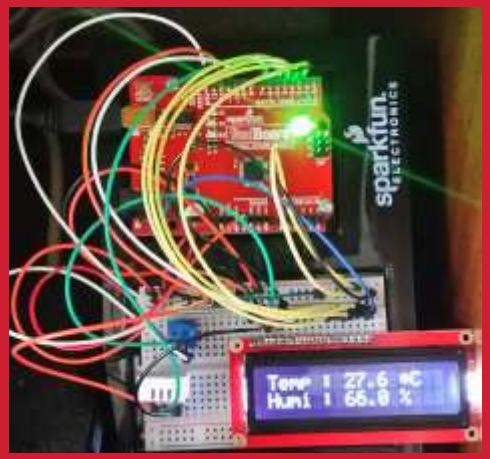


Arduino-IOT

[wk12]

Arduino + Node

Data storaging I

Visualization of Signals using Arduino, Node.js & Storing Signals in MongoDB & Mining Data using Python

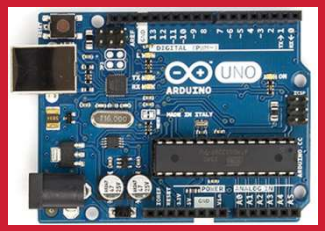
Comsi, INJE University

2nd semester, 2019

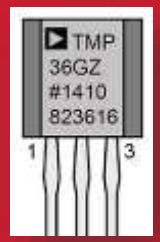
Email : chaos21c@gmail.com

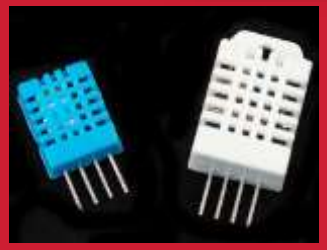
My ID

ID	성명
AA01	김관용
AA02	백동진
AA03	김도훈
AA04	김희찬
AA05	류재현
AA06	문민규
AA07	박진석
AA08	이승협
AA09	표혜성
AA10	김다영
AA11	성소진
AA12	김해인
AA13	신송주
AA14	윤지훈



[Review]





- [wk11]
  - RT Data Visualization with node.js
  - Multiple data and Usage of gauge.js
  - Complete your real-time WEB charts
  - Upload file name : AAnn_Rpt09

wk11 : Practice : AAnn_Rpt09

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

제출폴더명 : **AAnn_Rpt09**

- 압축할 파일들

① **AAnn_DS_cds_tmp36.png**

② **AAnn_cds_dht22_data.png**

③ **AAnn_cds_dht22.html**

④ **AAnn_cds_dht22.png**

⑤ **All *.ino**

⑥ **All *.js**

⑦ **All *.html**

Email : chaos21c@gmail.com

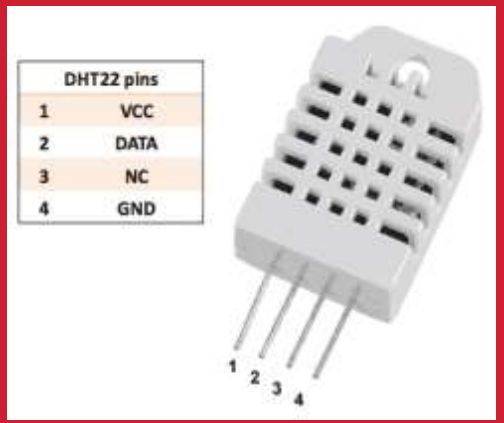
CdS + DHT22

+ plotly.js

Node project

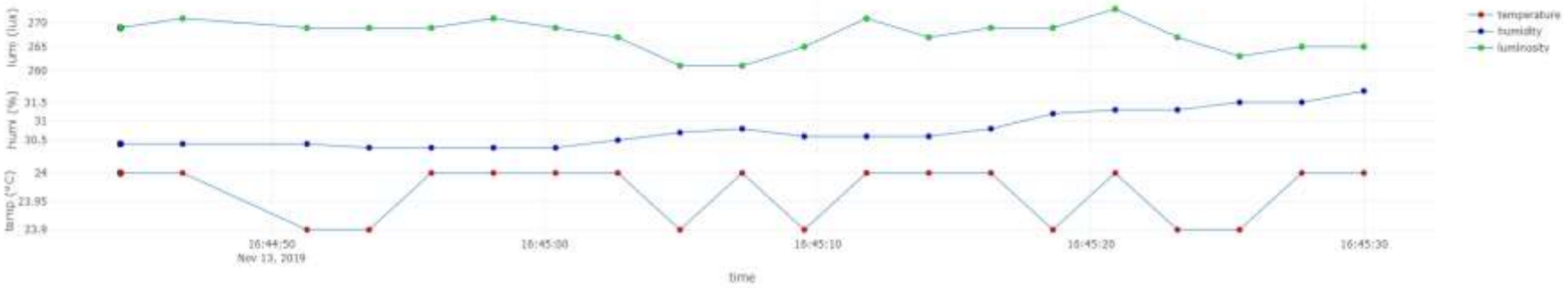
Multi-sensors

DHT22 + CdS



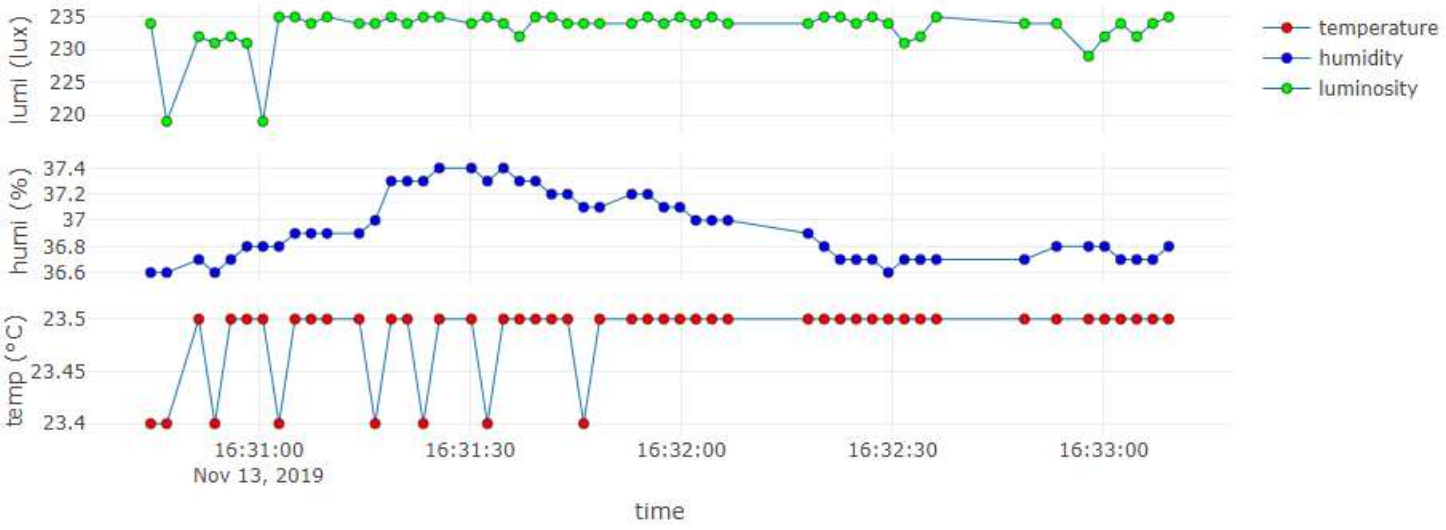
Real-time Weather Station from sensors

on Time: 2019-11-13 16:45:29.995



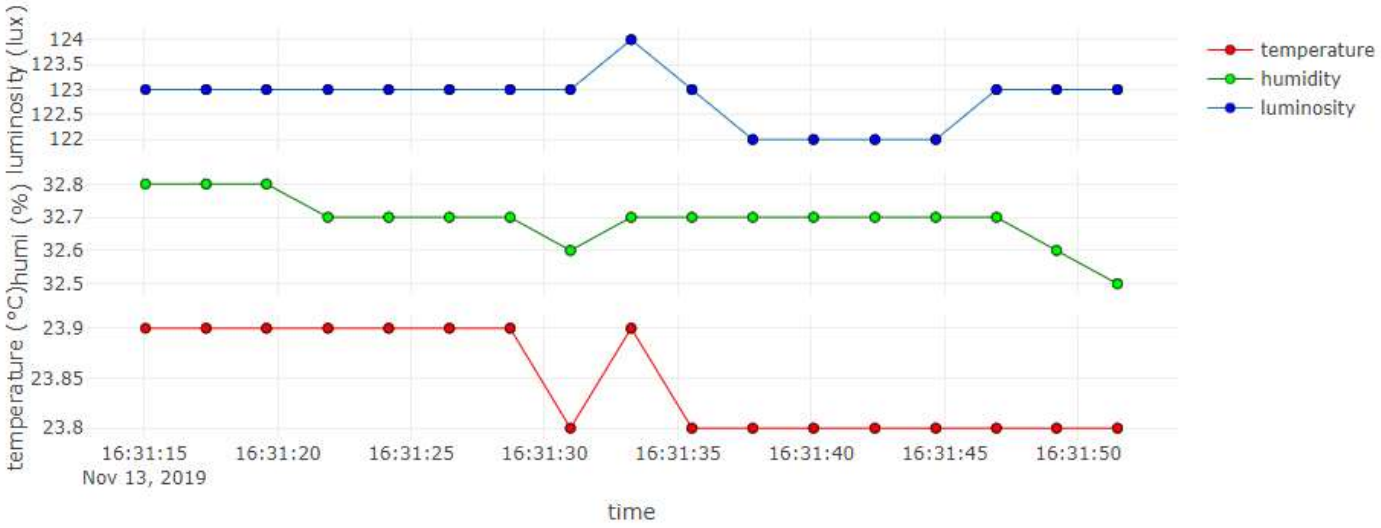
Real-time Weather Station from sensors

on Time: 2019-11-13 16:33:09.261

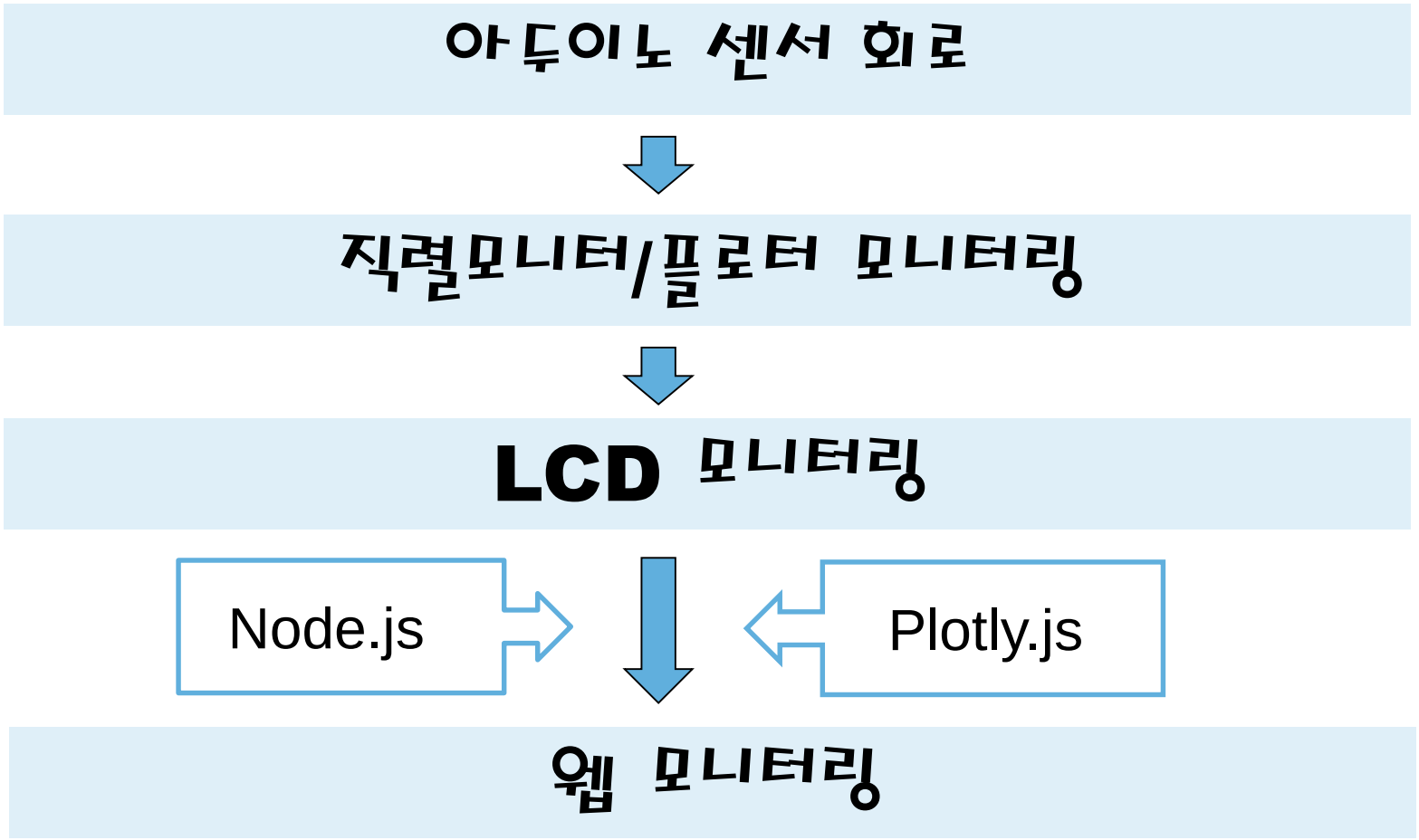


Real-time Weather Station from sensors

on Time: 2019-11-13 16:31:51.473

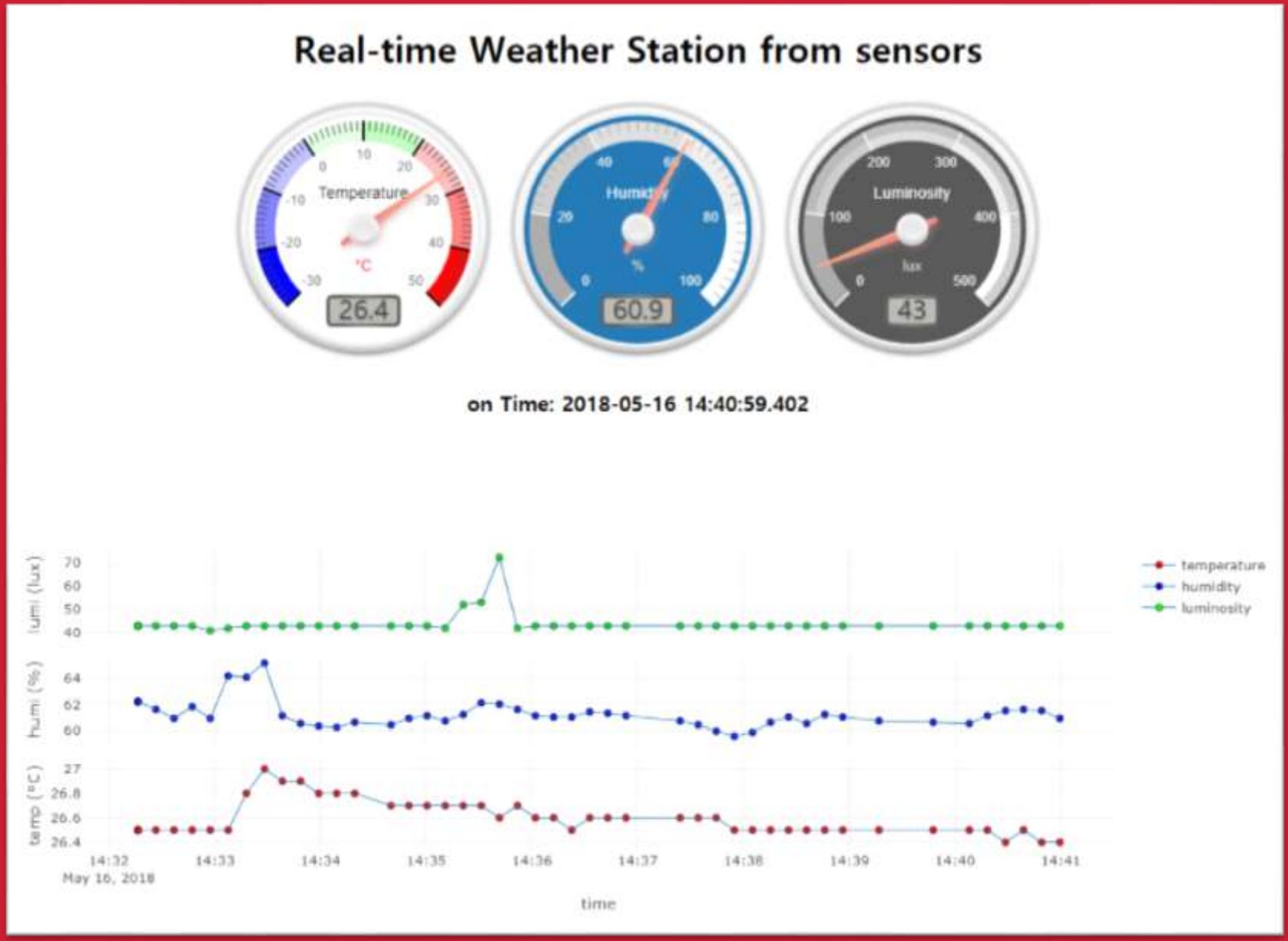


A5.1 Introduction to data visualization

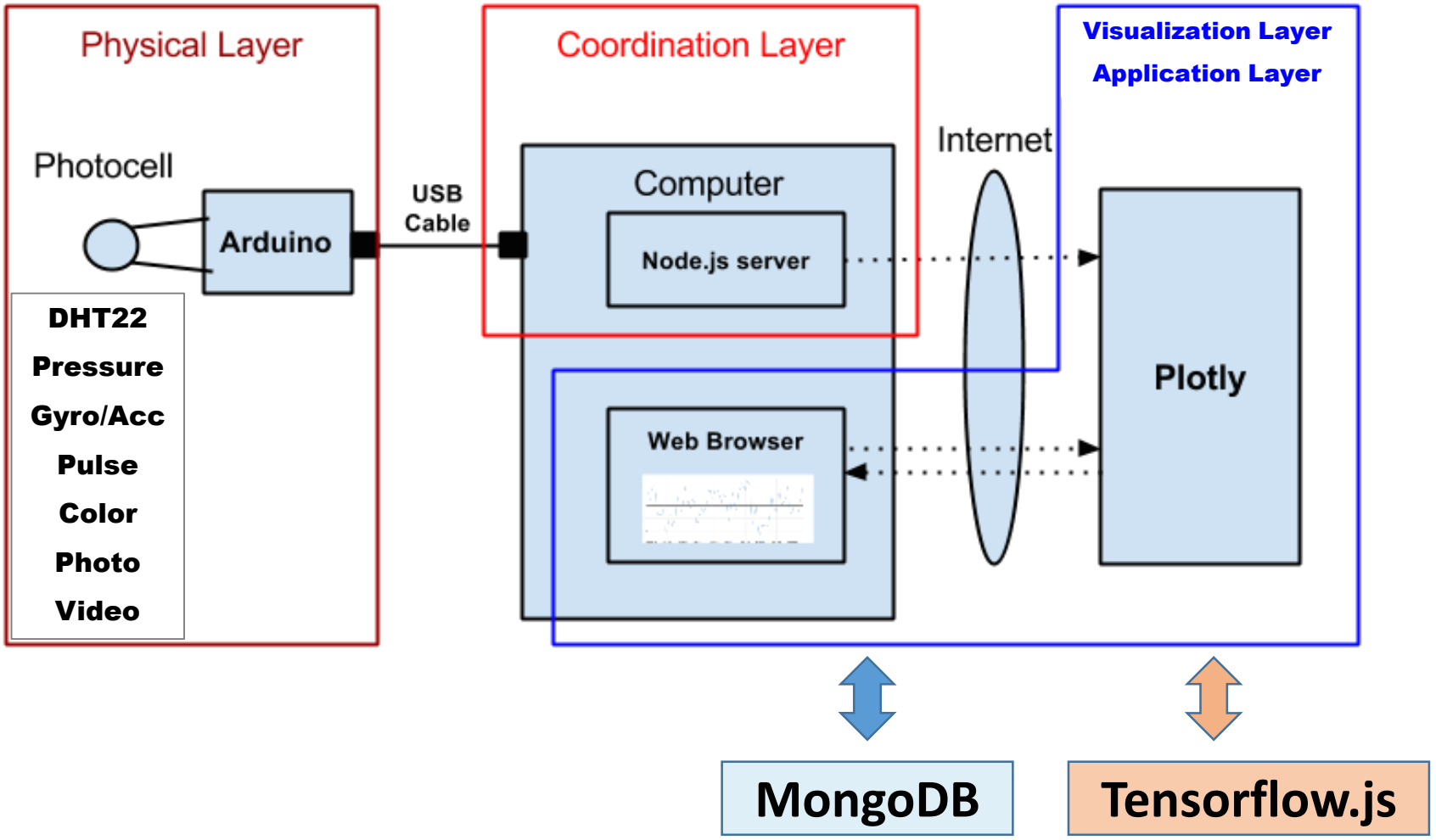


Arduino data on network socket

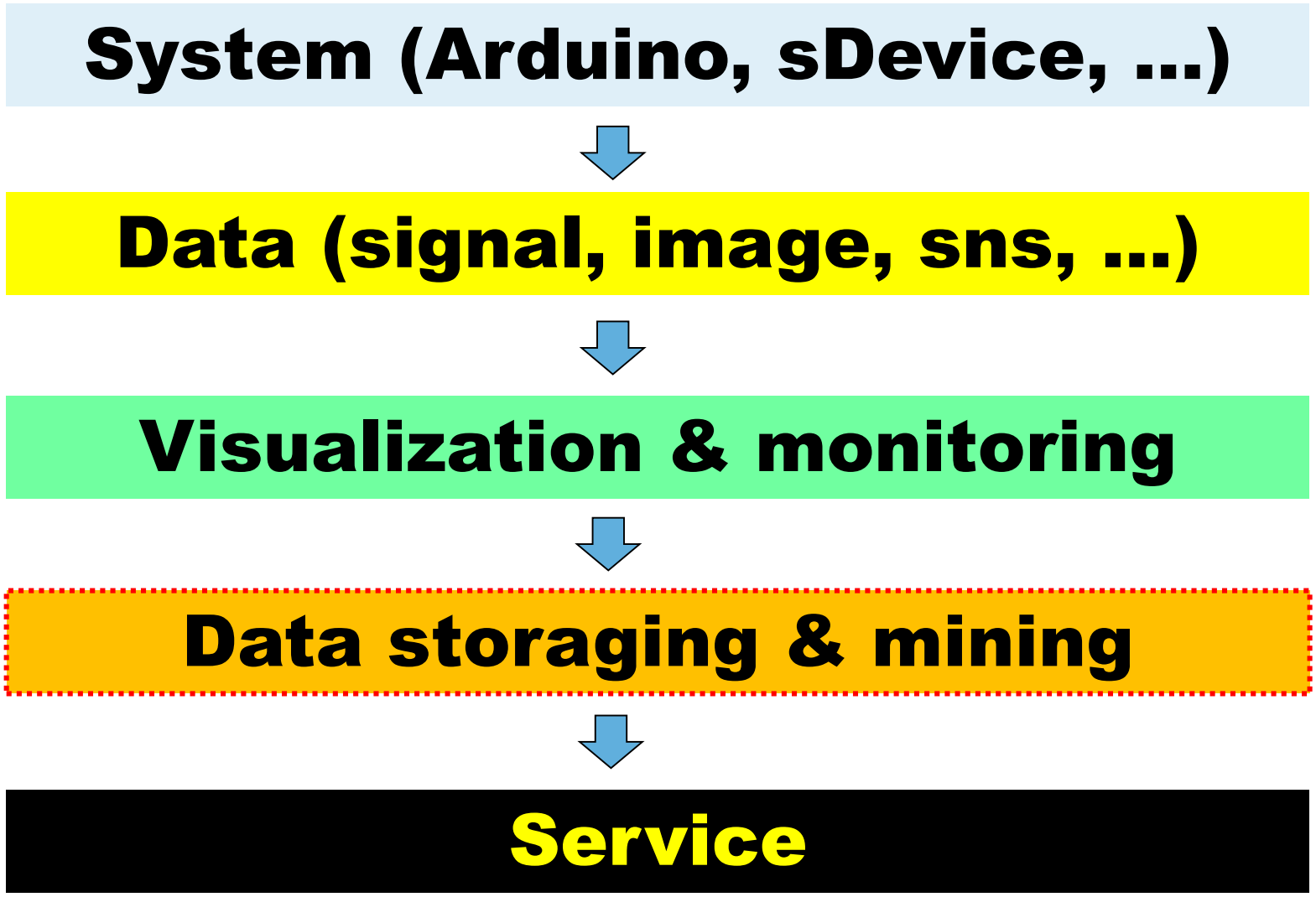
Arduino data + plotly

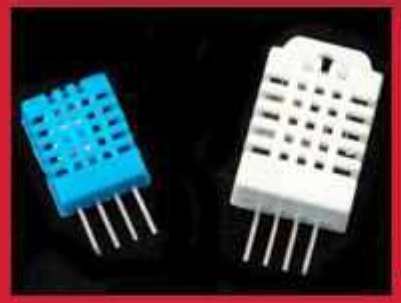


Layout [H S C]


Physical Layer
Photocell
Arduino
DHT22
Pressure
Gyro/Acc
Pulse
Color
Photo
Video
USB
Cable
Coordination Layer
Computer
Node.js server
Web Browser
Internet
Visualization Layer
Application Layer
Plotly
MongoDB
Tensorflow.js

A5. Introduction to IoT service





[Goal]

Arduino + Node.js

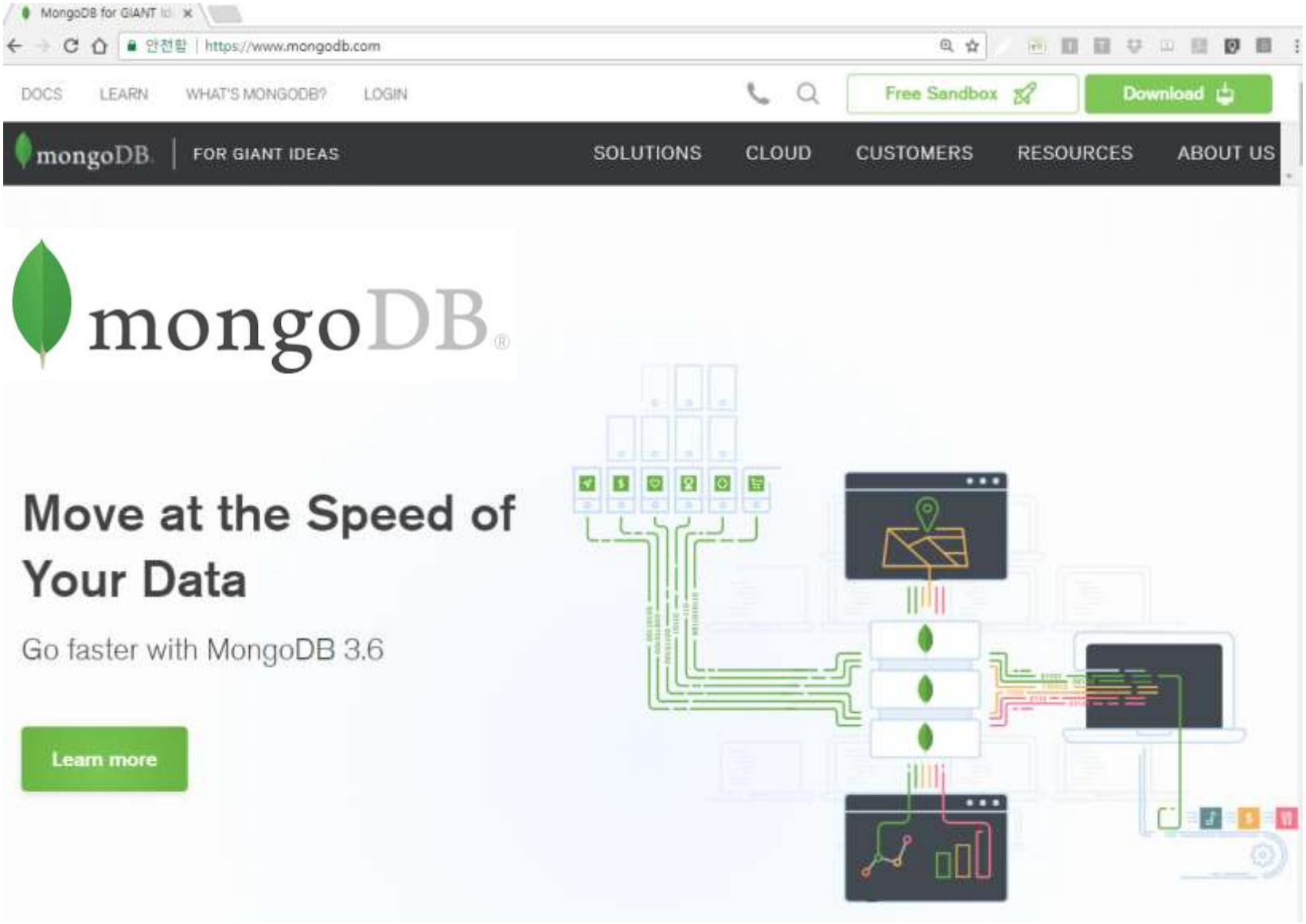
+ plotly.js

+ MongoDB

→ Data storaging

& visualization

A5.9 MongoDB


MongoDB for GIANT
https://www.mongodb.com
DOCS
LEARN
WHAT'S MONGODB?
LOGIN
Free Sandbox
Download
mongoDB.
FOR GIANT IDEAS
SOLUTIONS
CLOUD
CUSTOMERS
RESOURCES
ABOUT US
mongoDB.
Move at the Speed of Your Data
Go faster with MongoDB 3.6
Learn more

A5.9 MongoDB

MongoDB는 C++로 작성된 오픈소스 문서지향(Document-Oriented) 적 Cross-platform 데이터베이스이며, 뛰어난 확장성과 성능을 자랑합니다. 또한, 현존하는 NoSQL 데이터베이스 중 인지도 1위를 유지하고있습니다.

NoSQL?

흔히 NoSQL이라고 해서 아, SQL이 없는 데이터베이스구나! 라고 생각 할 수도 있겠지만, 진짜 의미는 Not Only SQL 입니다. 기존의 RDBMS의 한계를 극복하기 위해 만들어진 새로운 형태의 데이터저장소 입니다. 관계형 DB가 아니므로, RDMS처럼 고정된 스키마 및 JOIN 이 존재하지 않습니다.

Document?

Document Oriented 데이터베이스라는데.. 여기서 말하는 Document가 뭘까요? 문서? 이게 그냥 '문서' 로 번역해버리면 조금은 애매합니다. 문서라고 하면 보통 워드/엑셀에 사용되는 그런 문서가 떠오르는데요, 그것과는 다릅니다. Document는 RDMS의 record 와 비슷한 개념인데요, 이의 데이터 구조는 한개이상의 key-value pair 으로 이뤄져있습니다. MongoDB 샘플 Document를 확인 해 볼까요?

```
{ "_id": ObjectId("5099803df3f4948bd2f98391"),
"username": "velopert",
"name": { first: "M.J.", last: "Kim" } }
```

여기서 _id, username, name 은 key 이고 그 오른쪽에 있는 값들은 value 입니다.

_id 는 12bytes의 hexadecimal 값으로서, 각 document의 유일함(uniqueness)을 제공합니다.
이 값의 첫 4bytes 는현재 timestamp, 다음 3bytes는 machine id, 다음 2bytes는 MongoDB 서버의 프로세스id, 마지막 3bytes는 순차번호입니다 추가될때마다 값이 높아진다는거지요.

Document는 동적(dynamic)의 schema 를 갖고있습니다. 같은 Collection 안에 있는 Document 끼리 다른 schema 를 갖고 있을 수 있는데요, 쉽게 말하면 서로 다른 데이터 (즉 다른 key) 들을 가지고 있을 수 있습니다.

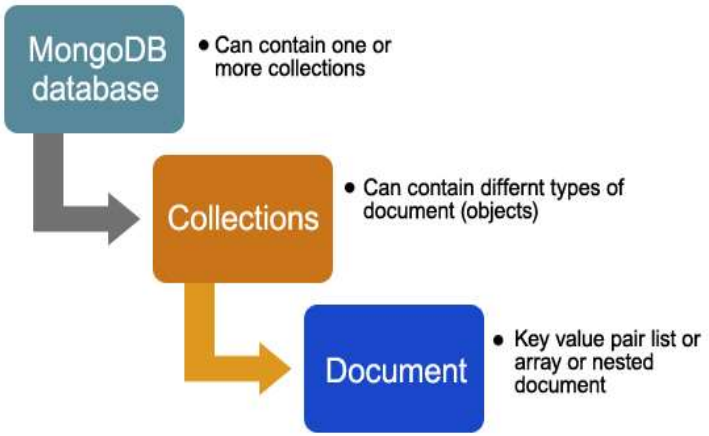
Collection?

Collection은 MongoDB Document의 그룹입니다. Document들이 Collection내부에 위치하고 있습니다. RDMS의 table과 비슷한 개념입니다만 RDMS와 달리 schema를 따로 가지고 있지않습니다. Document 부분설명에 나와있듯이 각 Document들이 동적인 schema를 가지고 있으니까요

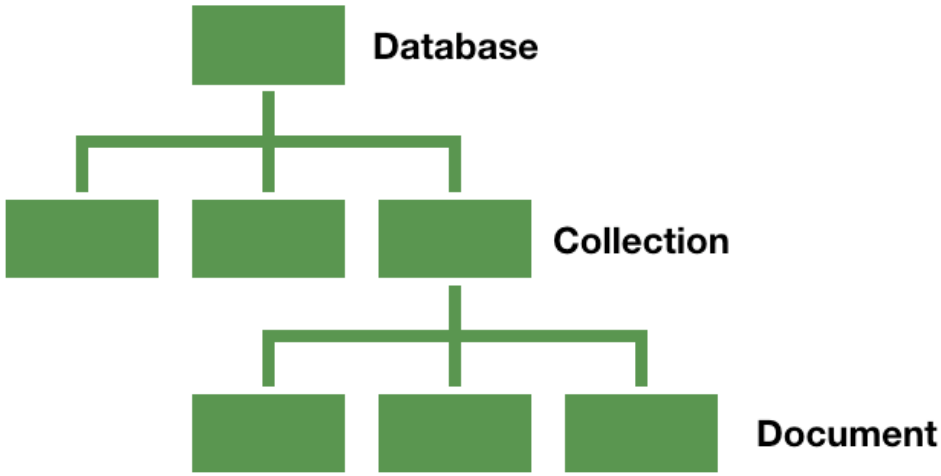
Database?

Database는 Collection들의 물리적인 컨테이너입니다. 각 Database는 파일시스템에 여러파일들로 저장됩니다.

A5.9 MongoDB



https://cdn.educba.com/academy/wp-content/uploads/2019/04/MongoDB-chart2.jpg

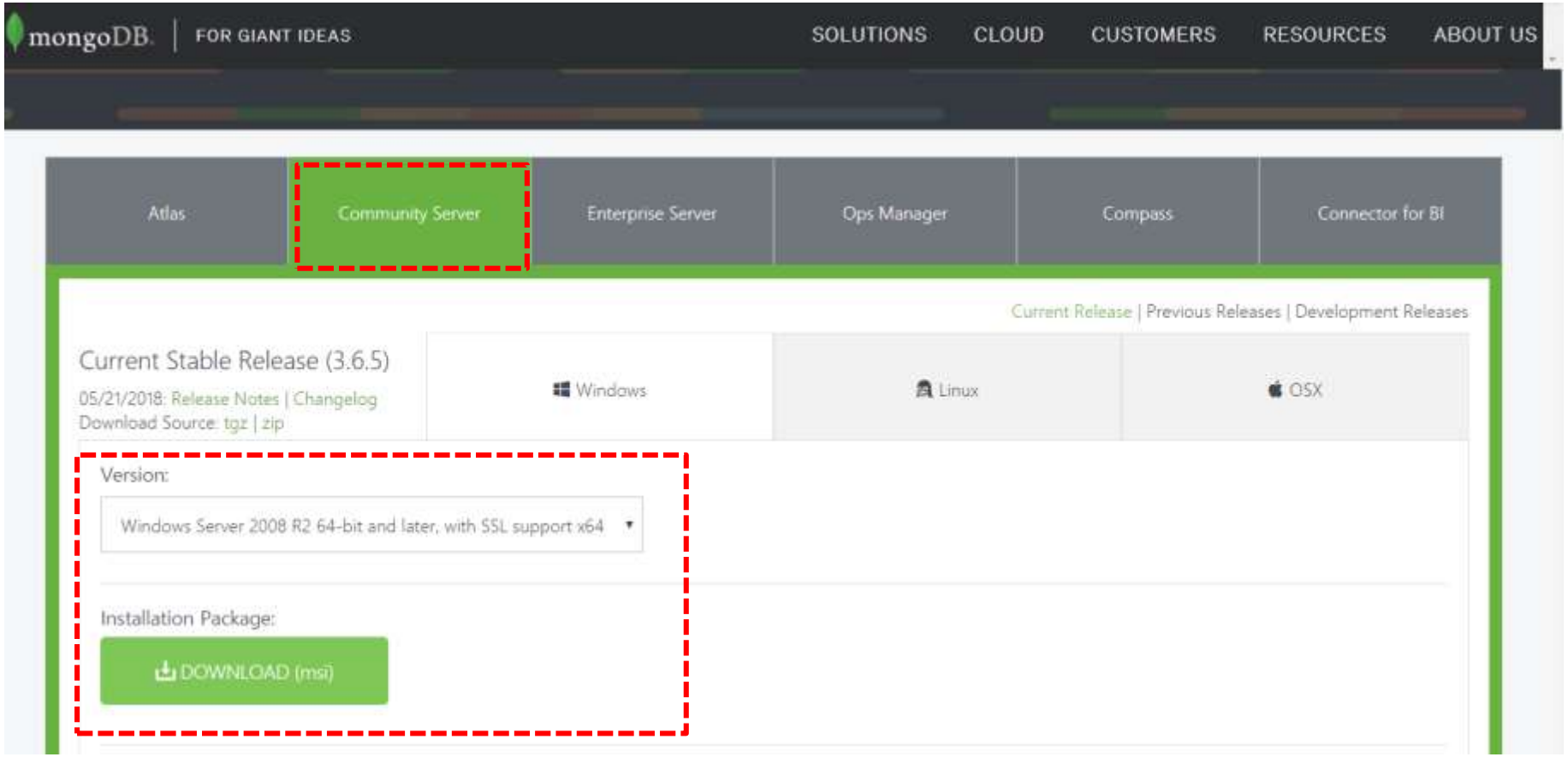


https://i.imgur.com/Att4uVC.png

A5.9 MongoDB

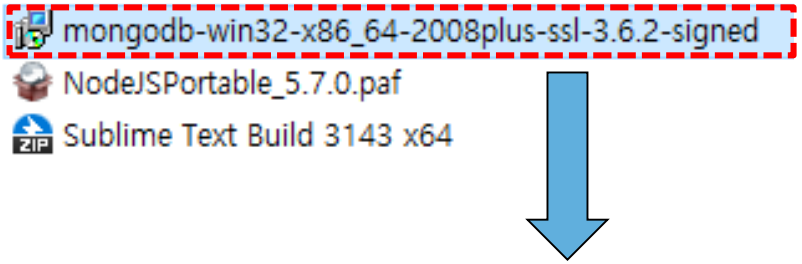
https://www.mongodb.com/download-center#community

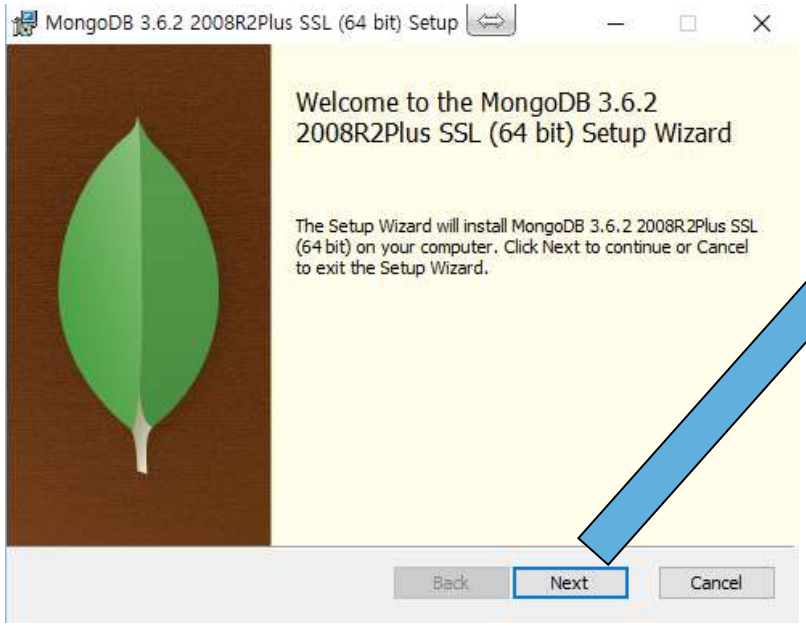
A5.9 MongoDB

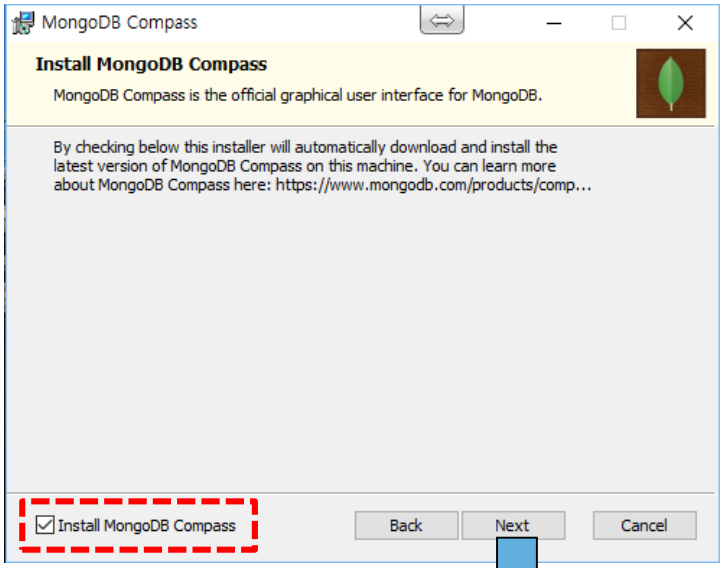


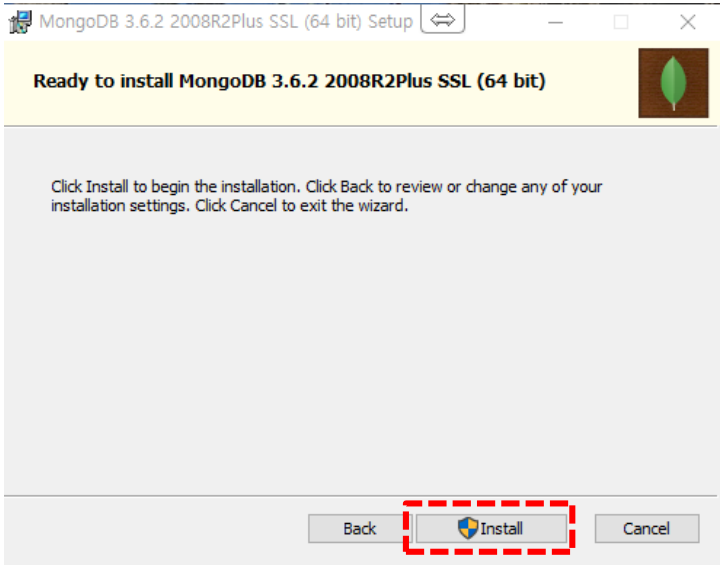
https://www.mongodb.com/download-center#community

A5.9.1 MongoDB install - 1

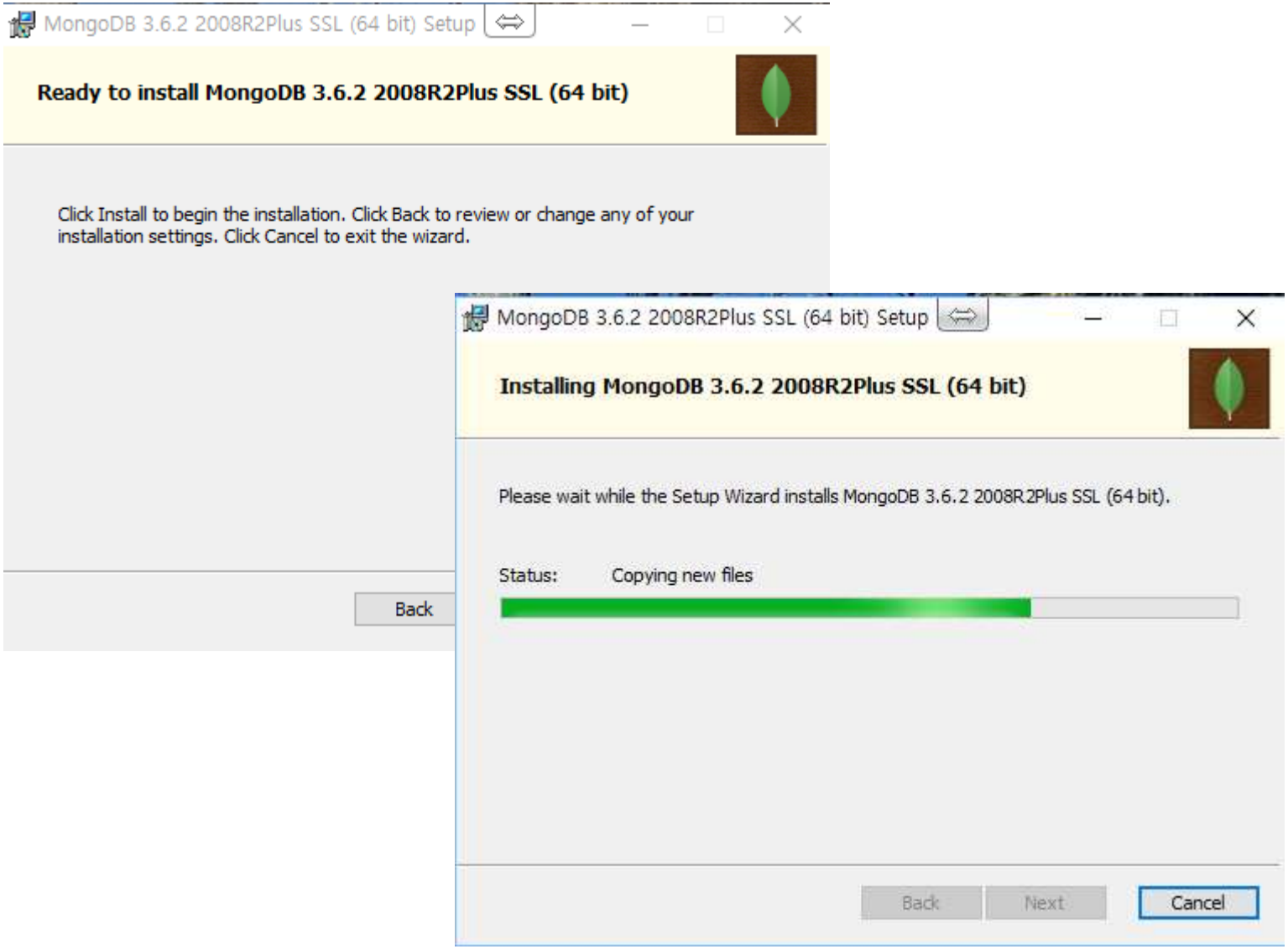






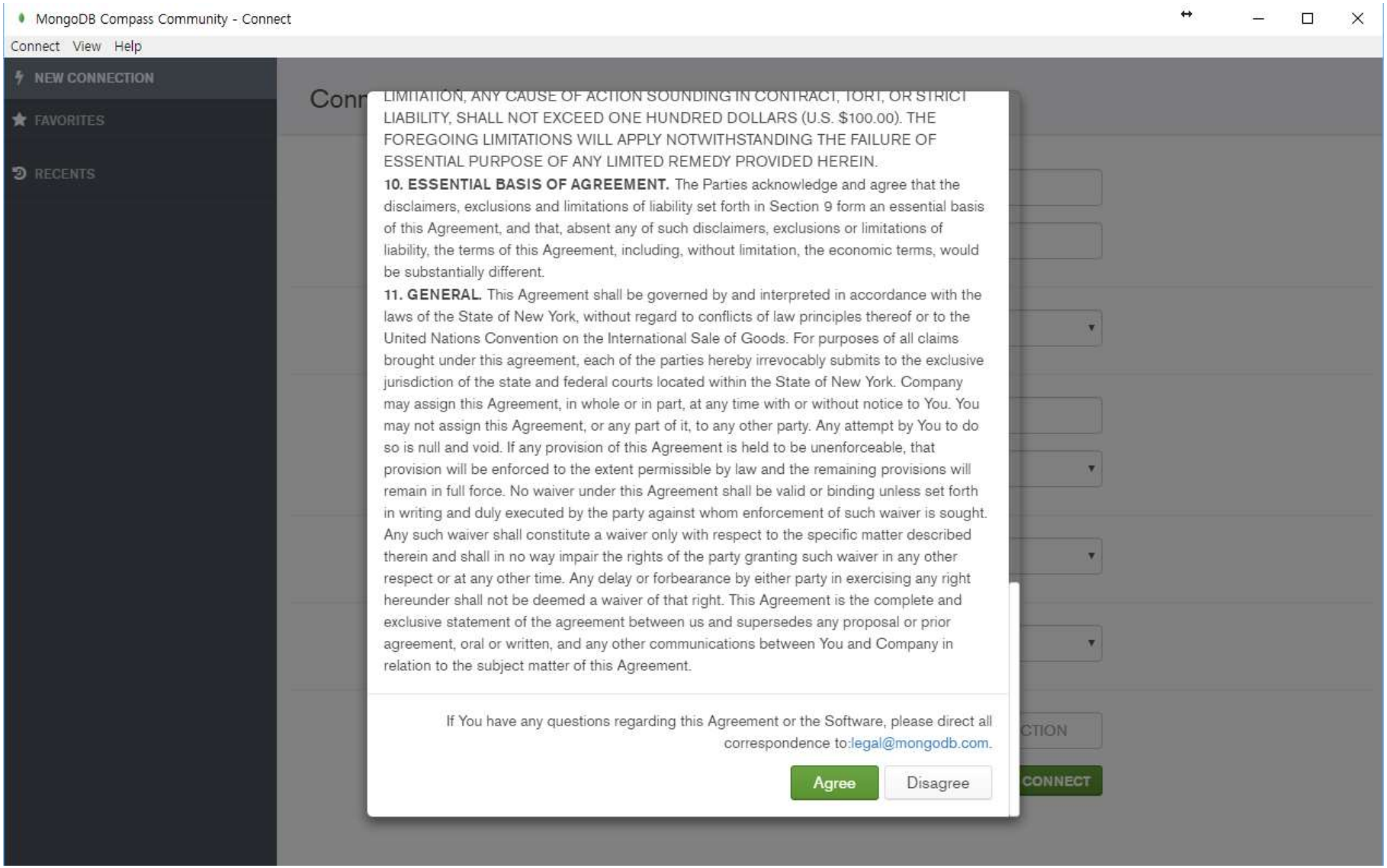


A5.9.1 MongoDB install - 2



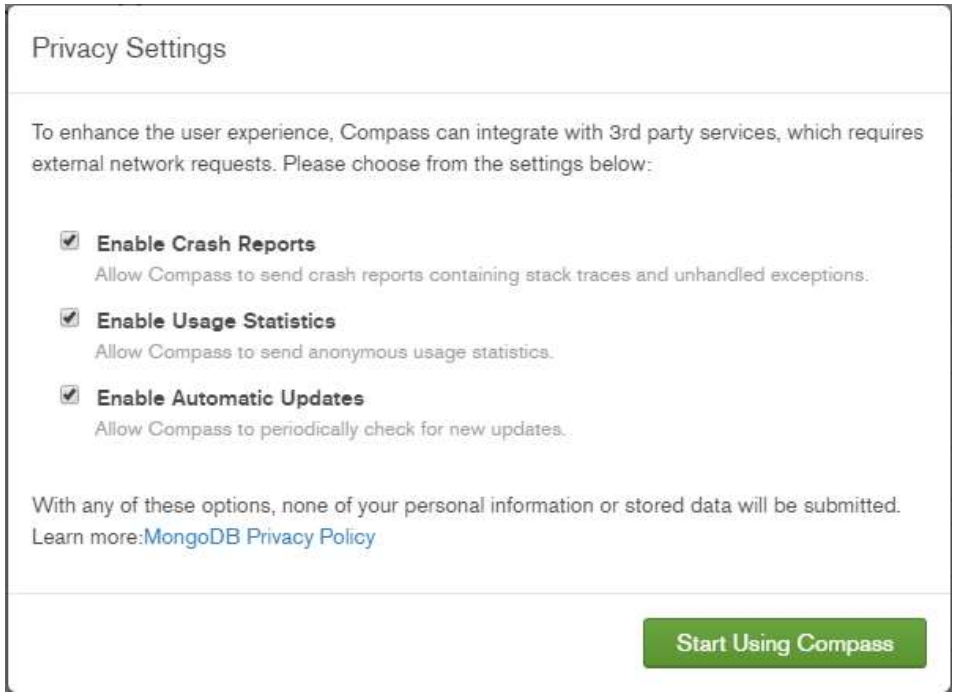
https://www.mongodb.com/download-center#community

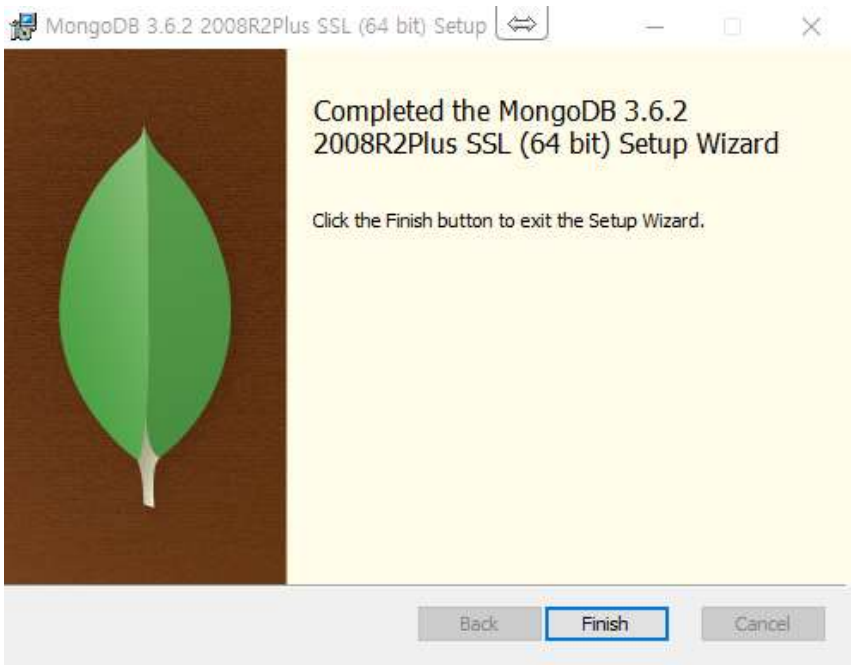
A5.9.1 MongoDB install – 3



https://www.mongodb.com/download-center#community

A5.9.1 MongoDB install – 4





https://www.mongodb.com/download-center#community

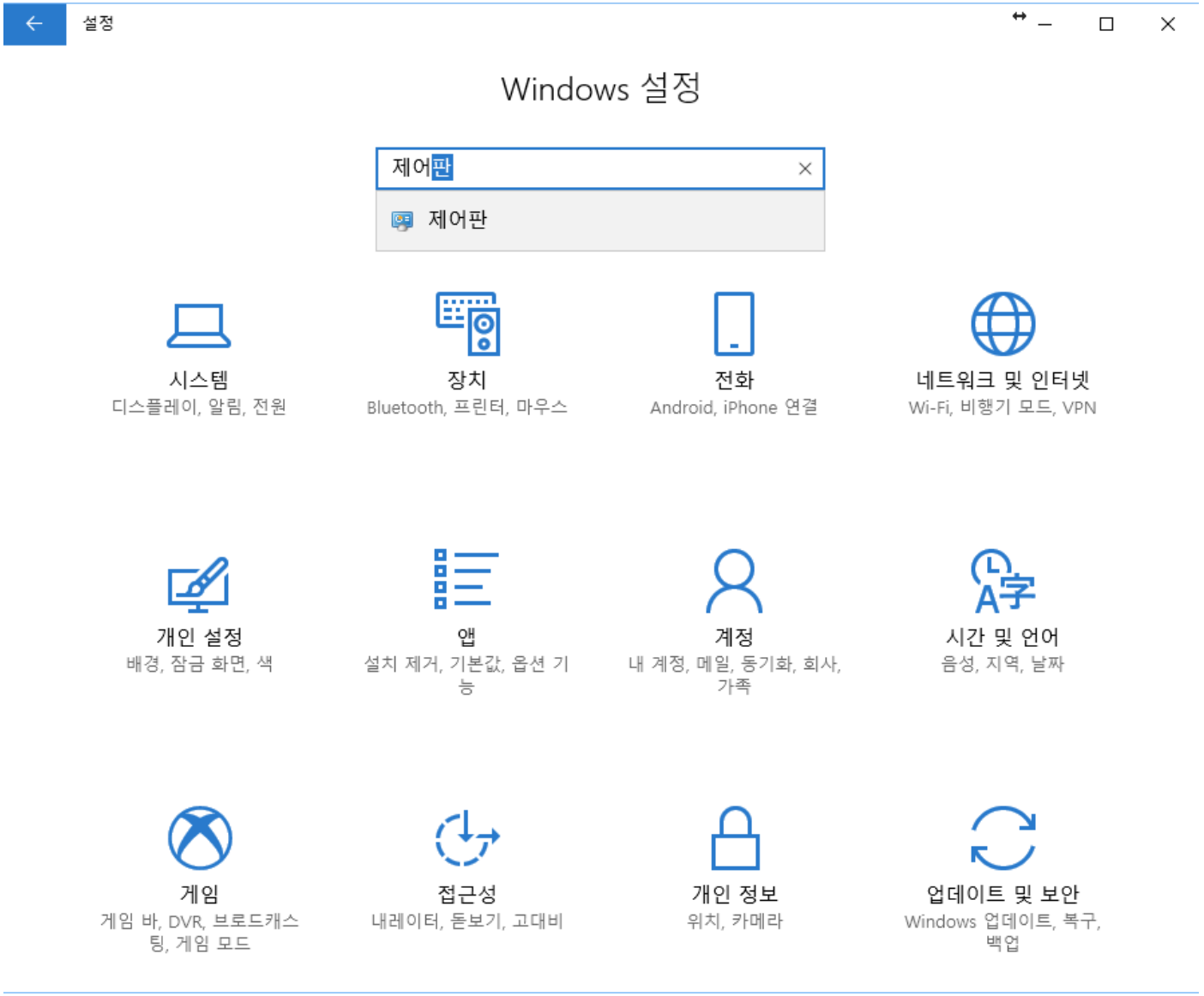
A5.9.1 MongoDB install – 5.

윈도우10: 설정 > 시스템 > 정보

[중요] 시스템 환경변수 : **PATH** 에 경로 추가

C:\Program Files\MongoDB\Server\3.6\bin

A5.9.1 MongoDB install – 6.



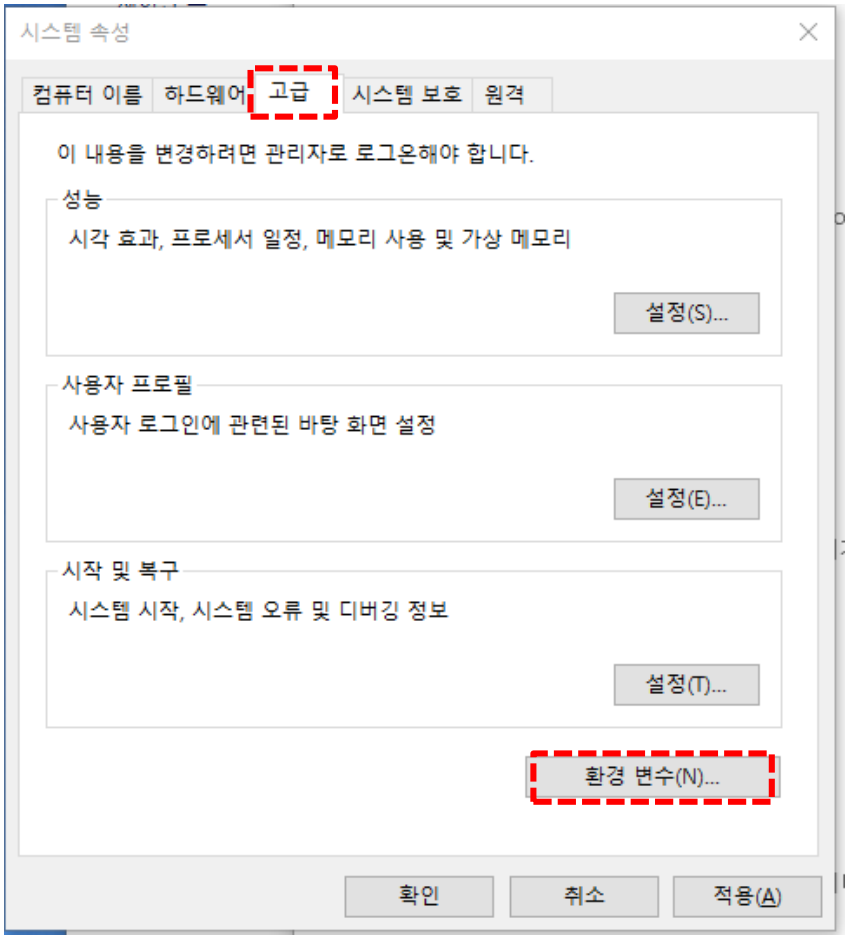
A5.9.1 MongoDB install – 7.

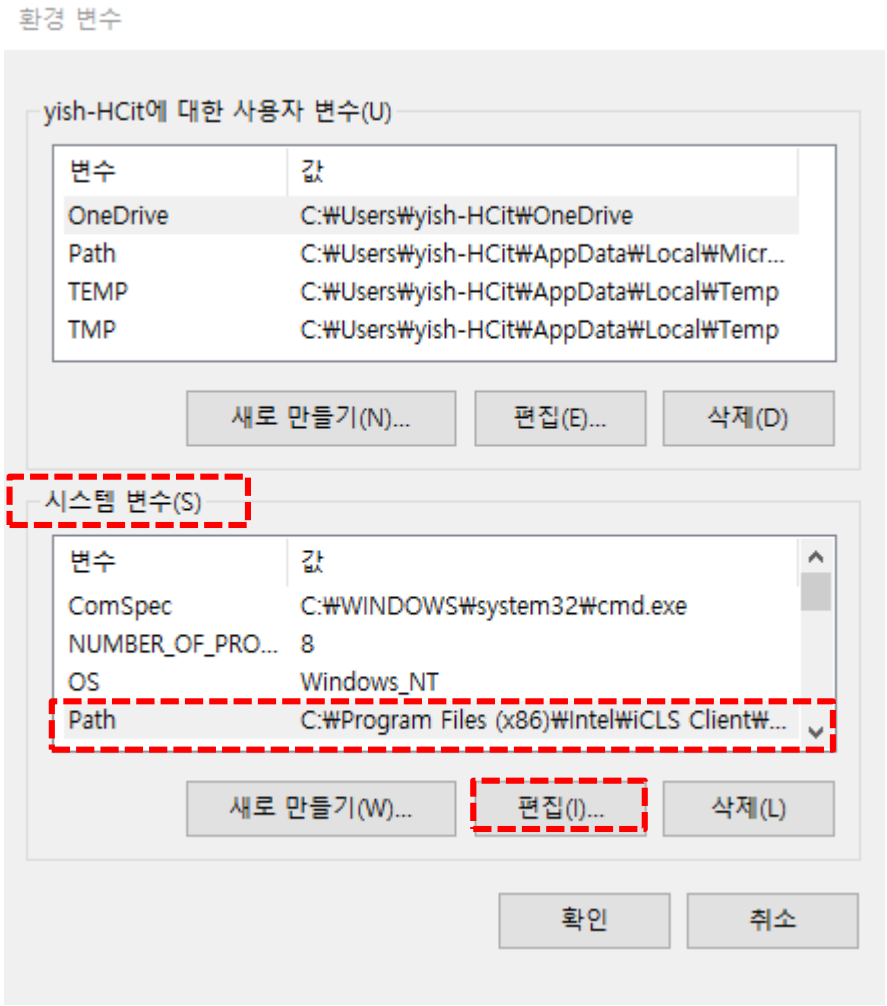
윈도우10: 설정 > '제어판' 검색 > 모든 제어판 항목에서 '시스템' 선택

> 고급 시스템 설정

A5.9.1 MongoDB install – 8.

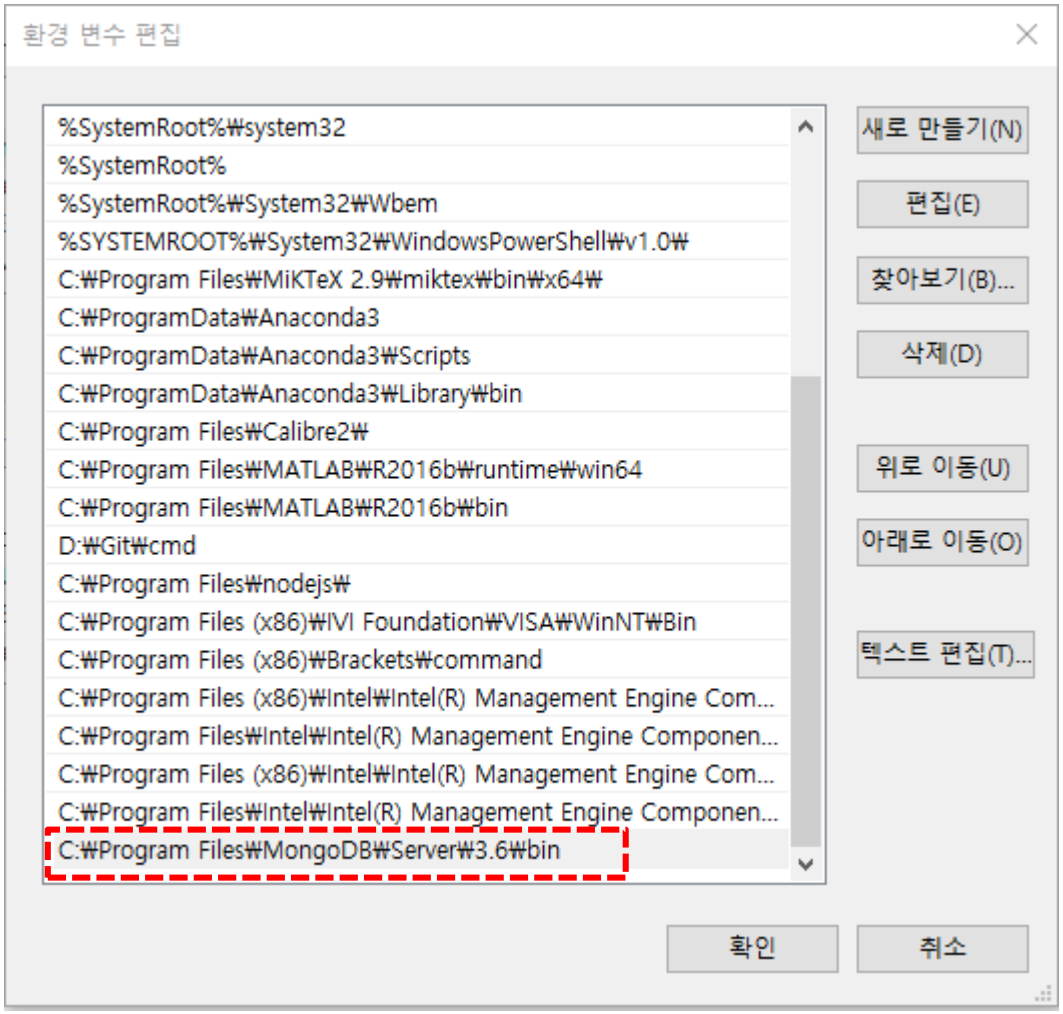
환경 변수 설정





A5.9.1 MongoDB install – 9.

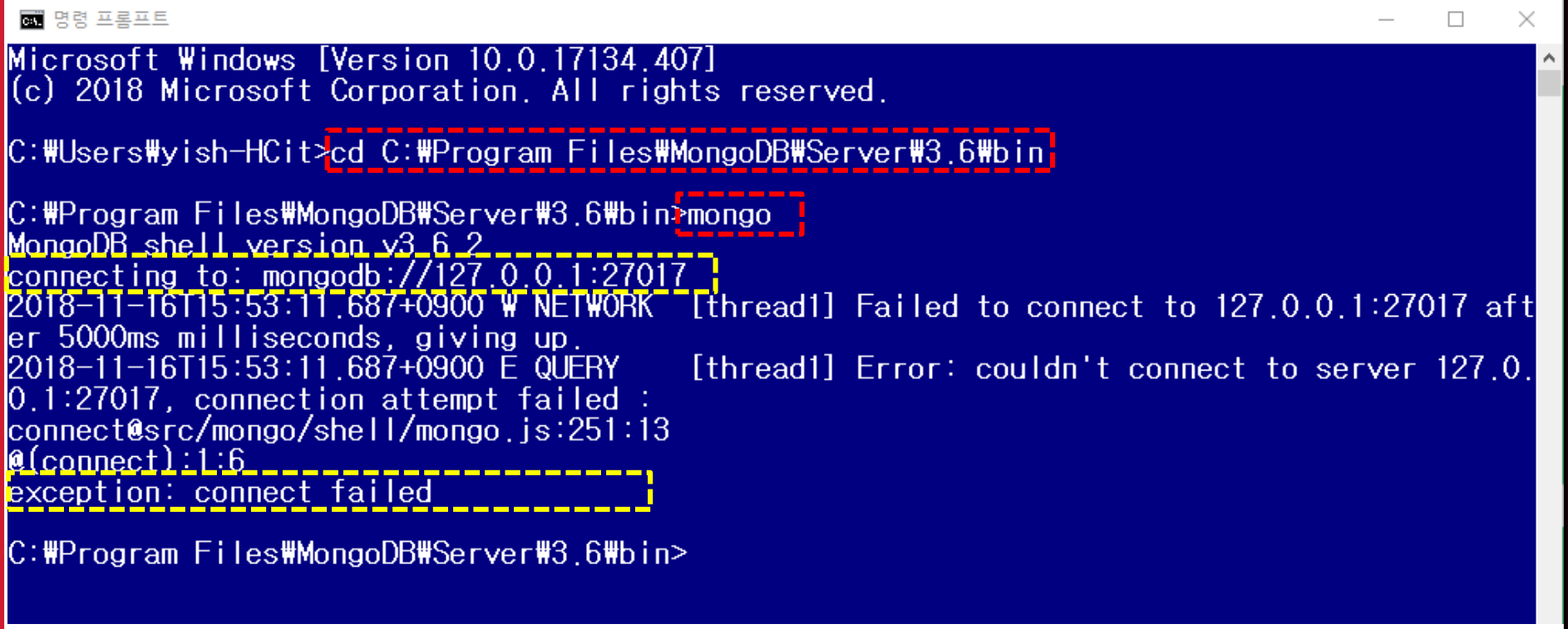
환경 변수 추가



A5.9.2 MongoDB shell - 1

1. Mongo shell 실행

> mongo

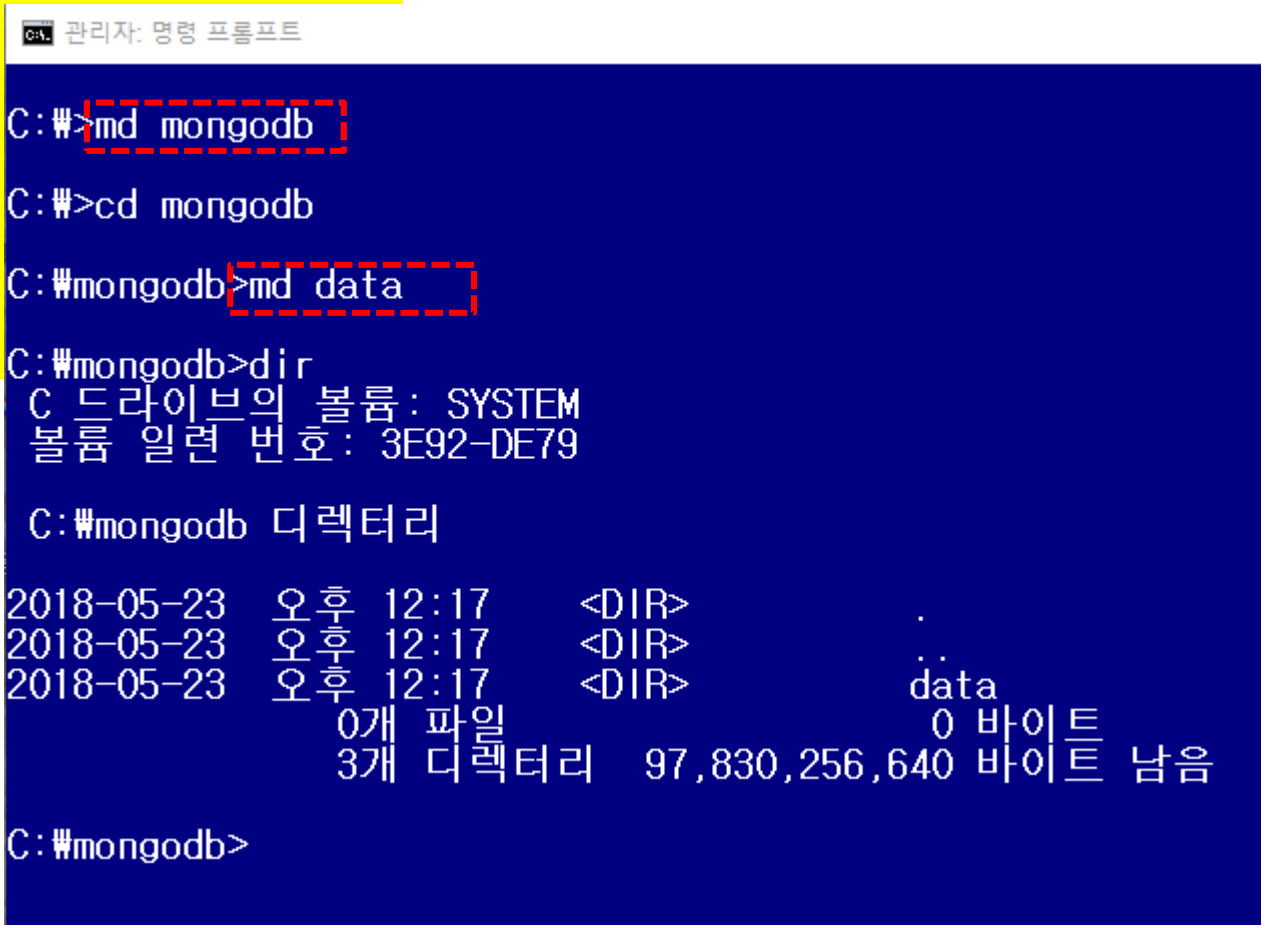


Connect failed... Why?

A5.9.2 MongoDB shell - 2

2. MongoDB 저장소 만들기 → D drive

- md mongodb
- cd mongodb
- dir
- md data
- dir



사용 PC 환경에 맞게 실행 (특히, 경로 지정)

실습실 환경에 맞춰서 D:에 mongoDB data 폴더 지정

A5.9.2 MongoDB shell - 3

3. Run MongoDB by using mongod.exe

- **mongod –dbpath d:\mongodb\data**

명령 프롬프트 - mongod -dbpath d:₩mongodb₩data

```
D:\mongodb>md data

D:\mongodb>mongod -dbpath d:\mongodb\data
2018-01-22T19:27:32.931-0700 I CONTROL  [initandlisten] MongoDB starting : pid=18820 port=27017
 dbpath=d:\mongodb\data 64-bit host=yish-HCit
2018-01-22T19:27:32.931-0700 I CONTROL  [initandlisten] targetMinOS: Windows 7/Windows Server 2
008 R2
2018-01-22T19:27:32.932-0700 I CONTROL  [initandlisten] db version v3.6.2
2018-01-23T11:27:33.699+0900 I COMMAND  [initandlisten] setting featureCompatibilityVersion to
3.6
2018-01-23T11:27:33.706+0900 I STORAGE  [initandlisten] createCollection: local.startup_log wit
h generated UUID: 06b3b7cb-62fe-4be5-a929-2a7478650a9b
2018-01-23T11:27:34.211+0900 I FTDC     [initandlisten] Initializing full-time diagnostic data
capture with directory 'd:/mongodb/data/diagnostic.data'
2018-01-23T11:27:34.215+0900 I NETWORK  [initandlisten] waiting for connections on port 27017
```

사용 PC 환경에 맞게 실행 (특히, 경로 지정)

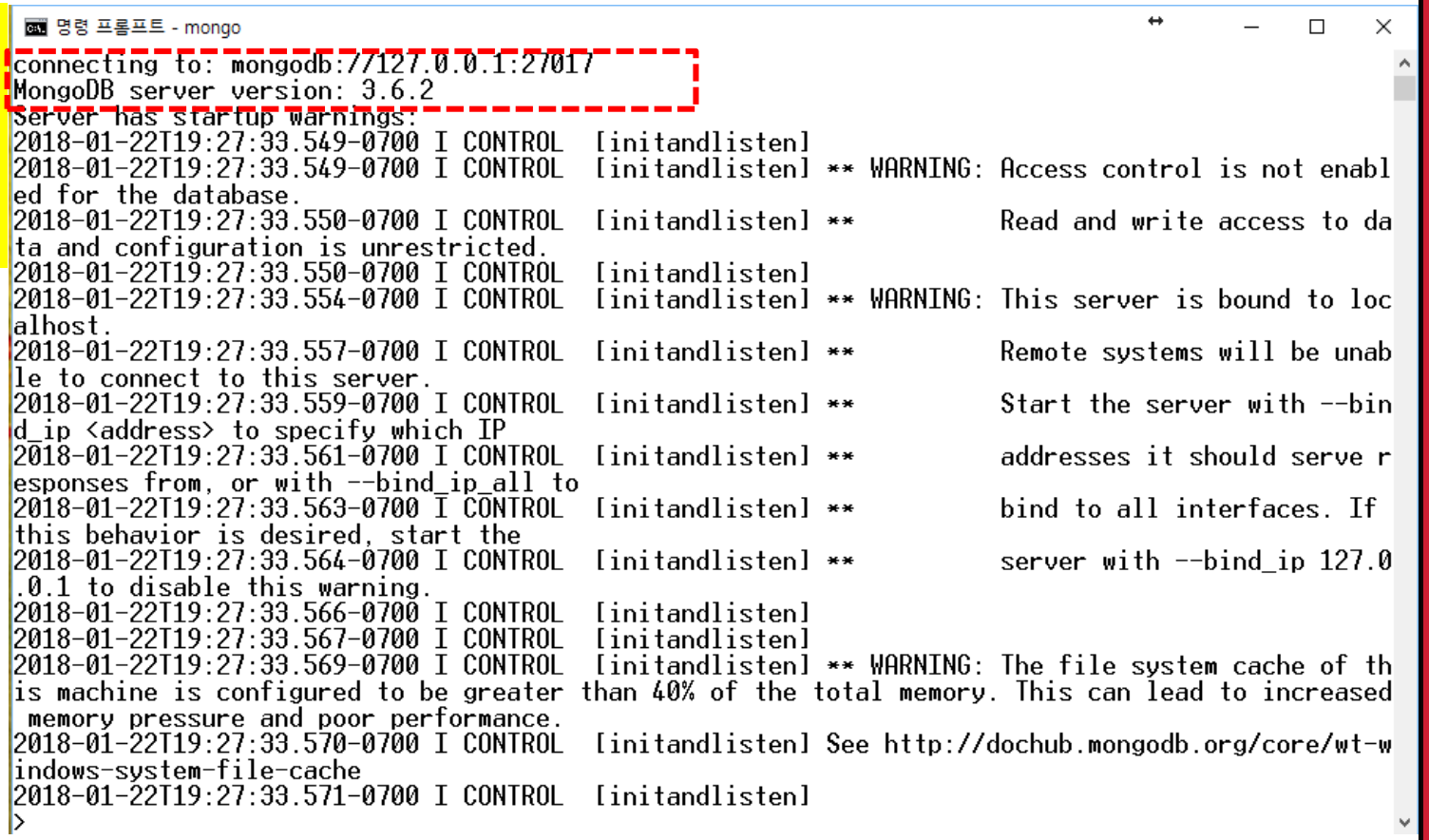
A5.9.2 MongoDB shell - 4

4. Run mongo shell : mongo.exe [use new cmd]

- **mongo**

Run new cmd

mongo



A5.9.2 MongoDB shell - 5

5. mongo shell :

Run new cmd

mongo

show dbs

use local

show collections

help

```
명령 프롬프트 - mongo
> show dbs
admin  0.000GB
local  0.000GB
> use local
switched to db local
> show collections
startup_log
> help
        db.help()                    help on db methods
        db.mycoll.help()             help on collection methods
        sh.help()                    sharding helpers
        rs.help()                    replica set helpers
        help admin                   administrative help
        help connect                 connecting to a db help
        help keys                    key shortcuts
        help misc                    misc things to know
        help mr                      mapreduce

        show dbs                     show database names
        show collections             show collections in current database
        show users                   show users in current database
        show profile                 show most recent system.profile entries with time >= 1ms
        show logs                    show the accessible logger names
        show log [name]              prints out the last segment of log in memory, 'global' is
default
        use <db_name>                set current database
        db.foo.find()                list objects in collection foo
        db.foo.find( { a : 1 } )     list objects in foo where a == 1
        it                           result of the last line evaluated; use to further iterate
        DBQuery.shellBatchSize = x   set default number of items to display on shell
        exit                         quit the mongo shell
>
```

A5.9.3 MongoDB shell coding

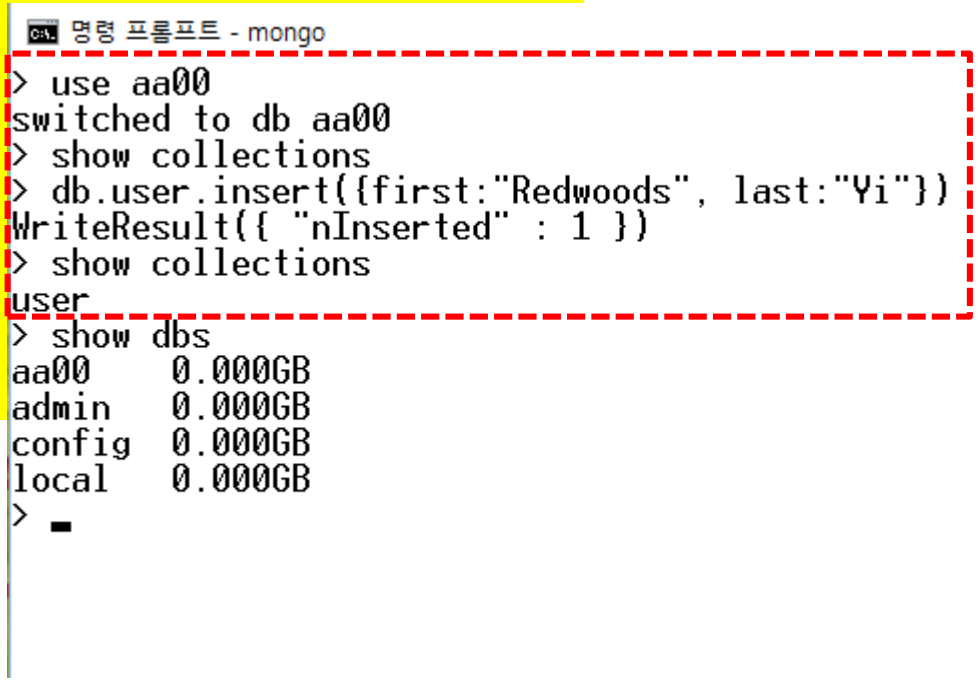
1. make my own db (aann) & insert one record (document)

```
use aa00
show collections

insert record with new collection “user”
db.user.insert({first:”Redwoods”, last:”Yi”})

show collections
→ “user”
show dbs

db.user.find()
```



A5.9.3 MongoDB shell coding

2. insert more records with different schema & show records

insert record2
insert record3

show collections

db.user.find()

db.user.find().pretty()

```
명령 프롬프트 - mongo
> db.user.insert({first:"Chaos", last:"Kim"})
WriteResult({ "nInserted" : 1 })
> db.user.insert({first:"Gildong", last:"Hong"})
WriteResult({ "nInserted" : 1 })
> show collections
user
> db.user.find()
{ "_id" : ObjectId("5a66b44b9f0d55608f5f7582"), "first" : "Redwoods", "last" : "Yi" }
{ "_id" : ObjectId("5a66b5759f0d55608f5f7583"), "first" : "Chaos", "last" : "Kim" }
{ "_id" : ObjectId("5a66b5869f0d55608f5f7584"), "first" : "Gildong", "last" : "Hong" }
> db.user.find().pretty()
{
        "_id" : ObjectId("5a66b44b9f0d55608f5f7582"),
        "first" : "Redwoods",
        "last" : "Yi"
}
{
        "_id" : ObjectId("5a66b5759f0d55608f5f7583"),
        "first" : "Chaos",
        "last" : "Kim"
}
{
        "_id" : ObjectId("5a66b5869f0d55608f5f7584"),
        "first" : "Gildong",
        "last" : "Hong"
}
>
```

_id 는 12bytes의 hexadecimal 값으로서, 각 document의 유일함(uniqueness)을 제공합니다.
이 값의 첫 4bytes는 현재 timestamp, 다음 3bytes는 machine id, 다음 2bytes는 MongoDB 서버의 프로세스id, 마지막 3bytes는 순차번호입니다.

A5.9.3 MongoDB shell coding

3. insert more records with different schema & show records

insert record4
with firstName key

db.user.find()

db.user.find().pretty()

```
명령 프롬프트 - mongo
> db.user.insert({firstName:"Fractal", last:"Park"})
WriteResult({ "nInserted" : 1 })
> db.user.find().pretty()
{
        "_id" : ObjectId("5a66b44b9f0d55608f5f7582"),
        "first" : "Redwoods",
        "last" : "Yi"
}
{
        "_id" : ObjectId("5a66b5759f0d55608f5f7583"),
        "first" : "Chaos",
        "last" : "Kim"
}
{
        "_id" : ObjectId("5a66b5869f0d55608f5f7584"),
        "first" : "Gildong",
        "last" : "Hong"
}
{
        "_id" : ObjectId("5a66b6439f0d55608f5f7585"),
        "firstName" : "Fractal",
        "last" : "Park"
}
>
```

Dynamic schema

동적스키마

Note that there are two kinds of schemas in JSON.
Save as
AAnn_mongo_schemas.png

A5.9.3 MongoDB shell coding

4. remove one of records (or documents)

remove record3

db.user.find().pretty()

명령 프롬프트 - mongo

```
> db.user.remove({last:"Kim"})
WriteResult({ "nRemoved" : 1 })
> db.user.find().pretty()
{
        "_id" : ObjectId("5a66b44b9f0d55608f5f7582"),
        "first" : "Redwoods",
        "last" : "Yi"
}
{
        "_id" : ObjectId("5a66b5869f0d55608f5f7584"),
        "first" : "Gildong",
        "last" : "Hong"
}
{
        "_id" : ObjectId("5a66b6439f0d55608f5f7585"),
        "firstName" : "Fractal",
        "last" : "Park"
}
>
```

A5.9.3 MongoDB shell coding

5. update a record

update record2

db.user.find().pretty()

명령 프롬프트 - mongo

```
> db.user.update({last:"Hong"},{$set:{first:"GilDong", age:21}})
WriteResult({ "nMatched" : 1, "nUpserted" : 0, "nModified" : 1 })
> db.user.find().pretty()
{
        "_id" : ObjectId("5a66b44b9f0d55608f5f7582"),
        "first" : "Redwoods",
        "last" : "Yi"
}
{
        "_id" : ObjectId("5a66b5869f0d55608f5f7584"),
        "first" : "GilDong",
        "last" : "Hong",
        "age" : 21
}
{
        "_id" : ObjectId("5a66b6439f0d55608f5f7585"),
        "firstName" : "Fractal",
        "last" : "Park"
}
> _
```

db.user.update({last:"Hong"},{$set:{first:"GilDong", age:21}})

Note that it is possible to change schema.

Save as

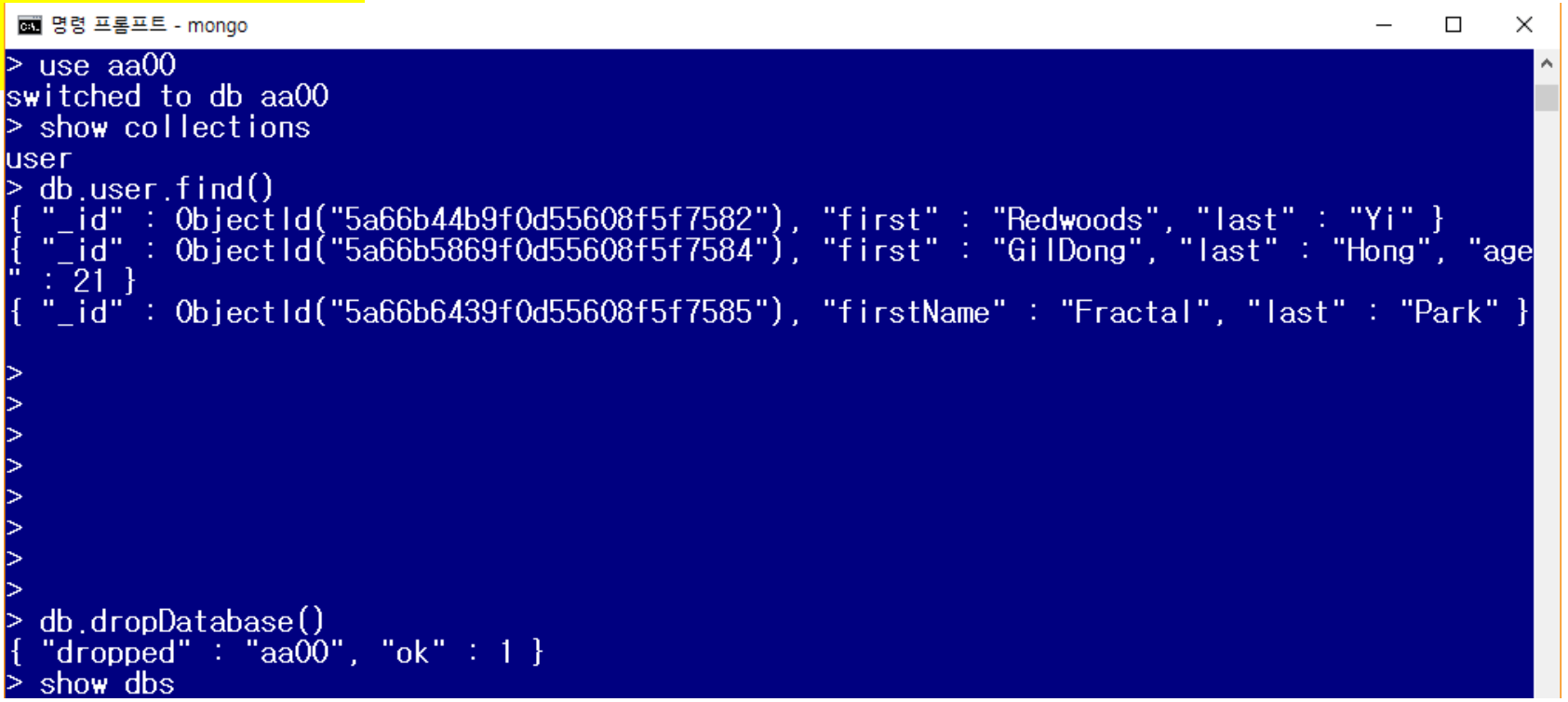
AAnn_mongo_update.png

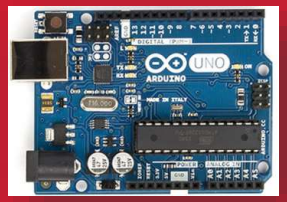
A5.9.3 MongoDB shell coding

6. Delete(or remove) DB

use dbName

db.dropDatabase()



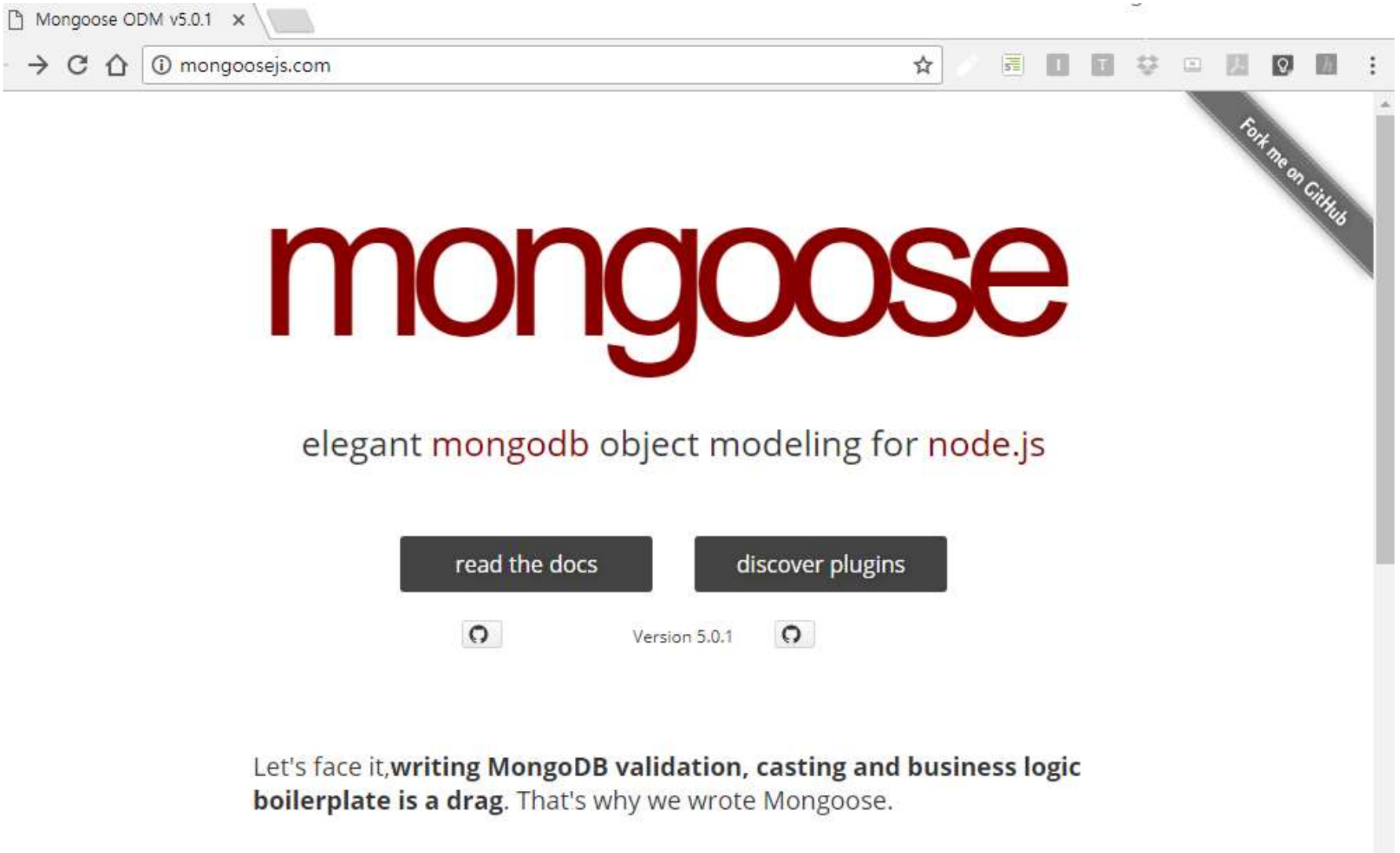


Node.js

+

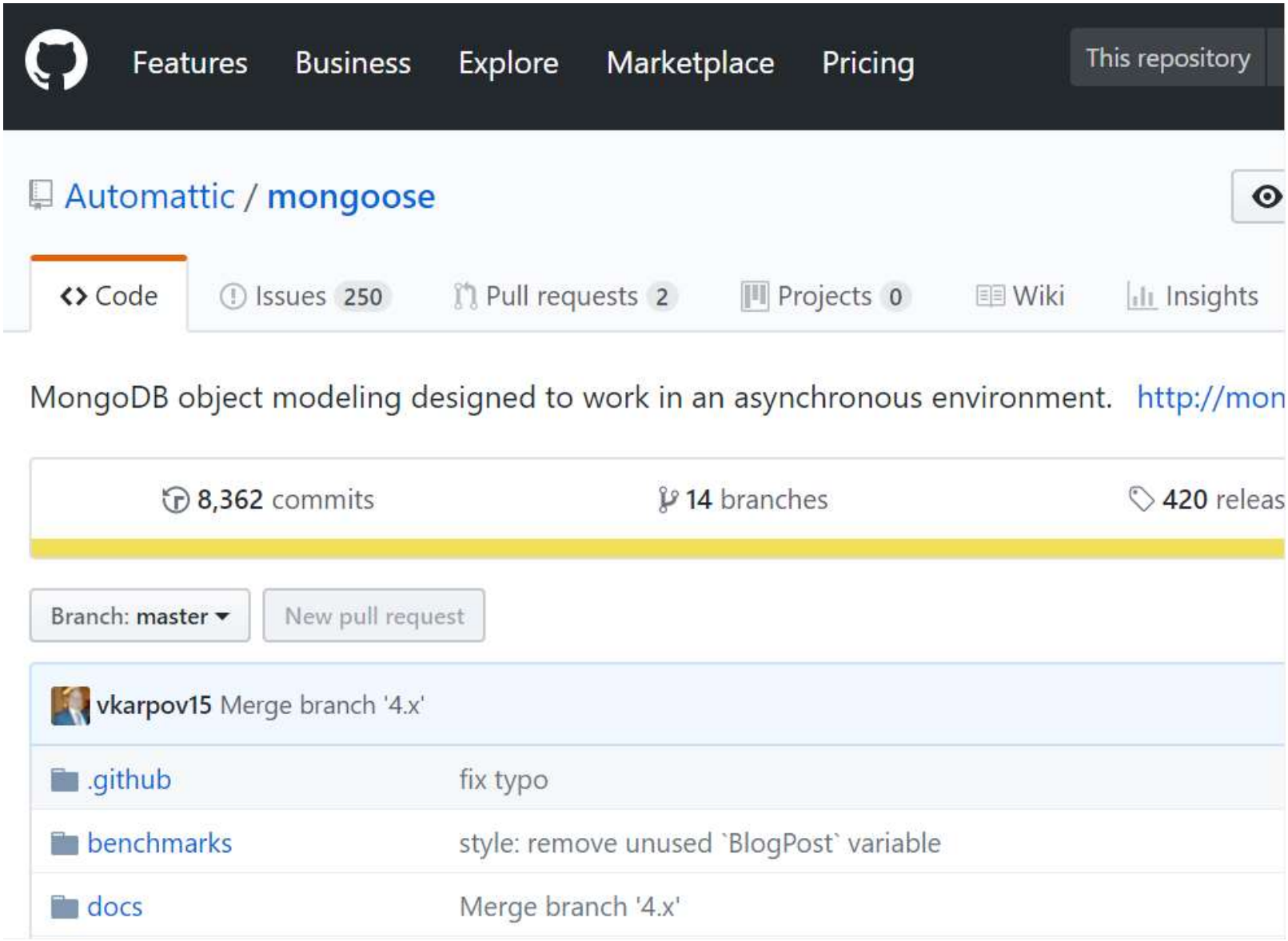
MongoDB

A5.9.4 MongoDB + Node.js：mongoose



http://mongoosejs.com/

A5.9.4 MongoDB + Node.js : mongoose



https://github.com/Automattic/mongoose

A5.9.4 MongoDB + Node.js : mongooseJS

1. Install mongoose in node.js project http://mongoosejs.com/

- Go to cds_dht22 project
- npm install --save mongoose (버전 : 5.0.1)

```
NodeJS
D:\Portable\NodeJSPortable\Data\aa00\iot\cds_dht22>npm install -s mongoose
loadRequestedDeps → fetch ? ??????????????????????????????????????????????????????????
loadRequestedDeps → fetch ? ??????????????????????????????????????????????????????????
loadRequestedDeps → netwo ? ??????????????????????????????????????????????????????????
loadRequestedDeps → fetch ? ??????????????????????????????????????????????????????????
loadDep:sliced → request  ? ??????????????????????????????????????????????????????????
loadDep:sliced → 200      ? ??????????????????????????????????????????????????????????
loadDep:sliced → fetch    ? ??????????????????????????????????????????????????????????
loadDep:sliced → headers  ? ??????????????????????????????????????????????????????????
loadDep:sliced → fetch    ? ??????????????????????????????????????????????????????????
loadDep:sliced → fetch    ? ??????????????????????????????????????????????????????????
loadDep:sliced → get      ? ??????????????????????????????????????????????????????????
loadDep:sliced → afterAdd ? ??????????????????????????????????????????????????????????
extract:mongoose → gunzla ? ??????????????????????????????????????????????????????????
extract:mongoose → gently ? ??????????????????????????????????????????????????????????
finalize:sliced → finaliz ? ??????????????????????????????????????????????????????????
build:resolve-from → link ? ??????????????????????????????????????????????????????????
cds_dht22@1.0.0 D:\Portable\NodeJSPortable\Data\aa00\iot\cds_dht22
└──mongoose@5.0.1  extraneous


D:\Portable\NodeJSPortable\Data\aa00\iot\cds_dht22>
```

A5.9.4 MongoDB + Node.js : mongoose

2. node.js project using mongoose (use Sublime Text 3)

- cds_dht22 project in SBT3
- New file: dbtest.js
- ^B (run dbtest.js)

```
// dbtest.js
var mongoose = require('mongoose');
mongoose.connect('mongodb://localhost/test');

var SensorSchema = new mongoose.Schema({
    data: String,
    created: Date
});

// data model
var Sensor = mongoose.model("Sensor", SensorSchema);

var sensor1 = new Sensor({data:'124', created: new Date()});
sensor1.save();

var sensor2 = new Sensor({data:'573', created: new Date()});
sensor2.save();

console.log("Sensor data were saved in MongoDB");
```

```
Sensor data were saved in MongoDB
```

Sensor data were saved in MongoDB

A5.9.4 MongoDB + Node.js : mongoose

3. node.js project using mongoose (mongo shell)

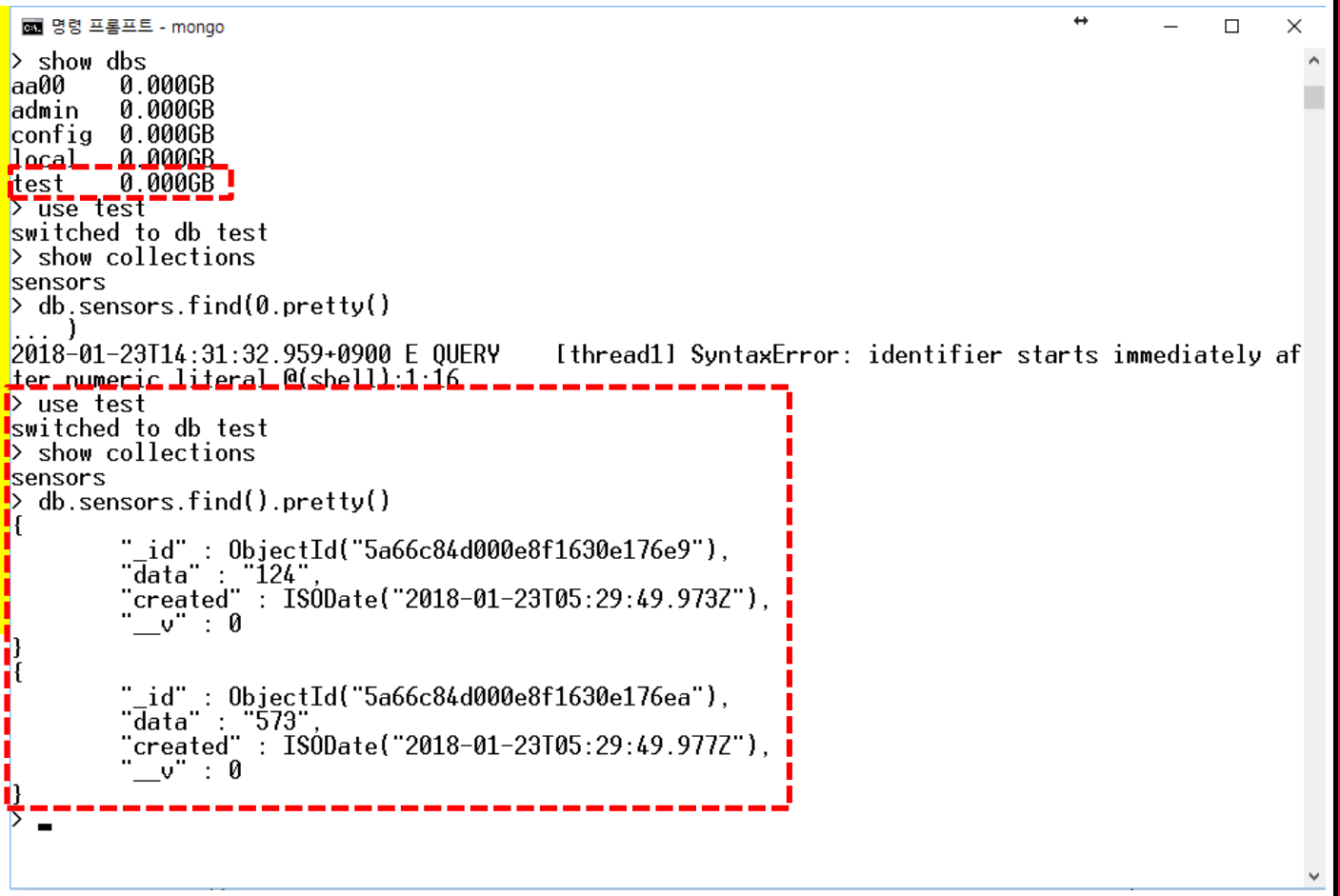
Mongo shell

> show dbs

> use test

> show collections

> db.sensors.find()
.pretty()



A5.9.4 MongoDB + Node.js : mongoose

4. dbtest2.js (use Sublime Text 3)

```
var SensorSchema = new mongoose.Schema({
        data: String,
        created: String
});
```

D:\Portable\NodeJSPortable\Data\aa00\iot\cds_dht22\dbtest2.js (Data) - Sublime Text (UNREGISTERED)

File Edit Selection Find View Goto Tools Project Preferences Help

FOLDERS

Data
- aa00
  - express
  - expressTest
  - iot
    - cds
      - node_modules
      - cds_node.js
      - package.json
    - cds_dht22
      - node_modules
      - cds_dht22_node.js
      - dbtest.js
      - dbtest2.js
      - package.json
    - cds_tmp36
    - plotly
    - tmp36
  - myApp
  - server
  - start
- node_modules
- npm_cache
- settings
- Temp
- express
- express.cmd
- npm
- npm.cmd
- PortableApps.comLauncherRuntimeData-NodeJSP

dbtest2.js

```
1  // dbtest2.js
2  var mongoose = require('mongoose');
3  mongoose.connect('mongodb://localhost/test2');
4
5  var SensorSchema = new mongoose.Schema({
6      data: String,
7      created: String
8  });
9
10 // data model
11 var Sensor = mongoose.model("Sensor", SensorSchema);
12
13 var sensor1 = new Sensor({data:'124', created: getDateString()});
14 sensor1.save();
15
16 var sensor2 = new Sensor({data:'573', created: getDateString()});
17 sensor2.save();
18
19 console.log("[dbtest2.js]: Sensor data were saved in MongoDB");
20
21 // helper function to get a nicely formatted date string
22 function getDateString() {
23     var time = new Date().getTime();
24     // 32400000 is (GMT+9 Korea, GimHae)
25     // for your timezone just multiply +/-GMT by 3600000
26     var datestr = new Date(time +32400000).
27     toISOString().replace(/T/, ' ').replace(/Z/, '');
28     return datestr;
29 }
```

```
[dbtest2.js]: Sensor data were saved in MongoDB
```

A5.9.4 MongoDB + Node.js : mongoose

5. dbtest2.js (change Schema & check using mongo shell)

Mongo shell

> show dbs

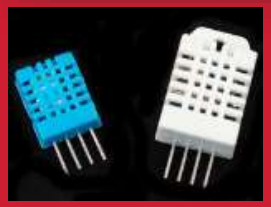
> use test2

> show collections

> db.sensors.find()
.pretty()

명령 프롬프트 - mongo

```
> show dbs
aa00    0.000GB
admin   0.000GB
config  0.000GB
local   0.000GB
test    0.000GB
test2   0.000GB
> use test2
switched to db test2
> show collections
sensors
> db.sensors.find().pretty()
{
        "_id" : ObjectId("5a66cc2f56c1ac4e4051ae35"),
        "data" : "124",
        "created" : "2018-01-23 14:46:23.231",
        "__v" : 0
}
{
        "_id" : ObjectId("5a66cc2f56c1ac4e4051ae36"),
        "data" : "573",
        "created" : "2018-01-23 14:46:23.235",
        "__v" : 0
}
>
```

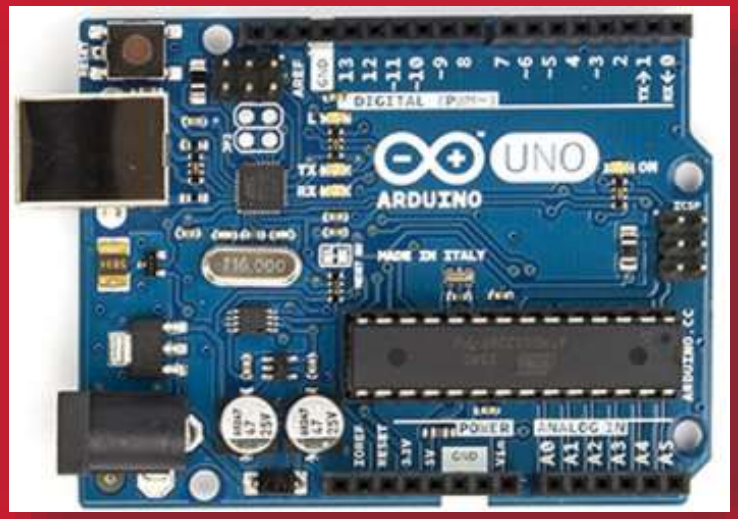


MongoDB from Arduino with node.js & mongoose

```
> show dbs
aa00      0.000GB
admin     0.000GB
config    0.000GB
iot       0.000GB
iot2      0.000GB
iot3      0.001GB
local     0.000GB
test      0.000GB
test2     0.000GB
>
```

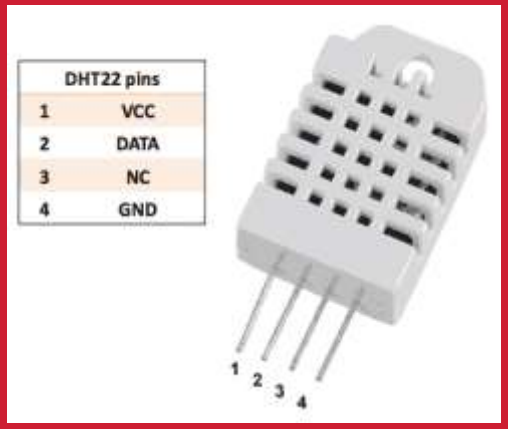
```
mongo db connection OK.
info() - Current date is 2015-11-26 12:04:21.411, Lumi: 67
info() - Current date is 2015-11-26 12:04:26.415, Lumi: 67
info() - Current date is 2015-11-26 12:04:31.416, Lumi: 67
info() - Current date is 2015-11-26 12:04:36.422, Lumi: 104
info() - Current date is 2015-11-26 12:04:41.427, Lumi: 92
info() - Current date is 2015-11-26 12:04:46.432, Lumi: 410
info() - Current date is 2015-11-26 12:04:51.432, Lumi: 67
info() - Current date is 2015-11-26 12:04:56.438, Lumi: 66
```

Arduino & Node.js & MongoDB

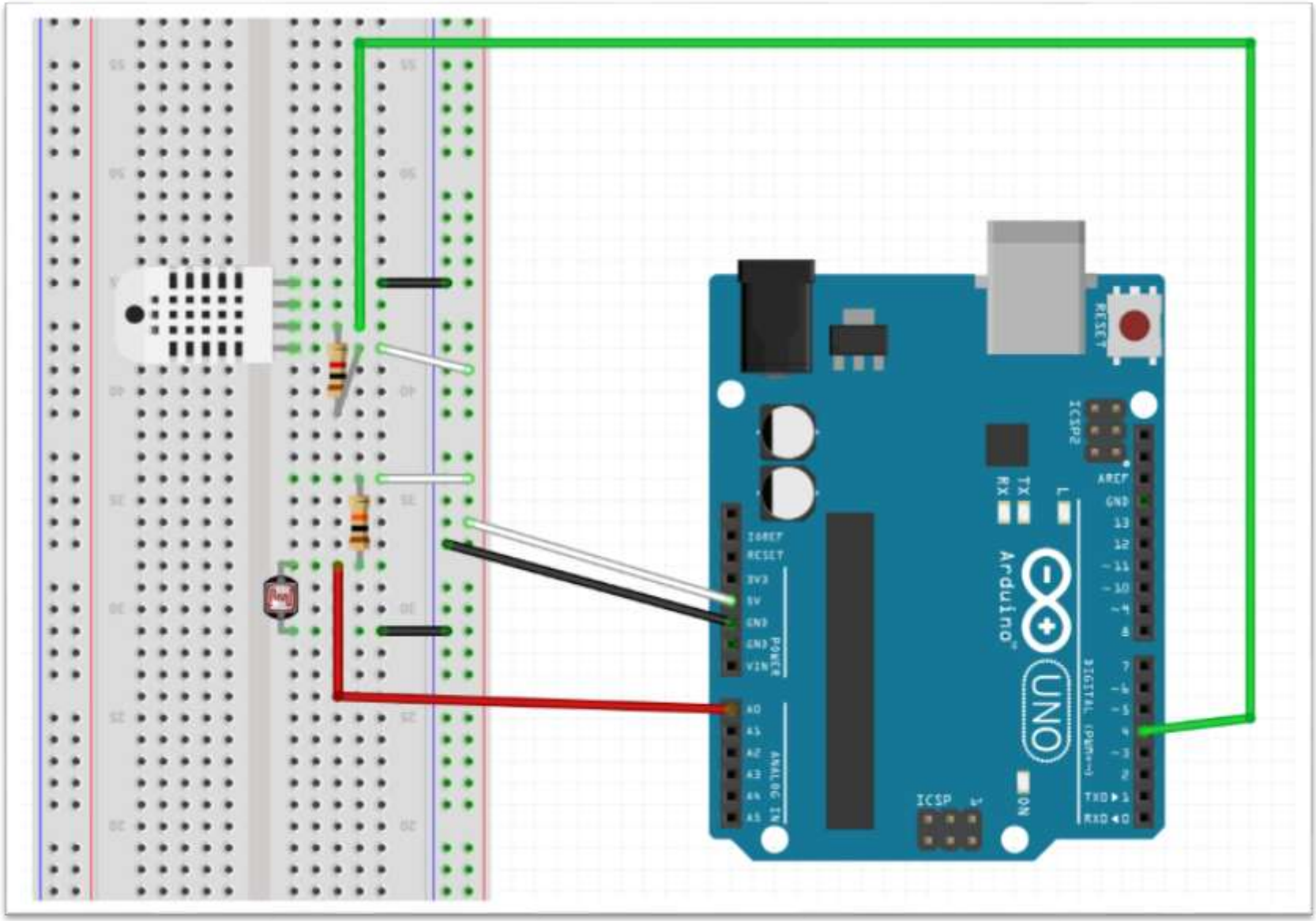


Multi-sensors

DHT22 + CdS

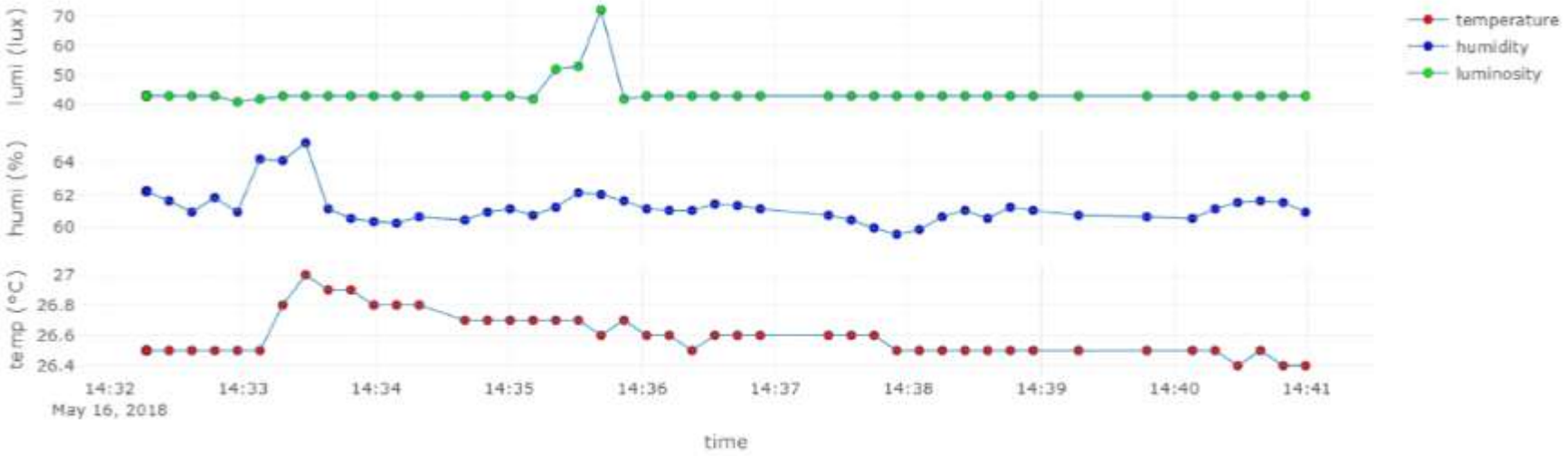


DHT22 + CdS : circuit



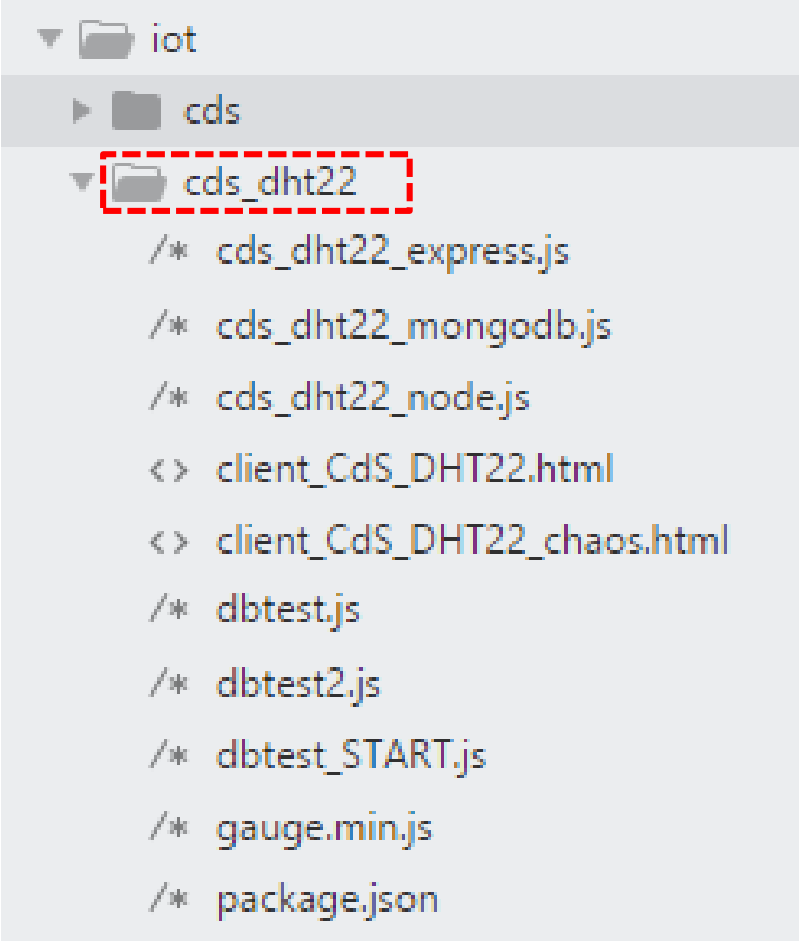
Real-time Weather Station from sensors

on Time: 2018-05-16 14:40:59.402



A5.9.5 DHT22 + CdS + Node.js + MongoDB

1. 작업 폴더 구조 [2018]



A5.9.5 DHT22 + CdS + Node.js + MongoDB

2.1 cds_dht22_mongodb.js

```
1  // cds_dht22_mongodb.js
2
3  var serialport = require('serialport');
4  var portName = 'COM4';  // check your COM port!!
5  var port     =    process.env.PORT || 3000;
6
7  var io = require('socket.io').listen(port);
8
9  // MongoDB
10 var mongoose = require('mongoose');
11 var Schema = mongoose.Schema;
12 // MongoDB connection
13 mongoose.connect('mongodb://localhost:27017/iot'); // DB name
14 var db = mongoose.connection;
15 db.on('error', console.error.bind(console, 'connection error:'));
16 db.once('open', function callback () {
17     console.log("mongo db connection OK.");
18 });
19 // Schema
20 var iotSchema = new Schema({
21     date : String,
22     temperature : String,
23     humidity : String,
24     luminosity: String
25 });
```

A5.9.5 DHT22 + CdS + Node.js + MongoDB

2.2 cds_dht22_mongodb.js

```
27 iotSchema.methods.info = function () {
28     var iotInfo = this.date
29     ? "Current date: " + this.date +", Temp: " + this.temperature
30     + ", Humi: " + this.humidity + ", Lux: " + this.luminosity
31     : "I don't have a date"
32     console.log("iotInfo: " + iotInfo);
33 }
34
35 // serial port object
36 var sp = new serialport(portName,{
37     baudRate: 9600,   // 9600  38400
38     dataBits: 8,
39     parity: 'none',
40     stopBits: 1,
41     flowControl: false,
42     parser: serialport.parsers.readline('\r\n')  // new serialport.parsers
43 });
44
45 var readData = '';  // this stores the buffer
46 var temp ='';
47 var humi ='';
48 var lux ='';
49 var mdata =[]; // this array stores date and data from multiple sensors
50 var firstcommaidx = 0;
51
52 var Sensor = mongoose.model("Sensor", iotSchema);  // sensor data model
```

A5.9.5 DHT22 + CdS + Node.js + MongoDB

2.3 cds_dht22_mongodb.js

```
54 sp.on('data', function (data) { // call back when data is received
55     readData = data.toString(); // append data to buffer
56     firstcommaidx = readData.indexOf(',');
57
58     // parsing data into signals
59     if (readData.lastIndexOf(',') > firstcommaidx && firstcommaidx > 0) {
60         temp = readData.substring(firstcommaidx + 1, readData.indexOf(',',firstcommaidx+1));
61         humi = readData.substring(readData.indexOf(',',firstcommaidx+1) + 1, readData.lastIndexOf(','));
62         lux = readData.substring(readData.lastIndexOf(',')+1);
63
64         readData = '';
65
66         dStr = getDateString();
67         mdata[0]=dStr;  // Date
68         mdata[1]=temp;  // temperature data
69         mdata[2]=humi;  // humidity data
70         mdata[3]=lux;   // luminosity data
71         //console.log(mdata);
72         var iot = new Sensor({date:dStr, temperature:temp, humidity:humi, luminosity:lux});
73         // save iot data to MongoDB
74         iot.save(function(err, iot) {
75             if(err) return handleEvent(err);
76             iot.info();  // Display the information of iot data  on console.
77         })
78         io.sockets.emit('message', mdata);  // send data to all clients
79     } else {  // error
80         console.log(readData);
81     }
82 });
```

2.4 cds_dht22_mongodb.js

```
85  io.sockets.on('connection', function (socket) {
86      // If socket.io receives message from the client browser then
87      // this call back will be executed.
88      socket.on('message', function (msg) {
89          console.log(msg);
90      });
91      // If a web browser disconnects from Socket.IO then this callback
92      socket.on('disconnect', function () {
93          console.log('disconnected');
94      });
95  });
96
97  // helper function to get a nicely formatted date string
98  function getDateString() {
99      var time = new Date().getTime();
100     // 32400000 is (GMT+9 Korea, GimHae)
101     // for your timezone just multiply +/-GMT by 3600000
102     var datestr = new Date(time +32400000).
103     toISOString().replace(/T/, ' ').replace(/Z/, '');
104     return datestr;
105 }
```

A5.9.5 DHT22 + CdS + Node.js + MongoDB

2.5 cds_dht22_mongodb.js → result (^B)

```
mongo db connection OK.
iotInfo: Current date: 2018-01-24 17:13:51.449, Temp: 18.6, Humi: 10.1, Lux: 179
iotInfo: Current date: 2018-01-24 17:13:53.720, Temp: 18.6, Humi: 10.1, Lux: 178
iotInfo: Current date: 2018-01-24 17:13:55.992, Temp: 18.6, Humi: 10.1, Lux: 178
iotInfo: Current date: 2018-01-24 17:13:58.264, Temp: 18.6, Humi: 10.1, Lux: 179
iotInfo: Current date: 2018-01-24 17:14:00.536, Temp: 18.6, Humi: 10.1, Lux: 177
iotInfo: Current date: 2018-01-24 17:14:02.792, Temp: 18.6, Humi: 10.0, Lux: 177
iotInfo: Current date: 2018-01-24 17:14:05.065, Temp: 18.6, Humi: 10.0, Lux: 178
iotInfo: Current date: 2018-01-24 17:14:07.336, Temp: 18.6, Humi: 10.0, Lux: 179
iotInfo: Current date: 2018-01-24 17:14:09.608, Temp: 18.6, Humi: 10.0, Lux: 179
iotInfo: Current date: 2018-01-24 17:14:11.880, Temp: 18.6, Humi: 10.0, Lux: 177
iotInfo: Current date: 2018-01-24 17:14:14.152, Temp: 18.6, Humi: 10.0, Lux: 180
```

A5.9.5 DHT22 + CdS + Node.js + MongoDB

3. cds_dht22_mongodb.js → Check documents in Mongo shell

Mongo shell

> show dbs

> use iot

> show collections

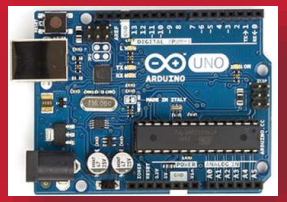
> db.sensors.find()
.pretty()

명령 프롬프트 - mongo

```
> show dbs
aa00    0.000GB
admin   0.000GB
config  0.000GB
iot     0.000GB
local   0.000GB
test    0.000GB
test2   0.000GB
> use iot
switched to db iot
> show collections
sensors
> db.sensors.find().pretty()
{
        "_id" : ObjectId("5a683ff83cdf6353104a5463"),
        "date" : "2018-01-24 17:12:40.708",
        "temperature" : "18.6",
        "humidity" : "10.1",
        "luminosity" : "178",
        "__v" : 0
}
{
        "_id" : ObjectId("5a683ffa3cdf6353104a5464"),
        "date" : "2018-01-24 17:12:42.979",
        "temperature" : "18.7",
        "humidity" : "10.3",
        "luminosity" : "179",
        "__v" : 0
}
{
        "_id" : ObjectId("5a683ffd3cdf6353104a5465"),
        "date" : "2018-01-24 17:12:45.251",
        "temperature" : "18.6",
        "humidity" : "10.2",
        "luminosity" : "180",
        "__v" : 0
}
```

Save as

AAnn_iot_mongdb.png



Arduino

& Node.js

& MongoDB

& Express server

mongoDB

node JS express

A5.9.6 DHT22 + CdS + Node.js + MongoDB

1. Install express server

- Go to cds_dht22 project
- npm install --save express
- package.json

```
{
  "name": "cds_dht22",
  "version": "1.0.0",
  "description": "cds-dht22-node project",
  "main": "cds_dht22_node.js",
  "scripts": {
    "test": "echo \"Error: no test specified\" && exit 1"
  },
  "author": "aa00",
  "license": "MIT",
  "dependencies": {
    "express": "^4.16.2",
    "mongoose": "^5.0.1",
    "serialport": "^4.0.7",
    "socket.io": "^1.7.3"
  }
}
```

A5.9.6 DHT22 + CdS + Node.js + MongoDB

2.1 cds_dht22_express.js

```
1  // cds_dht22_express.js
2
3  // Express
4  var express = require('express');
5  var app = express();
6  var web_port = 3030;  // express port
7
8  // MongoDB
9  var mongoose = require('mongoose');
10 var Schema = mongoose.Schema;  // Schema object
11 // MongoDB connection
12 mongoose.connect('mongodb://localhost:27017/iot'); // DB name
13 var db = mongoose.connection;
14 db.on('error', console.error.bind(console, 'connection error:'));
15 db.once('open', function callback () {
16         console.log("mongo db connection OK.");
17 });
18 // Schema
19 var iotSchema = new Schema({
20     date : String,
21     temperature : String,
22     humidity : String,
23     luminosity: String
24 });
25 var Sensor = mongoose.model("Sensor", iotSchema);  // sensor data model
```

A5.9.6 DHT22 + CdS + Node.js + MongoDB

2.2 cds_dht22_express.js

```
27 // Web routing addrebss
28 app.get('/', function (req, res) {  // localhost:3030/
29   res.send('Hello Arduino IOT: express server by AA00!');
30 });
31 // find all data & return them
32 app.get('/iot', function (req, res) {
33     Sensor.find(function(err, data) {
34         res.json(data);
35     });
36 });
37 // find data by id
38 app.get('/iot/:id', function (req, res) {
39     Sensor.findById(req.params.id, function(err, data) {
40         res.json(data);
41     });
42 });
43
44 // Express WEB
45 app.use(express.static(__dirname + '/public'));  // WEB root folder
46 app.listen(web_port);  // port 3030
47 console.log("Express_IOT is running at port:3030");
```

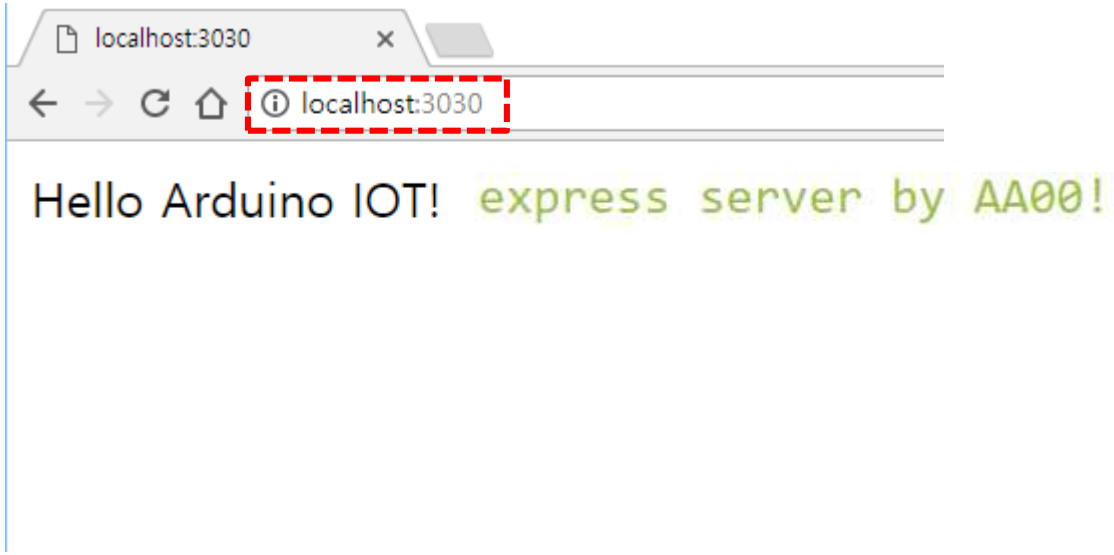
A5.9.6 DHT22 + CdS + Node.js + MongoDB

2.3 cds_dht22_express.js → Run

```
Express_IOT is running at port:3030
mongo db connection OK.
```

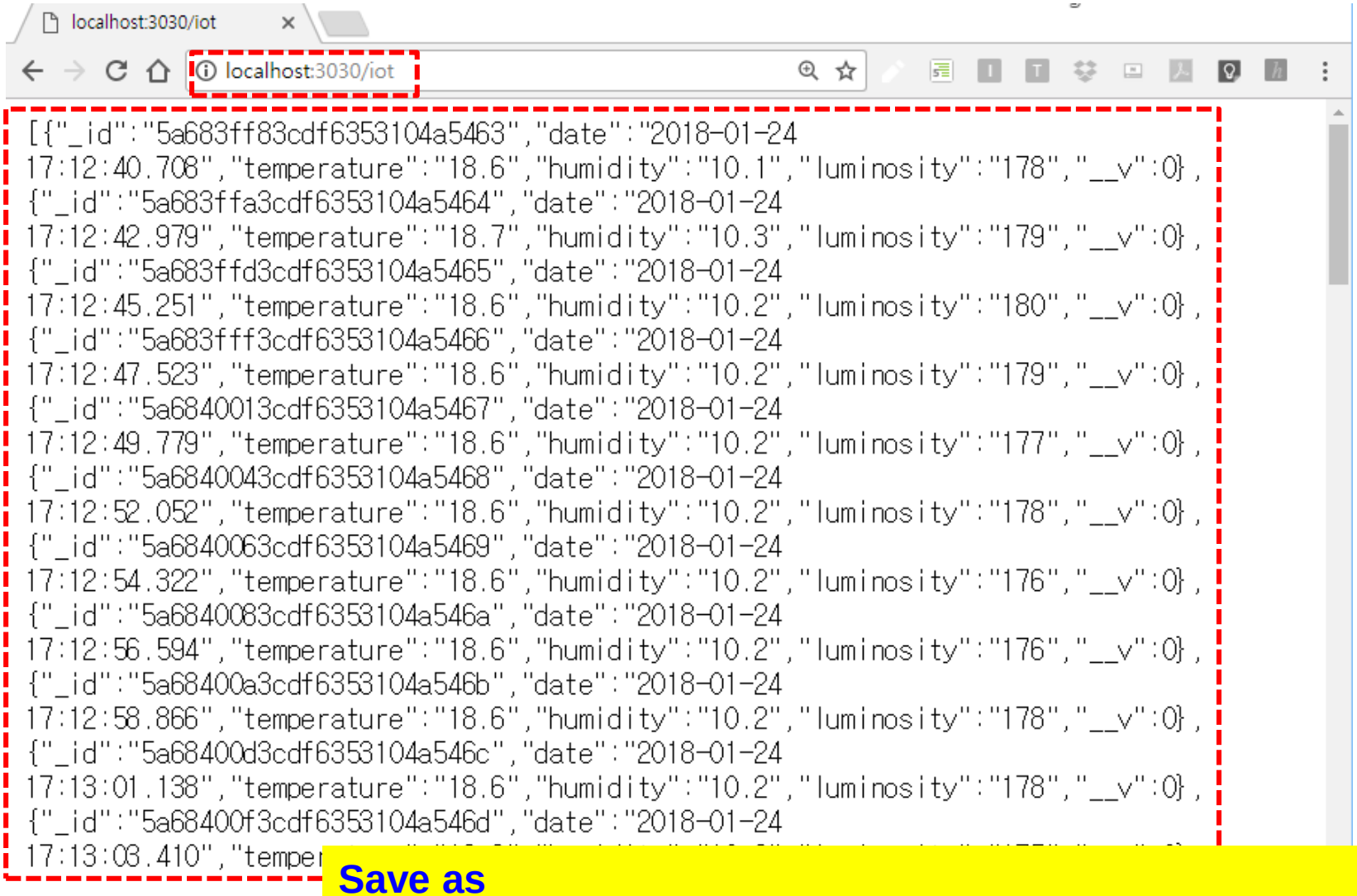
A5.9.6 DHT22 + CdS + Node.js + MongoDB

2.4 cds_dht22_express.js → routing1, http://localhost:3030/



A5.9.6 DHT22 + CdS + Node.js + MongoDB

2.5 cds_dht22_express.js → routing2 http://localhost:3030/iot

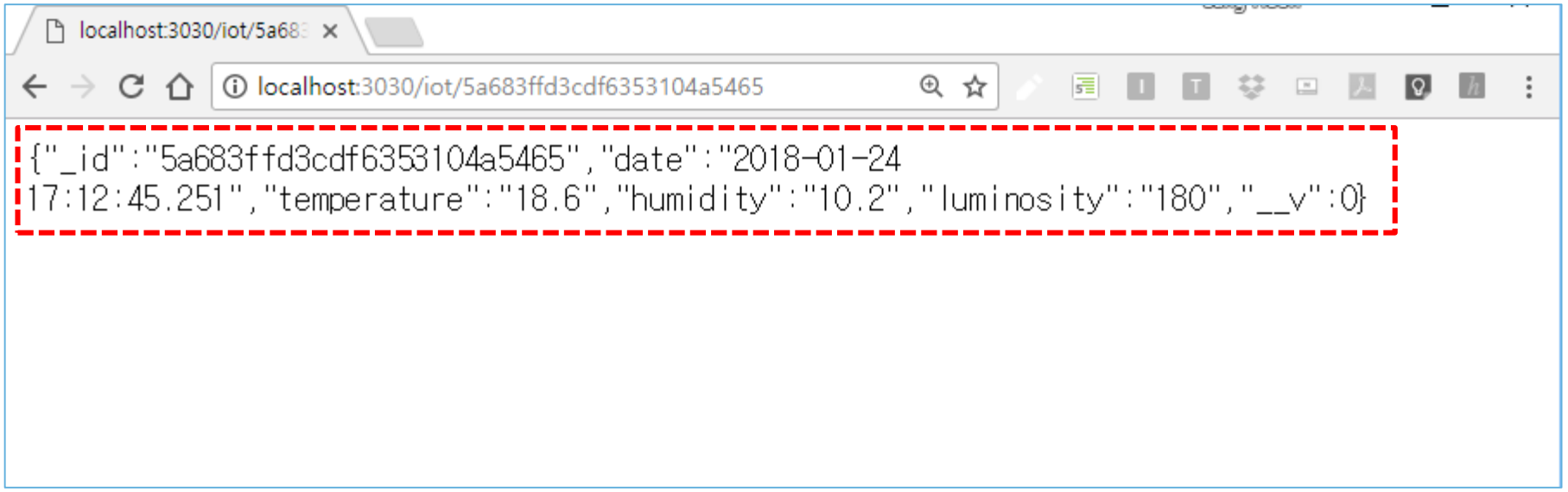


Save as

AAnn_iot_mongodb_web.png

A5.9.6 DHT22 + CdS + Node.js + MongoDB

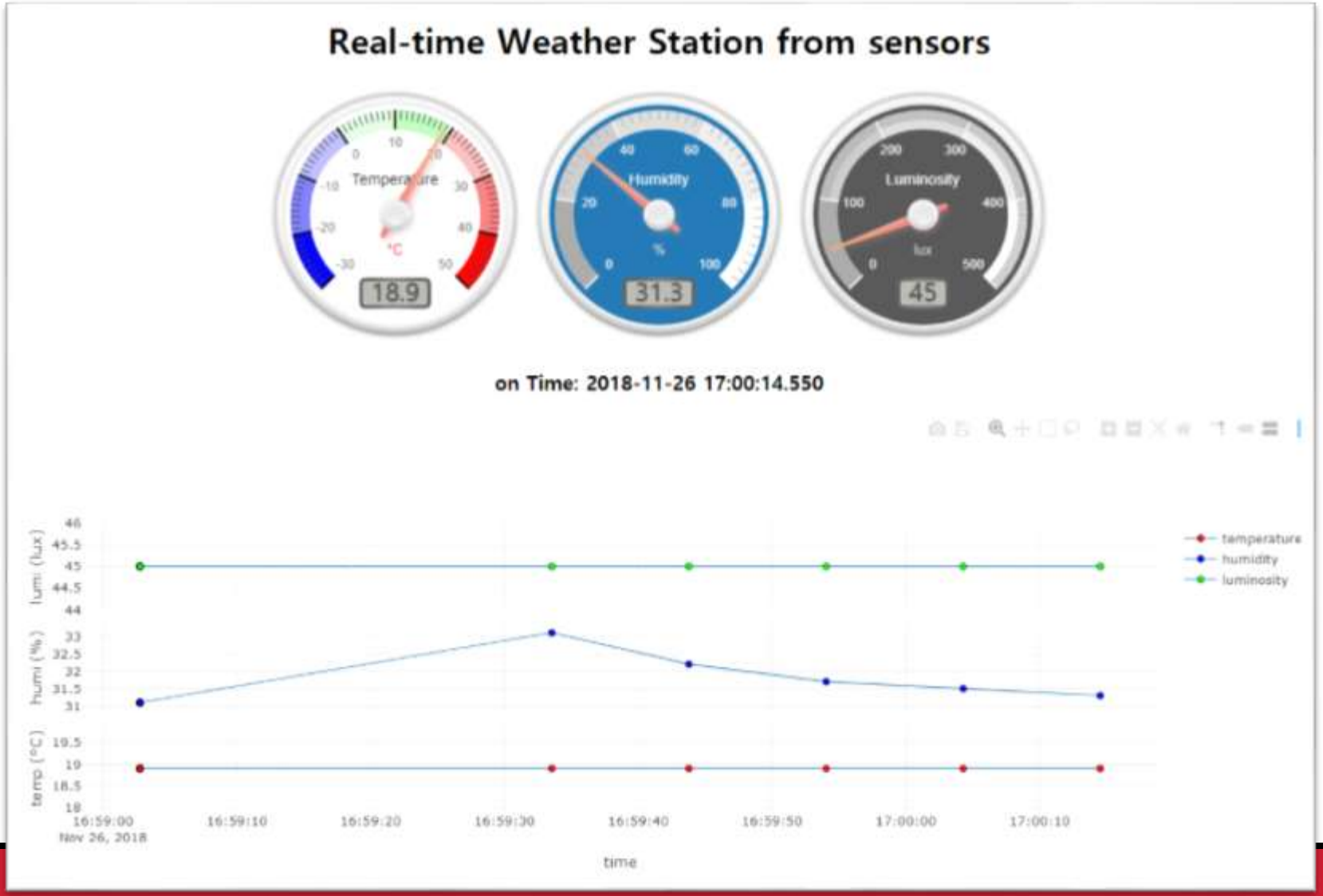
2.6 cds_dht22_express.js → routing2 http://localhost:3030/iot:id



A5.9.6 DHT22 + CdS + Node.js + MongoDB

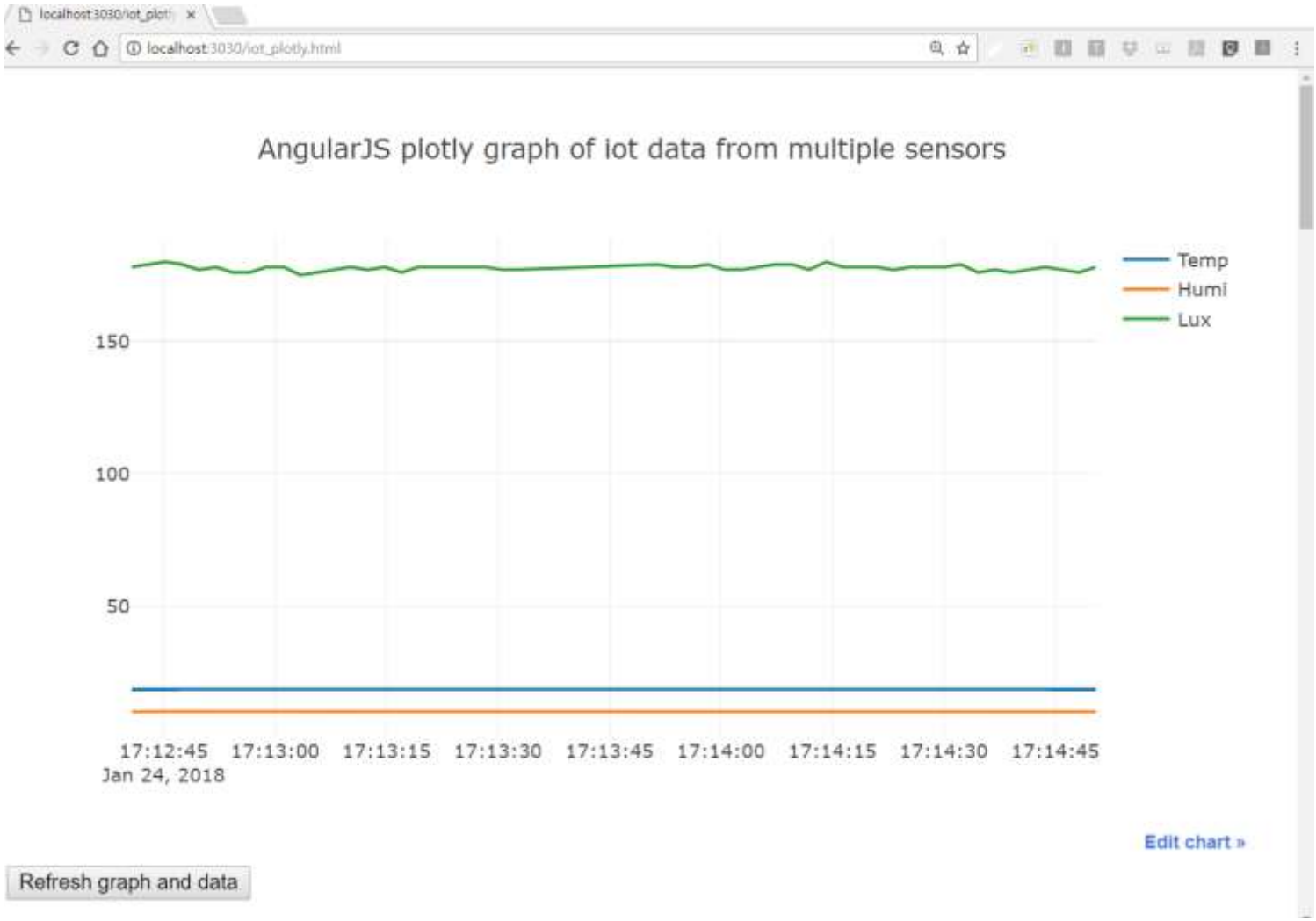
2.7 copy cds_dht22_client.html & gauge.min.js → ./public/ subfolder

http://localhost:3030/cds_dht22_client.html (web root folder)



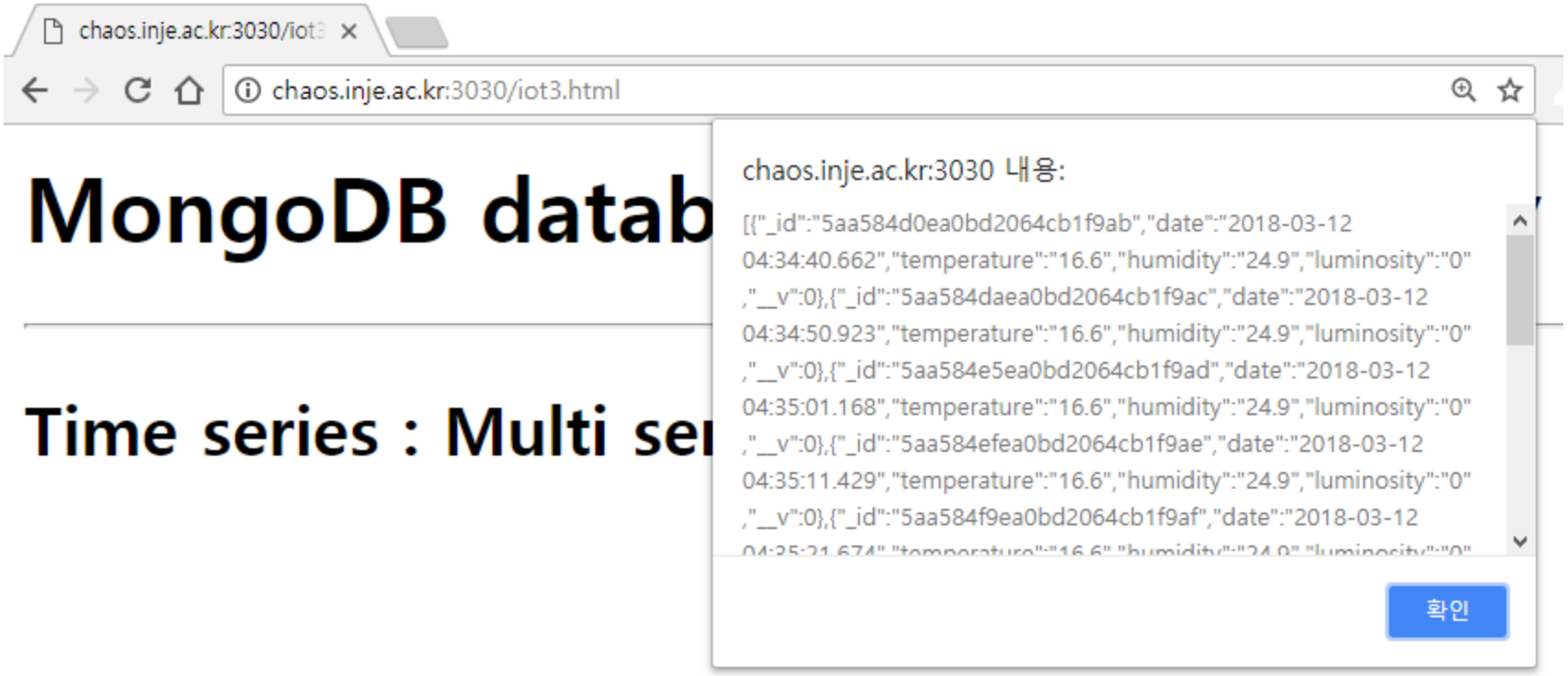
DHT22 + CdS + Node.js + MongoDB

[Next week] Web monitoring



DHT22 + CdS + Node.js + MongoDB

[Next week] Web monitoring

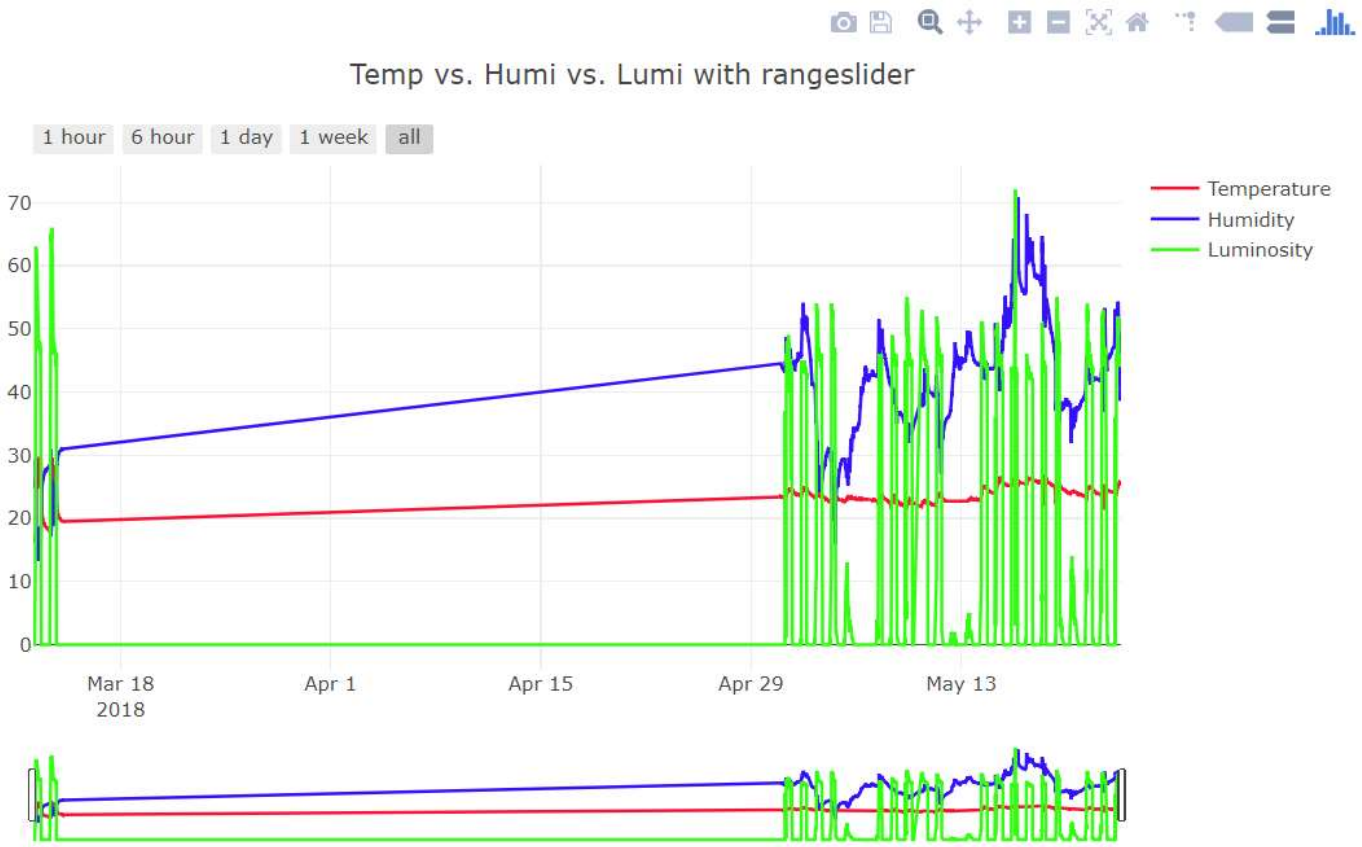


DHT22 + CdS + Node.js + MongoDB

[Next week] Web monitoring

MongoDB database visualization by AA00

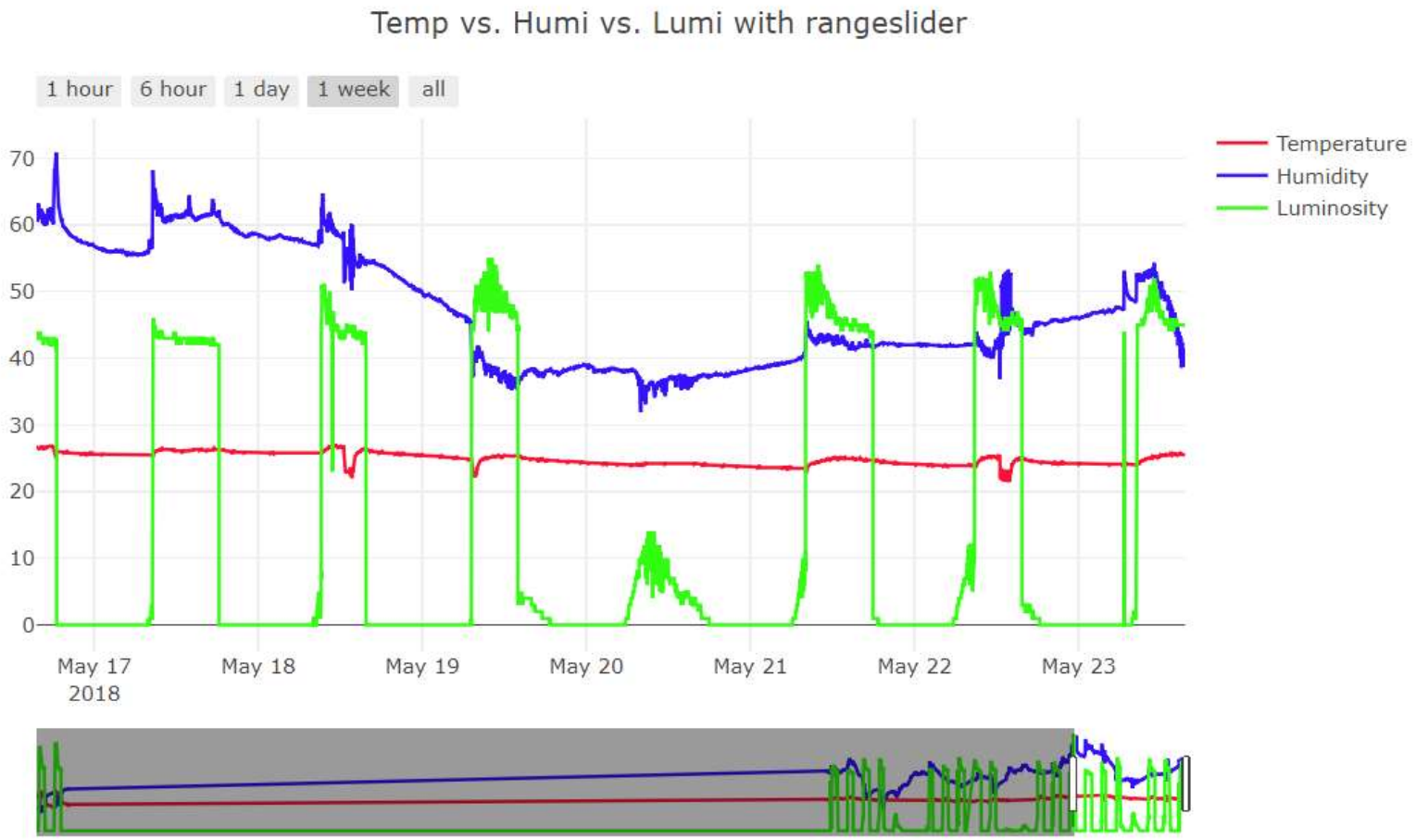
Time series : Multi sensor data

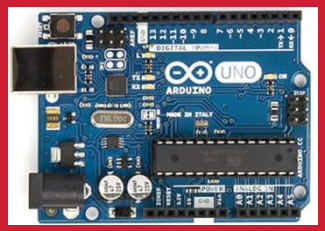


DHT22 + CdS + Node.js + MongoDB

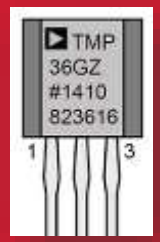
[Next week] Web monitoring

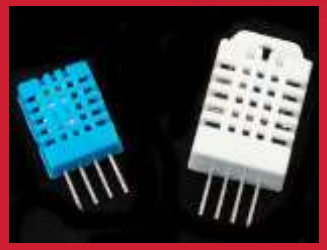
Time series : Multi sensor data





[Practice]





- [wk12]
  - RT Data storaging with MongoDB
  - Multi-sensor circuits (cds-dht22)
  - Complete your project
  - Upload folder: AAnn_Rpt10

wk12 : Practice : AAnn_Rpt10

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

제출폴더명 : **AAnn_Rpt10**

- 압축할 파일들

① AAnn_mongo_schemas.png

② AAnn_mongo_update.png

③ AAnn_iot_mongodb.png

④ AAnn_iot_mongodb_web.png

⑤ All *.ino

⑥ All *.js

⑦ All *.html

[Upload to github]

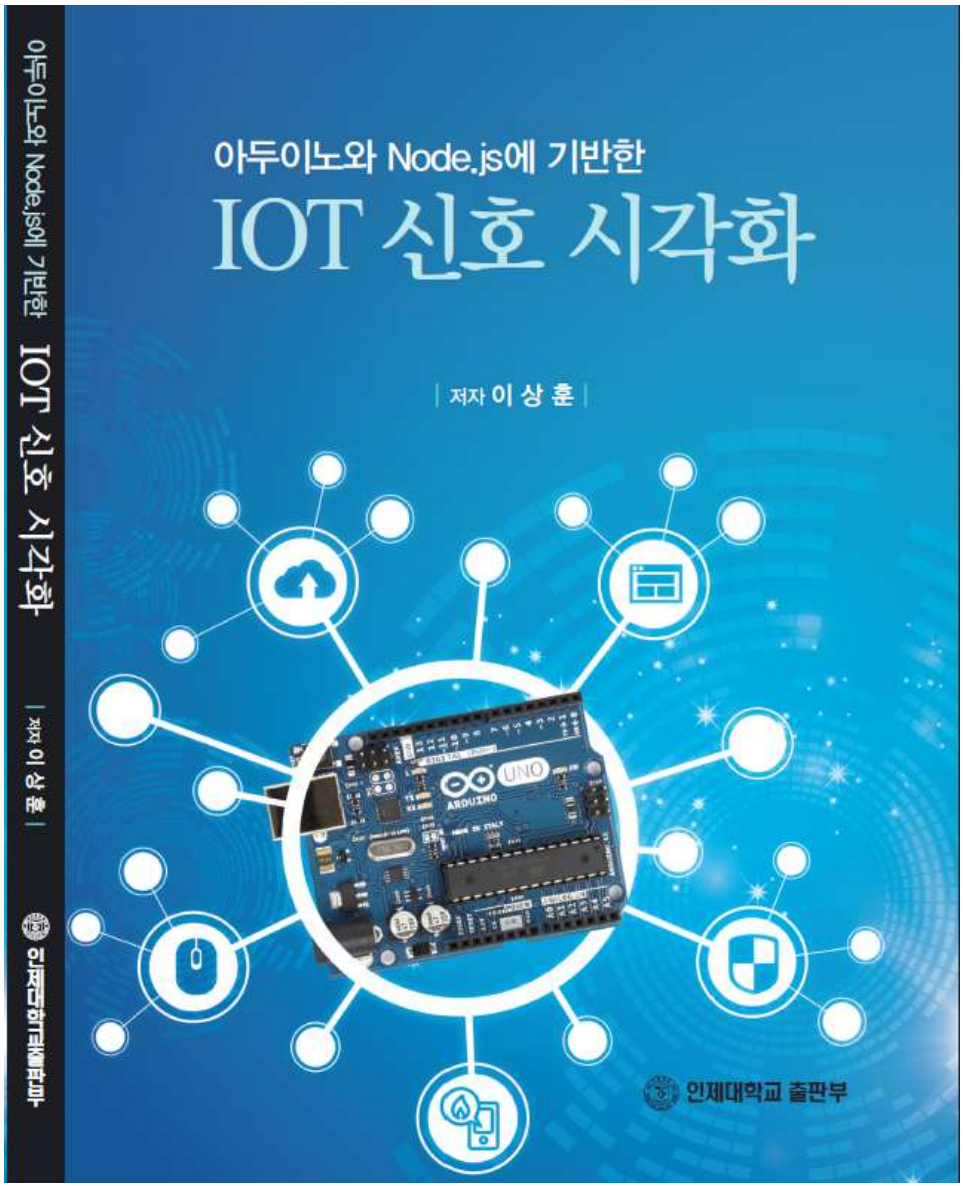
- [wk112]
  - upload all work of this week
  - Use repo “aann” in github
  - upload folder “aann_rpt10” in your github.

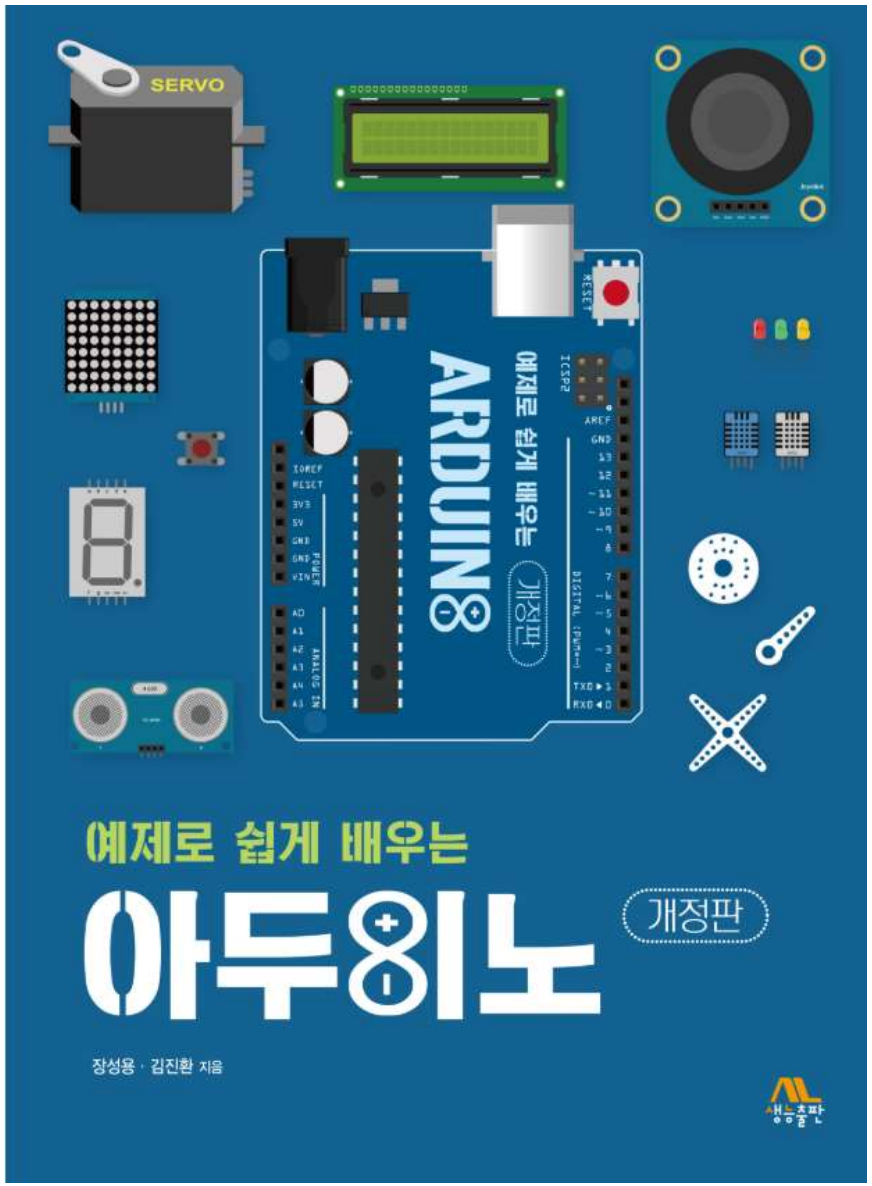
Lecture materials

References & good sites

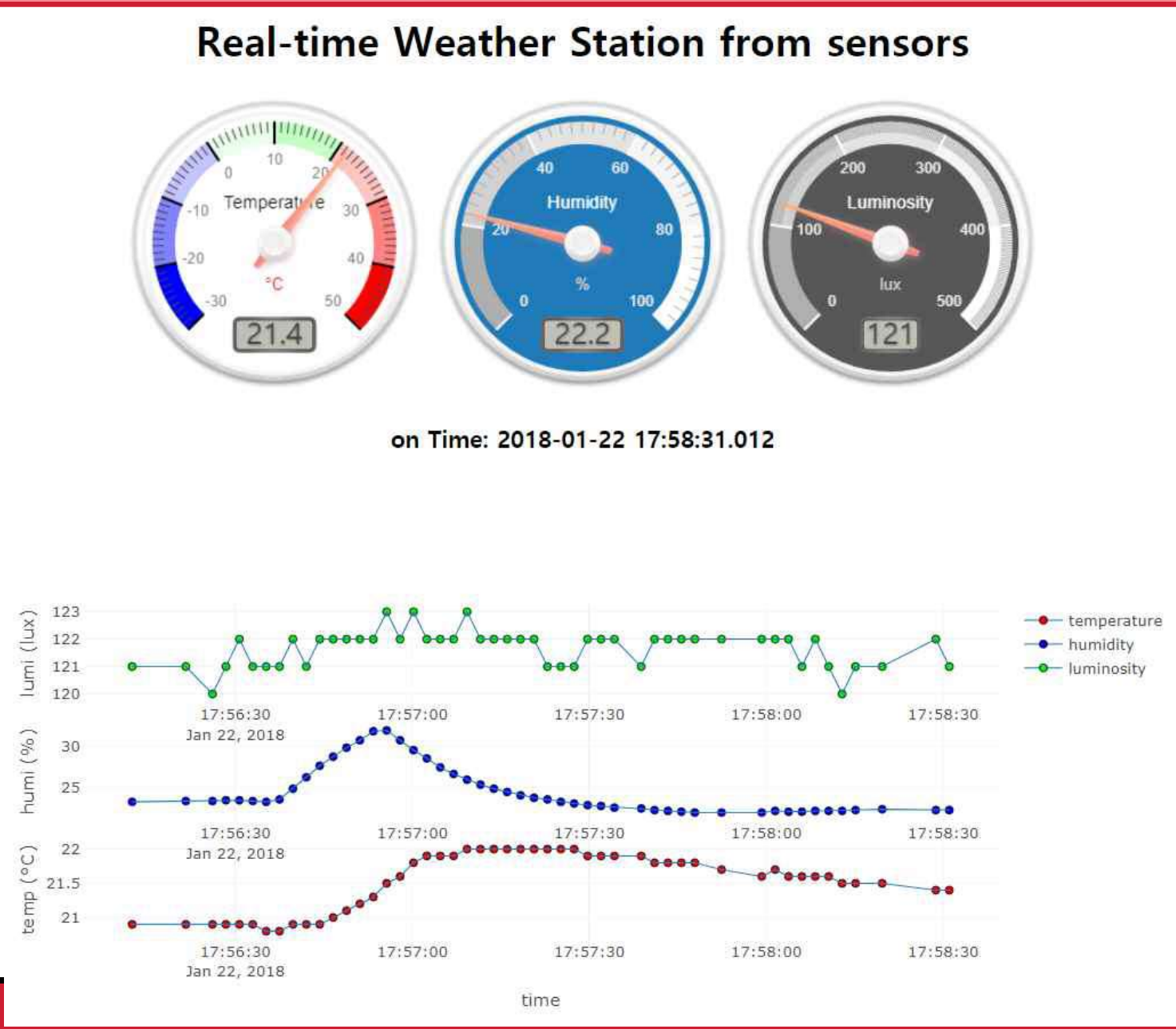
- ✓ http://www.arduino.cc Arduino Homepage
- ✓ http://www.nodejs.org/ko Node.js
- ✓ https://plot.ly/ plotly
- ✓ https://www.mongodb.com/ MongoDB
- ✓ http://www.w3schools.com By w3schools
- ✓ http://www.github.com GitHub

주교재 및 참고도서


아두이노와 Node.js에 기반한
IOT 신호 시각화
| 저자 이 상 훈 |
인제대학교 출판부
아두이노와 Node.js에 기반한 IOT 신호 시각화
| 저자 이 상 훈 |
인제대학교 출판부


SERVO
ARDUINO
예제로 쉽게 배우는
개정판
예제로 쉽게 배우는
아두이노
개정판
장성용 · 김진환 지음

Target of this class



Another target of this class