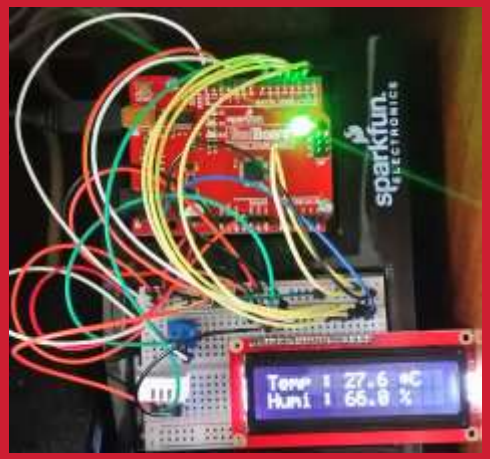


Arduino-IOT

[wk02]

Start node.js

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

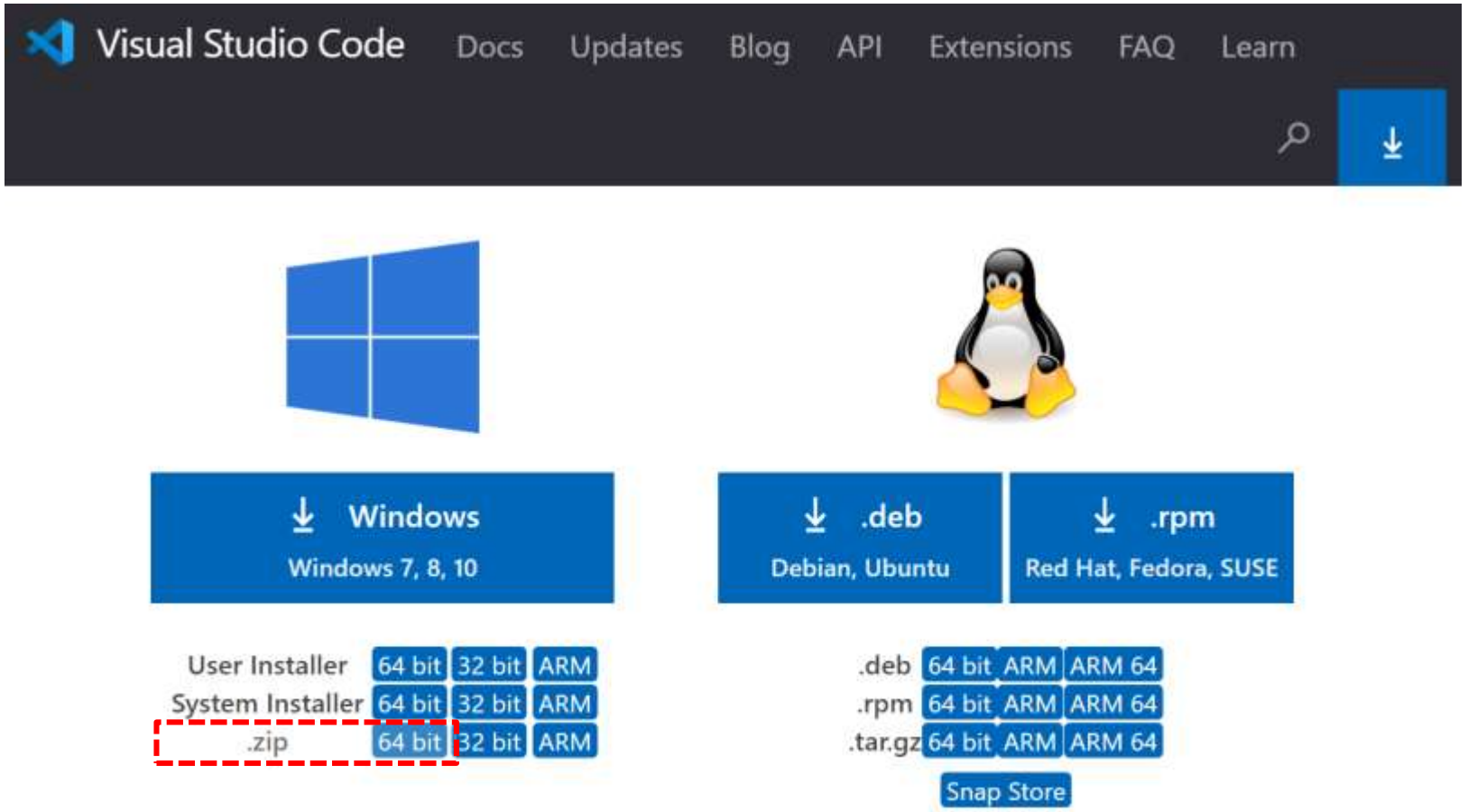
AA01	김준수	AA13	조재윤
AA02	김현서	AA14	고태승
AA03	박영훈	AA15	이한글
AA04	박윤호	AA16	장세진
AA05	성은지	AA17	장태호
AA06	손윤우	AA18	정지원
AA07	오세윤	AA19	진우태
AA08	우승철	AA20	황혁준
AA09	윤현석	AA21	장이제
AA10	이예주	AA22	박상현
AA11	강지환	AA23	정은성
AA12	성인제	AA24	김경영

위의 id를 이용해서 github에 repo를 만드시오.

Option: 아두이노응용 실습 과제 – AAnn

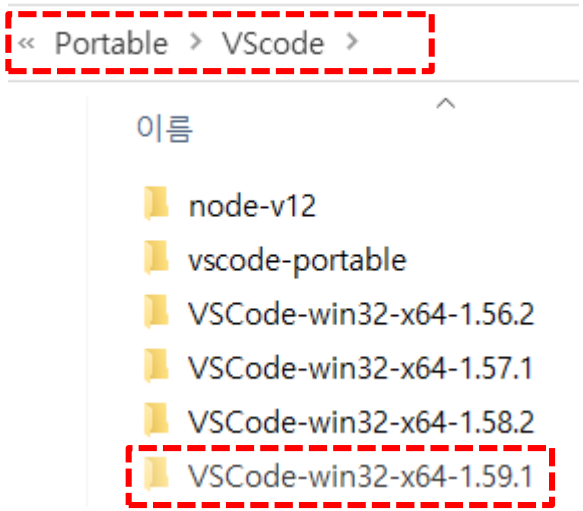
Public, **README.md** check

New editor: Vscode portable by MS



https://code.visualstudio.com/download

New editor: Vscode portable (MS)



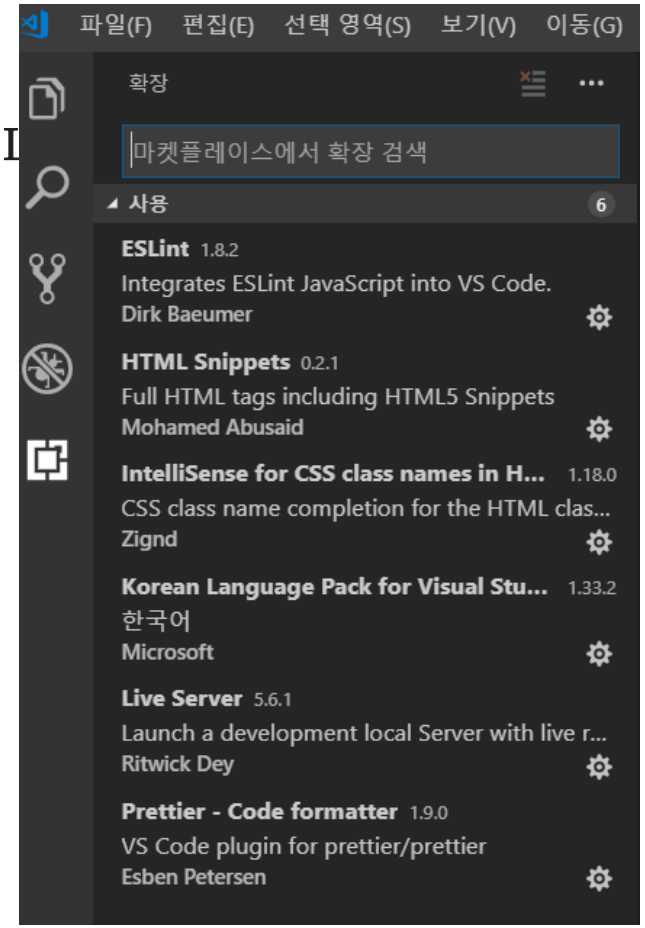
하드디스크 **D**에 **portable** 폴더를 만들고
vscode 폴더에
압축을 풀어서 사용

New editor: VScode

확장프로그램 설치 (각각 설치 후 vscode 재시작)

1. Korean language pack
2. HTML snippet
3. IntelliSense for CSS class names in HTML
4. Javascript (ES6)
5. Prettier
6. Live server (for HTML preview)

7. GitLens, Git History
8. Material Icon Theme
9. Python



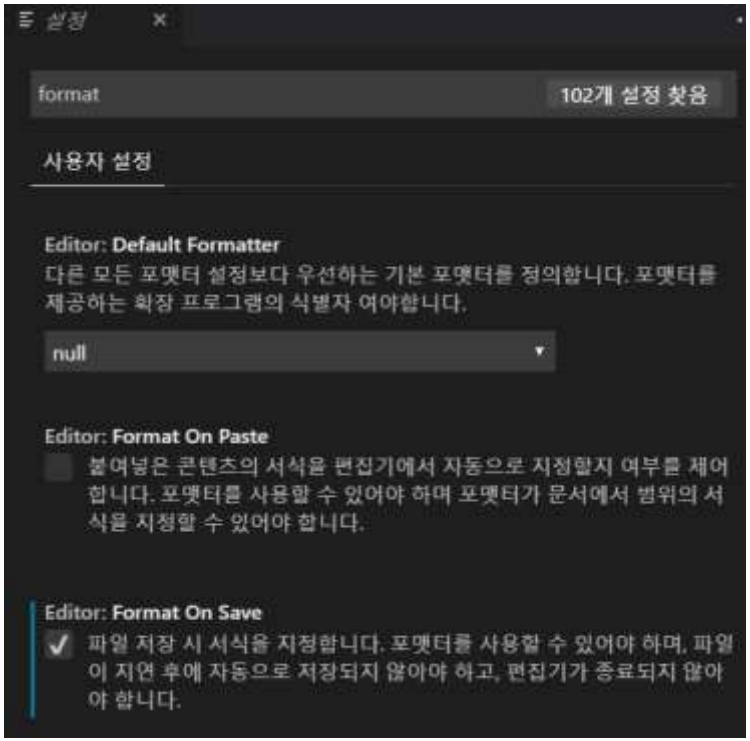
C, C++, Java,
Node.js
Python, Jupyter
... all coding!

New editor: VScode

확장프로그램 설정 (각각 설정 후 종료/재시작)

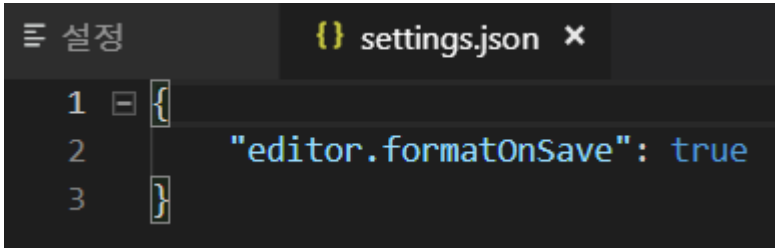
1. Prettier
2. Live server (for HTML preview)
3. GitLens, Git History

파일 > 기본설정 > 설정 → 사용자 설정



검색: format

Editor: Format on Save (check)



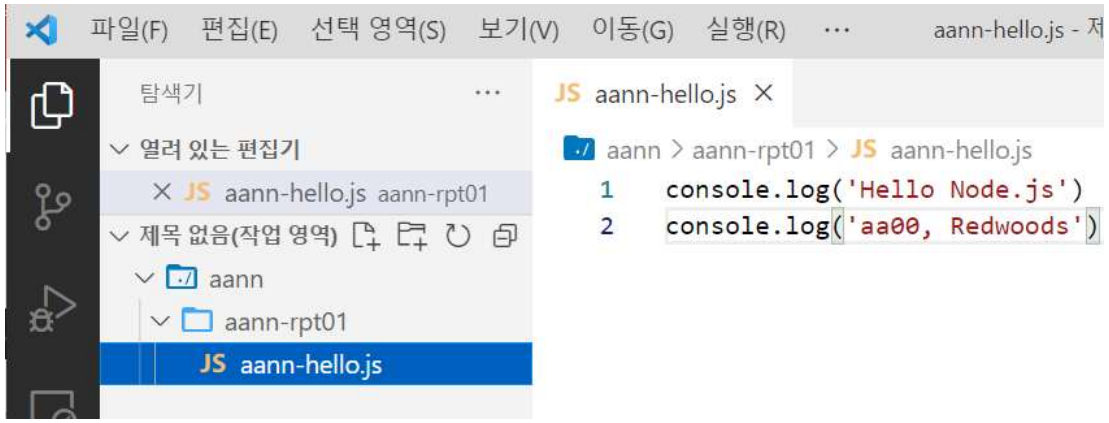
설정 → Ctrl + Shift + P

실습 준비: **aann/aann-rpt01** 폴더에서 js code

[파일] 메뉴

→ Node js 소스 만들기

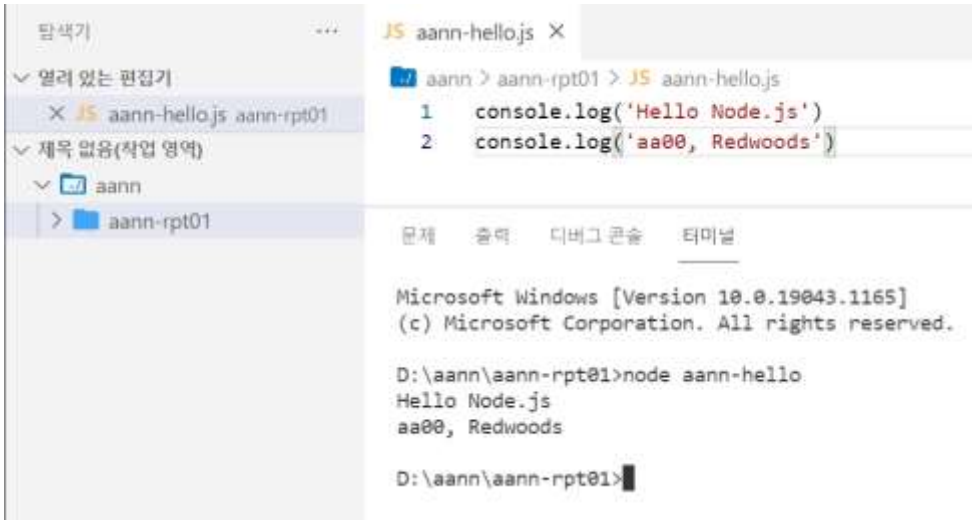
aann-rpt01 폴더 내에
aann-hello.js 파일 소스 생성.



→ Node js 소스 실행

aann-rpt01 폴더를 우클릭
통합터미널 열기 선택
다음 명령 실행

node aann-hello.js



[Project]

- [wk01]
  - upload all work of this week
  - Make repo “aann” in github
  - upload folder “aann-rpt01” in your github.

실습 : 결과를 나의 github에 올리기

따라서 함께 해봅시다.

◆ Github.com 에 각자의 public 계정을 만드시오. (이미 github 계정이 있으면 불필요)

1. 실습 결과를 올리는 github repo를 “aann”로 만드시오. (반드시 README.md 를 추가)

2. README.md에는 “아두이노응용 실습 과제” 입력

3. “aann” repo 에 aann-rpt01 폴더 upload

4. 각자의 github 주소를 이메일로 보내시오.
   https://github.com/accountName/aann

Email : chaos21c@gmail.com

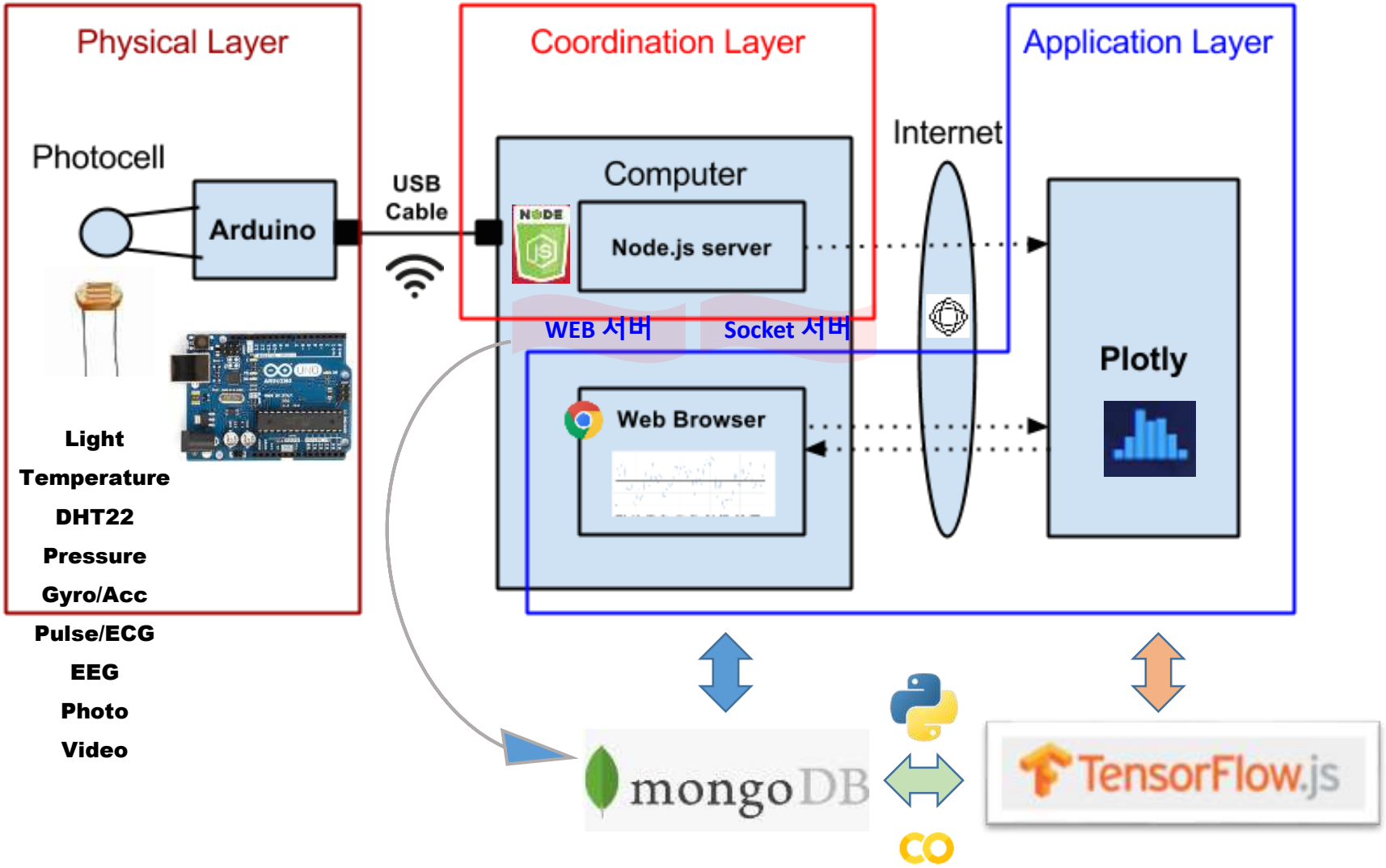
Purpose of AA

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

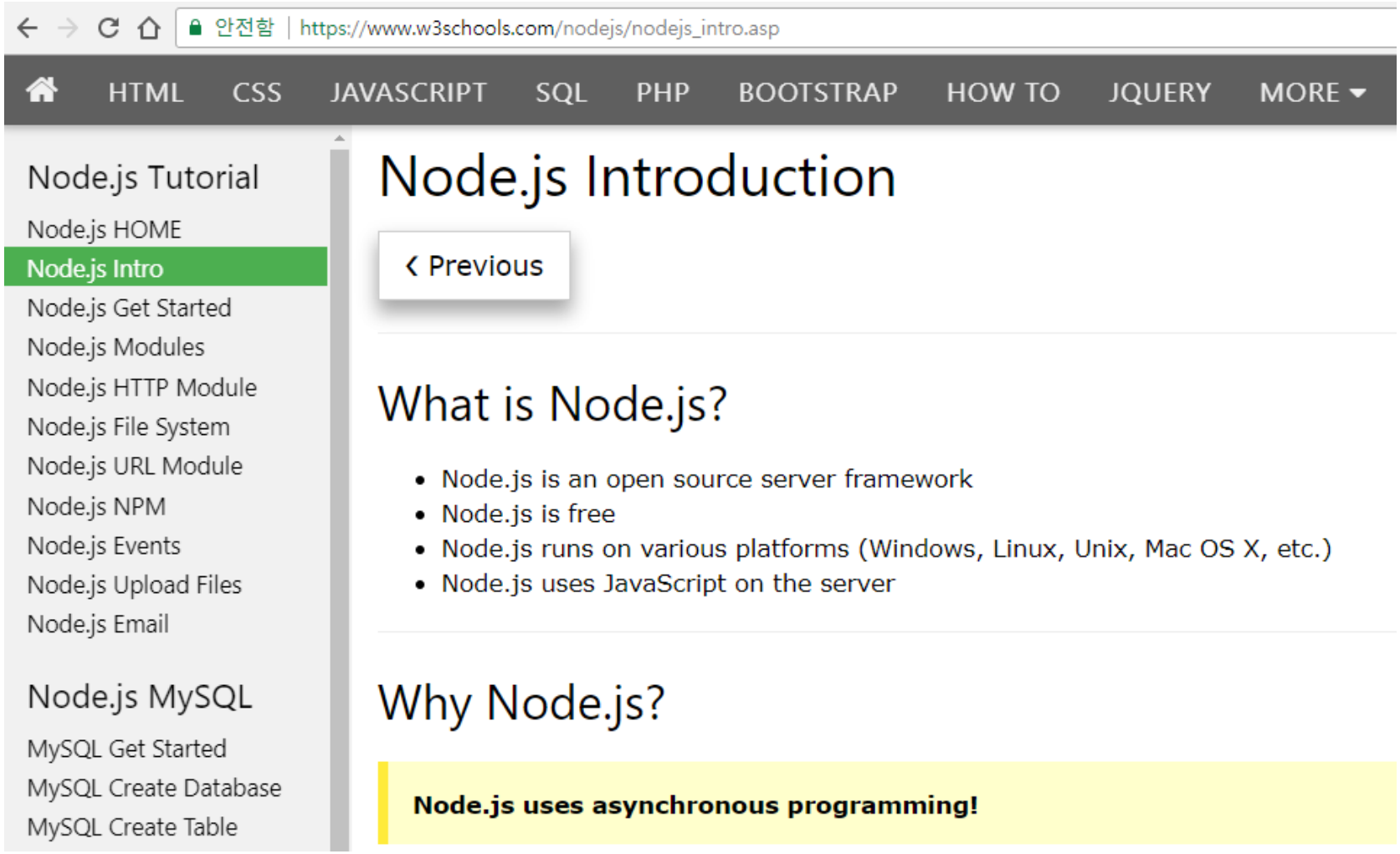
4. 저장된 IoT 데이터의 마이닝 (파이썬 코딩)

Layout [H S C]


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

1.0 What is node.js?

1.0 What is node.js?



https://www.w3schools.com/nodejs/nodejs_intro.asp

Javascript on Server

Node.js is an open-source, runtime environment for developing server-side and network applications in JavaScript.

Its event-driven architecture and non-blocking I/O model makes it ideal for building real-time applications that run across distributed devices.

1.1 What is node.js?

1.2 What is node.js?

- Node.js® is a JavaScript runtime built on Chrome's V8 JavaScript engine.
- Node.js uses an event-driven, non-blocking I/O model that makes it lightweight and efficient.
- Node.js' package ecosystem, npm, is the largest ecosystem of open source libraries in the world.

1.3 Non-blocking IO

Blocking Code

```
var contents = readFile('/path/some/file.txt');
console.log(contents);
console.log('Another independent operation');
```

Non-Blocking Code

```
var contents = readFile('/path/some/file.txt', function(err, contents){
      console.log(err || contents);
      });

console.log('Another independent operation');
```

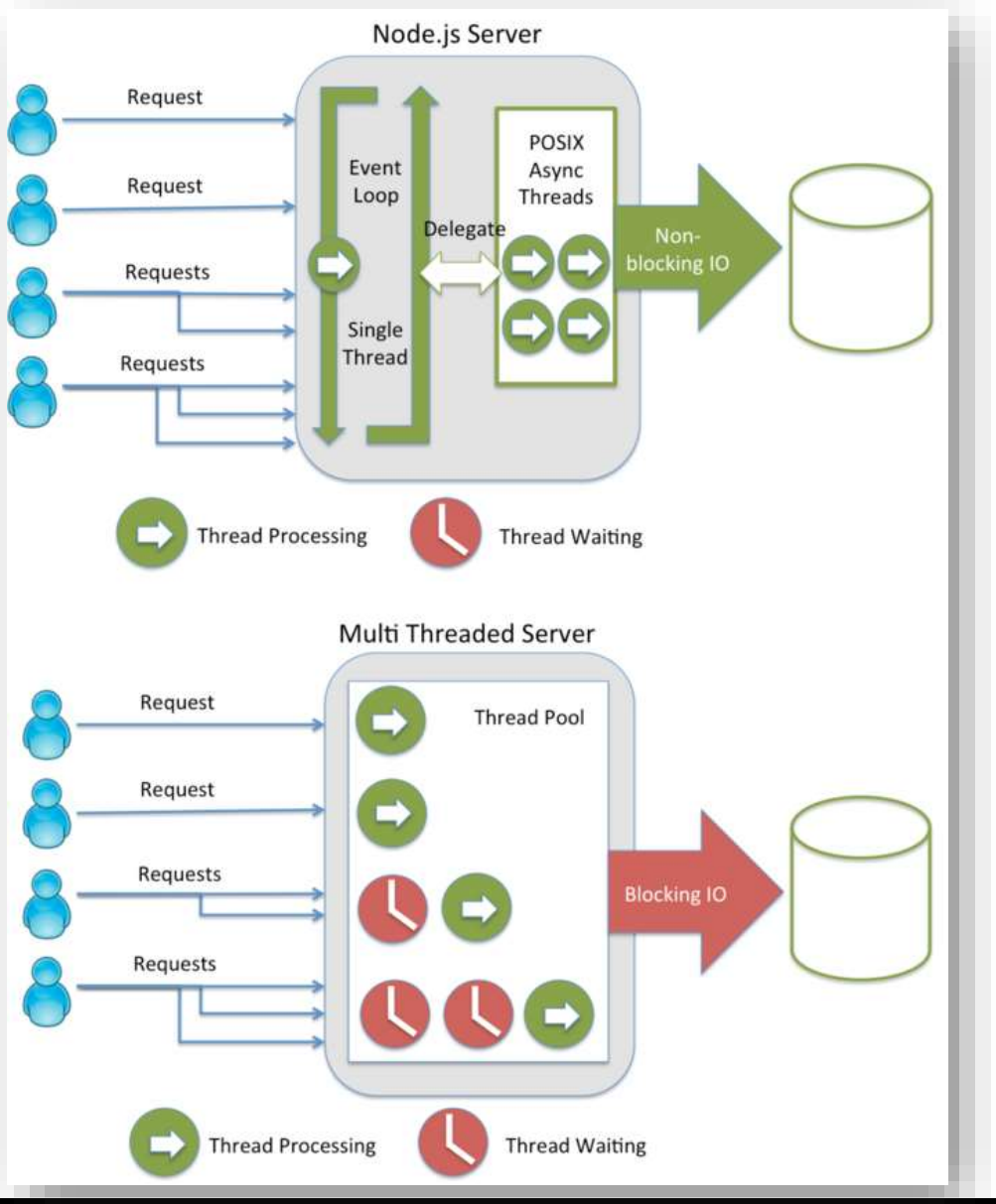
[Quiz] 계란 1개를 삶을 때 10분이 걸린다.

그러면 계란 10개를 삶을 때 걸리는 시간은?

Blocking : ?

Non-blocking : ?

1.3 Non-blocking IO



Single thread

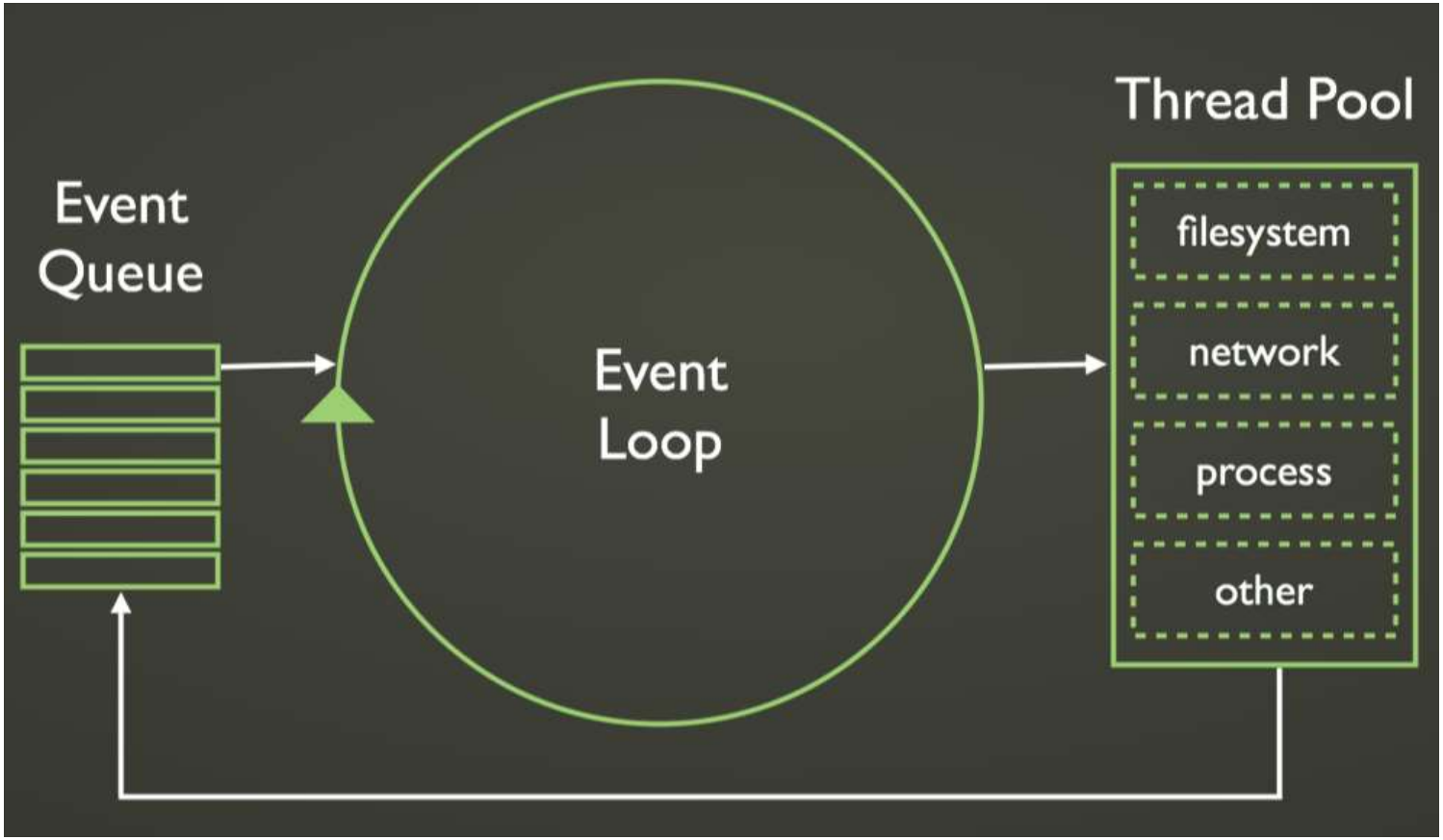
Non-blocking IO

Multi thread

Blocking IO

https://strongloop.com/strongblog/node-js-is-faster-than-java/

1.4 Non-blocking event loop



2.1 Install node.js

다운로드

최신 LTS 버전:

플랫폼에 맞게 미리 빌드된 Node.js 인스톨러나 소스코드를 다운받아서 바로 개발을 시작하세요.

LTS 대다수 사용자에게 추천	현재 버전 최신 기능
Windows Installer node-v12.18.3-x64.msi	macOS Installer node-v12.18.3.pkg
Source Code node-v12.18.3.tar.gz	

Windows Installer (.msi)	32-bit	64-bit
Windows Binary (.zip)	32-bit	64-bit
macOS Installer (.pkg)	64-bit	
macOS Binary (.tar.gz)	64-bit	
Linux Binaries (x64)	64-bit	
Linux Binaries (ARM)	ARMv7	ARMv8

https://nodejs.org/ko/download/

2.2 Verify installation

명령 프롬프트

```
Microsoft Windows [Version 10.0.19041.450]
(c) 2020 Microsoft Corporation. All rights reserved.

C:₩Users₩life21c>node -v
v14.9.0

C:₩Users₩life21c>npm -v
6.14.8

C:₩Users₩life21c>_
```

node -v

npm -v

2.3 Testing node.js – node shell

명령 프롬프트

```
C:₩Users₩life21c>node
Welcome to Node.js v14.9.0.
Type ".help" for more information.
> a=2
2
> b=5
5
> c=a+b
7
> a*b
10
> a/b
0.4
> a%b
2
> b%a
1
>
(To exit, press ^C again or ^D or type .exit)
>

C:₩Users₩life21c>_
```

// node shell
node
>
>
// exit
^C^C

2.4 Testing node.js – final test

Final test if Node.js was installed correctly:

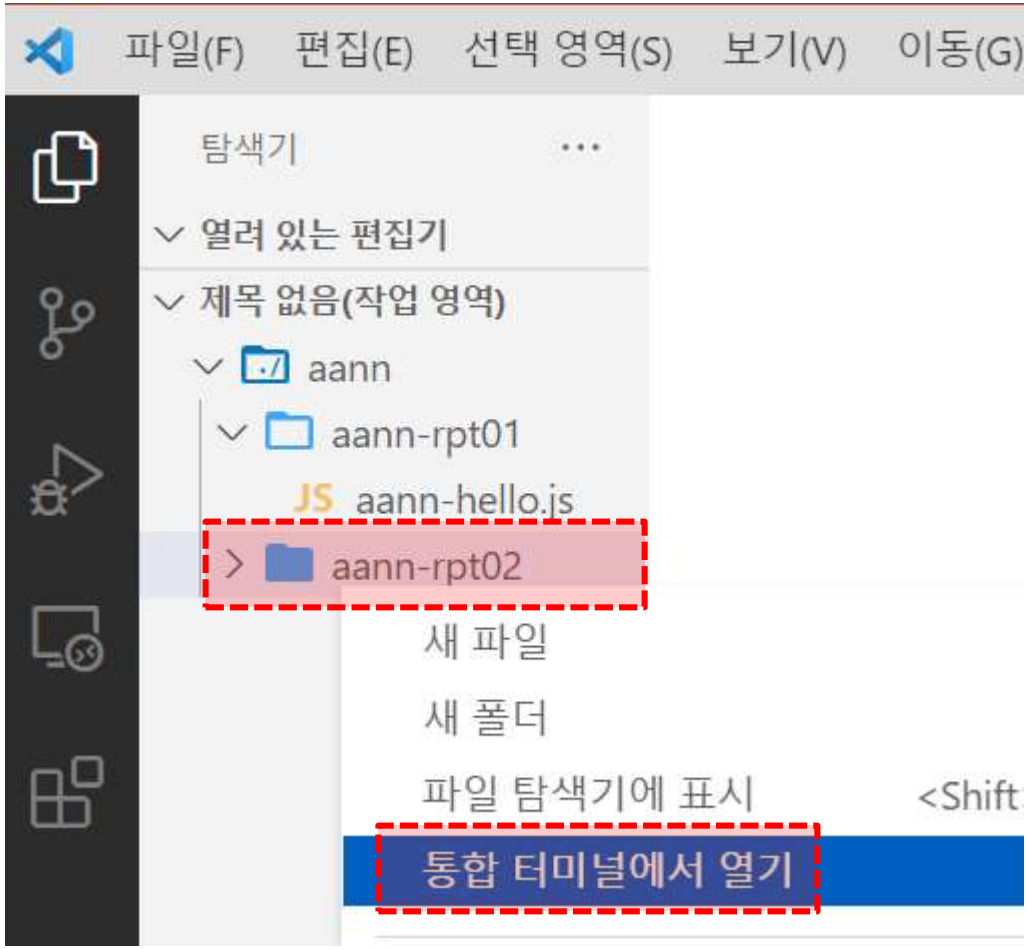
```
node -e "console.log('Hello from node.js ' + process.version)"
```

Node.js Project

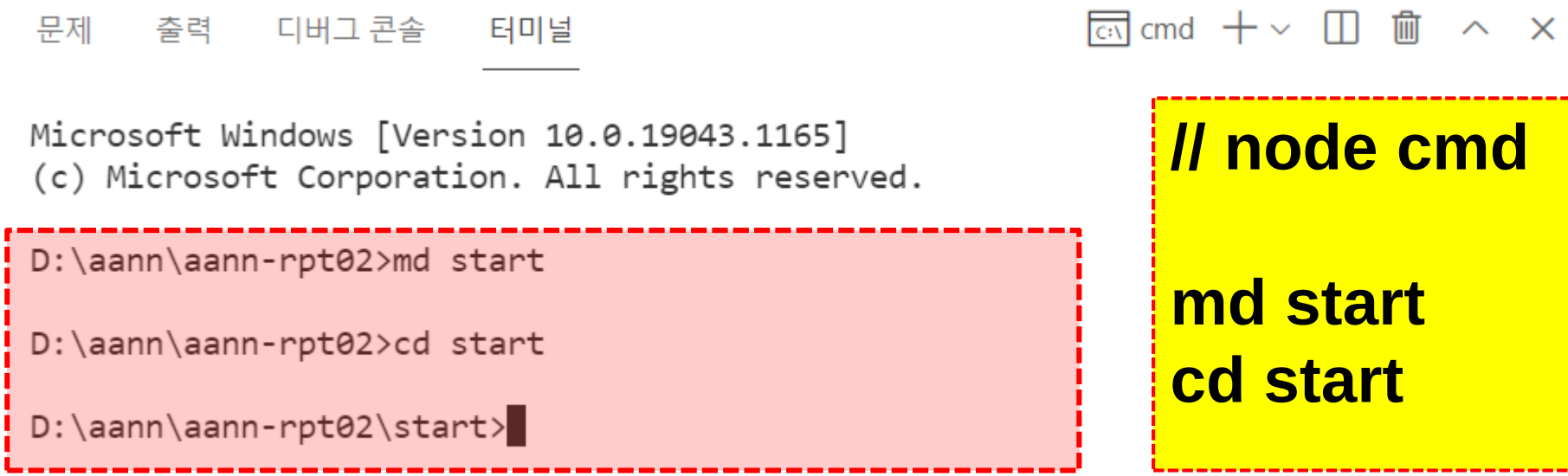
npm init

4.1 Node project : start terminal

// VScode
작업영역에
aann-rpt02
폴더 만들고
터미널 열기



4.1 Node project : start terminal



// node cmd

md start
cd start

4.2 Node project : npm init

```
D:\aann\aann-rpt02\start>npm init
This utility will walk you through creating a package.json file.
It only covers the most common items, and tries to guess sensible defaults.

See `npm help init` for definitive documentation on these fields
and exactly what they do.

Use `npm install <pkg>` afterwards to install a package and
save it as a dependency in the package.json file.

Press ^C at any time to quit.
package name: (start)
version: (1.0.0)
description: strat node project
entry point: (index.js)
test command:
git repository:
keywords: test
author: aa00
license: (ISC) MIT
```

// node project

npm init

4.3.1 Node project : package.json

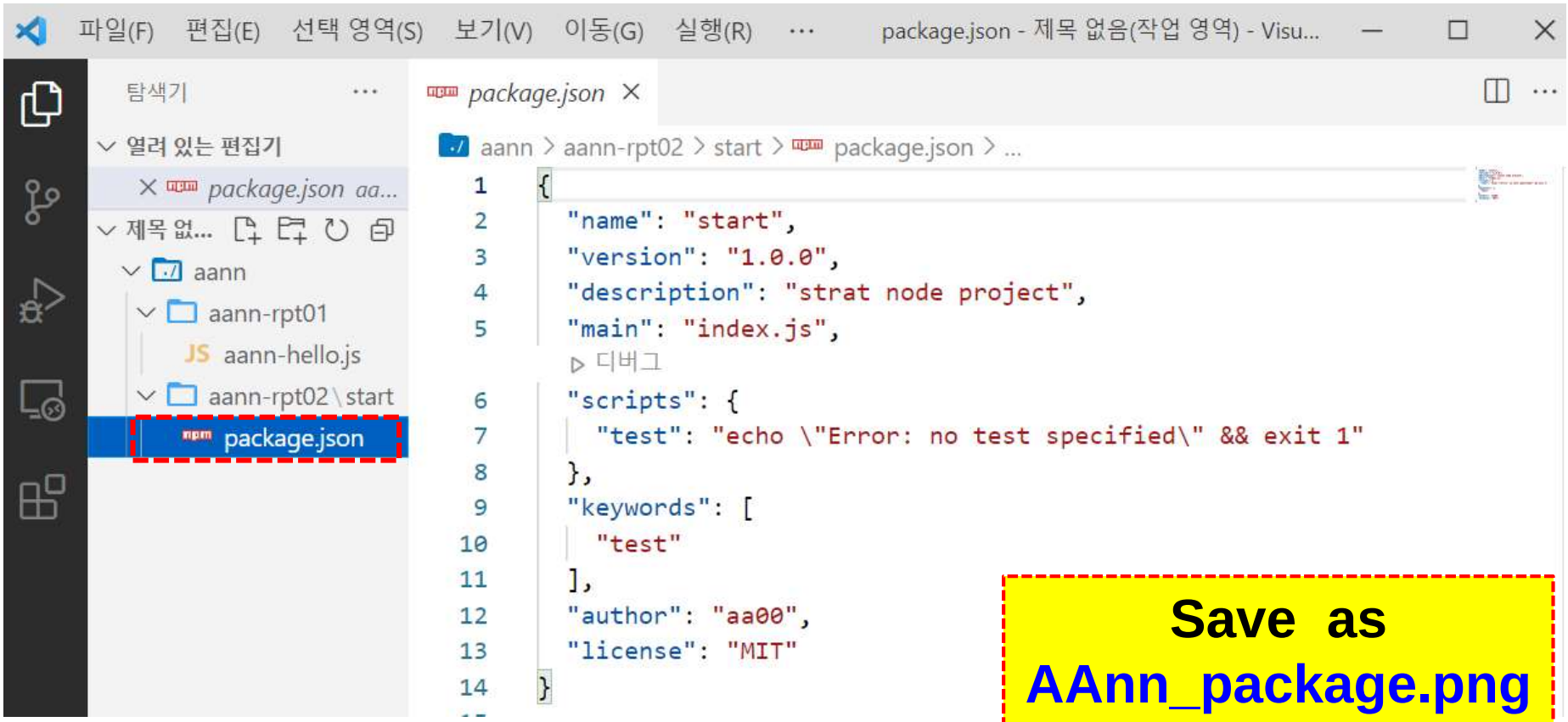
```
{
  "name": "start",
  "version": "1.0.0",
  "description": "strat node project",
  "main": "index.js",
  "scripts": {
    "test": "echo \"Error: no test specified\" && exit 1"
  },
  "keywords": [
    "test"
  ],
  "author": "aa00",
  "license": "MIT"
}
```

```
Is this OK? (yes)

D:\aann\aann-rpt02\start>dir
 D 드라이브의 볼륨: DATA
 볼륨 일련 번호: 82D1-4852

 D:\aann\aann-rpt02\start 디렉터리

2021-09-07  오후 01:47    <DIR>          .
2021-09-07  오후 01:47    <DIR>
2021-09-07  오후 01:47               255 package.json
               1개 파일                 255 바이트
               2개 디렉터리  2,467,748,704,256 바이트 남음
```

4.3.2 Node project : package.json

package.json

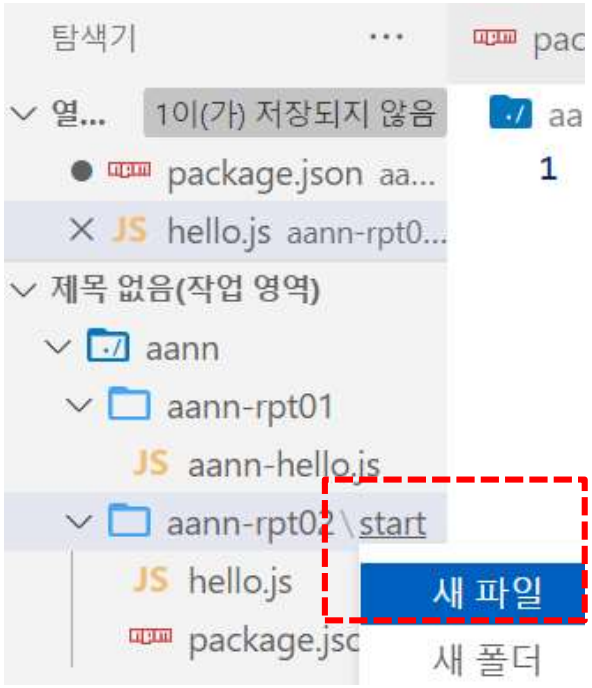
Node 프로젝트 설정 파일
- json file



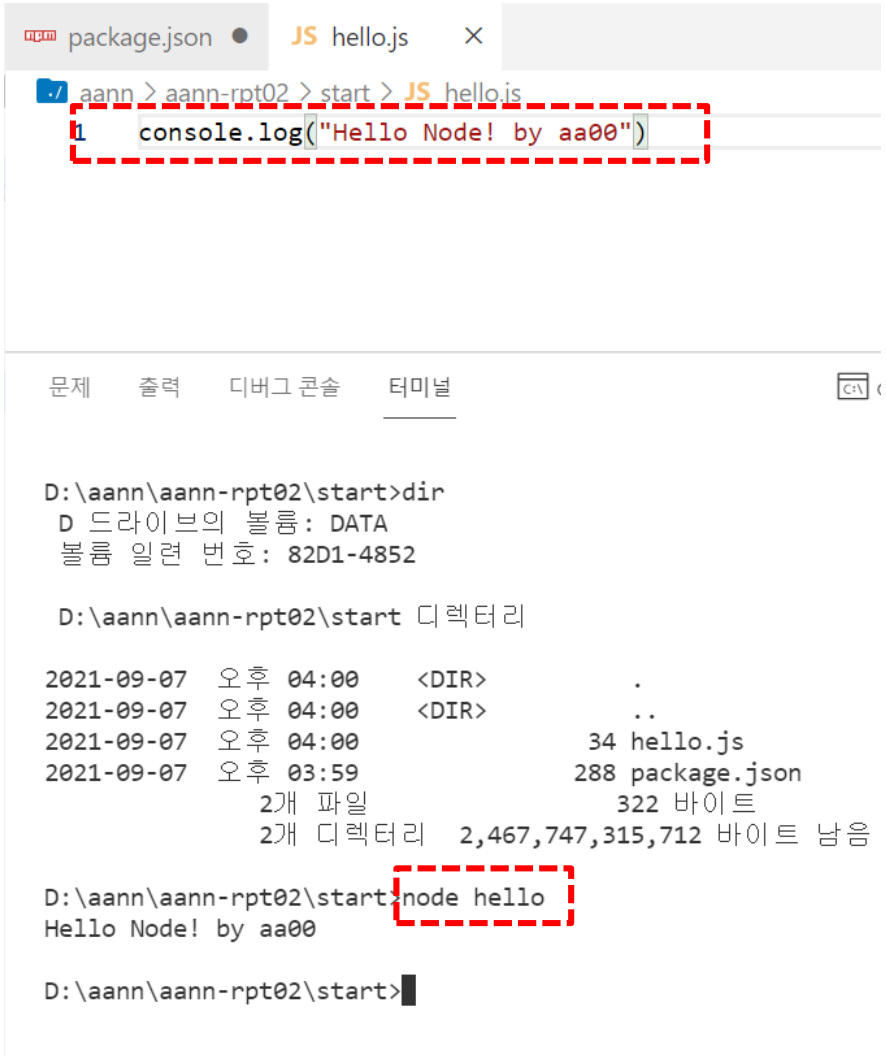
Save as
AAnn_package.png

Node Apps

5.1.1 Hello Node! – hello.js



start 폴더 안에 hello.js 파일



VSCode 터미널에서 실행 : node js-file-name

5.1.2 Hello Node! – npm start 로 실행

Using function in node

5.2.1 Using function in node

package.json | JS hello_function.js | JS hello.js

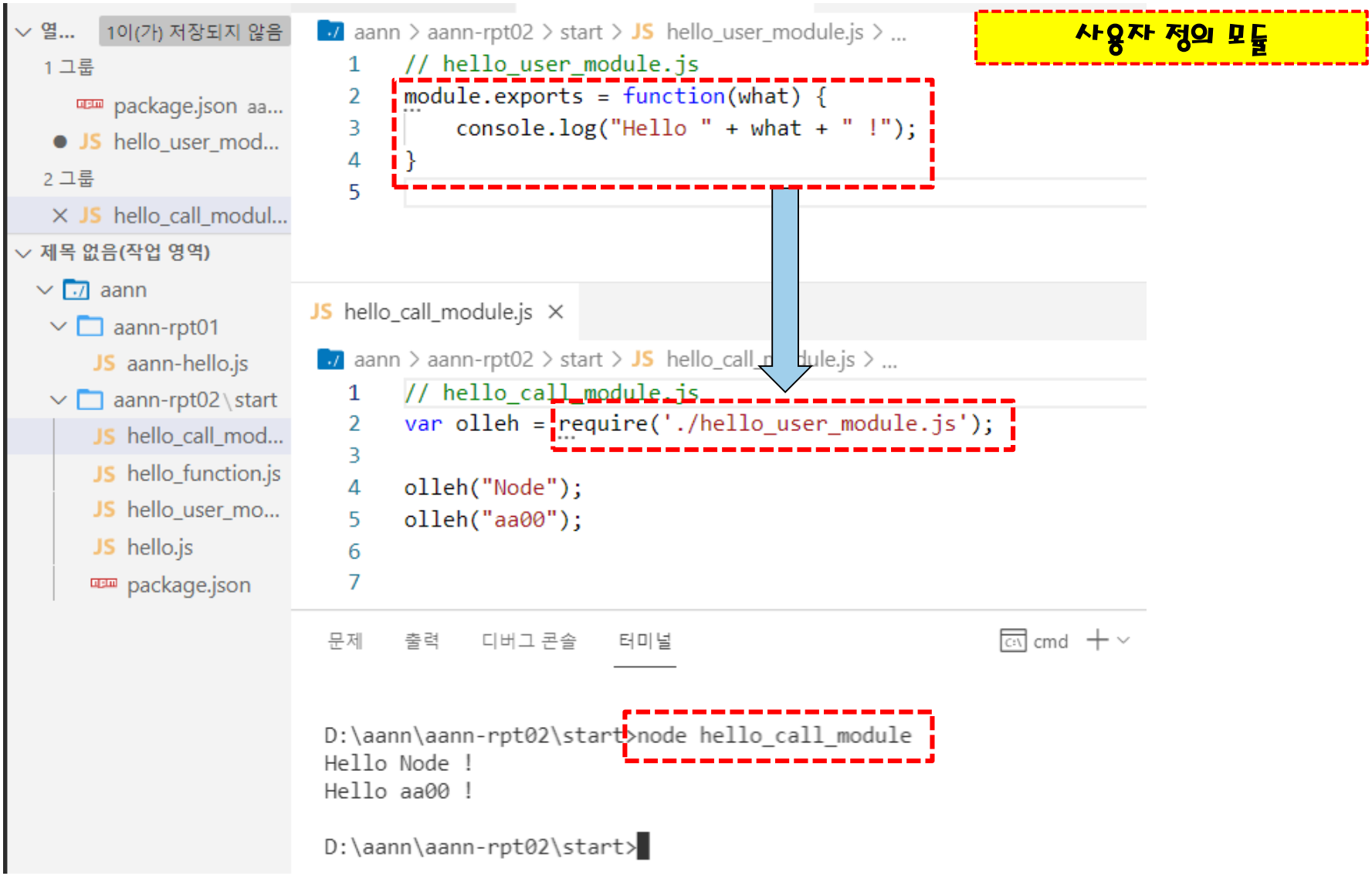
aann > aann-rpt02 > start > JS hello_function.js > ...

```
1  // hello_function.js
2  function hello(what) {
3      console.log("Hello " + what + " !");
4  }
5
6  hello("aa00");
7  hello("redwoods, 홍길동");
8
```

문제 출력 디버그 콘솔 터미널 cmd

```
D:\aann\aann-rpt02\start>node hello_function
Hello aa00 !
Hello redwoods, 홍길동 !

D:\aann\aann-rpt02\start>
```

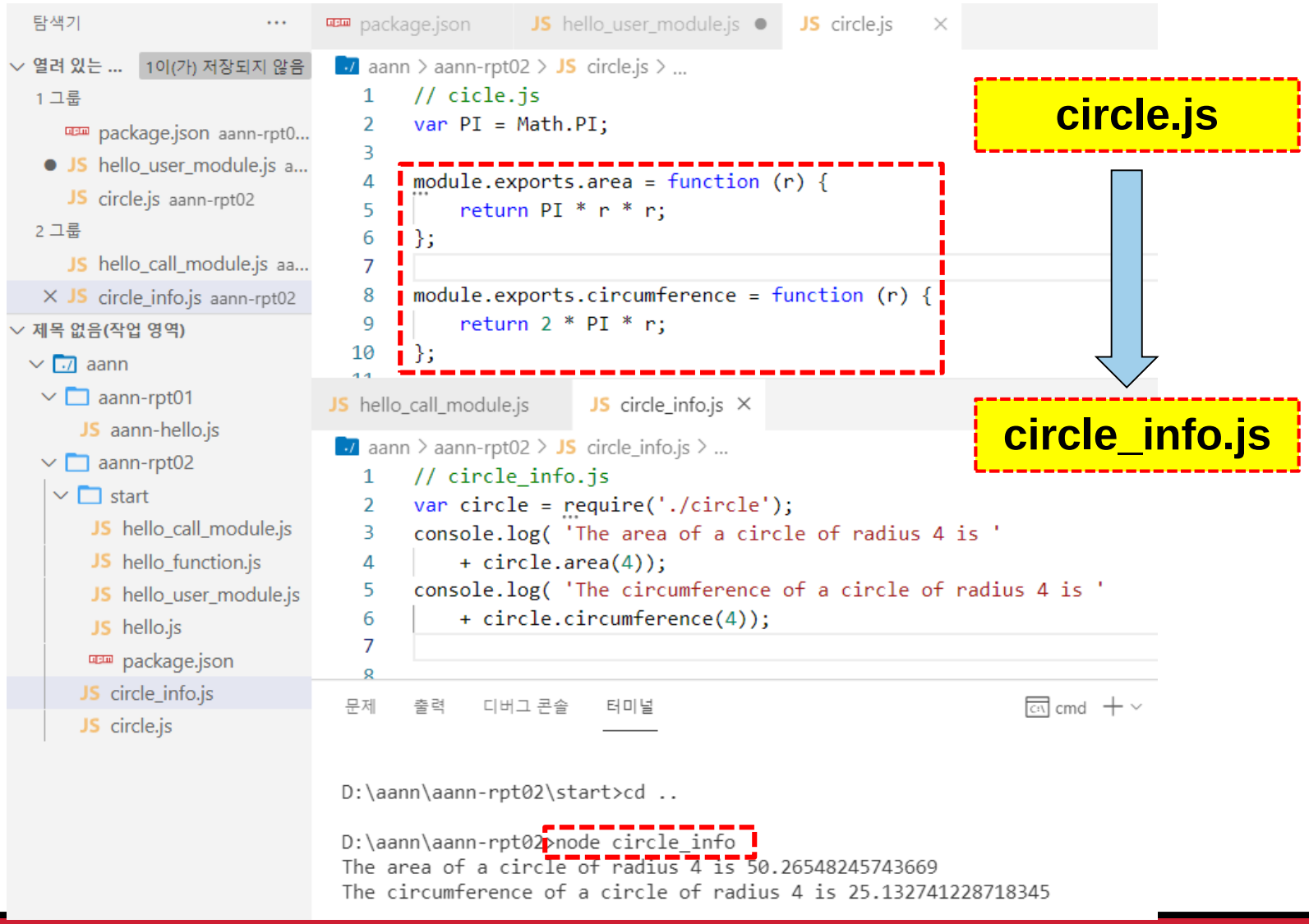
5.2.2 Using user-module: hello_user_module.js



Call user-module ‘hello_user_module.js’ from hello_call_module.js

[extra code] local module : circle.js

circle_info.js uses local module circle.js.



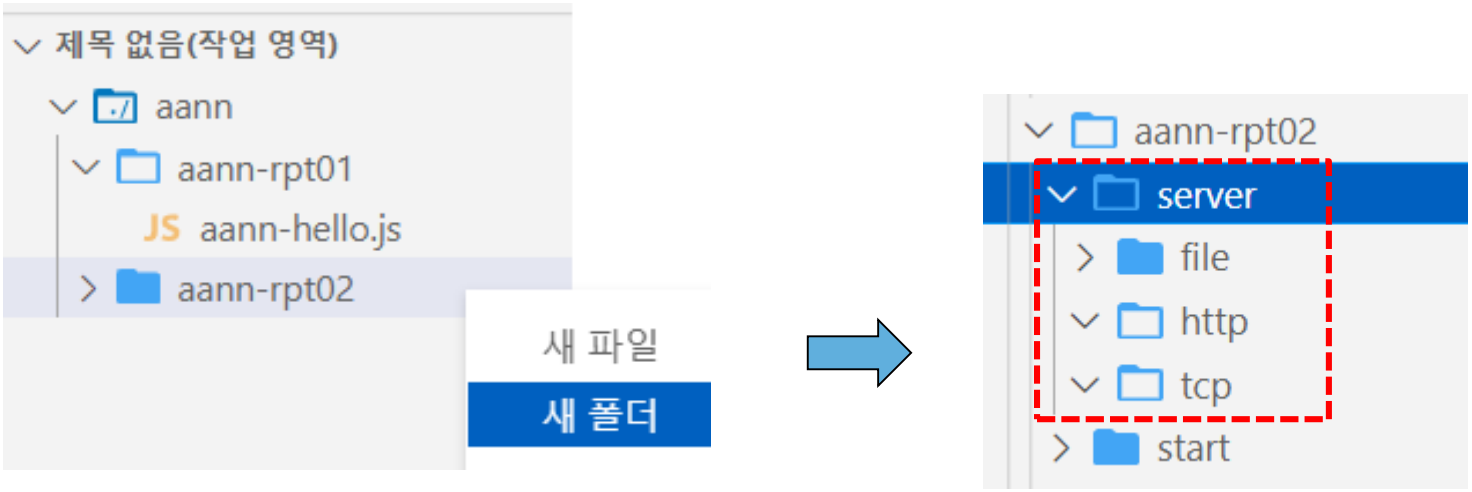
Node.js Server

1. http, tcp, file
2. Express

Node Server I.

1. HTTP server
2. TCP server
3. File upload

6.1 Node server : working folders



Node Server I.

1. HTTP server
2. TCP server
3. File upload

6.1.1 http server

JS index.js

aann > aann-rpt02 > server > http > JS index.js > ...

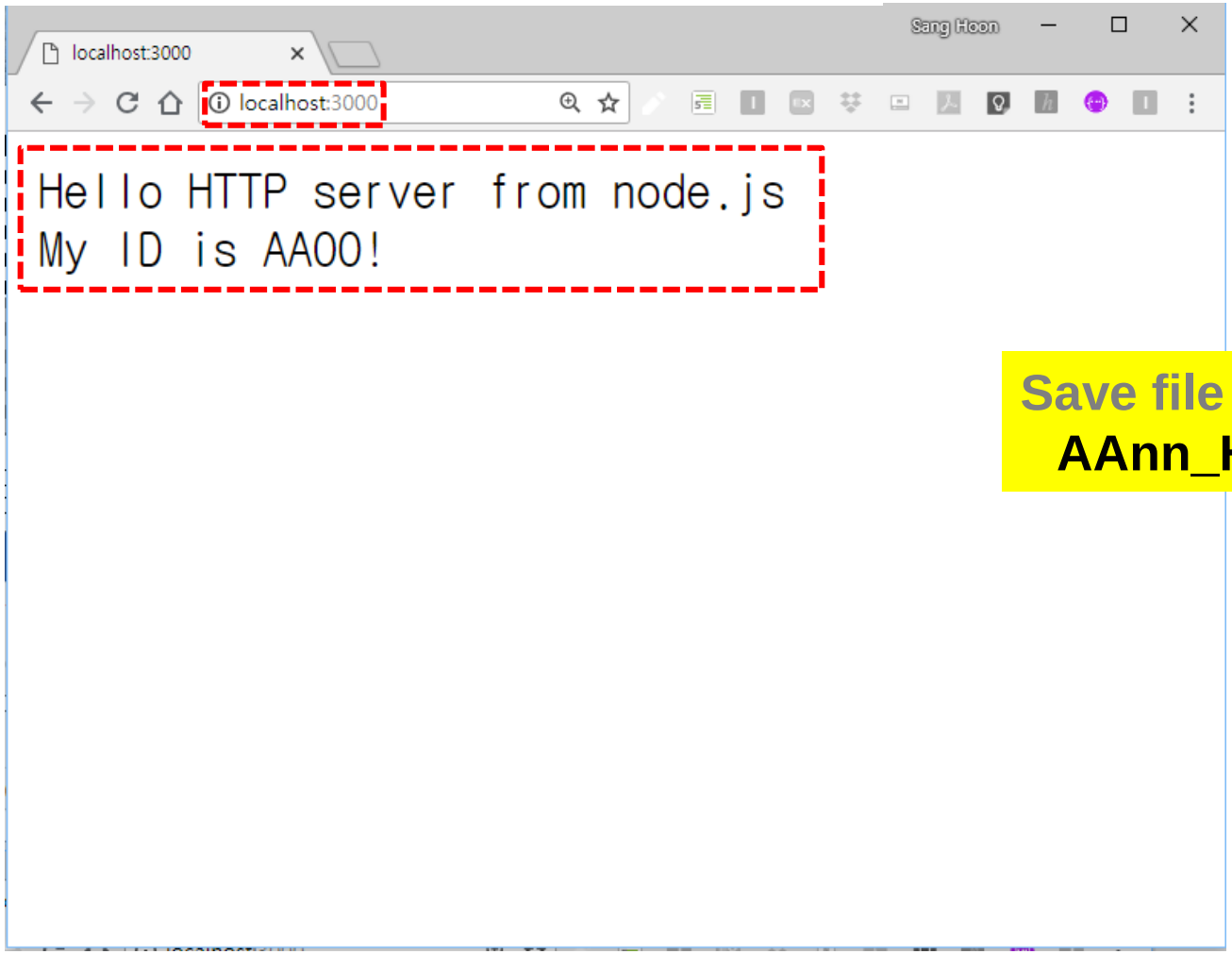
```
1   // http server : index.js
2
3   var http = require('http');
4   port = 3000;
5
6   var server = http.createServer(function(request, response) {
7     response.writeHeader(200, {
8       "Content-Type": "text/plain"
9     });
10    response.write("Hello HTTP server from node.js"); // WEB response
11    response.write("\nMy ID is AA00!");
12    response.end();
13
14  });
15
16  server.listen(port);
17  console.log("Server Running on " + port +
18    ".\nLaunch http://localhost:" + port);
```

문제 출력 디버그 콘솔 터미널

```
D:\aann\aann-rpt02\server\http>node index
Server Running on 3000.
Launch http://localhost:3000
```

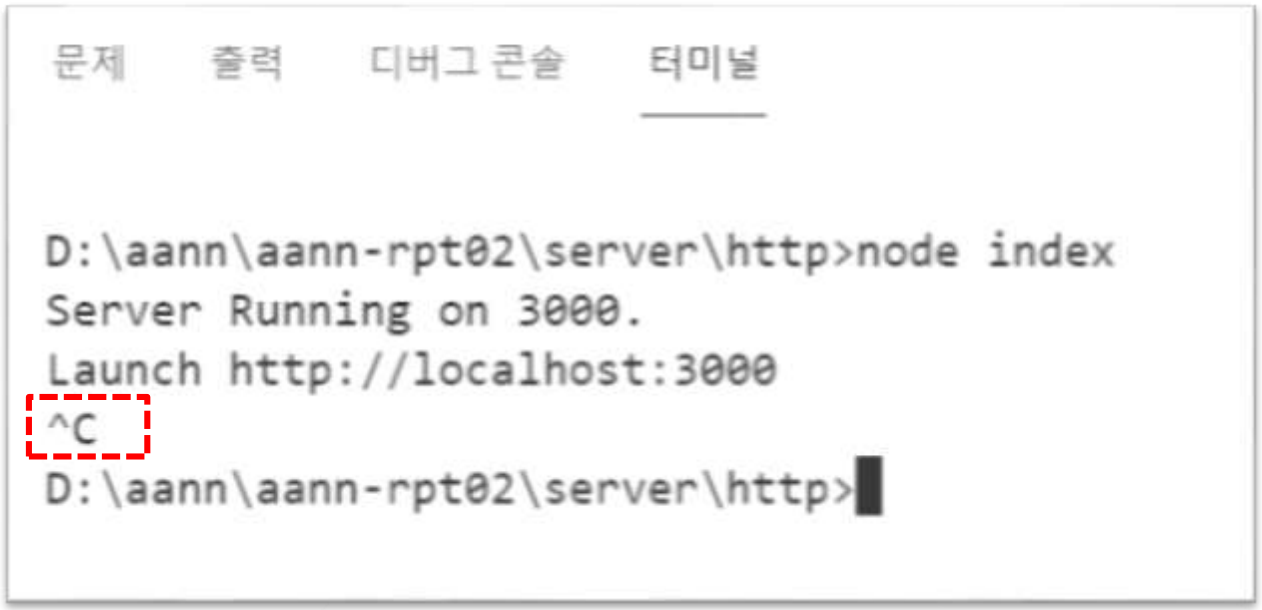
6.1.2 http server : result 1

```
Server Running on 3000.
Launch http://localhost:3000
```



Save file
AAnn_HTTP.png

6.1.3 http server – stop server !!! → ^C



6.1.4 http server – ES6 version

JS index_ES6.js

aann > aann-rpt02 > server > http > JS index_ES6.js > server > http.createServer() callback

```
1   // http server : index_ES6.js
2
3   var http = require('http');
4   port = 3000;
5
6   var server = http.createServer((request, response) => {
7     response.writeHeader(200, {
8       "Content-Type": "text/plain"
9     });
10    response.write("Hello HTTP server from node.js, ES6"); // WEB response
11    response.write("\nMy ID is AA00!");
12    response.end();
13
14  });
15
16  server.listen(port);
17  console.log("Server Running on " + port +
18      ".\nLaunch http://localhost:" + port);
19
```

문제 출력 디버그 콘솔 터미널 node

```
D:\aann\aann-rpt02\server\http>node index_ES6
Server Running on 3000.
Launch http://localhost:3000
```

[Tip] port number

★사용해도 되는 포트번호와 사용할 수 없는 포트 번호

1. 잘 알려진 포트는 0~1023 까지입니다.

(특정 프로그램들이 사용하기로 예약되어 있기 때문에 쓸 수 없는 포트 번호)

2. 등록된 포트는 1024~49151 까지입니다. (사용가능)

3. 동적 및/또는 개인 포트는 49152~65535 까지입니다. (사용가능)

참고: http://support.microsoft.com/kb/174904/ko

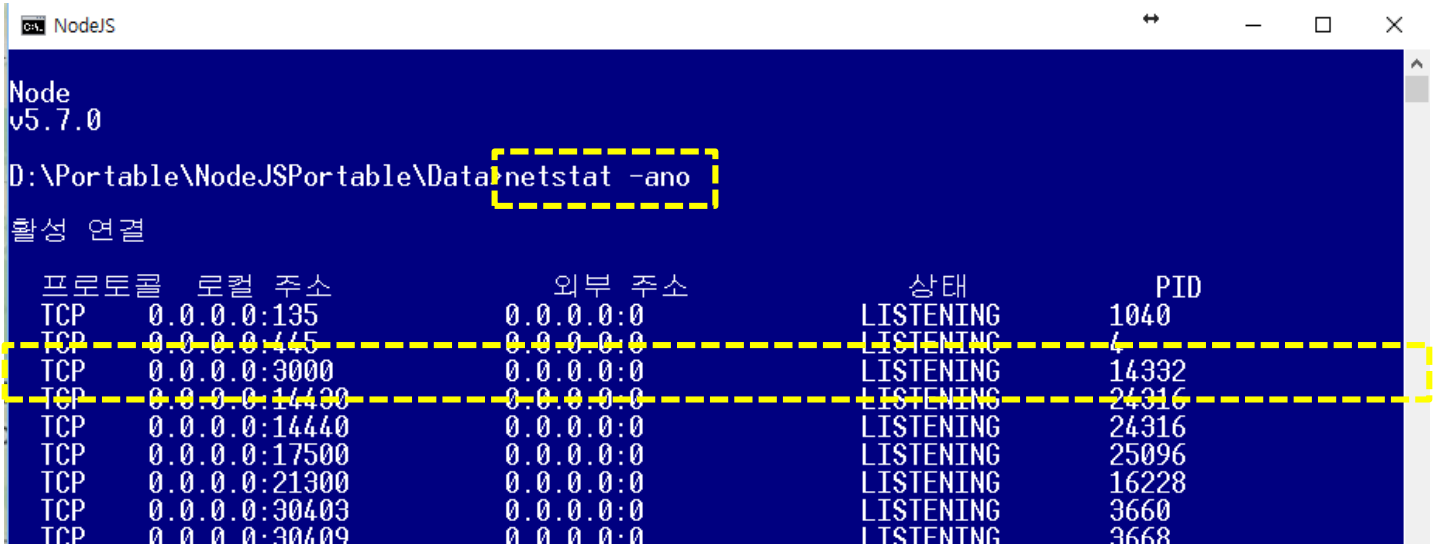
[Tip] listen EADDRINUSE 오류 해결 -1

1. listen **EADDRINUSE 오류**
   -사용중인 포트이거나 포트를 중지시키지 않고 종료시켰을 경우 계속 포트가 사용되고 있는데 연결 시키려고 할 때 나타나는 오류

```
Server Running on 3000.
Launch http://localhost:3000
events.js:154
      throw er; // Unhandled 'error' event
      ^

Error: listen EADDRINUSE :::3000
    at Object.exports._errnoException (util.js:856:11)
    at exports._exceptionWithHostPort (util.js:879:20)
```

2. 해결 방법
   (1) cmd창에서 **netstat –ano**를 입력한 후, 로컬주소에서 사용 중인 포트 번호를 확인
   (2) 사용중인 포트번호를 확인하고 그 해당포트의 **pid번호를 확인**한다.

[Tip] listen EADDRINUSE 오류 해결 -2



2. 해결 방법 (cmd에서 다음 명령 실행 후 port 3000의 pid가 제거됨을 확인)
   taskkill /pid PID_number

```
D:\Portable\NodeJSPortable\Data>taskkill /pid 14332
성공: 프로세스(PID 14332)에 종료 신호를 보냈습니다.
```

```
D:\Portable\NodeJSPortable\Data>netstat -ano

활성 연결

  프로토콜  로컬 주소          외부 주소          상태           PID
  TCP    0.0.0.0:135      0.0.0.0:0      LISTENING       1040
  TCP    0.0.0.0:445      0.0.0.0:0      LISTENING       4
  TCP    0.0.0.0:14430    0.0.0.0:0      LISTENING       24316
```

Node Server I.

1. HTTP server
2. TCP server
3. File upload

6.2.1 tcp server (socket connection)

JS server.js

aann > aann-rpt02 > server > tcp > JS server.js > ...

```
1   // tcp server (network server)
2   var net = require('net');
3   var port = 3000;
4
5   // Network connection using socket
6   var server = net.createServer(function(socket) {
7       console.log("Connection from " + socket.remoteAddress);
8       socket.end("Hello AA00! from localhost:3000");
9   });
10
11  server.listen(port, "127.0.0.1");
12  console.log("Network server started at port : " + port);
13
```

Socket으로 전송

문제 출력 디버그 콘솔 터미널 node

```
D:\aann\aann-rpt02\server\tcp>node server
Network server started at port : 3000
```

6.2.2 tcp client

JS server.js JS client.js ×

aann > aann-rpt02 > server > tcp > JS client.js > ...

```
1   // tcp client
2   var net = require('net');
3   var port = 3000;
4   var client = new net.Socket();
5   // Connection using socket
6   client.connect(port, "127.0.0.1");
7   // Receive data from socket
8   client.on('data', function (data) {
9       console.log('Data: ' + data);
10      client.destroy();
11  });
12
13  // Add a 'close' event handler for the client socket
14  client.on('close', function () {
15      console.log('Connection closed');
16  });
```

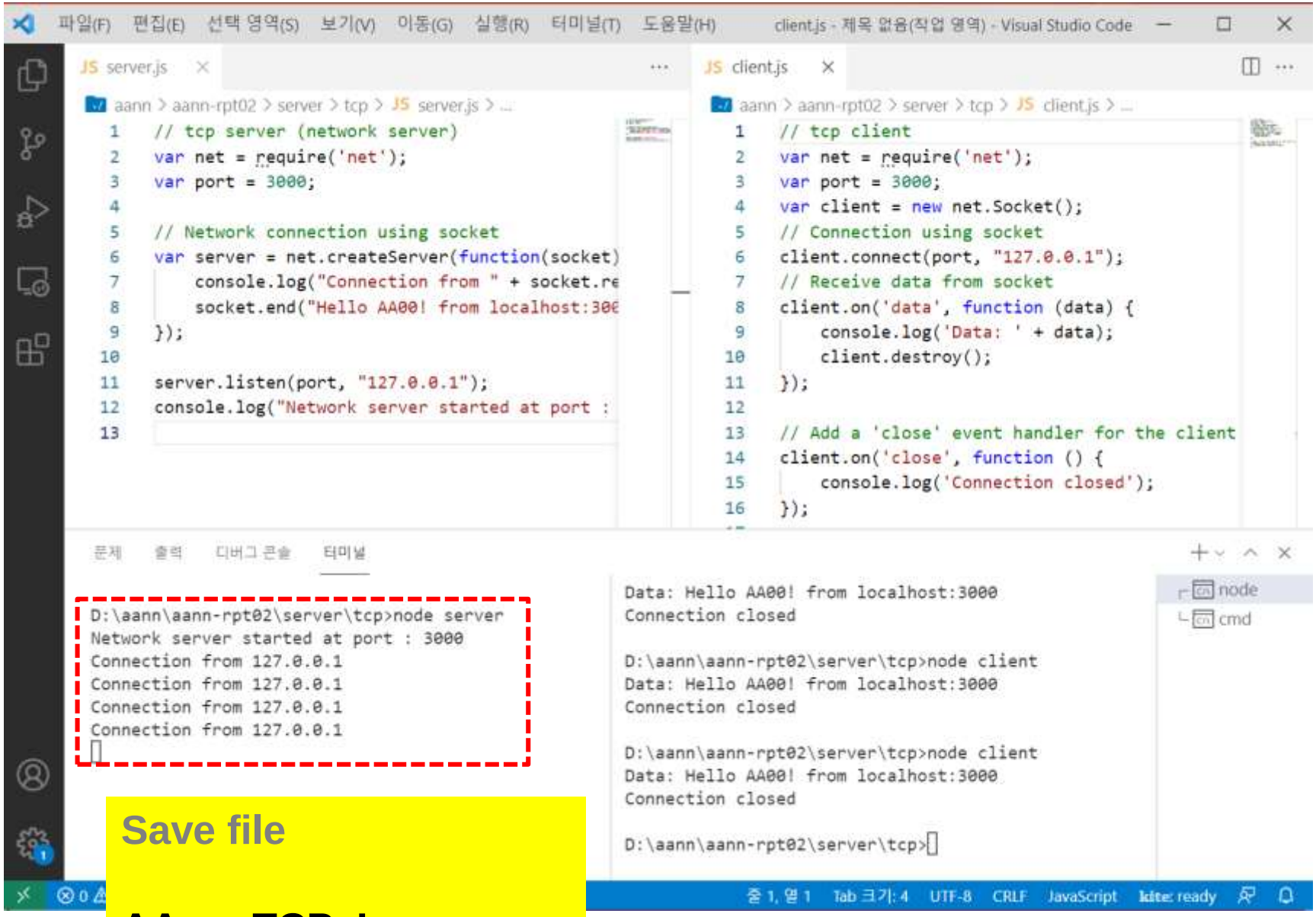
Socket으로 전송되는 데이터를 처리하고 종료

문제 출력 디버그 콘솔 터미널

```
D:\aann\aann-rpt02\server\tcp>node server
Network server started at port : 3000
Connection from 127.0.0.1
```

```
D:\aann\aann-rpt02\server\tcp>node client
Data: Hello AA00! from localhost:3000
Connection closed

D:\aann\aann-rpt02\server\tcp>
```

6.2.3 tcp server & client : result



Save file

AAnn_TCP_Log.png

Node Server I.

1. HTTP server
2. TCP server
3. **File upload**

6.3.1 file upload using module 'formidable'

JS file_server.js ×

aann > aann-rpt02 > server > file > JS file_server.js > ...

```
1  // File upload using formidable node module
2  var formidable = require('formidable'),
3      http = require('http'),
4      util = require('util'),
5      port = 3663;
6
7  http.createServer(function(req, res) {
8    if (req.url == '/upload' && req.method.toLowerCase() == 'post') {
9      // parse a file upload
10     var form = new formidable.IncomingForm();
11
12     form.parse(req, function(err, fields, files) {
13       res.writeHead(200, {'content-type': 'text/plain'});
14       res.write('received upload:\n\n');
15       res.end(util.inspect({fields: fields, files: files}));
16     });
17     return;
18   }
19   // show a file upload form
```

문제 출력 디버그 콘솔 터미널 node

```
D:\aann\aann-rpt02\server\file>node file_server
File server Running on 3663.
Launch http://localhost:3663
```

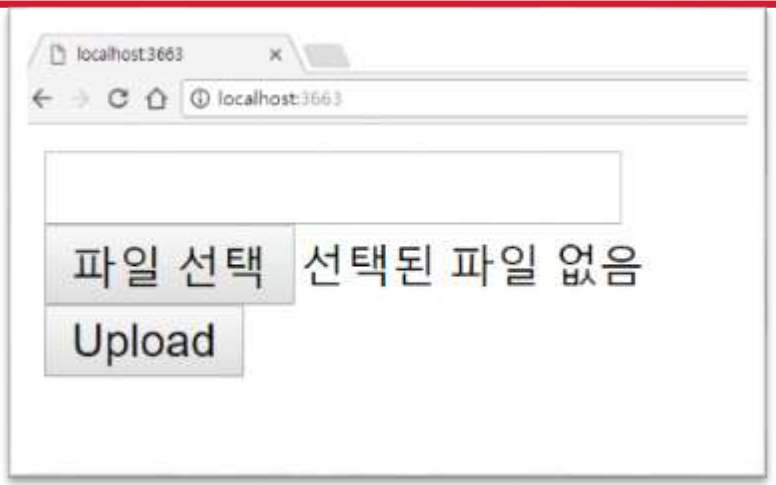
6.3.2 file upload : npm install formidable

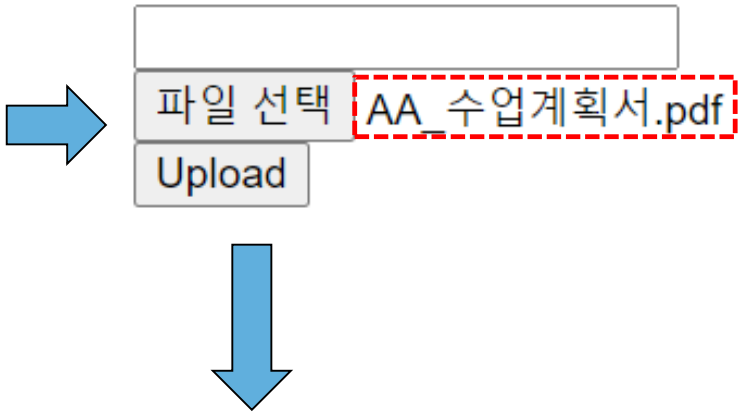
문제 출력 디버그 콘솔 터미널 cmd

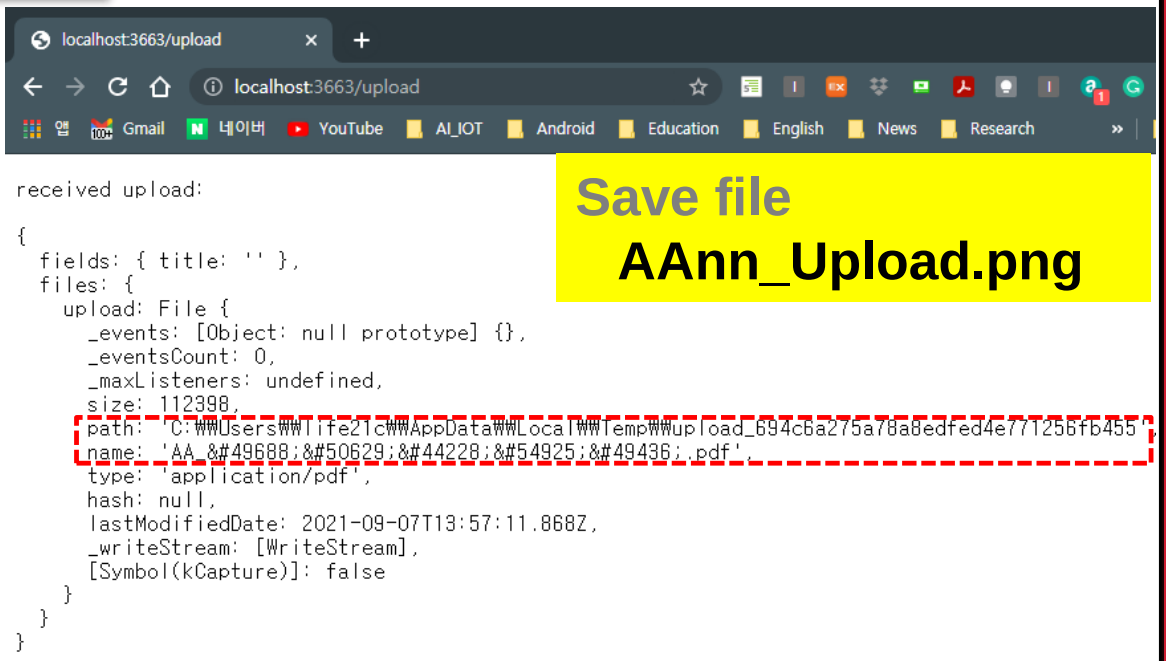
```
D:\aann\aann-rpt02\server\file>npm install formidable
npm WARN saveError ENOENT: no such file or directory, open 'D:\aann\aann-rpt02\server\file\packa
ge.json'
npm notice created a lockfile as package-lock.json. You should commit this file.
npm WARN enoent ENOENT: no such file or directory, open 'D:\aann\aann-rpt02\server\file\package.
json'
npm WARN file No description
npm WARN file No repository field.
npm WARN file No README data
npm WARN file No license field.

+ formidable@1.2.2
added 1 package and audited 1 package in 0.96s

1 package is looking for funding
  run `npm fund` for details

found 0 vulnerabilities


D:\aann\aann-rpt02\server\file>
```

```
D:\aann\aann-rpt02\server\file>dir
 D 드라이브의 볼륨: DATA
 볼륨 일련 번호: 82D1-4852

 D:\aann\aann-rpt02\server\file 디렉터리

2021-09-07  오후 10:45    <DIR>          .
2021-09-07  오후 10:45    <DIR>          ..
2017-12-29  오후 05:21             1,048 file_server.js
2021-09-07  오후 10:45    <DIR>          node_modules
2021-09-07  오후 10:45               323 package-lock.json
               2개 파일               1,371 바이트
               3개 디렉터리  2,467,732,140,032 바이트 남음
```

6.3.3 file upload







[Practice]

- [wk02]
  - Node module : aanninfo.js
  - Upload folder: aann-rpt02

[practice] local module : aanninfo.js

index_aann.js uses local module aanninfo.js in start subfolder.


```
My Info
ID : aa00
Name : Redwoods
Phone : 010-1234-5678

My Info
ID : aa55
Name : Comsi
Phone : 010-5678-1234

[Finished in 0.2s]
```

Save as
AAnn_info.png

[practice] local module : aanninfo.js

How to make aanninfo.js in start subfolder.

1. **Make local module – aanninfo.js**
2. **Call aanninfo.js from index_aann.js.**
3. **Capture your result.**

index_aann.js | aanninfo.js

```
1  // aanninfo.js
2
3  module.exports = function(id, name, phone) {
4      console.log("My Info");
5      console.log("ID : " + id);
6      console.log("Name : " + name);
7      console.log("Phone : " + phone +"\n");
8  }
```

[참고] Node local module 만들기

wk02 : Practice-01 : AAnn_Rpt02

- [Target of this week]

  My Info using node module – aanninfo.js

Upload folder : aann-rpt02

- 제출할 파일들

  ① AAnn_package.png

  ② AAnn_HTTP.png

  ③ AAnn_TCP_Log.png

  ④ AAnn_Upload.png

  ⑤ AAnn_info.png

  ⑥ start folder

  ⑦ server folder

[Upload to github]

- [wk02]
  - upload all work of this week
  - Use repo “aann” in github
  - upload folder “aann-rpt02” 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
- ✓ https://www.anaconda.com/ Anaconda
- ✓ http://www.github.com GitHub
- ✓ https://colab.research.google.com/ Colab