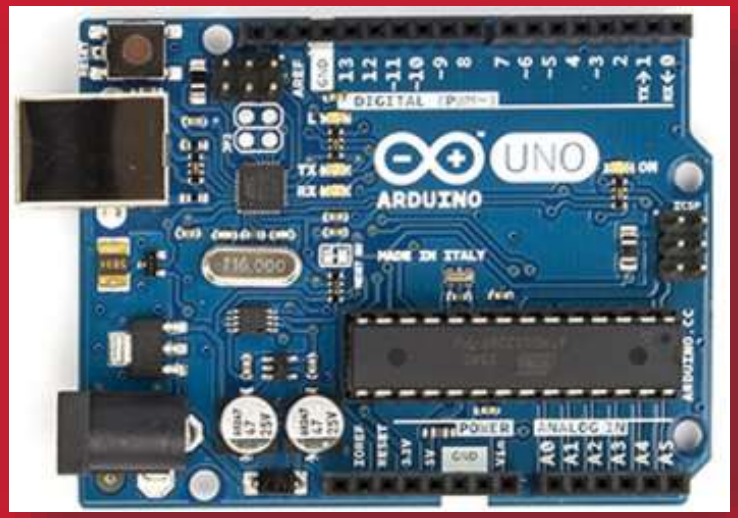
Purpose of AA

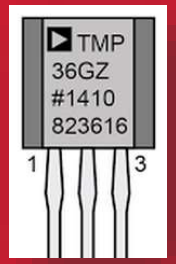
주요 수업 목표는 다음과 같다.

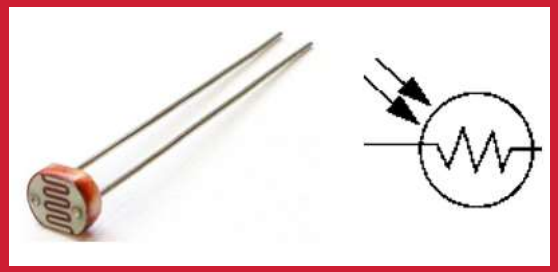
1. Node.js를 이용한 아두이노 센서 신호 처리
2. Plotly.js를 이용한 아두이노 센서 신호 시각화
3. MongoDB에 아두이노 센서 데이터 저장 및 처리

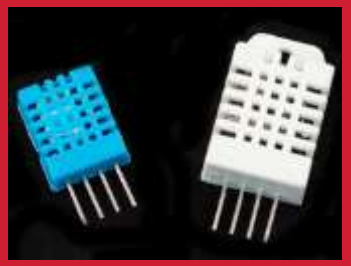
4. 저장된 IoT 데이터의 마이닝 (파이썬 코딩)

Arduino Sensors + Node.js









IOT: HSC

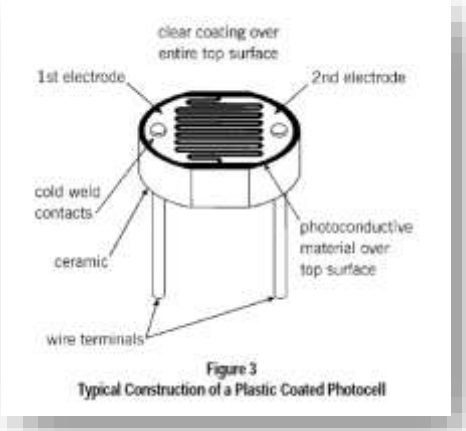
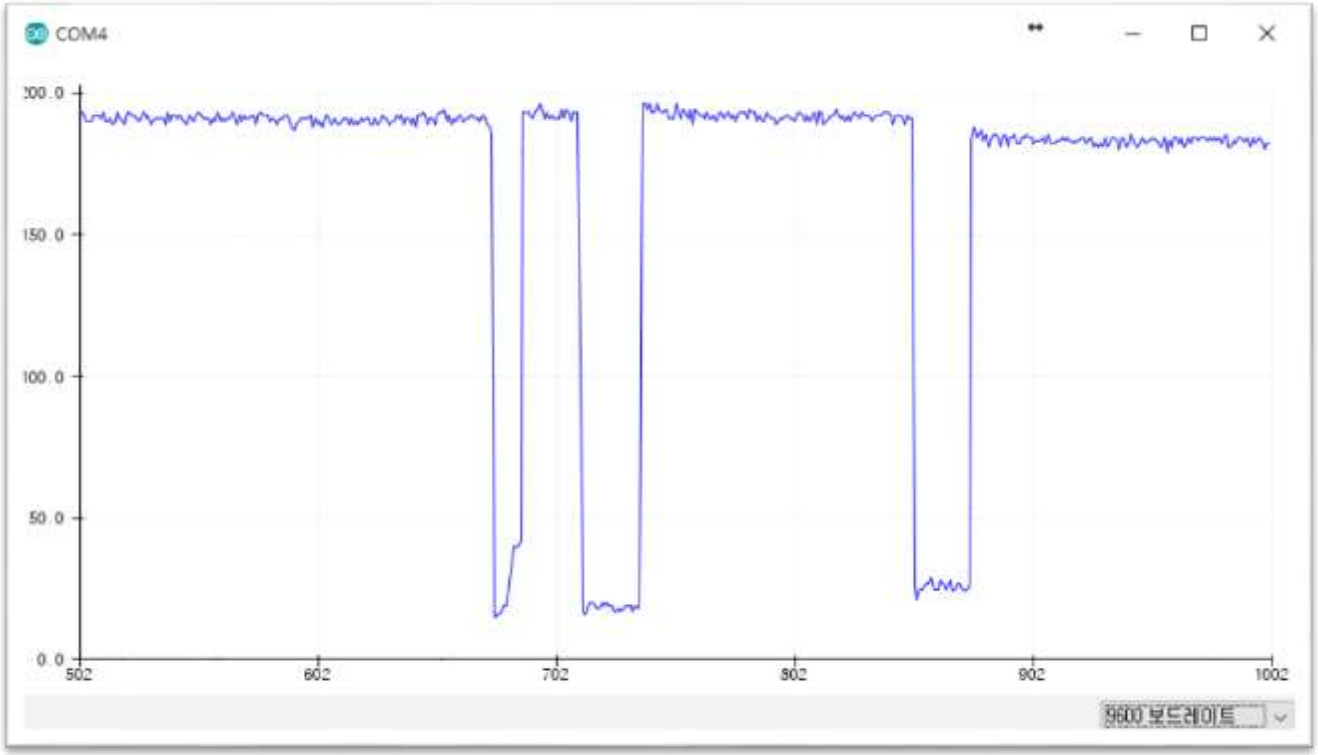
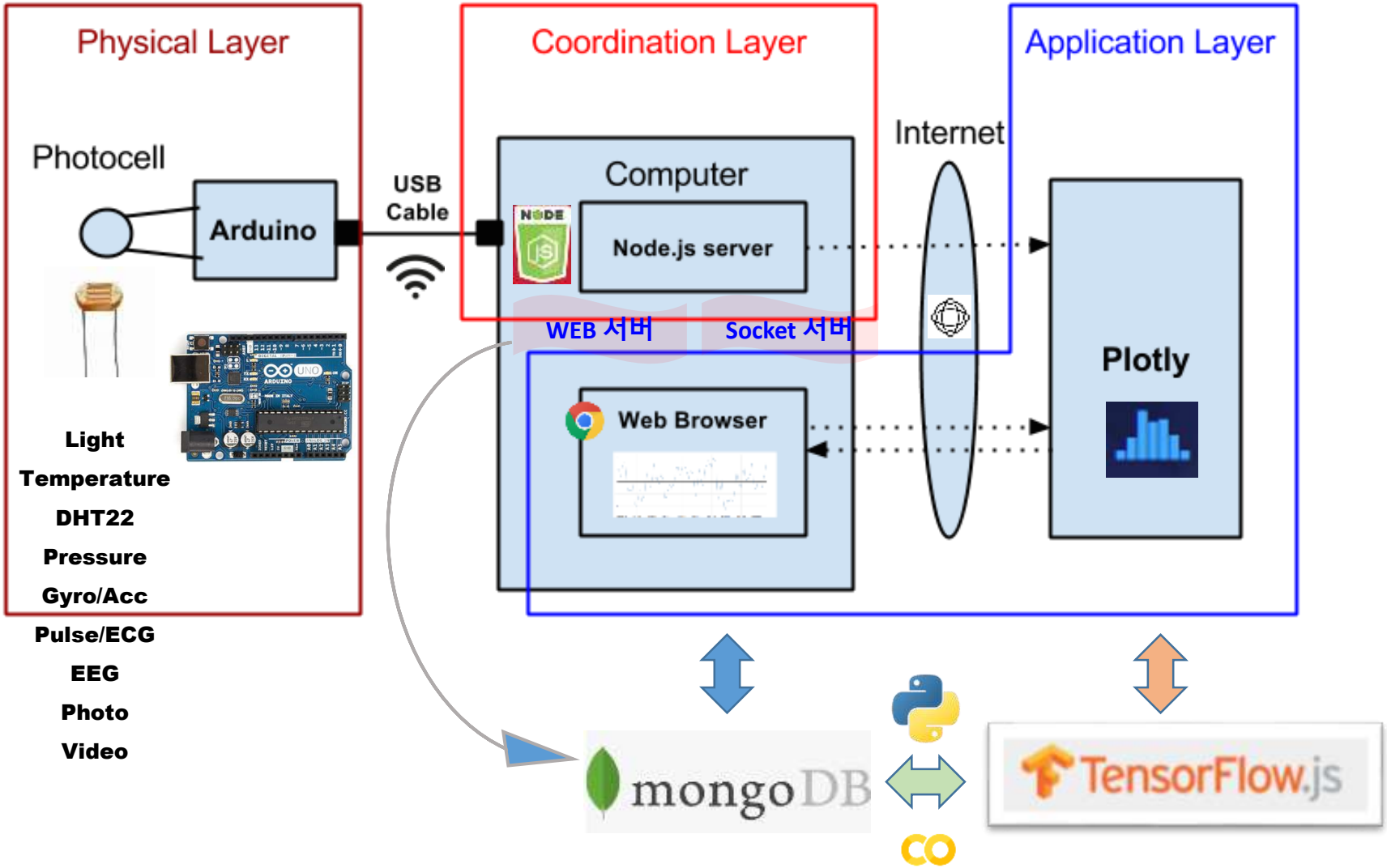


Figure 3
Typical Construction of a Plastic Coated Photocell



Layout [H S C]


Physical Layer
Photocell
Arduino
Light
Temperature
DHT22
Pressure
Gyro/Acc
Pulse/ECG
EEG
Photo
Video
USB
Cable
Coordination Layer
Computer
Node.js server
WEB 서버
Socket 서버
Web Browser
Internet
Application Layer
Plotly
mongoDB
TensorFlow.js

on WEB monitoring Arduino data

IoT Signal from Arduino

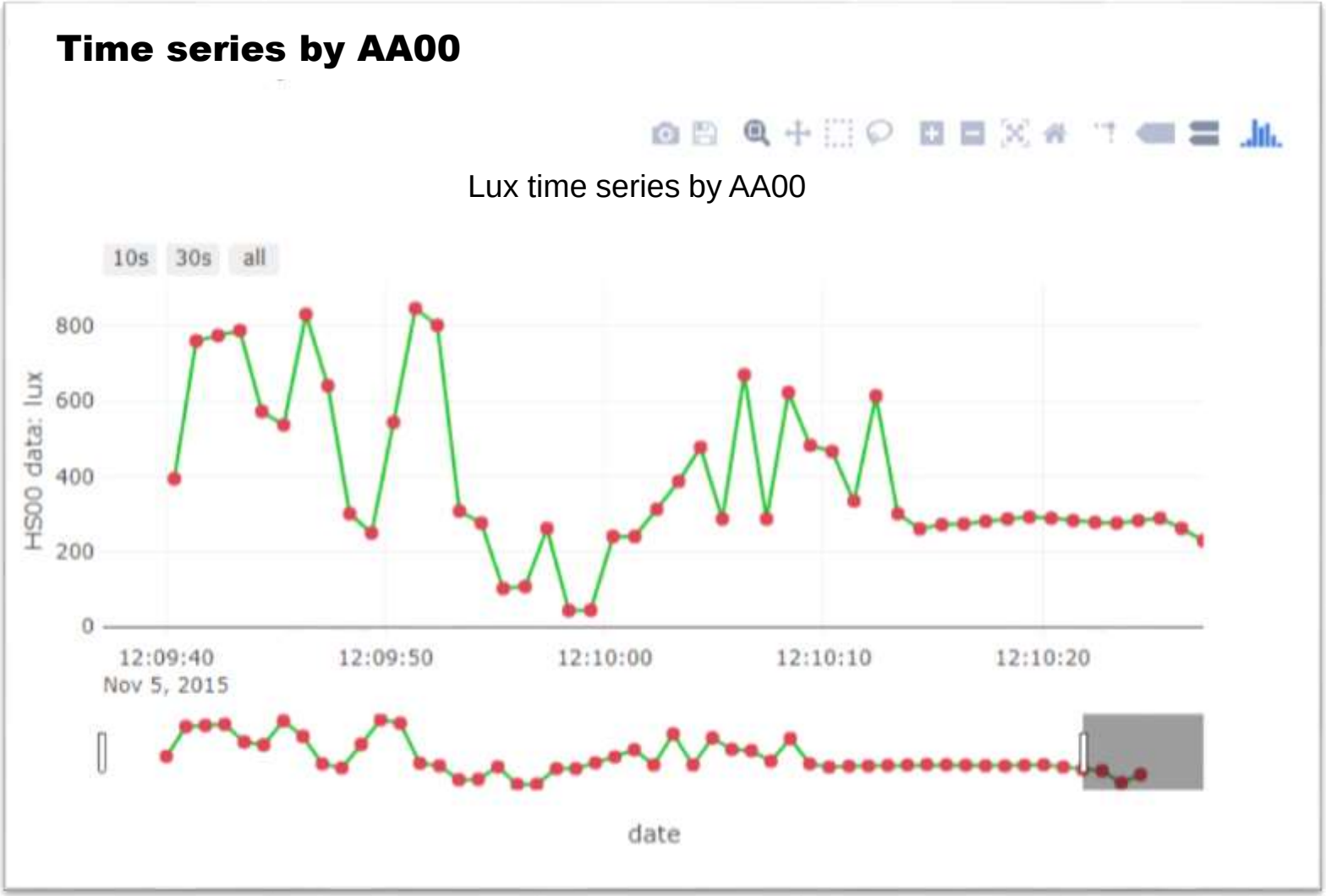
Real-time Signals

on Time: 2021-10-06 09:49:49.818

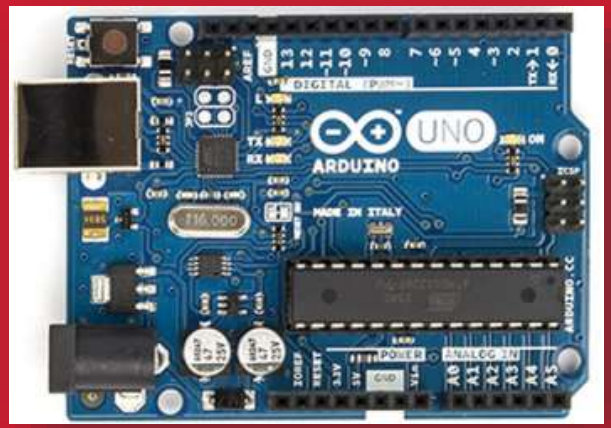
Signals (조도,습도,온도) : 166,60,-5

http://chaos.inje.ac.kr:3030/iot_multi.html

Arduino data + plotly

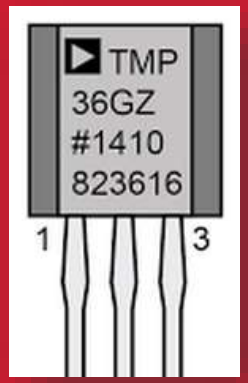


Single sensor: tmp36



TMP36

Node project



A4.1.10 tmp36 node project (date & data → IOT)

[Terminal] node tmp36_node

```
D:\aann\aann-rpt06\iot\tmp36>node tmp36_node
serial port open
AA00,2021-10-05 11:31:03.941,26.25
AA00,2021-10-05 11:31:04.944,26.25
AA00,2021-10-05 11:31:05.945,26.25
AA00,2021-10-05 11:31:06.948,26.25
AA00,2021-10-05 11:31:07.951,26.25
AA00,2021-10-05 11:31:08.951,26.25
AA00,2021-10-05 11:31:09.954,25.76
AA00,2021-10-05 11:31:10.954,26.25
AA00,2021-10-05 11:31:11.958,26.25
AA00,2021-10-05 11:31:12.957,26.25
AA00,2021-10-05 11:31:13.961,26.25
AA00,2021-10-05 11:31:14.964,26.25
AA00,2021-10-05 11:31:15.964,26.25
```

시간 , 온도

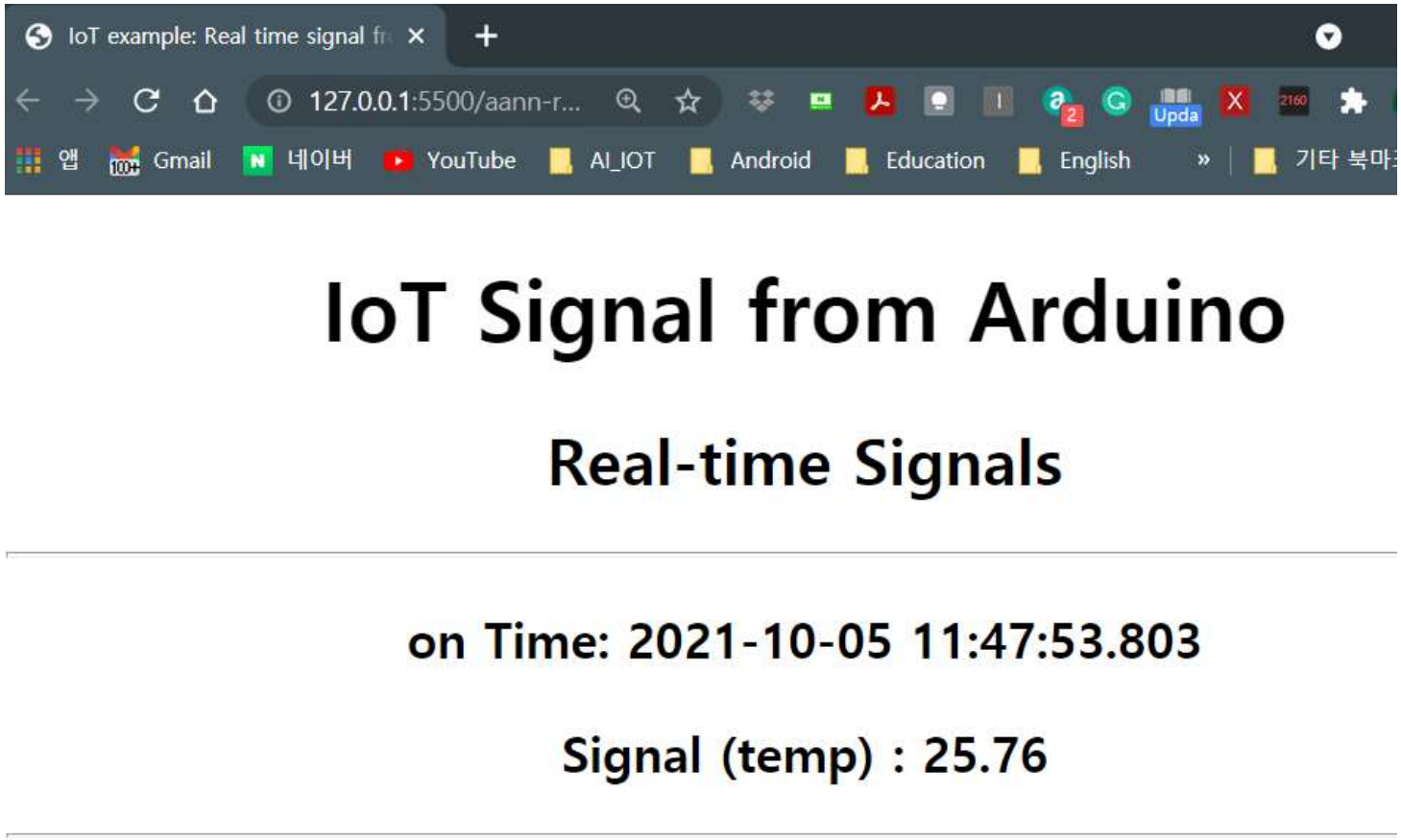
IOT data format
시간, **data**
시간, 온도

AAnn_tmp36_IOT_data.png
로 저장

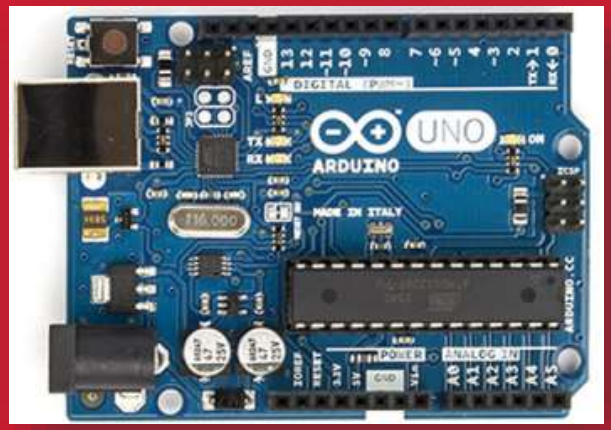
공백없이 “,”로
시간과 온도 구분

A4.1.11 tmp36 node project (web monitoring)

[Web monitoring] client_signal_tmp36.html



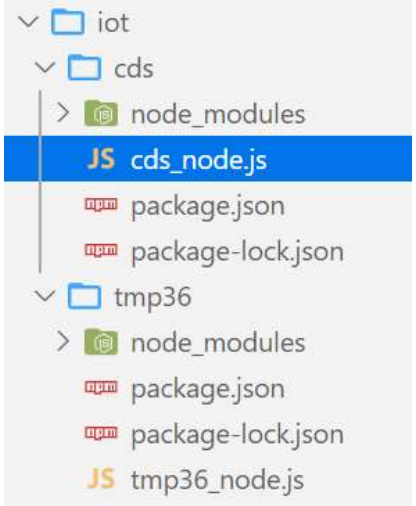
Single sensor: CdS



CdS (LDR)

Node project

A4.2.3 Luminosity sensor [node code]

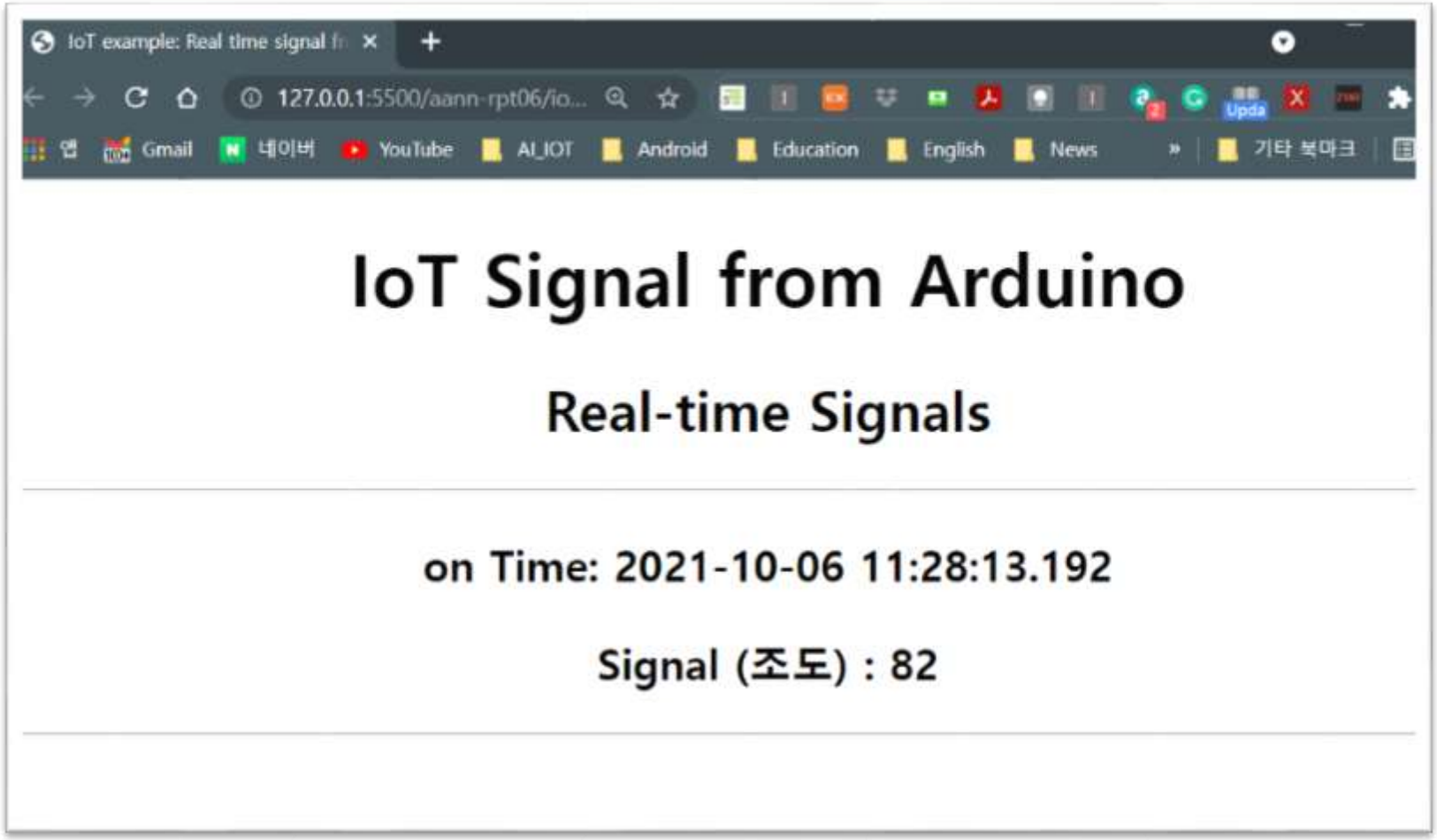


Save tmp36_node.js as cds_node.js in cds folder (code 재활용)

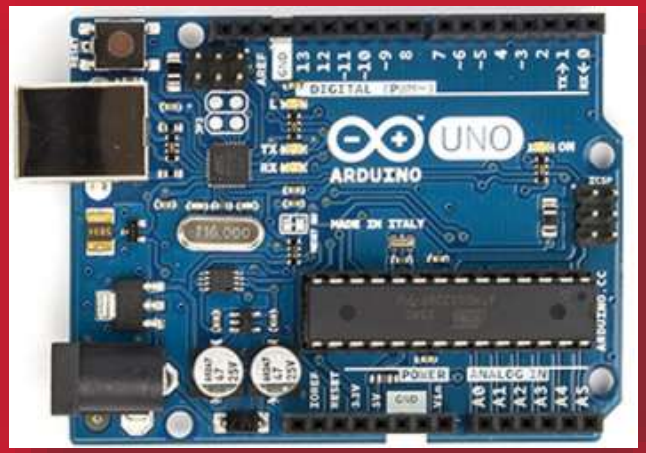
```
D:\aann\aann-rpt06\iot\cds>node cds_node
serial port open
AA00,2021-10-06 11:22:58.665,82
AA00,2021-10-06 11:22:59.669,83
AA00,2021-10-06 11:23:00.668,82
AA00,2021-10-06 11:23:01.672,83
AA00,2021-10-06 11:23:02.672,82
AA00,2021-10-06 11:23:03.675,82
AA00,2021-10-06 11:23:04.675,82
AA00,2021-10-06 11:23:05.678,82
AA00,2021-10-06 11:23:06.678,83
```

A4.2.4 CdS node project (web monitoring)

[Web monitoring] client_signal_cds.html

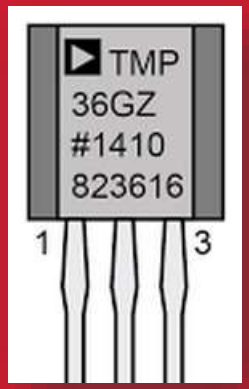


Multiple sensors



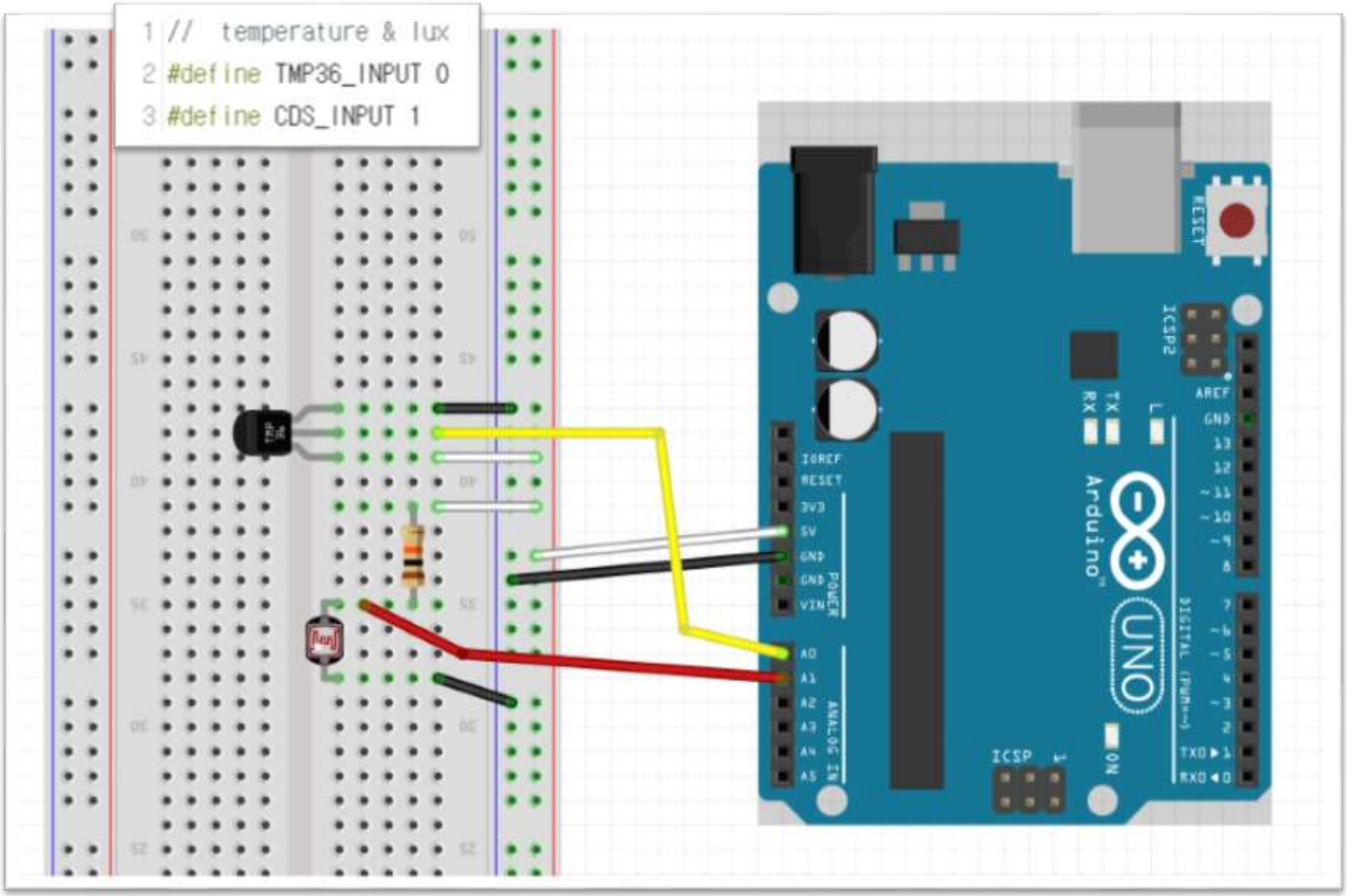
Arduino

+ Node.js

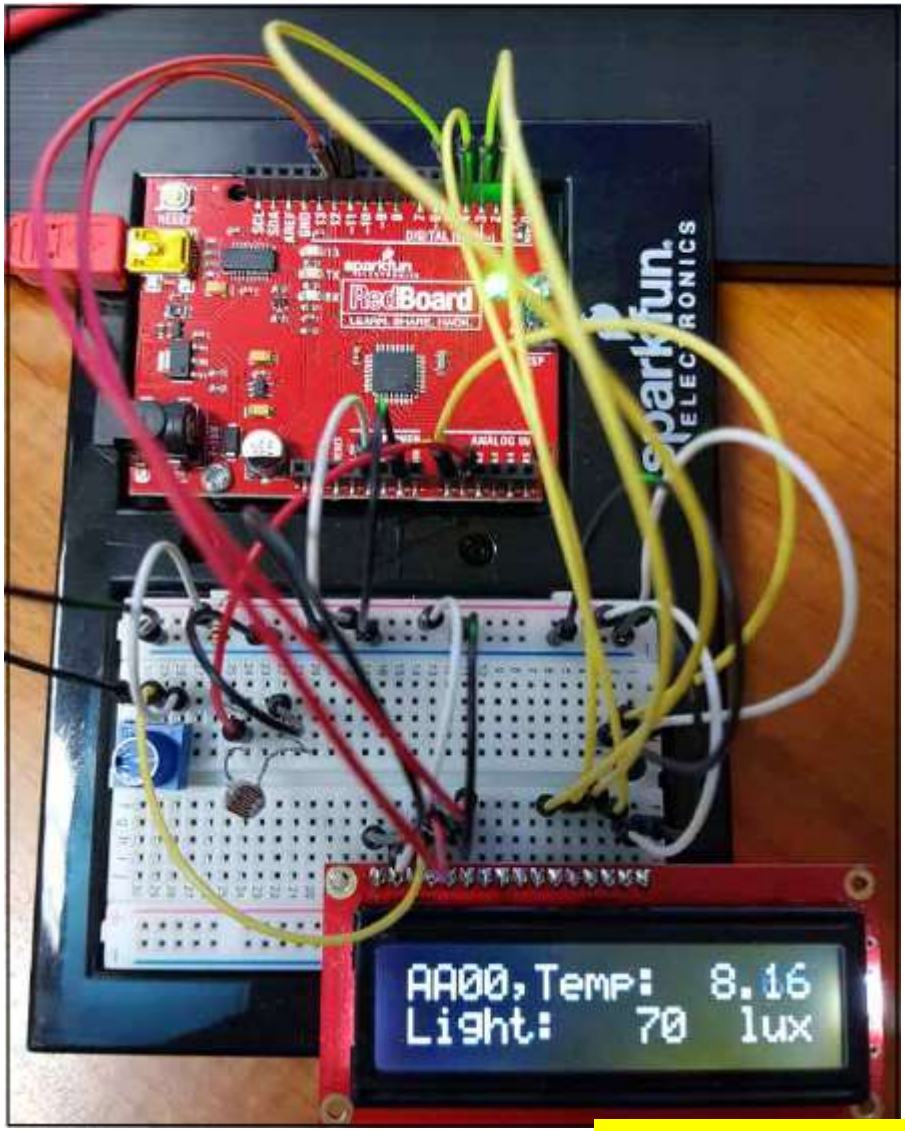


Monitoring via Serial monitor & LCD

A4.3.1 TMP36 + CdS : circuit

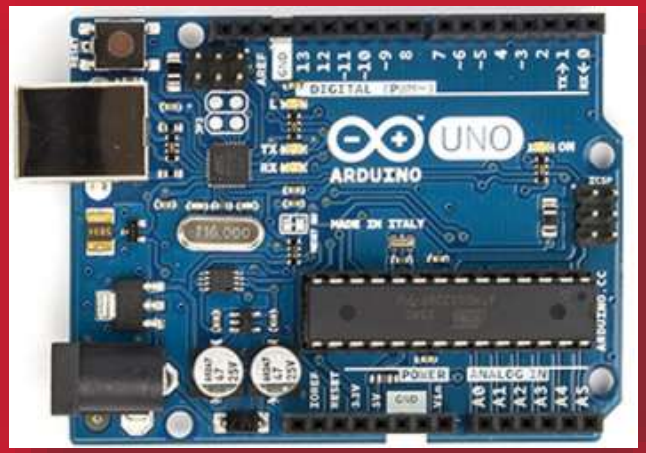


A4.4.5 TMP36 + CdS + LCD : result-2



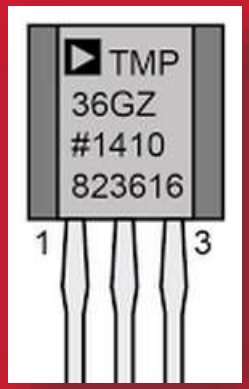
Save as
AAnn_cds_tmp36_lcd.png

Multiple sensors



CdS + TMP36

Node project



A4.5.1 CdS + TMP36 + Node project

1. Make cds_tmp36 node project
- md cds_tmp36 in iot folder
2. Go to cds_tmp36 subfolder
- Start terminal
- npm init

"main": "cds_tmp36_node.js"
"author": “aann"

name : cds_tmp36

description : cds-tmp36-node project

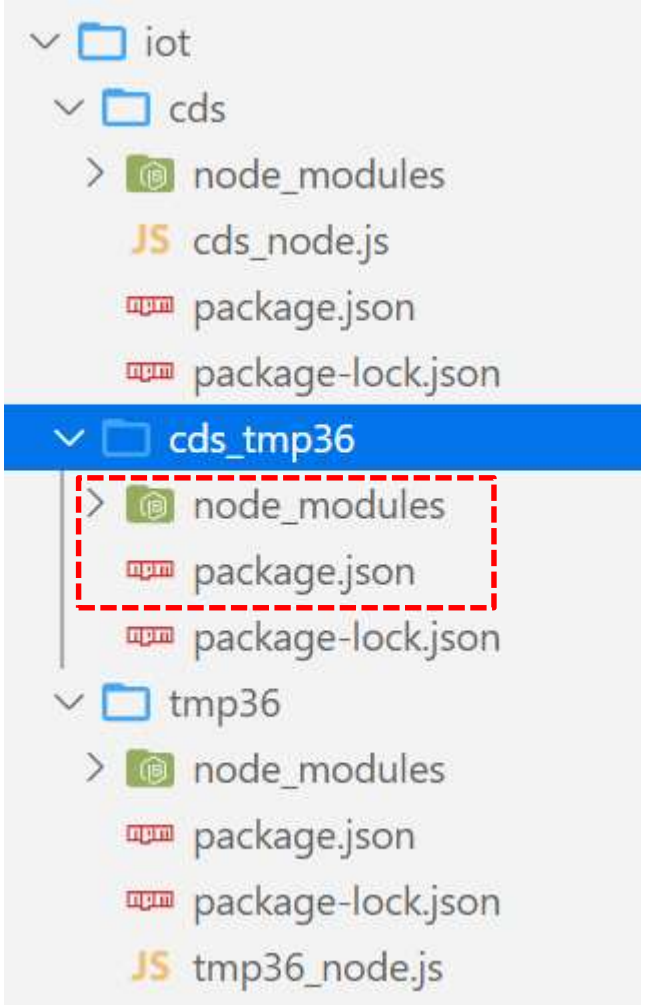
entry point : cds_tmp36_node.js

author : hsnn

A4.5.2 CdS + TMP36 + Node project

- npm install –save serialport
- npm install –save socket.io@2.4.1

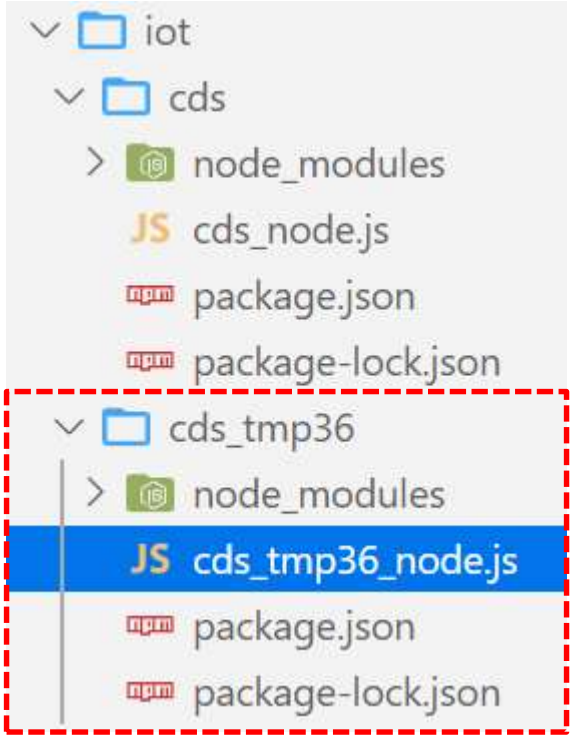
```
"keywords": [
  "cds",
  "tmp36",
  "node"
],
"author": "aa00",
"license": "MIT",
"dependencies": {
  "serialport": "^9.2.4",
  "socket.io": "^2.4.1"
}
```



A4.5.3 CdS + TMP36 + Node project

Recycling code:
코드 재활용

Save cds_node.js as
cds_tmp36_node.js



A4.5.4.1 CdS + TMP36 + Node project : code-1

cds_tmp36_node.js

```
// cds_tmp36_node.js

var serialport = require("serialport");
var portName = "COM3"; // check your COM port!!
var port = process.env.PORT || 3000;

var io = require("socket.io").listen(port);

const Readline = require("@serialport/parser-readline");
// serial port object
var sp = new serialport(portName, {
  baudRate: 9600, // 9600  38400
  dataBits: 8,
  parity: "none",
  stopBits: 1,
  flowControl: false,
  parser: new Readline("\r\n"),
});

const parser = sp.pipe(new Readline({ delimiter: "\r\n" }));

// Read the port data
sp.on("open", () => {
  console.log("serial port open");
});
```

A4.5.4.2 CdS + TMP36 + Node project : code-2

cds_tmp36_node.js – parsing data

```
27  var dStr = "";
28  var readData = "";
29  var temp = "";
30  var lux = "";
31  var mdata = [];
32  var firstcommaidx = 0;
33
34  parser.on("data", (data) => {
35    // call back when data is received
36    readData = data.toString();
37    firstcommaidx = readData.indexOf(",");
38    if (firstcommaidx > 0) {
39      temp = readData.substring(0, firstcommaidx);
40      lux = readData.substring(firstcommaidx + 1);
41      readData = "";
42
43      dStr = getDateString();
44      mdata[0] = dStr; //date
45      mdata[1] = temp; //data
46      mdata[2] = lux;
47      console.log("AA00," + mdata.toString());
48      io.sockets.emit("message", mdata); // send data to all clients
49    } else {
50      console.log(readData);
51    }
52  });
```

Parsing Data

A4.5.4.3 CdS + TMP36 + Node project : code-3

cds_tmp36_node.js

```
54  io.sockets.on("connection", function (socket) {
55    // If socket.io receives message from the client browser then
56    // this call back will be executed.
57    socket.on("message", function (msg) {
58      console.log(msg);
59    });
60    // If a web browser disconnects from Socket.IO then this callback is called.
61    socket.on("disconnect", function () {
62      console.log("disconnected");
63    });
64  });
65
66  // helper function to get a nicely formatted date string for IOT
67  function getDateString() {
68    var time = new Date().getTime();
69    // 32400000 is (GMT+9 Korea, GimHae)
70    // for your timezone just multiply +/-GMT by 3600000
71    var datestr = new Date(time + 32400000)
72      .toISOString()
73      .replace(/T/, " ")
74      .replace(/Z/, "");
75    return datestr;
76  }
```

A4.5.5 CdS + TMP36 + Node project : result

Terminal에서 실행

```
D:\aann\aann-rpt06\iot\cds_tmp36>node cds_tmp36_node
serial port open
AA00,2021-10-05 13:57:38.119,25.27,84
AA00,2021-10-05 13:57:39.119,25.27,84
AA00,2021-10-05 13:57:40.122,24.78,83
AA00,2021-10-05 13:57:41.125,24.78,84
AA00,2021-10-05 13:57:42.125,24.78,84
AA00,2021-10-05 13:57:43.129,25.27,84
AA00,2021-10-05 13:57:44.132,25.27,83
AA00,2021-10-05 13:57:45.132,25.76,83
AA00,2021-10-05 13:57:46.135,24.78,84
```

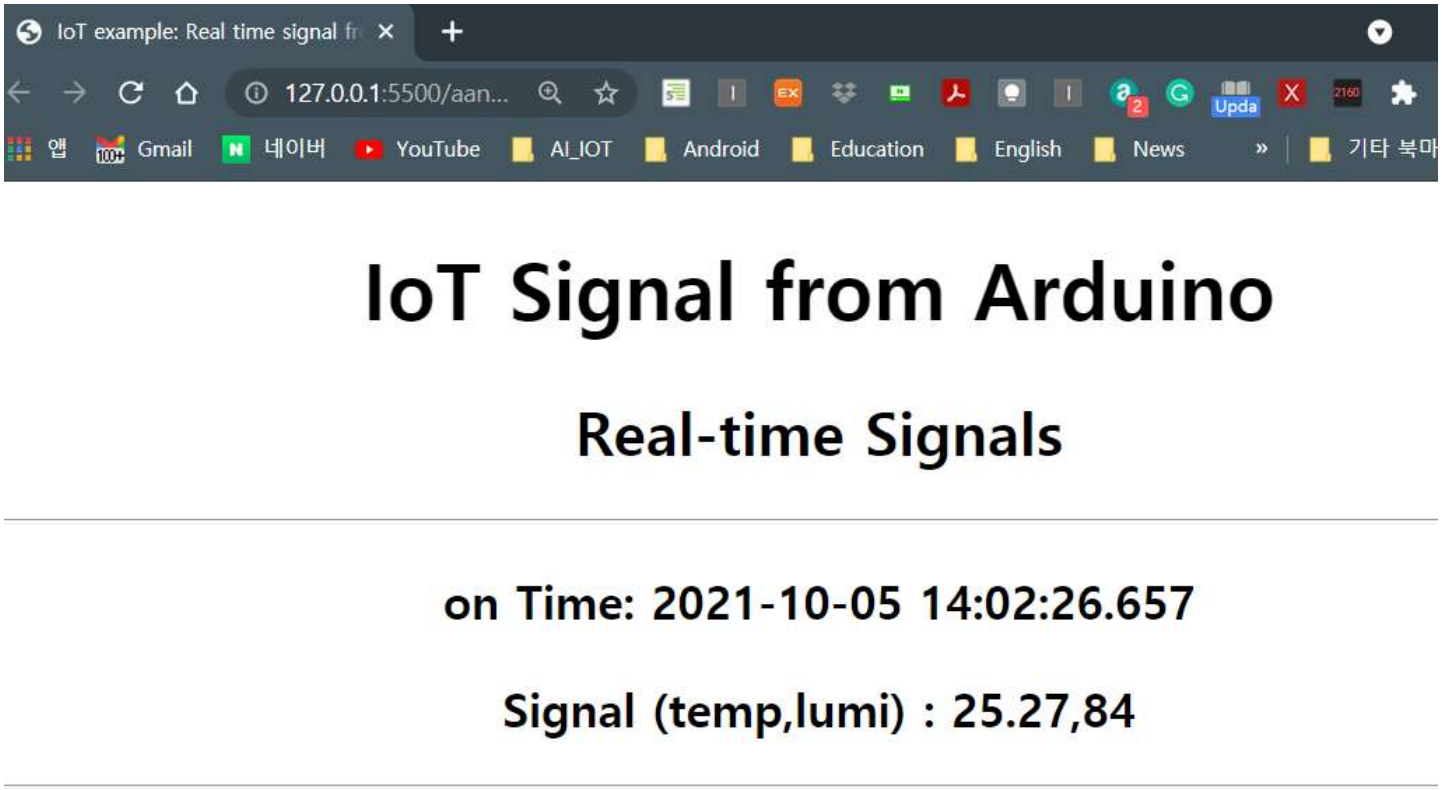
IOT data format

시간, 온도,조도

Save as
AAnn_cds_tmp36_IOT.png

A4.5.6 CdS + TMP36 + Node project : WEB

[Web monitoring] client_signal_cds_tmp36.html

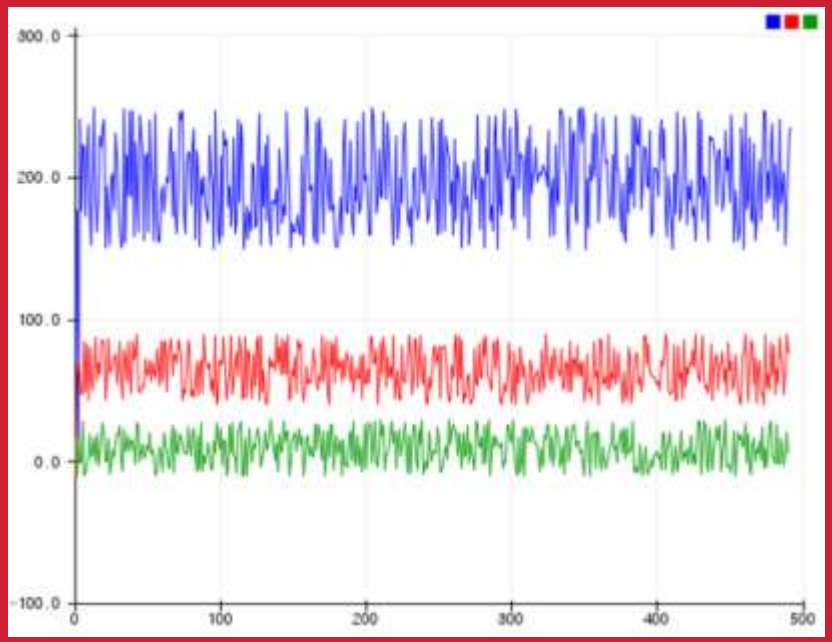


Save as
AAnn_cds_tmp36_WEB.png

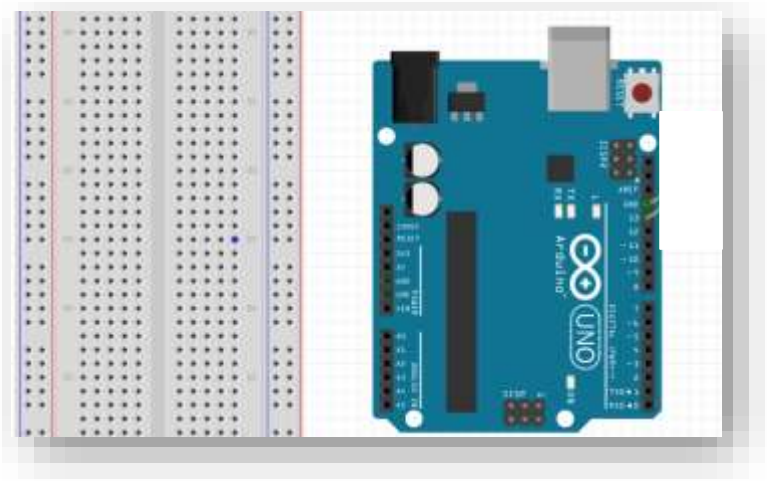
[DIY] Multi-signals

다중신호 시뮬레이션

+ node.js



DIY – 스케치



아두이노에서 **LED**와 저항을 모두 제거하고 **USB**만 컴퓨터와 연결한다.

전자 소자 연결 없이 마구잡이 수 생성 함수를 이용해서 조도, 습도, 온도에 해당되는 **3**개의 신호를 만든다.

온도는 값의 범위를 **–10 ~ 30,** 습도는 **40 ~ 90,** 그리고 조도는 **150 ~ 250** 으로 가상적 으로 설정한다.

직렬통신 모니터링을 이용해서 세 개의 신호의 변화를 모니터링 하는 코드를 만들어 결과를 확인한다.

▶ 스케치 구성

1. 3 개의 신호를 담을 변수를 초기화한다.

2. setup()에서 직렬 통신 속도를 9600 bps 로 설정하고 컴퓨터와 연결한다.

3. loop()에서 마구잡이 수를 세 개 발생시켜서 직렬 통신으로 3 개의 pwm 값을 각각 컴퓨터로 전송한다.

DIY – code

sketch05_multi_signals

```
/*
  Multi Signals
  Simulation of multiple random signals
*/
// signals
int humi=0;
int temp=0;
int lux=0;

// the setup routine runs once when you press reset:
void setup() {
  // initialize serial communication at 9600 bits per second:
  Serial.begin(9600);
}

// the loop routine runs over and over again forever:
void loop() {
  // Multi signals
  humi = random(40,90);
  temp = random(-10, 30);
  lux = random(150,250);
  Serial.print("AA00, Ambient lux: ");
  Serial.print(lux);
  Serial.print(" , Humidity: ");
  Serial.print(humi);
  Serial.print(" , Temperature: ");
  Serial.println(temp);
  delay(500);        // delay in between reads for stability
}
```

DIY - result

DIY 결과

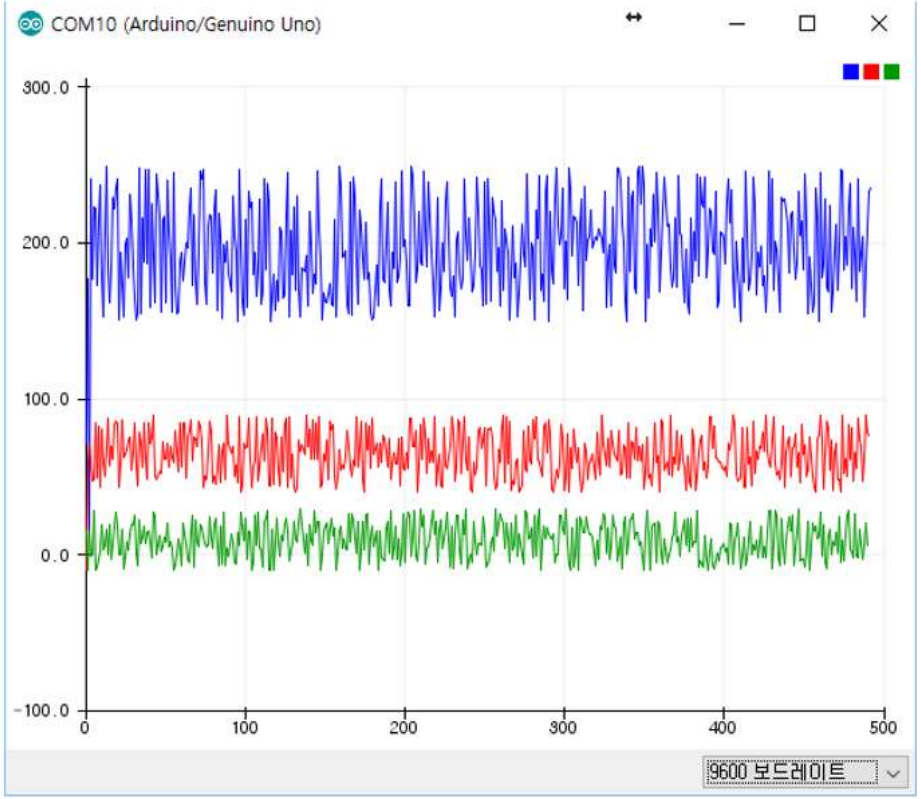
가상적인 세 개의 센서신호 시뮬레이션:조도(위), 습도(중간), 온도(아래).

COM10 (Arduino/Genuino Uno)

전송

```
AA00, Ambient lux: 186 , Humidity: 54 , Temperature: 13
AA00, Ambient lux: 165 , Humidity: 65 , Temperature: 19
AA00, Ambient lux: 151 , Humidity: 84 , Temperature: 19
AA00, Ambient lux: 155 , Humidity: 57 , Temperature: 25
AA00, Ambient lux: 248 , Humidity: 44 , Temperature: 1
AA00, Ambient lux: 155 , Humidity: 78 , Temperature: -7
AA00, Ambient lux: 216 , Humidity: 72 , Temperature: 22
AA00, Ambient lux: 188 , Humidity: 56 , Temperature: 7
AA00, Ambient lux: 247 , Humidity: 84 , Temperature: 11
AA00, Ambient lux: 187 , Humidity: 61 , Temperature: 18
AA00, Ambient lux: 247 , Humidity: 48 , Temperature: 7
AA00, Ambient lux: 159 , Humidity: 84 , Temperature: 14
AA00, Ambient lux: 225 , Humidity: 71 , Temperature: 15
AA00, Ambient lux: 192 , Humidity: 75 , Tempera
```

자동 스크롤 | line ending 없음 | 9600 보드레이트 | 출력 지우기



DIY – New result 1

DIY 결과 [1] : 가상적인 세 개의 센서신호 시뮬레이션 → 조도,습도,온도

COM10 (Arduino/Genuino Uno)

전송

```
222,61,-3
235,83,6
241,85,18
151,84,27
194,43,18
174,58,0
153,86,0
199,62,16
203,64,-9
178,67,-2
231,73,8
215,75,3
186,54,13
165,65,19
```

조도,습도,온도

☑ 자동 스크롤 | line ending 없음 | 9600 보드레이트 | 출력 지우기

DIY – New result 2-1

DIY 결과 [2]: 가상적인 세 개의 센서신호 시뮬레이션 → 조도,습도,온도를 **Node.js**로 처리

[1 단계] Node cmd

1. Make multi_signals node project

- **md multi_signals in iot folder**
- **cd multi_signals**

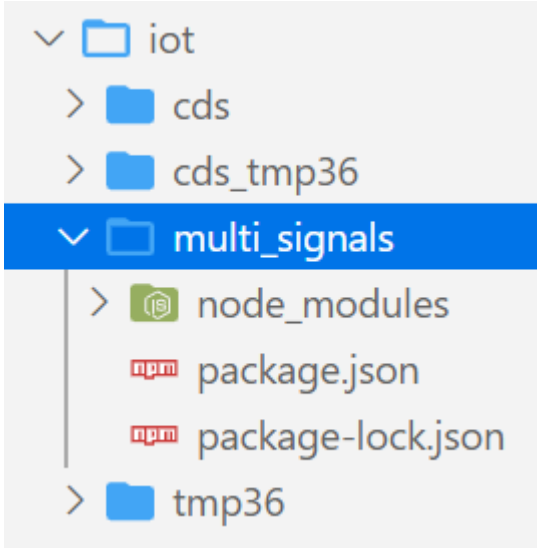
2. Go to multi_signals subfolder

- **npm init**

  name : multi_signals
  description : multi-signals-node project
  entry point : aann_multi_signals.js
  author : aann

3. Install node modules

- **npm install –save serialport**
- **npm install –save socket.io@2.4.1**



DIY – New result 2-2

DIY 결과 [2]: 가상적인 세 개의 센서신호 시뮬레이션 → 조도,습도,온도를 Node.js로 처리

Recycling code:
Save cds_tmp36_node.js as
aann_multi_signals.js in multi_signals subfolder
Update code

```
var dStr ='';
var readData='';
var temp='';
var humi='';
var lux='';
var mdata=[];
var firstcommaidx = 0;
var secondcommaidx= 0;
```

DIY – New result 2-3

DIY 결과 [2]: 가상적인 세 개의 센서신호 시뮬레이션 → 조도,습도,온도를 **Node.js**로 처리

```
parser.on("data", (data) => {
  // call back when data is received
  readData = data.toString();
  firstcommaidx = readData.indexOf(",");
  secondcommaidx = readData.indexOf(",", firstcommaidx + 1);
  if (firstcommaidx > 0) {
```

아두이노가 직렬통신으로 전송하는 2 개의 comma (,)로 구분된

조도,습도,온도 데이터 메시지를 **parsing**하여 **mdata** 배열에 담는 코드를 완성하시오.

substring() 함수에서 firstcommaidx, secondcommaidx를 잘 이용하시오.

```
    console.log("AA00," + mdata);
    io.sockets.emit("message", mdata); // send data to all clients
  } else {
    console.log(readData);
  }
});
```

DIY – New result 2-3

DIY 결과 [2]: 가상적인 세 개의 센서신호 시뮬레이션 → 조도,습도,온도를 **Node.js**로 처리

```
parser.on("data", (data) => {
  // call back when data is received
  readData = data.toString();
  firstcommaidx = readData.indexOf(",");
  secondcommaidx = readData.indexOf(",", firstcommaidx + 1);
  if (firstcommaidx > 0) {
    lux = readData.substring(0, firstcommaidx);
    humi = readData.substring(firstcommaidx + 1, secondcommaidx);
    temp = readData.substring(secondcommaidx + 1);
    readData = "";

    dStr = getDateString();
    mdata[0] = dStr; //date
    mdata[1] = lux; //data
    mdata[2] = humi;
    mdata[3] = temp;
    console.log("AA00," + mdata.toString());
    io.sockets.emit("message", mdata); // send data to all clients
  } else {
    console.log(readData);
  }
});
```

DIY – New result 2-4 : js functions

DIY 결과 [2]: 가상적인 세 개의 센서신호 시뮬레이션 → 조도,습도,온도를 **Node.js**로 처리

Hint:

javascript function : indexOf() https://www.w3schools.com/jsref/jsref_indexof.asp

Syntax

```
string.indexOf(searchvalue, start)
```

Parameter Values

Parameter	Description
searchvalue	Required. The string to search for
start	Optional. Default 0. At which position to start the search

javascript function : substring()

```
string.substring(start, end)
```

Parameter Values

Parameter	Description
start	Required. The position where to start the extraction. First character is at index 0
end	Optional. The position (up to, but not including) where to end the extraction. If omitted, it extracts the rest of the string

DIY – New result 2-5

DIY 결과 [2]: 가상적인 세 개의 센서신호 시뮬레이션 → 조도,습도,온도를 **Node.js**로 처리

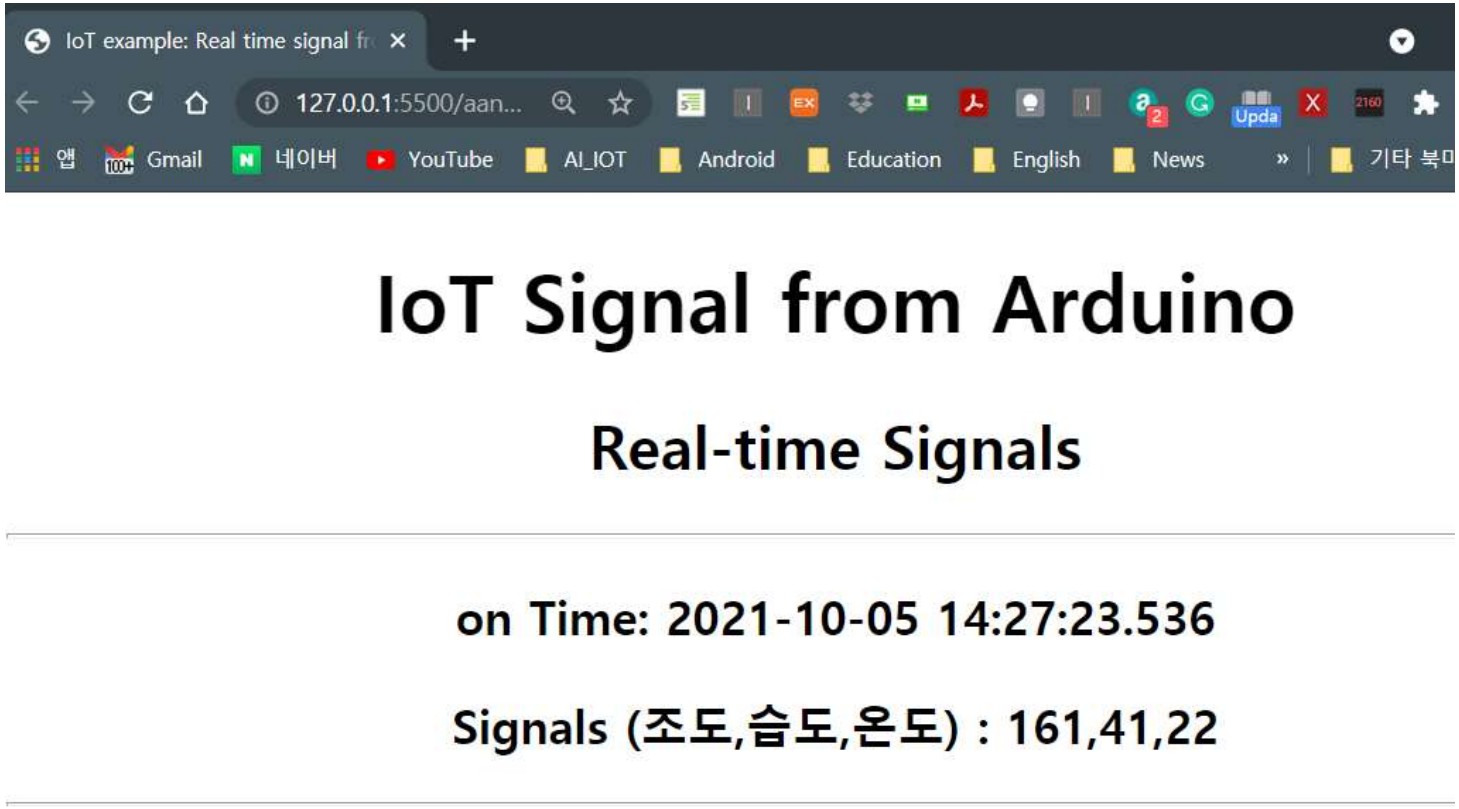
```
D:\aann\aann-rpt06\iot\multi_signals>node aann_multi_signals
serial port open
AA00,2021-10-05 14:21:10.805,223,47,-1
AA00,2021-10-05 14:21:11.804,222,48,0
AA00,2021-10-05 14:21:12.808,173,84,28
AA00,2021-10-05 14:21:13.811,215,49,-10
AA00,2021-10-05 14:21:14.811,237,82,-8
AA00,2021-10-05 14:21:15.815,179,43,-3
AA00,2021-10-05 14:21:16.814,153,80,2
AA00,2021-10-05 14:21:17.818,207,59,19
AA00,2021-10-05 14:21:18.817,249,50,3
AA00,2021-10-05 14:21:19.821,185,68,6
AA00,2021-10-05 14:21:20.820,162,87,16
```

ID,시간,조도,습도,온도

Save this result as AAnn_multi_signals_node .png

A4.5.6 multi-signals + Node project : WEB

[Web monitoring] client_multi_signals.html



Save as AAnn_multi_signals_WEB.png

wk06 : Practice : aann-rpt06

- [Target of this week]
  - Complete your works
  - Save your outcomes and
  - upload outputs in github repo.

제출폴더명 : **aann-rpt06**

- 압축할 파일들

① AAnn_tmp36_message.png

② AAnn_tmp36_IOT_data.png

③ AAnn_cds_tmp36_serial.png

④ AAnn_cds_tmp36_lcd.png

⑤ AAnn_cds_tmp36_IOT.png

⑥ AAnn_cds_tmp36_WEB.png

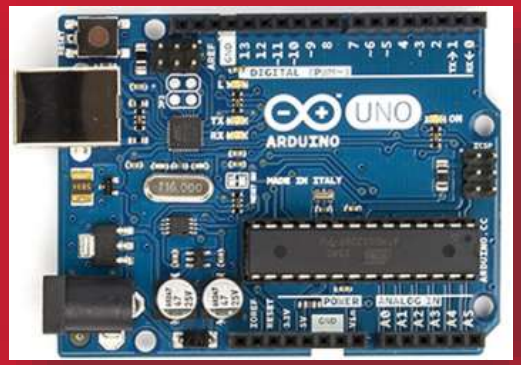
⑦ AAnn_multi_signals_node.png

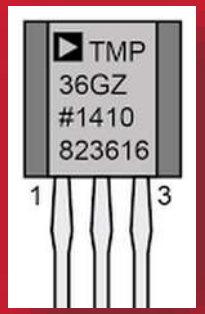
⑧ AAnn_multi_signals_WEB.png

⑨ All *.ino

⑩ All *.js

⑪ NO node_modules folder

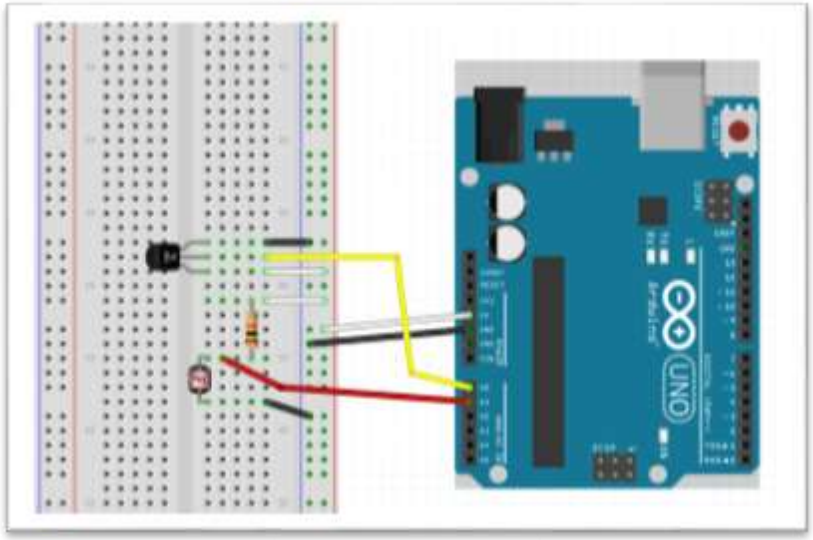




Data visualization using plot.ly

Network socket emitting data

tmp36 + CdS circuit



```
AA00,2020-10-17 11:41:30.533,25.27,245
AA00,2020-10-17 11:41:31.535,25.27,243
AA00,2020-10-17 11:41:32.535,25.27,158
AA00,2020-10-17 11:41:33.534,24.29,40
AA00,2020-10-17 11:41:34.538,24.29,33
AA00,2020-10-17 11:41:35.537,24.78,86
AA00,2020-10-17 11:41:36.541,25.27,249
AA00,2020-10-17 11:41:37.540,25.76,245
AA00,2020-10-17 11:41:38.543,25.76,243
AA00,2020-10-17 11:41:39.543,25.27,245
```

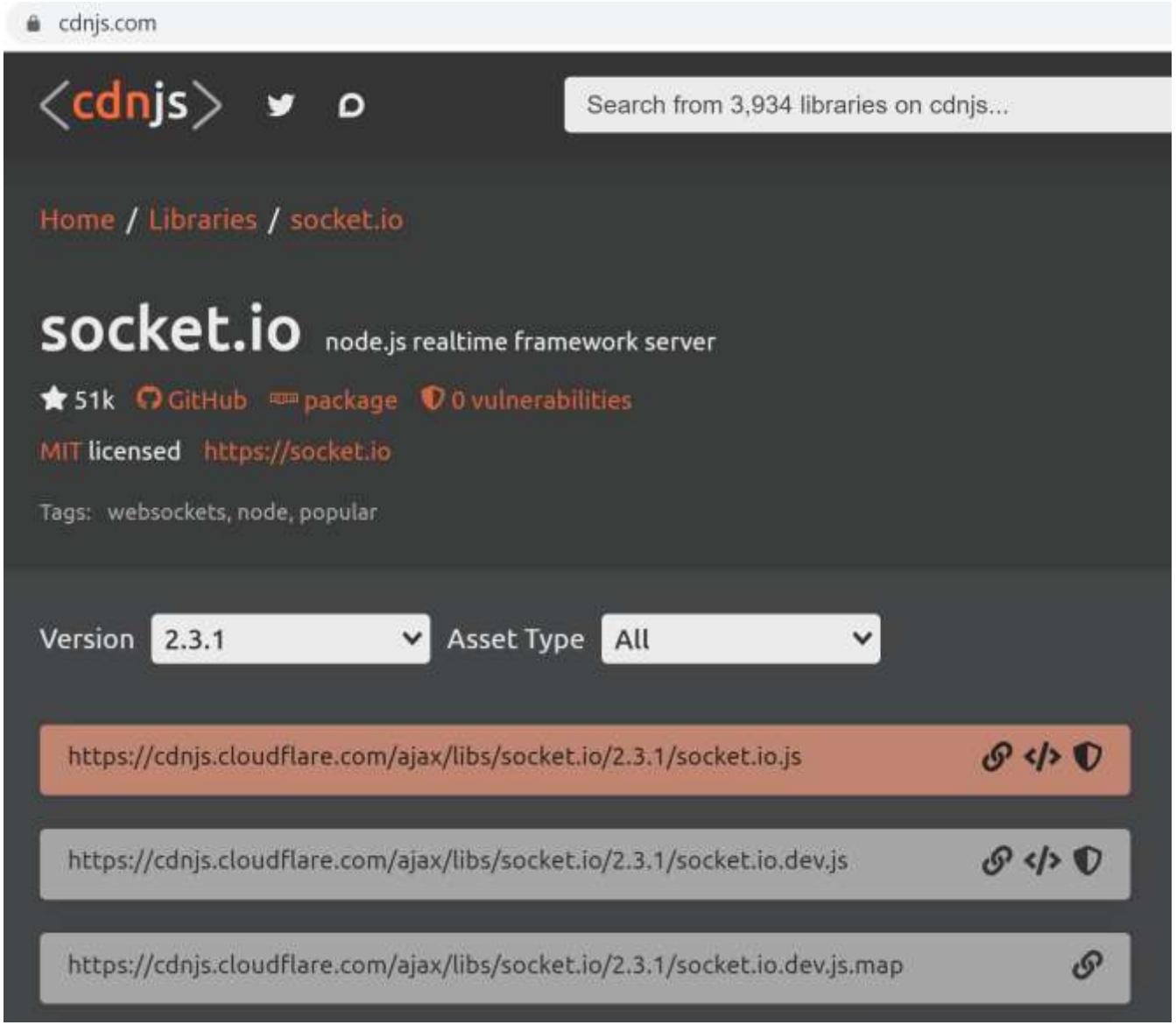
```
var readData = "";
var temp = "";
var lux = "";
var mdata = [];
var firstcommaidx = 0;

parser.on("data", (data) => {
  // call back when data is received
  readData = data.toString();
  firstcommaidx = readData.indexOf(",");
  if (firstcommaidx > 0) {
    temp = readData.substring(0, firstcommaidx);
    lux = readData.substring(firstcommaidx + 1);
    readData = "";

    dStr = getDateString();
    mdata[0] = dStr; //date
    mdata[1] = temp; //data
    mdata[2] = lux;
    console.log("AA00," + mdata);
    io.sockets.emit("message", mdata); // send data
  } else {
    console.log(readData);
  }
});
```

시간,온도,조도

Arduino data on network socket

Google search

socket.io.js cdn



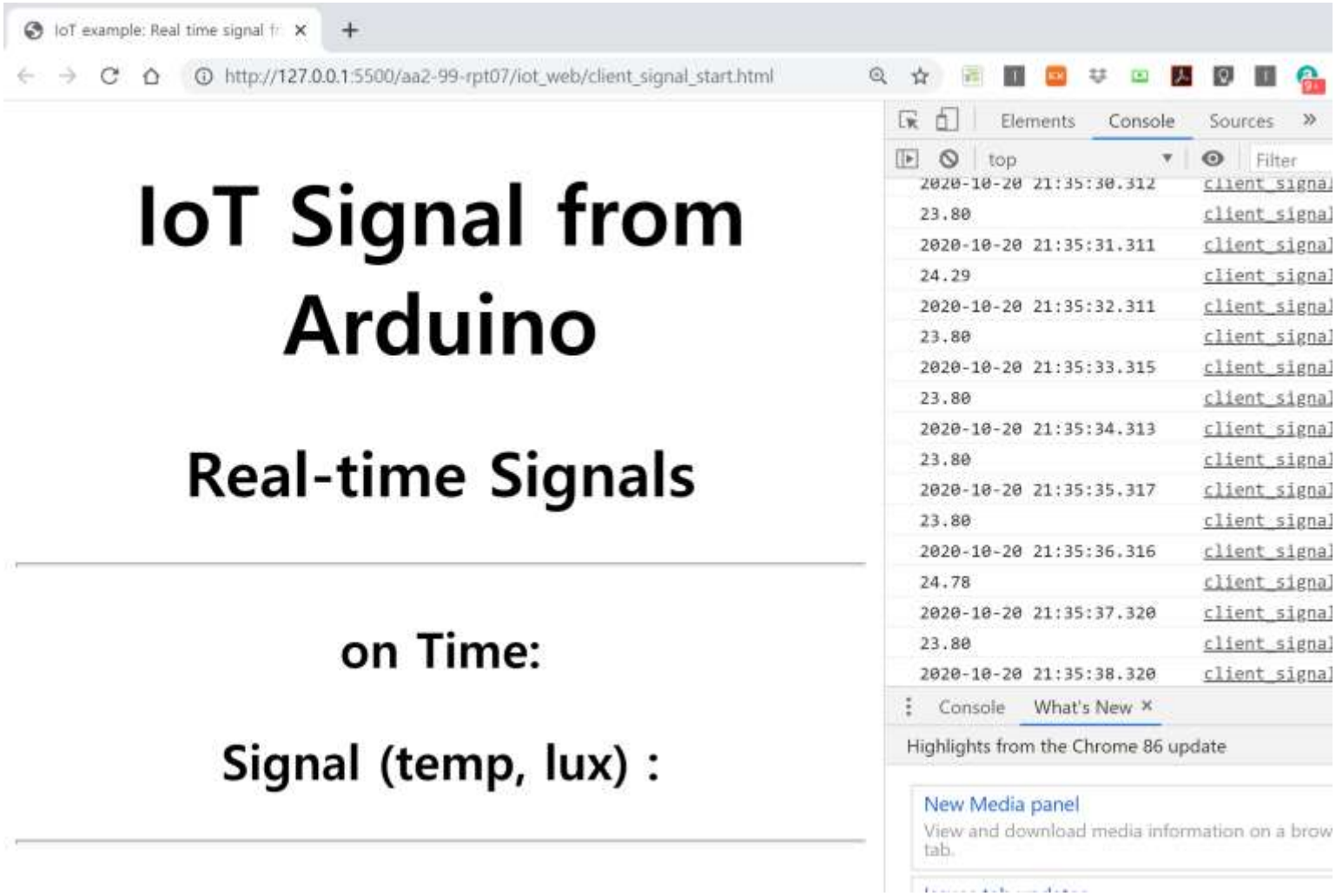
Arduino data on network socket

client_signal_start.html

```html
<!DOCTYPE html>
<head>
  <meta charset="utf-8">
  <title>IoT example: Real time signal from Arduino</title>

  <script type="text/javascript" src="https://cdnjs.cloudflare.com/ajax/libs/socket.io/2.3.1/socket.io.js"></script>
  <!-- <script type="text/javascript" src="https://cdnjs.cloudflare.com/ajax/libs/socket.io/1.3.6/socket.io.js"></scr
  <style>body{padding:0;margin:30;background:#fff}</style>
</head>

<body>  <!-- style="width:100%;height:100%"> -->

<h1 align="center"> IoT Signal from Arduino </h1>

<h2 align="center"> Real-time Signals </h2>

<hr>

<h3 align="center"> on Time: <span id="time"> </span> </h3>

<h3 align="center"> Signal (temp, lux) : <span id="data"> </span> </h3>
```

Google search : socket.io.js cdn

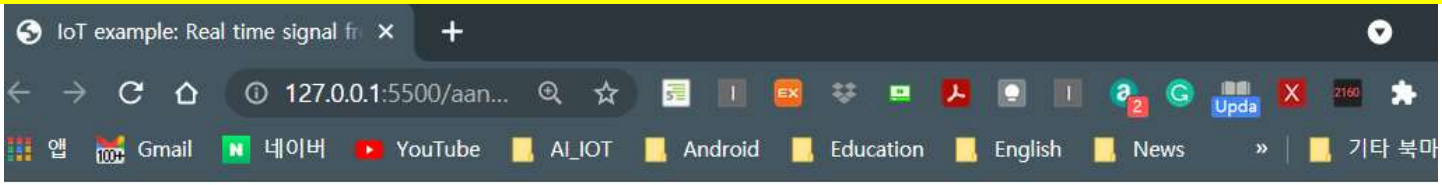
Arduino data on network socket



Real-time console showing signals from Arduino in Chrome browser

Arduino data on network socket

[Web monitoring] client_signal_cds_tmp36.html



IoT Signal from Arduino

Real-time Signals

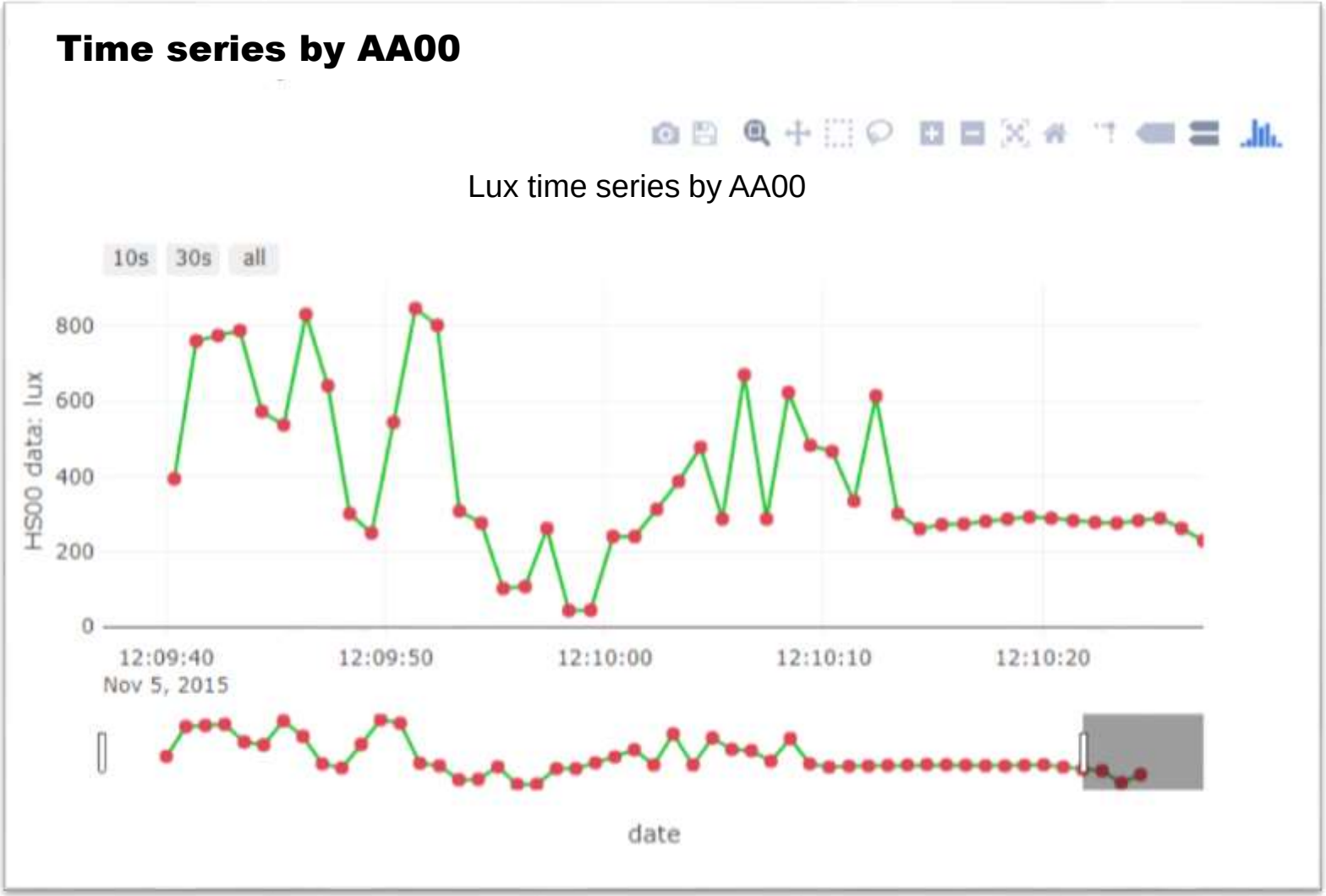
---

on Time: 2021-10-05 14:02:26.657

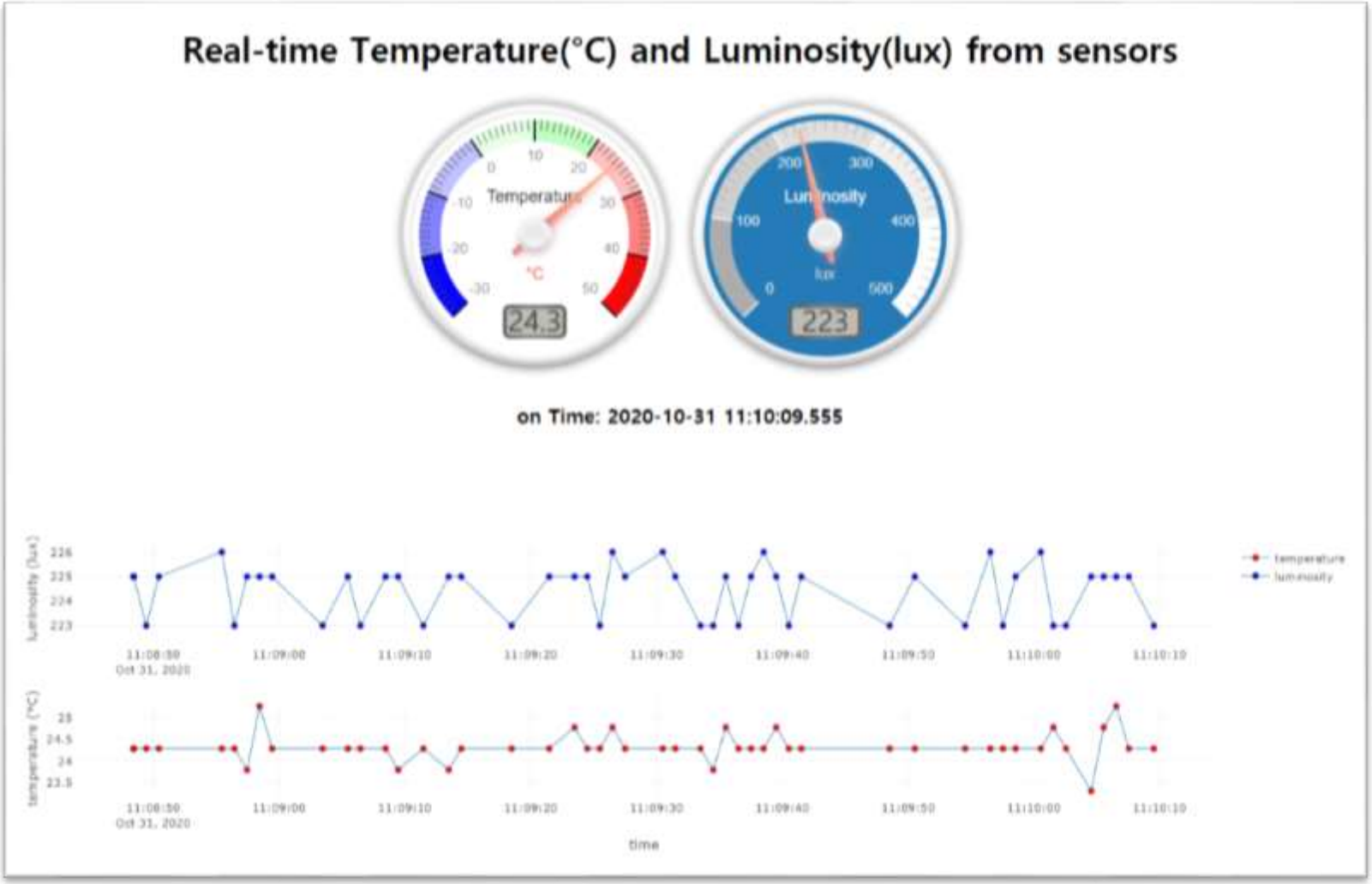
Signal (temp,lumi) : 25.27,84

Real-time monitoring of signals from Arduino tmp36 + CdS circuit

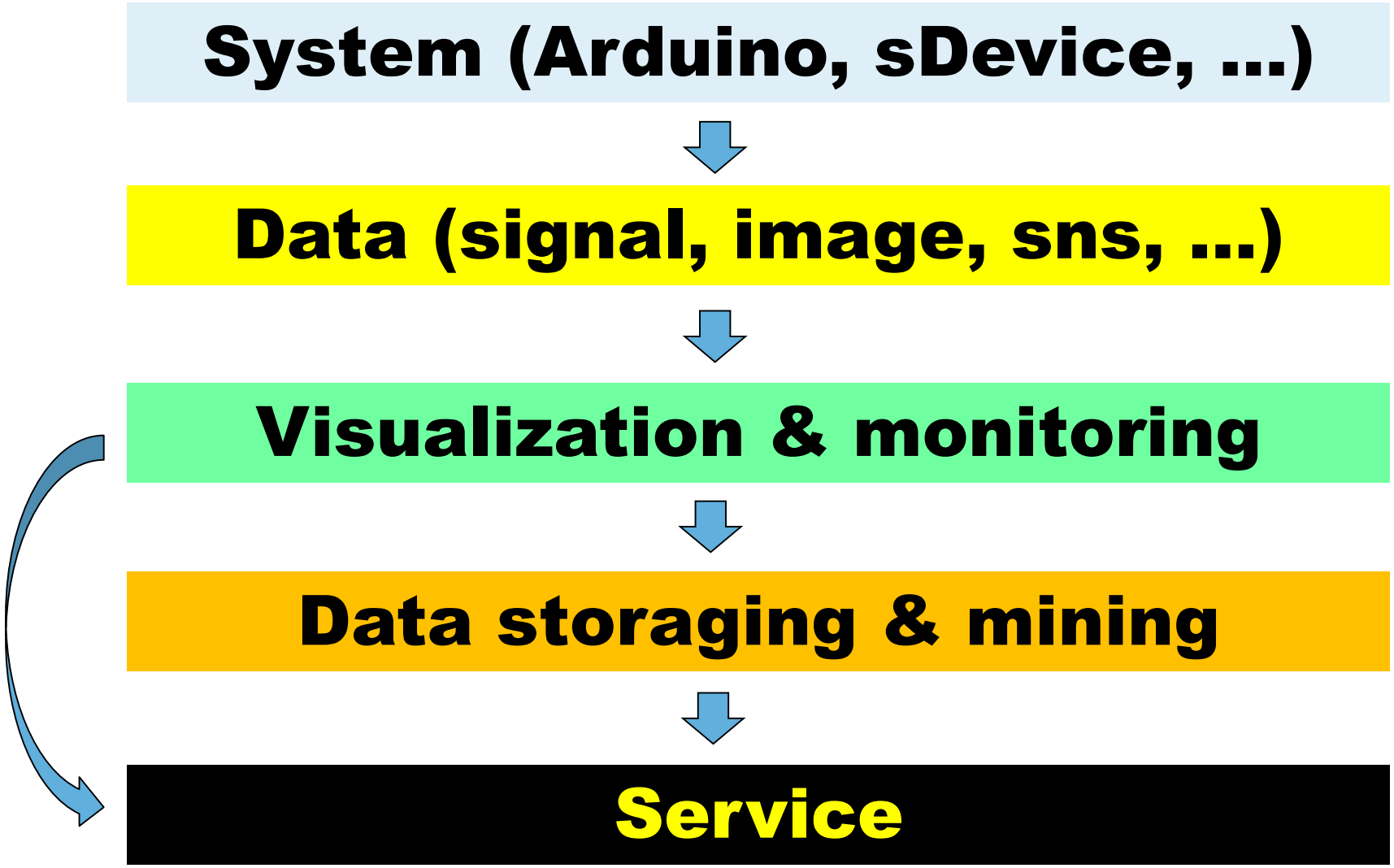
Arduino data + plotly



Arduino data + plotly + gauge.js



A5. Introduction to visualization



A5.1 Introduction to data visualization

아두이노 센서 회로

↓

직렬모니터/플로터 모니터링

↓

LCD 모니터링

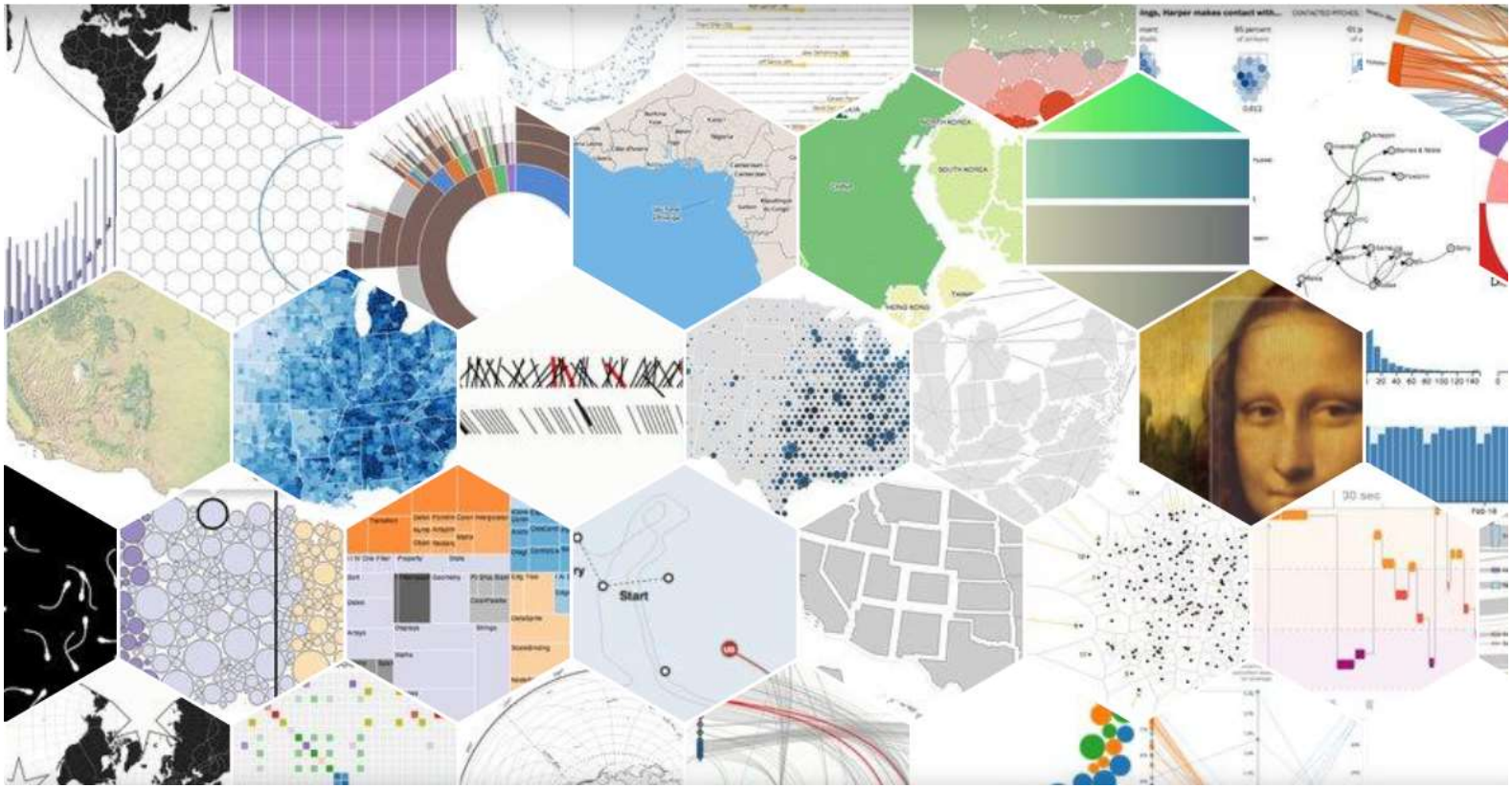
Node.js → ↓ ← Plotly.js

웹 모니터링 (시각화)

A5.1.1 D3.js

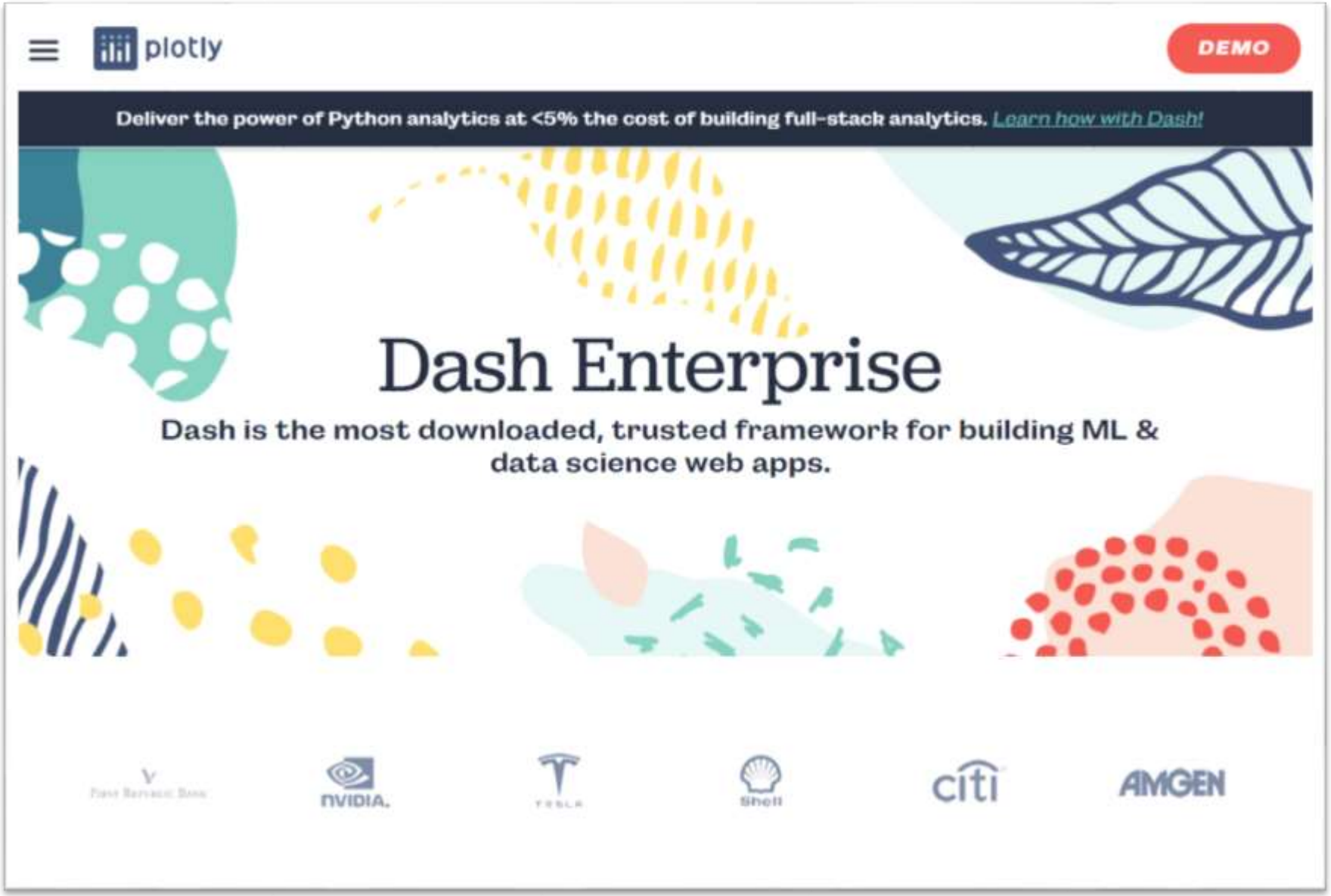
Overview Examples Documentation API Source

Data-Driven Documents



http://d3js.org/

A5.1.2 plot.ly



https://plotly.com/

A5.1.3 plotly.js

Built on top of d3.js and stack.gl,

Plotly.js is a high-level, declarative charting library.

plotly.js ships with over 40 chart types, including 3D charts, statistical graphs, and SVG maps.

https://plot.ly/javascript/

A5.1.4 Introduction to plotly.js

plotly | Graphing Libraries

Star 12,327 DO MORE WITH DASH

Search...

Quick Start

- Getting Started
- Is Plotly Free?
- Cheat Sheet
- Figure Reference
- Function Reference
- Event Reference
- Configuration Options
- GitHub
- community.plotly.com

Examples

- Fundamentals
- Basic Charts
- Statistical Charts
- Scientific Charts
- Financial Charts
- Maps

Plotly JavaScript Open Source Graphing Library

Built on top of d3.js and stack.gl, Plotly.js is a high-level, declarative charting library. plotly.js ships with over 40 chart types, including 3D charts, statistical graphs, and SVG maps.

plotly.js is free and open source and you can view the source, report issues or contribute on GitHub.

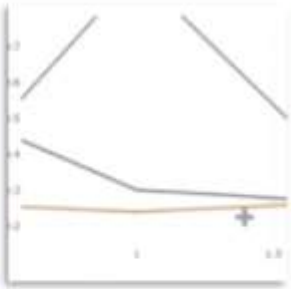
▸ Read more about plotly.js features

Fundamentals

More Fundamentals »

Configuration Options

Responsive / Fluid Layouts

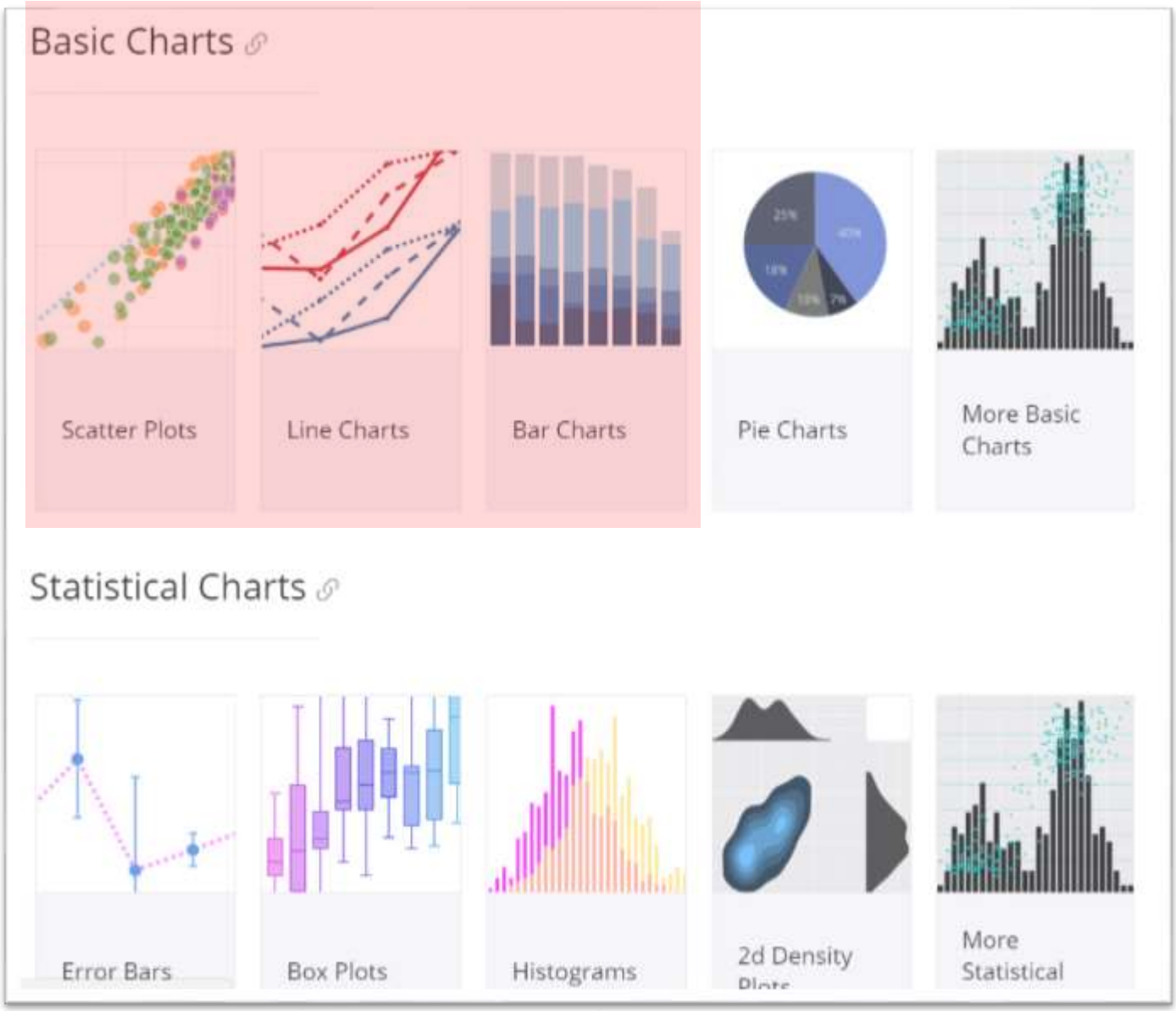


uirevision in Plotly.react

React Plotly.js

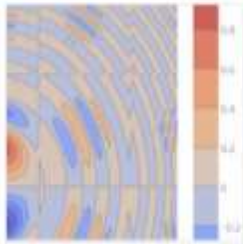
https://plotly.com/javascript/

A5.1.5 Introduction to plotly.js charts

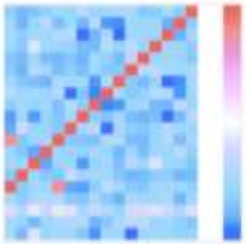


A5.1.6 Introduction to plotly.js charts

Scientific Charts

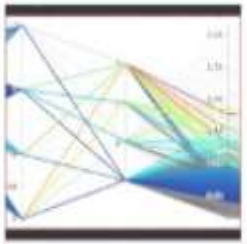


Contour Plots

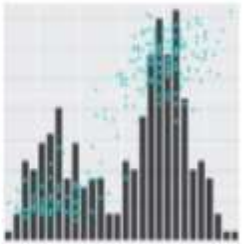


Heatmaps

Ternary Plots



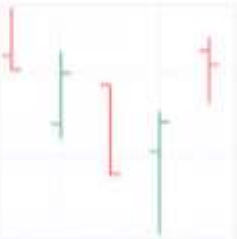
Parallel Coordinates Plot



More Scientific Charts

Financial Charts

Time Series



OHLC Charts

Candlestick Charts

A5.1.7 Introduction to plotly.js charts

Maps

Choropleth Maps

Scatter Plots on Maps

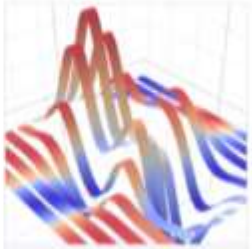
Bubble Maps

Lines on Maps

Scatter Plots on Mapbox

3D Charts

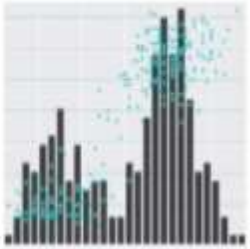
3D Scatter Plots



Ribbon Plots

3D Surface Plots

3D Mesh Plots



More 3D Charts

A5.1.8 plotly.js: time series & streaming

https://plot.ly/javascript/time-series/

https://plot.ly/javascript/streaming/

A5.1.9 Getting started: plotly.js

https://plot.ly/javascript/getting-started/

A5.1.10 Getting started: plotly.js

plotly.js CDN

You can also use the ultrafast plotly.js CDN link. This CDN is graciously provided by the incredible team at Fastly.

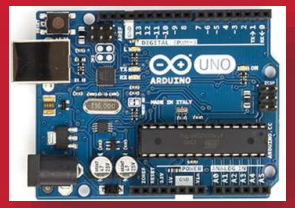
```
<head>
    <script src="https://cdn.plot.ly/plotly-latest.min.js"></script>
</head>
```

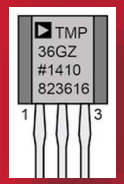
Else, if you want to get a specific version of plotly.js, say 1.2.0:

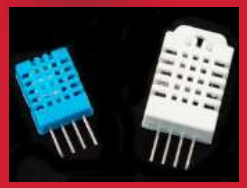
```
<head>
    <script src="https://cdn.plot.ly/plotly-1.2.0.min.js"></script>
</head>
```

<script src="https://cdn.plot.ly/plotly-latest.min.js"></script>

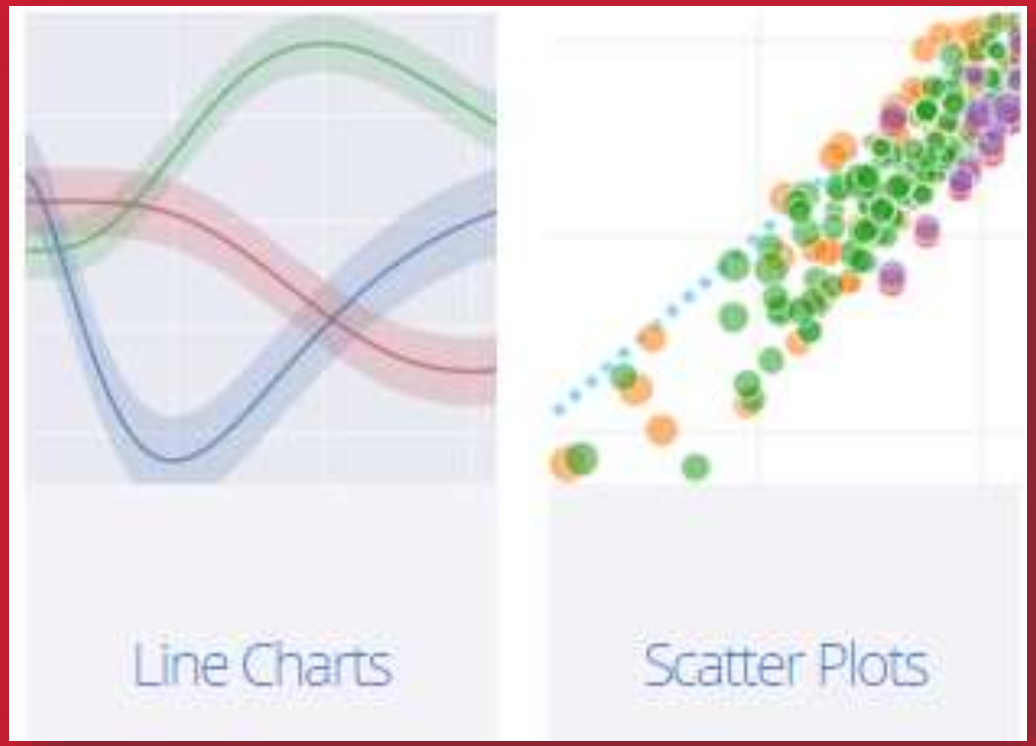
https://plot.ly/javascript/getting-started/







Data charts using plotly.js



A5.2 Data charts

Navigation

Basic Line Plot

Line and Scatter Plot

Adding Names to Line and Scatter Plot

Line and Scatter Styling

Styling Line Plot

Colored and Styled Scatter Plot

Line Shape Options for Interpolation

Graph and Axes Titles

Line Dash

Connect Gaps Between Data

Labelling Lines with Annotations

Back To Plotly.Js

Line Charts in plotly.js

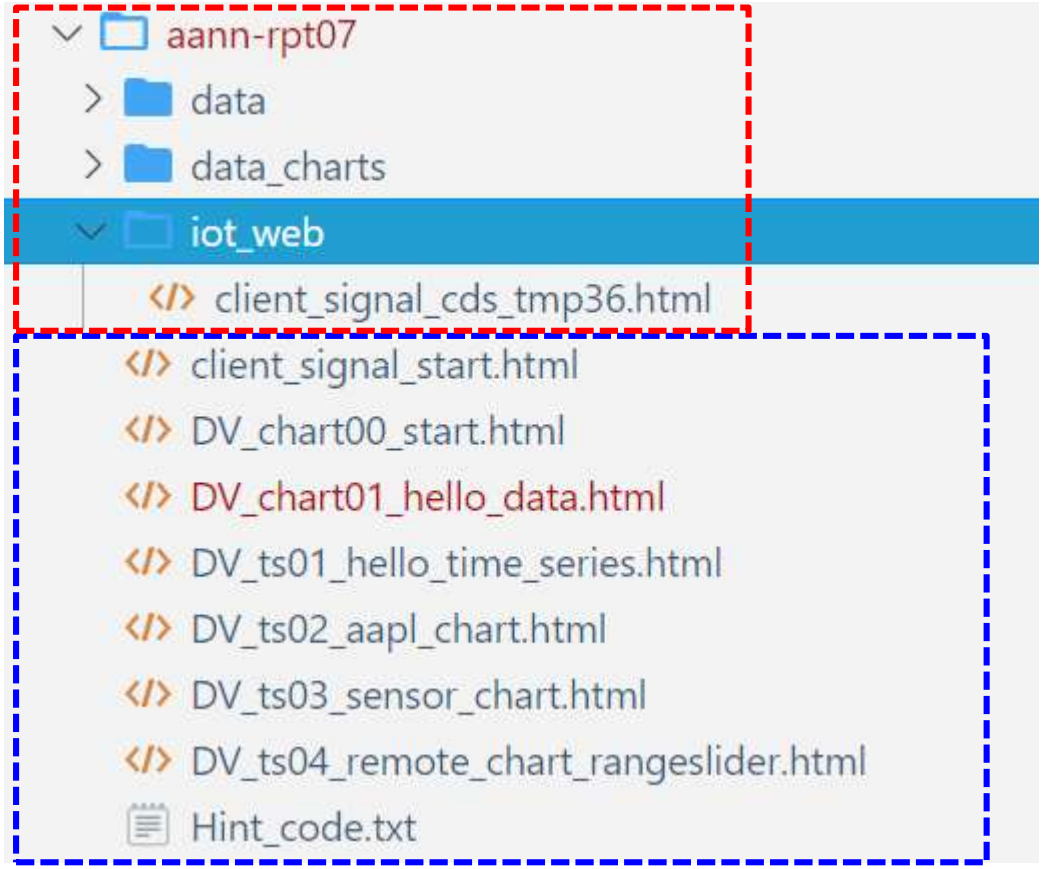
How to make D3.js-based line charts in JavaScript.

R | plotly.js | Python | Pandas

Basic Line Plot

```
var trace1 = {
  x: [1, 2, 3, 4],
  y: [10, 15, 13, 17],
  type: 'scatter'
};

var trace2 = {
  x: [1, 2, 3, 4],
  y: [16, 5, 11, 9],
  type: 'scatter'
};
```

A5.2.1 Working folders



A5.2.2.1 Starting plotly basic chart

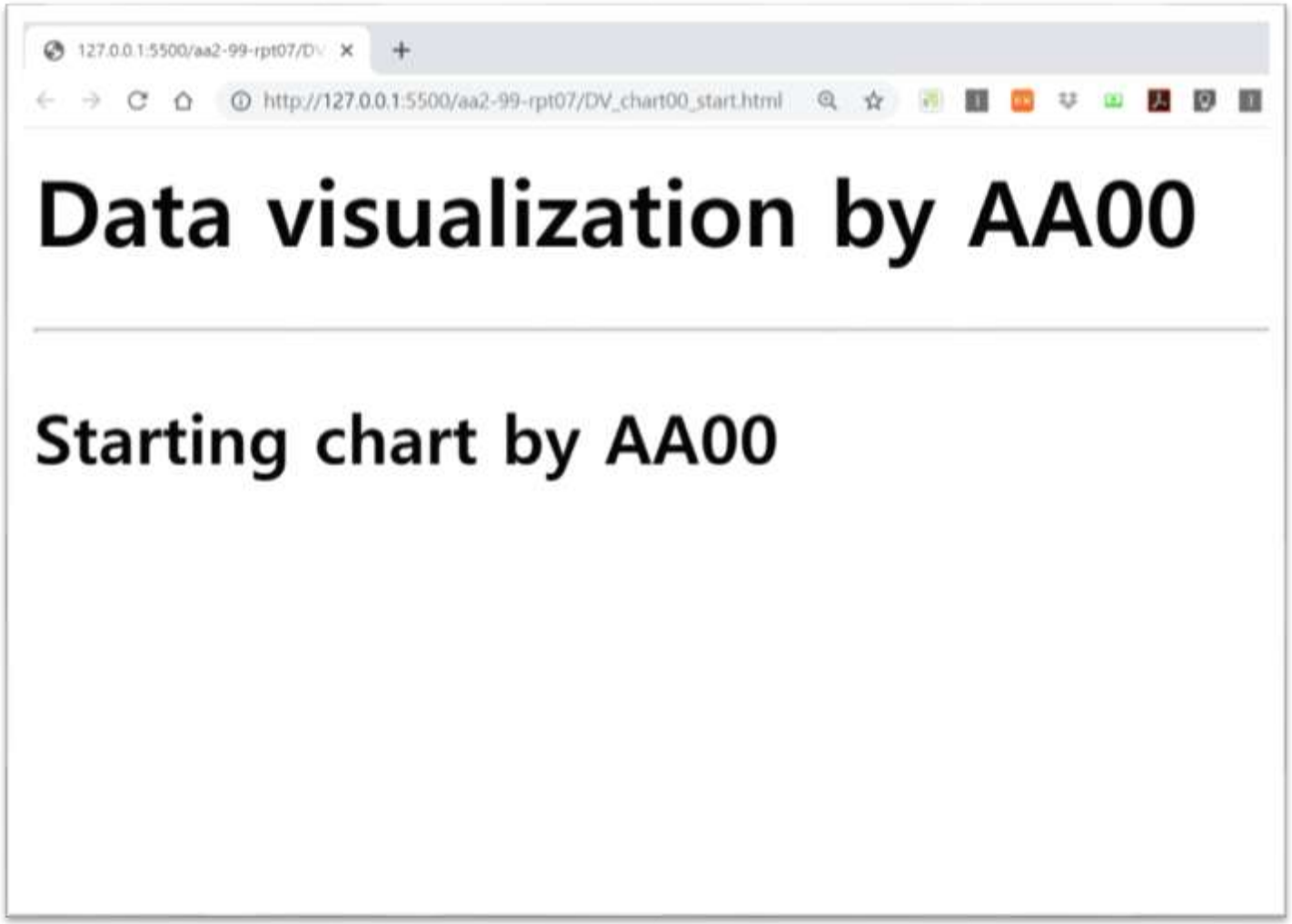
DV_chart00_start.html

Starting chart!

```html
<html>
<head>
    <meta charset="utf-8">
    <!-- Plotly.js -->
    <script src="https://cdn.plot.ly/plotly-latest.min.js"></script>
</head>
<body>
    <h1>Data visualization by AA00</h1>
    <hr>
    <h2>Starting graph by AA00</h2>

    <!-- Plotly chart will be drawn inside this DIV -->
    <div id="myDiv" style="width: 500px;height: 300px"></div>

    <script>
        <!-- JAVASCRIPT CODE GOES HERE -->


    </script>
</body>
</html>
```

A5.2.2.2 Starting plotly basic chart

VSCode, live server



A5.2.3.1 Hello plotly basic chart

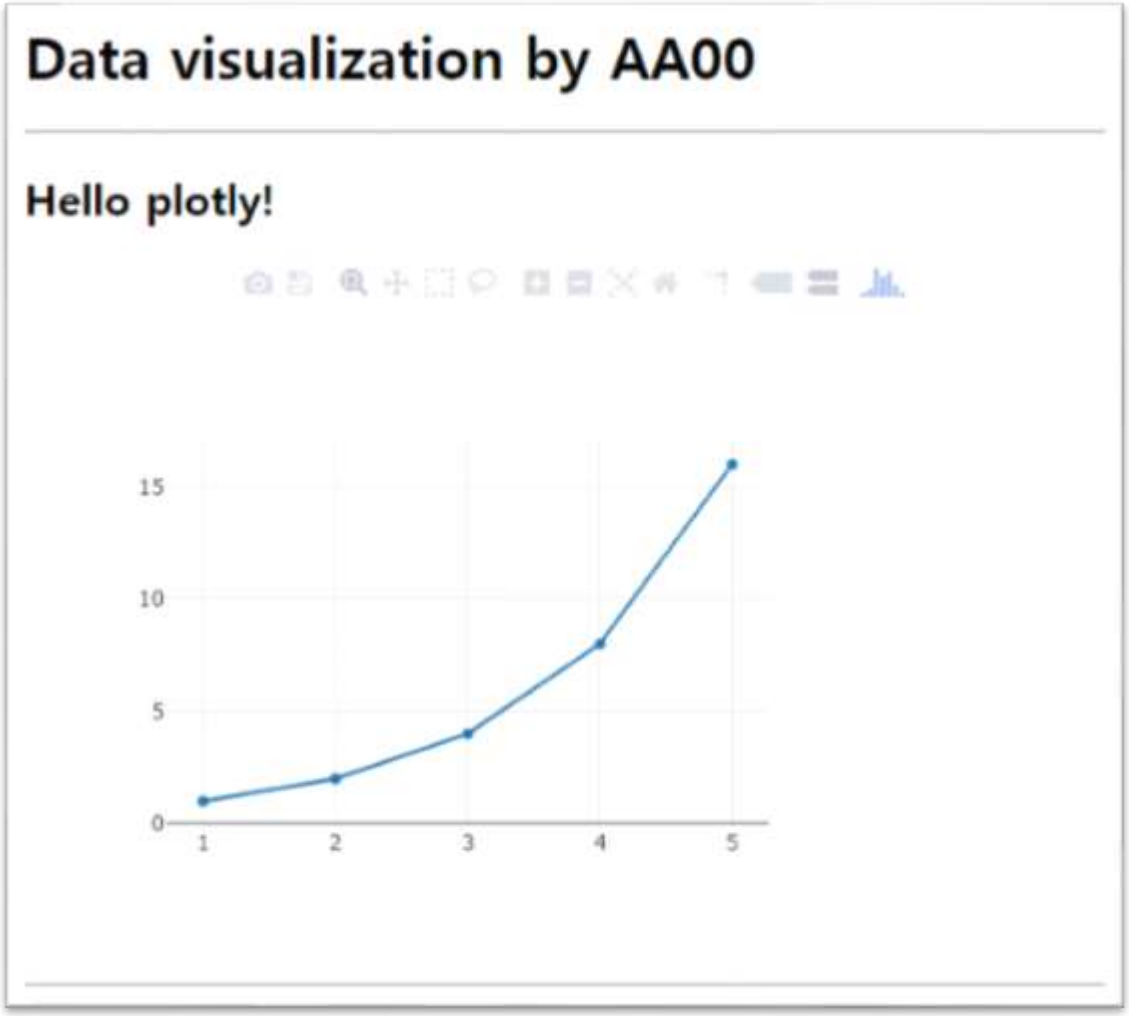
Hello plotly data chart!

```html
<html>
<head>
    <meta charset="utf-8">
    <!-- Plotly.js -->
    <script src="https://cdn.plot.ly/plotly-latest.min.js"></script>
</head>
<body>
    <h1>Data visualization by AA00</h1>
    <hr>
    <h2>Hello plotly!</h2>
    <!-- Plotly chart will be drawn inside this DIV -->
    <div id="myDiv" style="width: 500px;height: 400px"></div>
    <hr>
    <script>
        <!-- JAVASCRIPT CODE GOES HERE -->
        var data = [
        {
            x: [1, 2, 3, 4, 5],
            y: [1, 2, 4, 8, 16],
            type: 'scatter'
        }];

        Plotly.newPlot('myDiv', data);

    </script>
</body>
</html>
```

data는 무엇?
그래프 객체들의 구조,
데이터 배열

A5.2.3.2 Hello plotly basic chart

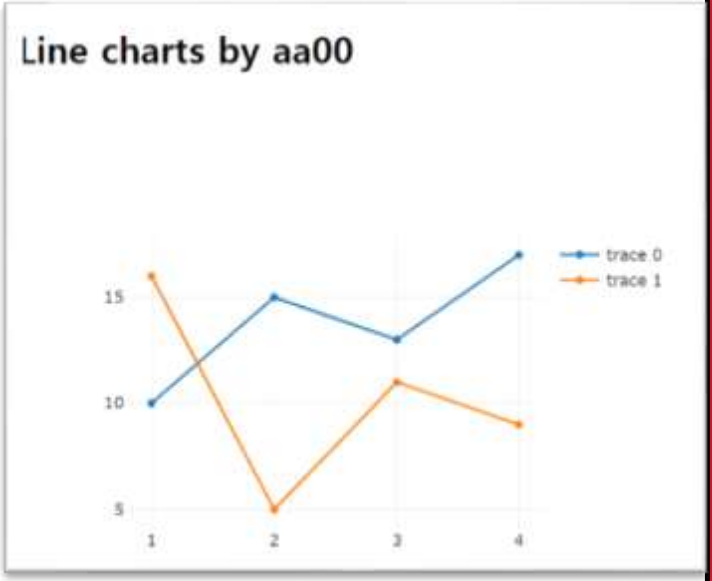
Graph : Hello plotly chart!



A5.2.4 plotly.js: Line Charts

[1] Basic multi-line charts

```
<script>
    <!-- JAVASCRIPT CODE GOES HERE -->

    var trace1 = {
        x: [1, 2, 3, 4],
        y: [10, 15, 13, 17],
        type: 'scatter'
    };

    var trace2 = {
        x: [1, 2, 3, 4],
        y: [16, 5, 11, 9],
        type: 'scatter'
    };

    var data = [trace1, trace2];

    Plotly.newPlot('myDiv', data);

</script>
```

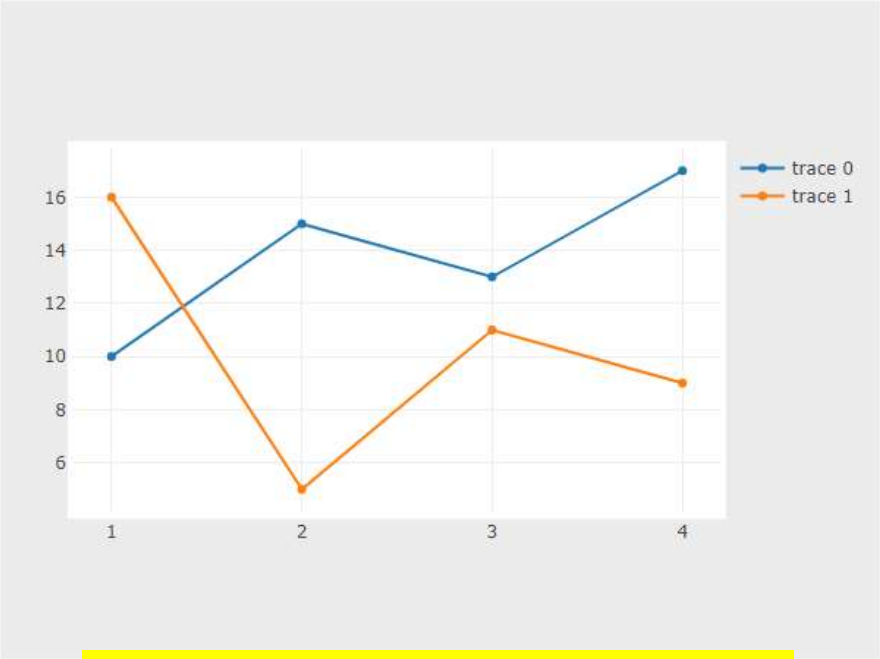


A5.2.5 plotly.js: Line Charts

[2] Basic line charts with layout

```
var layout = {
    autosize: false,
    width: 600,
    height: 450,
    margin: {
        l: 50,  // left
        r: 50,  // right
        b: 100, // bottom
        t: 100, // top
        pad: 4  // padding
    },
    paper_bgcolor: '#ececec',
    plot_bgcolor: '#ffffff' //'#rrggbb'
};

Plotly.newPlot('myDiv', data, layout);
```

Line charts with layout by AA00



AAnn_Chart_Layout.png

Test: pad → 40

A5.2.6.1 plotly.js: Line & Scatter plot

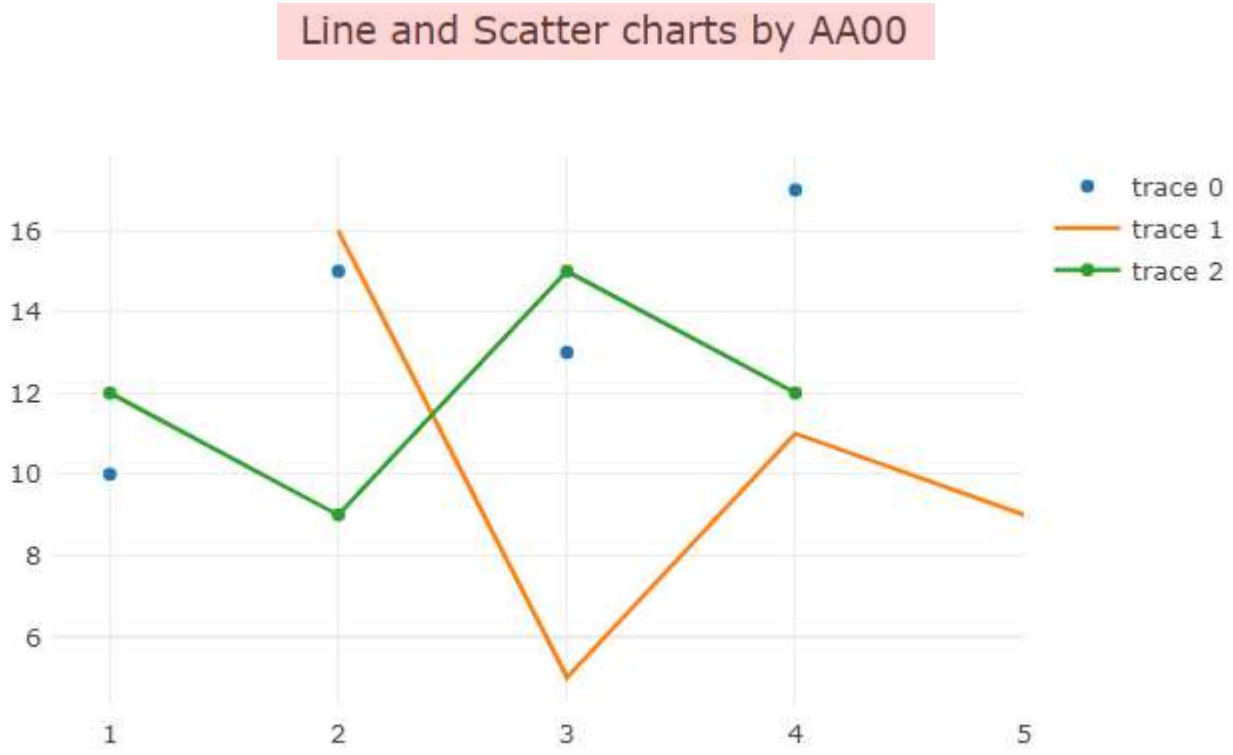
[3] Line & scatter plot : setting mode

```
var trace1 = {
    x: [1, 2, 3, 4],
    y: [10, 15, 13, 17],
    mode: 'markers'
};

var trace2 = {
    x: [2, 3, 4, 5],
    y: [16, 5, 11, 9],
    mode: 'lines'
};

var trace3 = {
    x: [1, 2, 3, 4],
    y: [12, 9, 15, 12],
    mode: 'lines+markers'
};
```

```
var data = [ trace1, trace2, trace3 ];

var layout = {
    title:'Line and Scatter charts by AA00',
    width: 600,
    height: 450,
    margin: {
        l: 50,
        r: 50,
        b: 100,
        t: 100,
        pad: 4
    },
};

Plotly.newPlot('myDiv', data, layout);
```

A5.2.6.2 plotly.js: Line & Scatter plot

[3.1] Line & scatter plot with title



A5.2.6.3 plotly.js: Line & Scatter plot

[3.2] Line & scatter plot with axis name

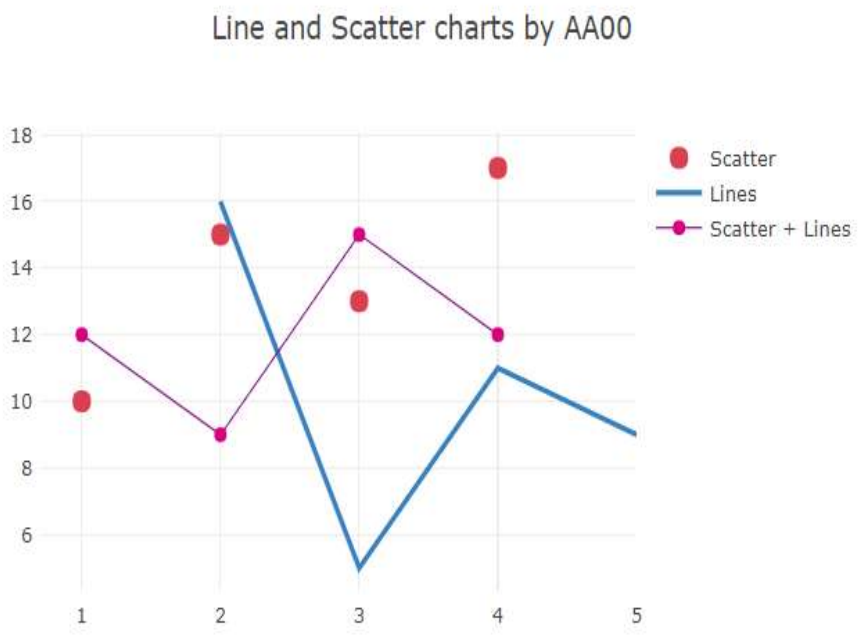
```
var trace1 = {
    x: [1, 2, 3, 4],
    y: [10, 15, 13, 17],
    mode: 'markers',
    name: 'Scatter'
};

var trace2 = {
    x: [2, 3, 4, 5],
    y: [16, 5, 11, 9],
    mode: 'lines',
    name: 'Lines'
};

var trace3 = {
    x: [1, 2, 3, 4],
    y: [12, 9, 15, 12],
    mode: 'lines+markers',
    name: 'Scatter + Lines'
};
```

A5.2.6.4 plotly.js: Line & Scatter plot

[3.3] Line & scatter plot with style

```
var trace1 = {
  x: [1, 2, 3, 4],
  y: [10, 15, 13, 17],
  mode: 'markers',
  name: 'Scatter',
  marker: {
    color: 'rgb(219, 64, 82)',
    size: 12
  }
};

var trace2 = {
  x: [2, 3, 4, 5],
  y: [16, 5, 11, 9],
  mode: 'lines',
  name: 'Lines',
  line: {
    color: 'rgb(55, 128, 191)',
    width: 3
  }
};
```

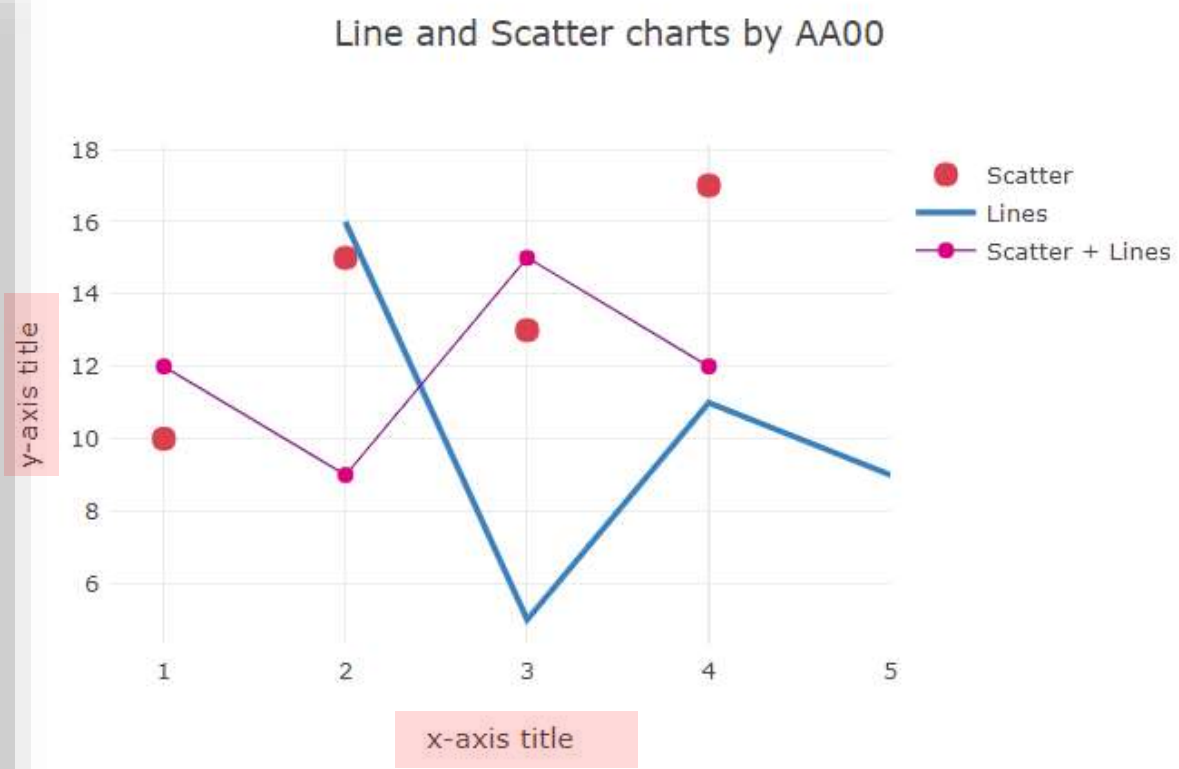
```
var trace3 = {
  x: [1, 2, 3, 4],
  y: [12, 9, 15, 12],
  mode: 'lines+markers',
  name: 'Scatter + Lines',
  marker: {
    color: 'rgb(128, 0, 128)',
    size: 8
  },
  line: {
    color: 'rgb(128, 0, 128)',
    width: 1
  }
};
```



A5.2.6.5 plotly.js: Line & Scatter plot

[3.4] Line & scatter plot with axis titles

```
var layout = {
  title:'Line and Scatter Plot',
  width: 600, height: 450,
  margin: {
    l: 50,
    r: 50,
    b: 100,
    t: 100,
    pad: 4
  },
  xaxis: {
    title: 'x-axis title'
  },
  yaxis: {
    title: 'y-axis title'
  }
};
```



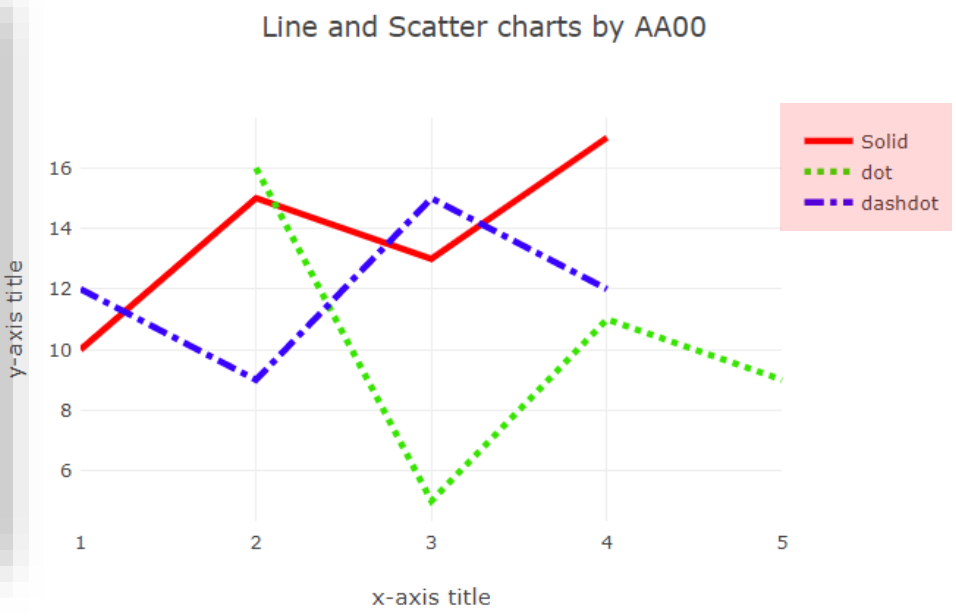
AAnn_Axis_Title.png

A5.2.6.6 plotly.js: Line & Scatter plot

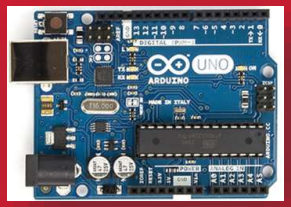
[3.5] Line & scatter plot with dash and dot

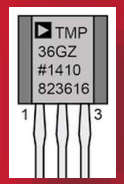
```
var trace1 = {
  x: [1, 2, 3, 4],
  y: [10, 15, 13, 17],
  mode: 'lines',
  name: 'Solid',
  line: {
    color: 'rgb(255, 0, 0)',
    dash: 'solid',
    width: 4
  }
};

var trace2 = {
  x: [2, 3, 4, 5],
  y: [16, 5, 11, 9],
  mode: 'lines',
  name: 'dot',
  line: {
    color: 'rgb(55, 228, 0)',
    dash: 'dot',
    width: 4
  }
};
```

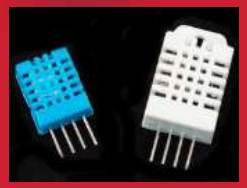
```
var trace3 = {
  x: [1, 2, 3, 4],
  y: [12, 9, 15, 12],
  mode: 'lines',
  name: 'dashdot',
  line: {
    color: 'rgb(55, 0, 255',
    dash: 'dashdot',
    width: 4
  }
};
```



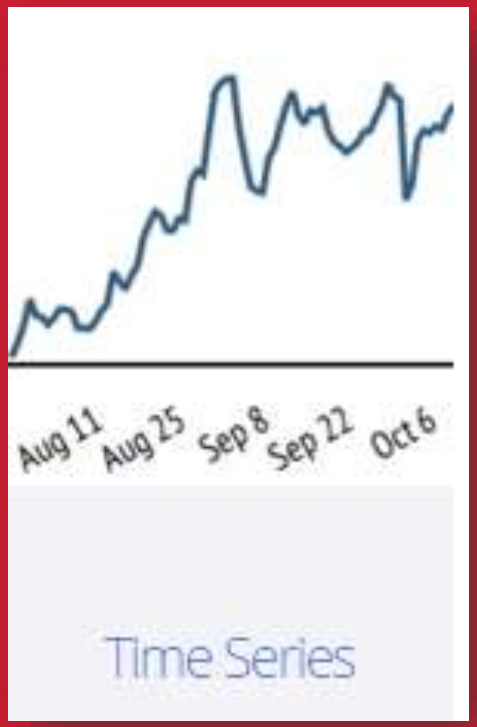
AAnn_Line_Dash_Dot.png







Data visualization using plotly.js



A5.3. Time series

Navigation

Date Strings

Basic Time Series

Manually Set Range

Time Series with Rangeslider

Back To Plotly.Js

Time Series in plotly.js

How to plot D3.js-based date and time in Plotly.js. An example of a time-series plot.

R | Python | matplotlib | plotly.js | Pandas | node.js | MATLAB

Date Strings

```
var data = [
  {
    x: ['2013-10-04 22:23:00', '2013-11-04 22:23:00', '2013-12-04 22:23:00'],
    y: [1, 3, 6],
    type: 'scatter'
  }
];

Plotly.newPlot('myDiv', data);
```

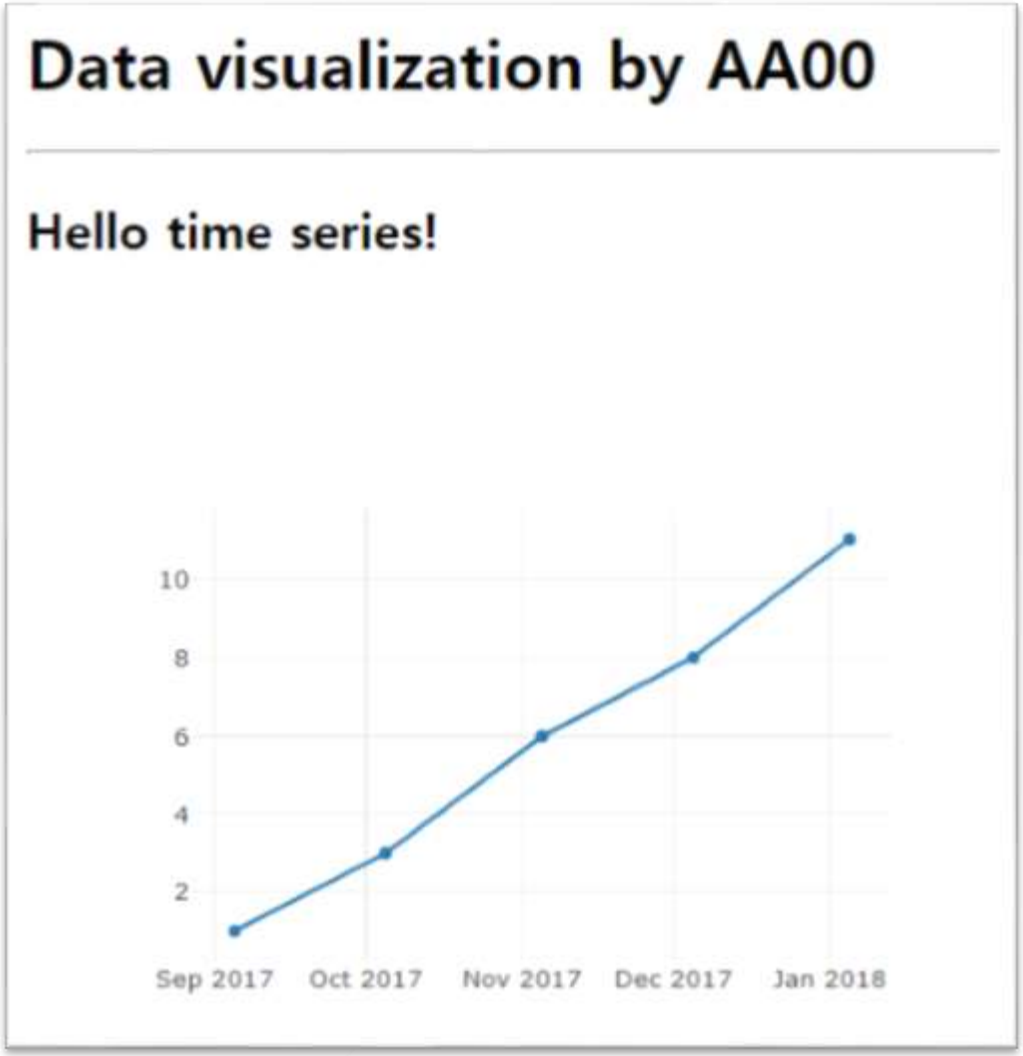
A5.3.1 plotly.js: Time series

[1] Time series : date strings

```
<!-- Plotly chart will be drawn inside this DIV -->
<div id="myDiv" style="width: 500px;height: 400px"></div>

<script>
    <!-- JAVASCRIPT CODE GOES HERE -->

    var data = [
    {
        x: ['2017-9-04 22:23:00',
        '2017-10-04 22:23:00',
        '2017-11-04 22:23:00',
        '2017-12-04 22:23:00'],
        y: [1, 3, 6, 8],
        type: 'scatter'
    }
    ];

    Plotly.newPlot('myDiv', data);

</script>
```

A5.3.2 plotly.js: Time series

Time series : date strings – result



오늘 날자와
데이터를 추가

A5.3.3.1 plotly.js: Time series

[2] Time series : financial data strings – AAPL stock price

안전함 | https://raw.githubusercontent.com/plotly/datasets/master/finance-charts-a...

```
Date,AAPL.Open,AAPL.High,AAPL.Low,AAPL.Close,AAPL.Volume,AAPL.Adjusted,dn,mavg,up,direction
2015-02-17,127.489998,128.880005,126.919998,127.830002,63152400,122.905254,106.7410523,117.9276669,129.1142814,Increasing
2015-02-18,127.629997,128.779999,127.449997,128.720001,44891700,123.760965,107.842423,118.9403335,130.0382439,Increasing
2015-02-19,128.479996,129.029999,128.330002,128.449997,37362400,123.501363,108.8942449,119.8891668,130.8840887,Decreasing
2015-02-20,128.619995,129.5,128.050003,129.5,48948400,124.510914,109.7854494,120.7635001,131.7415509,Increasing
2015-02-23,130.020004,133,129.660004,133,70974100,127.876074,110.3725162,121.7201668,133.0678174,Increasing
2015-02-24,132.940002,133.600006,131.169998,132.169998,69228100,127.078049,111.0948689,122.6648335,134.2347981,Decreasing
2015-02-25,131.559998,131.600006,128.149994,128.789993,74711700,123.828261,113.2119183,123.6296667,134.0474151,Decreasing
2015-02-26,128.789993,130.869995,126.610001,130.419998,91287500,125.395469,114.1652991,124.2823333,134.3993674,Increasing
2015-02-27,130,130.570007,128.240005,128.460007,62014800,123.510987,114.9668484,124.8426669,134.7184854,Decreasing
2015-03-02,129.25,130.279999,128.300003,129.089996,48096700,124.116706,115.8770904,125.4036668,134.9302432,Decreasing
2015-03-03,128.960007,129.520004,128.089996,129.360001,37816300,124.376308,116.9535132,125.9551669,134.9568205,Increasing
2015-03-04,129.100006,129.559998,128.320007,128.539993,31666300,123.587892,118.0874253,126.4730002,134.8585751,Decreasing
2015-03-05,128.580002,128.75,125.760002,126.410004,56517100,121.539962,119.1048311,126.848667,134.5925029,Decreasing
2015-03-06,128.399994,129.369995,126.260002,126.599998,72842100,121.722637,120.190797,127.2288335,134.26687,Decreasing
2015-03-09,127.959999,129.570007,125.059998,127.139999,88528500,122.241834,121.6289771,127.631167,133.6333568,Decreasing
2015-03-10,126.410004,127.220001,123.800003,124.510002,68856600,119.71316,123.1164763,127.9235004,132.7305246,Decreasing
2015-03-11,124.75,124.769997,122.110001,122.239998,68939000,117.530609,123.592756,128.0033337,132.4139113,Decreasing
2015-03-12,122.309998,124.900002,121.629997,124.449997,48362700,119.655466,123.4894559,127.9813337,132.4732114,Increasing
2015-03-13,124.400002,125.400002,122.580002,123.589996,51827300,118.828598,123.045606,127.8490003,132.6523946,Decreasing
2015-03-16,123.879997,124.949997,122.870003,124.949997,35874300,120.136203,122.6967016,127.7283335,132.7599655,Increasing
2015-03-17,125.900002,127.32,125.650002,127.040001,51023100,122.145688,122.616033,127.6680002,132.7199674,Increasing
2015-03-18,127,129.160004,126.370003,128.470001,65270800,123.520597,122.6064498,127.652167,132.6978842,Increasing
2015-03-19,128.75,129.25,127.400002,127.5,45809500,122.587966,122.5939029,127.6245004,132.6550979,Decreasing
2015-03-20,128.25,128.399994,125.160004,125.900002,68695100,121.049608,122.4865925,127.4980004,132.5094083,Decreasing
2015-03-23,127.120003,127.849998,126.519997,127.209999,37709700,122.309137,122.6741703,127.2633335,131.8524968,Increasing
2015-03-24,127.230003,128.039993,126.559998,126.690002,32842300,121.809174,123.0410183,127.0025001,130.9639818,Decreasing
2015-03-25,126.540001,126.82,123.379997,123.379997,51655200,118.626689,122.8276392,126.7531667,130.6786943,Decreasing
2015-03-26,122.760002,124.879997,122.599998,124.239998,47572900,119.453558,122.5538523,126.4835001,130.4131478,Increasing
2015-03-27,124.57,124.699997,122.910004,123.25,39546200,118.5017,122.2826504,126.2099998,130.1373491,Decreasing
2015-03-30,124.050003,126.400002,124,126.370003,47099700,121.501502,122.346906,126.0283332,129.7097604,Increasing
2015-03-31,126.089996,126.489998,124.360001,124.43,42090600,119.63624,122.395242,125.8334998,129.2717577,Decreasing
2015-04-01,124.82,125.120003,123.099998,124.25,40621400,119.463174,122.3761274,125.6009999,128.8258723,Decreasing
```

A5.3.3.2 plotly.js: Time series

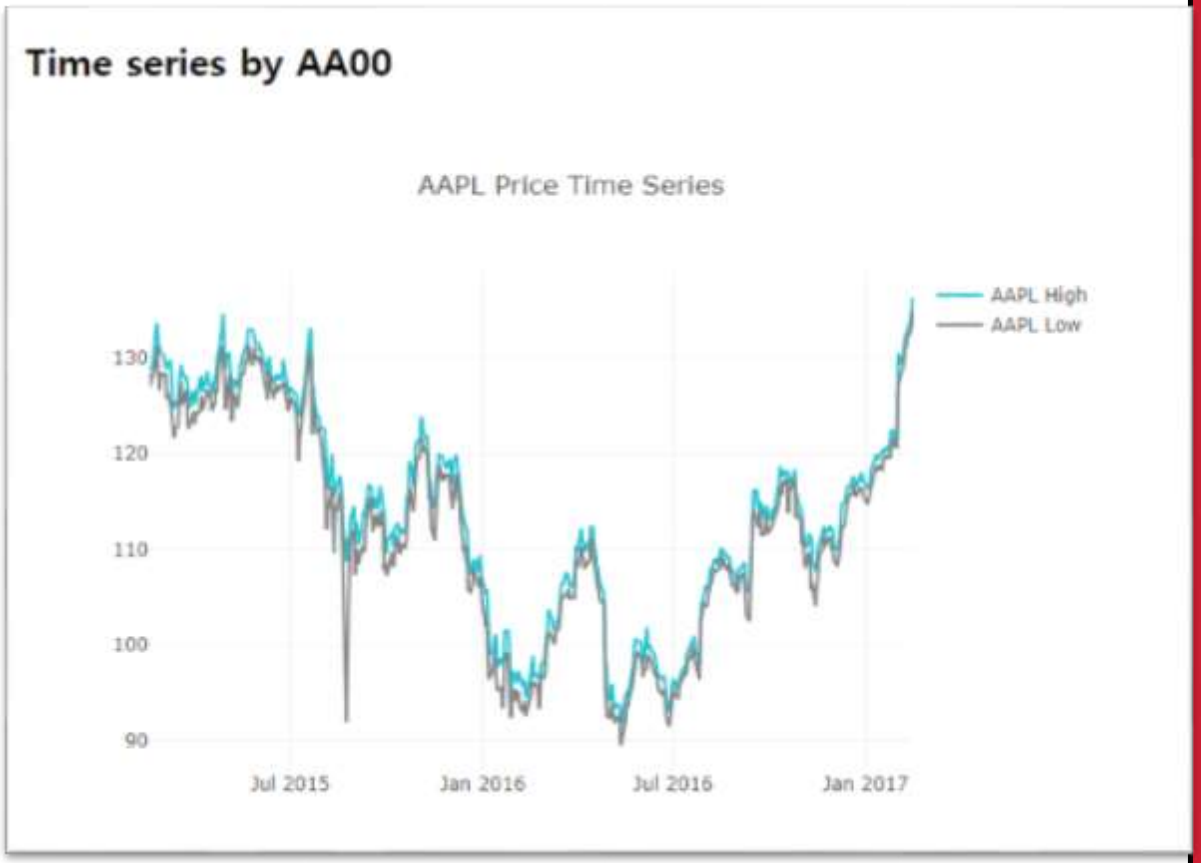
[2] Time series : financial data strings – AAPL stock price

```
Plotly.d3.csv("https://raw.githubusercontent.com/plotly/datasets/master/
    finance-charts-apple.csv", function(err, rows){

    function unpack(rows, key) {
        return rows.map(function(row) { return row[key]; });
    }


    var trace1 = {
        type: "scatter",
        mode: "lines",
        name: 'AAPL High',
        x: unpack(rows, 'Date'),
        y: unpack(rows, 'AAPL.High'),
        line: {color: '#17BECF'}
    }

    var trace2 = {
        type: "scatter",
        mode: "lines",
        name: 'AAPL Low',
        x: unpack(rows, 'Date'),
        y: unpack(rows, 'AAPL.Low'),
        line: {color: '#7F7F7F'}
    }

    var data = [trace1,trace2];
```

A5.3.3.3 plotly.js: Time series

[2] Time series : financial data strings – AAPL stock price

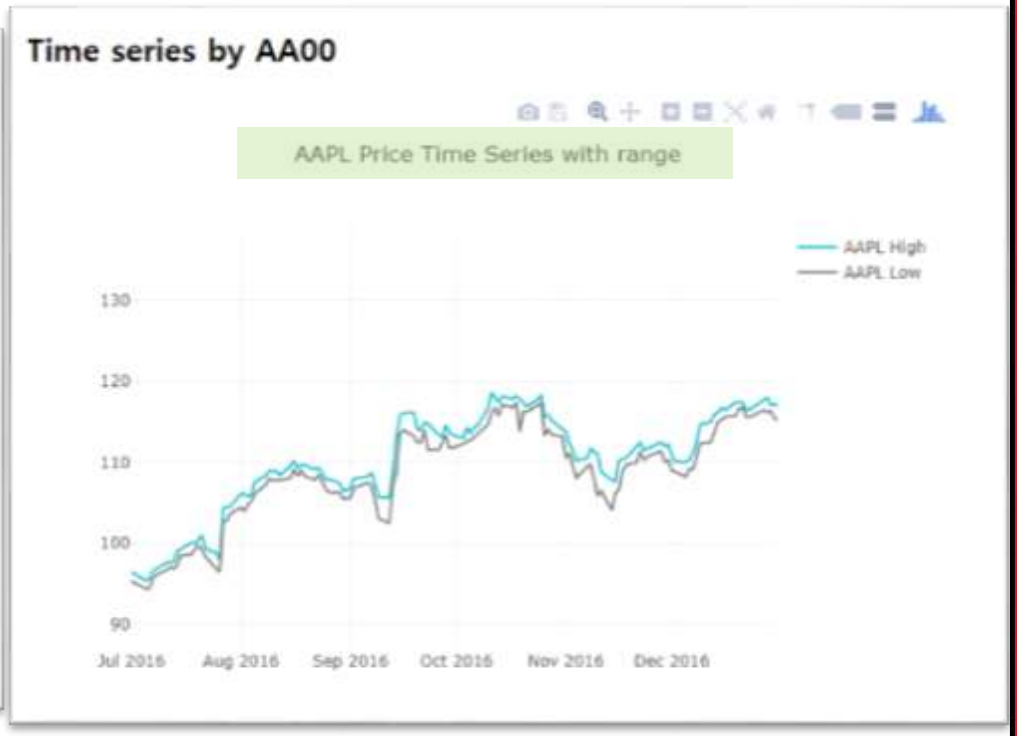
```
var data = [trace1,trace2];

var layout = {
    title: 'AAPL Price Time Series',
};

Plotly.newPlot('myDiv', data, layout);
```



A5.3.3.4 plotly.js: Time series

[2] Time series : financial data strings – set range

```
var data = [trace1,trace2];

var layout = {
    title: 'AAPL Price Time Series with range',
    xaxis: {
        range: ['2016-07-01', '2016-12-31'],
        type: 'date'
    },
    yaxis: {
        autorange: true,
        range: [86.8700008333, 138.870004167],
        type: 'linear'
    }
};

Plotly.newPlot('myDiv', data, layout);
```



날짜와 주가의 범위를 지정

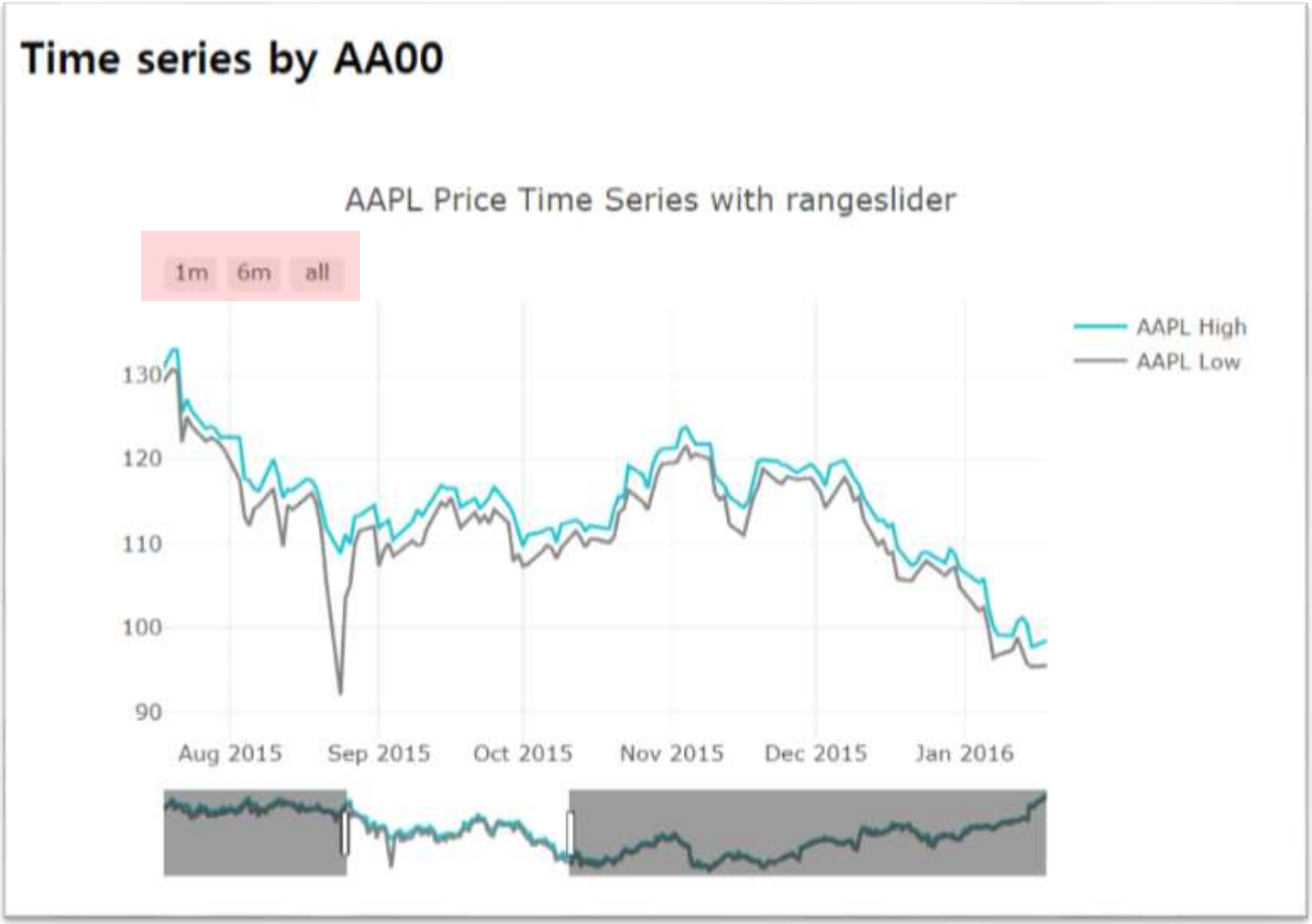
A5.3.3.5 plotly.js: Time series

[2] Time series : financial data strings – Range slider

```
var layout = {
    title: 'AAPL Price Time Series with rangeslider',
    xaxis: {
        autorange: true,
        range: ['2015-02-17', '2017-02-16'],
        rangeselector: {buttons: [
            {
                count: 1,
                label: '1m',
                step: 'month',
                stepmode: 'backward'
            },
            {
                count: 6,
                label: '6m',
                step: 'month',
                stepmode: 'backward'
            },
            {step: 'all'}
            ]},
            rangeslider: {range: ['2015-02-17', '2017-02-16']},
            type: 'date'
        },
        yaxis: {
            autorange: true,
            range: [86.8700008333, 138.870004167],
            type: 'linear'
        }
    };
```

A5.3.3.6 plotly.js: Time series

[2] Time series : financial data strings – Range slider



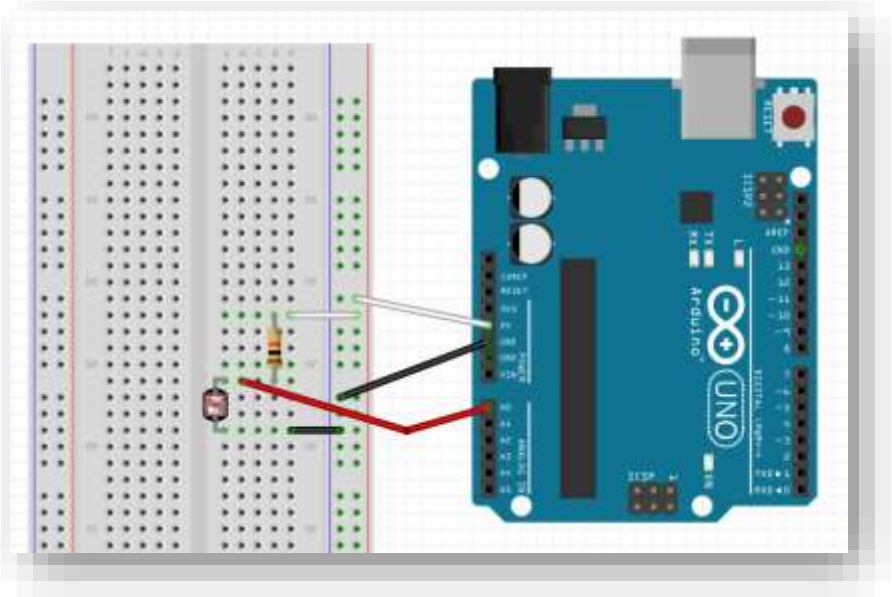
A5.3.4.1 plotly.js: Sensor time series

[3] Time series : my lux data

```
'2015-11-05 12:09:41.382',
'2015-11-05 12:09:42.380',
'2015-11-05 12:09:43.378',
'2015-11-05 12:09:44.377',
'2015-11-05 12:09:45.375',
'2015-11-05 12:09:46.389',
'2015-11-05 12:09:47.388',
'2015-11-05 12:09:48.386',
'2015-11-05 12:09:49.384',
'2015-11-05 12:09:50.383',
'2015-11-05 12:09:51.381',
'2015-11-05 12:09:52.380',
'2015-11-05 12:09:53.394',
'2015-11-05 12:09:54.392',
'2015-11-05 12:09:55.391',
'2015-11-05 12:09:56.389',
'2015-11-05 12:09:57.387',
'2015-11-05 12:09:58.386',
'2015-11-05 12:09:59.384',
'2015-11-05 12:10:00.398',
'2015-11-05 12:10:01.397',
```

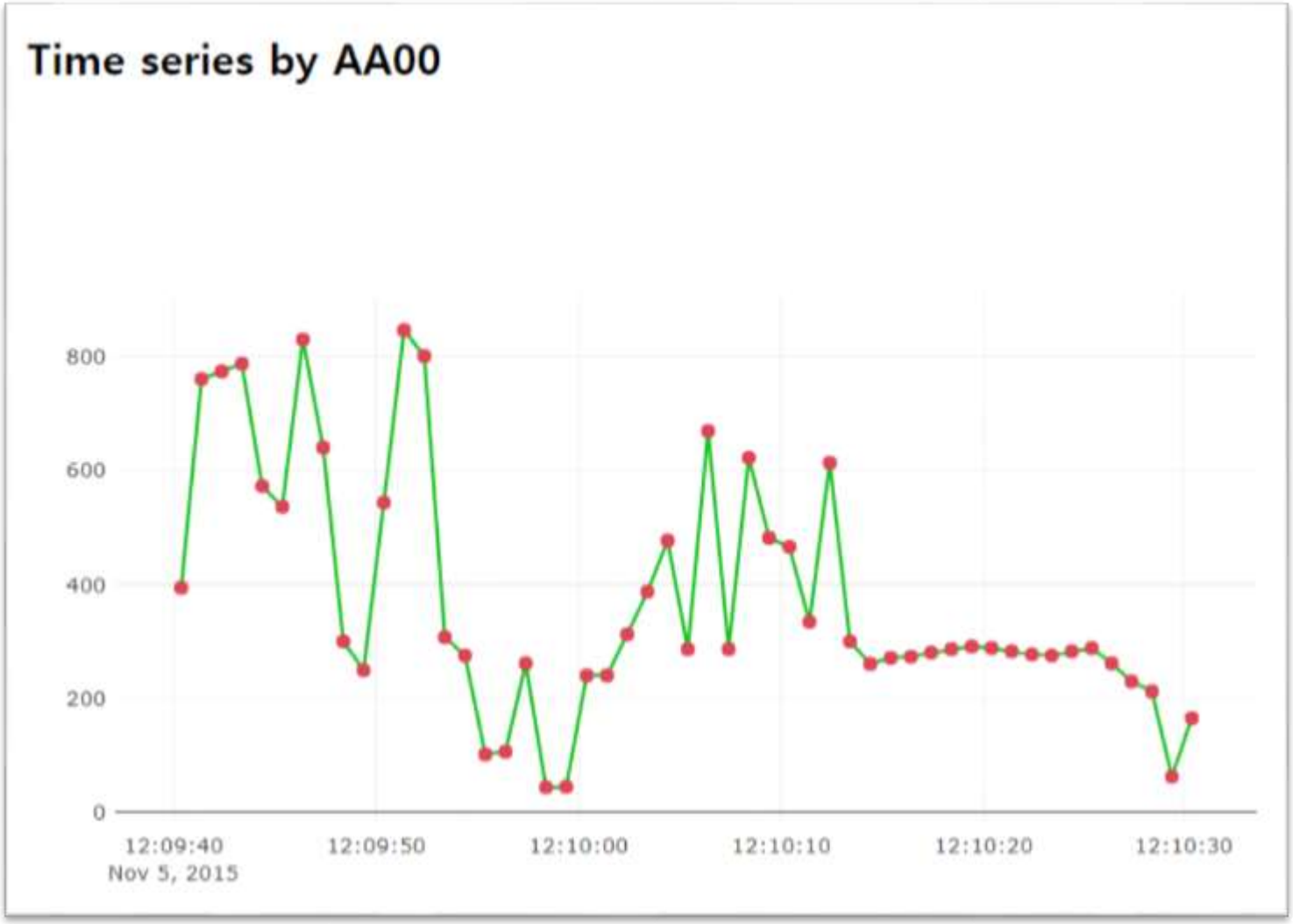
Data :

date,value



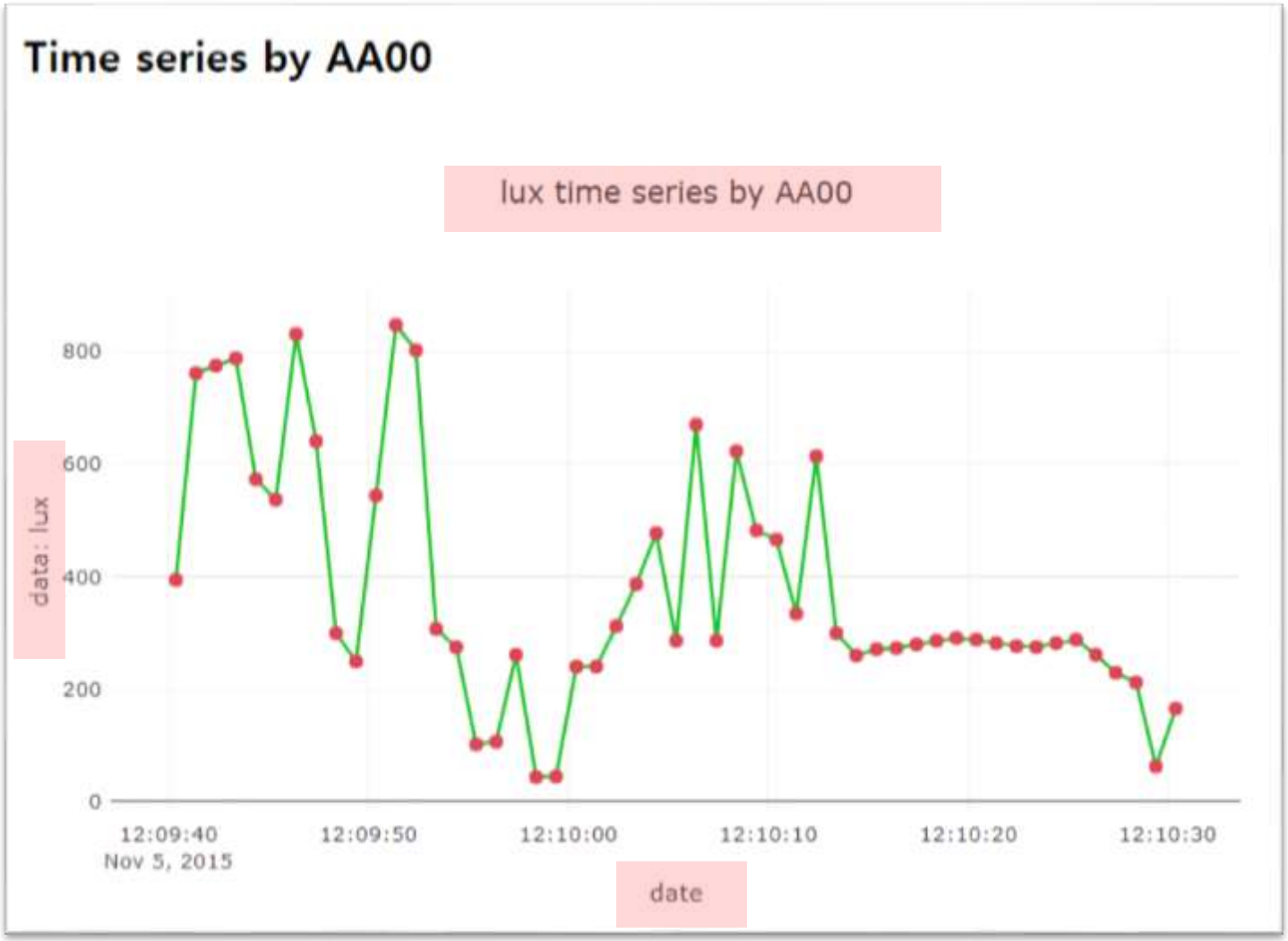
A5.3.4.2 plotly.js: Time series

[3] Time series : my lux data → DV_ts03_sensor_chart.html



A5.3.4.3 plotly.js: Time series

[3] Time series : my lux data – [DIY] → Set title and axis title

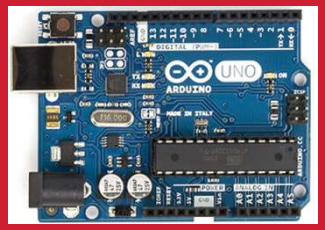


AAnn_lux_Time_Series.png

Project: Time series with Rangeslider

[Project-DIY] AAnn_lux_Rangelslider.html

AAnn_lux_Rangelslider.png



[Practice]

- [wk07]
  - charts by plotly
  - Complete your project
  - Upload folder: aann-rpt07
  - Use repo “aann” in github

wk07 : Practice : aann-rpt07

- [Target of this week]
  - Complete your works
  - Save your outcomes and upload outputs in github

제출폴더명 : **aann-rpt07**

- 압축할 파일들

① AAnn_Chart_Layout.png

② AAnn_Axis_Title.png

③ AAnn_Line_Dash_Dot.png

④ AAnn_lux_Time_Series.png

⑤ AAnn_lux_Rangeslider.png

⑥ All *.html in data_charts folder

Lecture materials

References & good sites

- ✓ http://www.arduino.cc Arduino Homepage
- ✓ http://www.nodejs.org/ko Node.js
- ✓ https://plot.ly/ plotly
- ✓ https://www.mongodb.com/ MongoDB
- ✓ http://www.w3schools.com By w3schools
- ✓ http://www.github.com GitHub

Target of this class

Real-time Weather Station from nano 33 BLE sensors

on Time: 2020-09-09 10:27:17.321