



Arduino-IoT

[wk01]

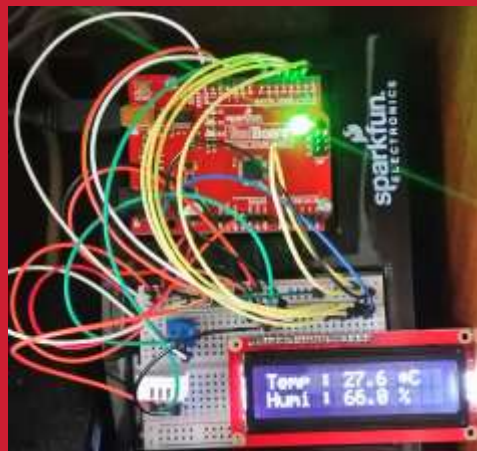
Introduction

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

Drone-IoT-Comsi, INJE University

2nd semester, 2022

Email : chaos21c@gmail.com





My ID

ID를 확인하고 github에 repo 만들기

| | | | |
|------|-----|------|-----|
| AA01 | 강대진 | AA13 | 박제홍 |
| AA02 | 김민재 | AA14 | 심준혁 |
| AA03 | 김성우 | AA15 | 이상혁 |
| AA04 | 김정현 | AA16 | 이승무 |
| AA05 | 김주호 | AA17 | 이승준 |
| AA06 | 김창연 | AA18 | 이준희 |
| AA07 | 김창욱 | AA19 | 이현준 |
| AA08 | 김태화 | AA20 | 임태형 |
| AA09 | 남승현 | AA21 | 정동현 |
| AA10 | 류재환 | AA22 | 정지환 |
| AA11 | 박세훈 | AA23 | 정희서 |
| AA12 | 박신영 | AA24 | 최재형 |

위의 id를 이용해서 github에 repo를 만드시오.

Option: 아두이노응용 실습 과제 - AAnn

Public, README.md check

사물인터넷 -> HSC (하소연)

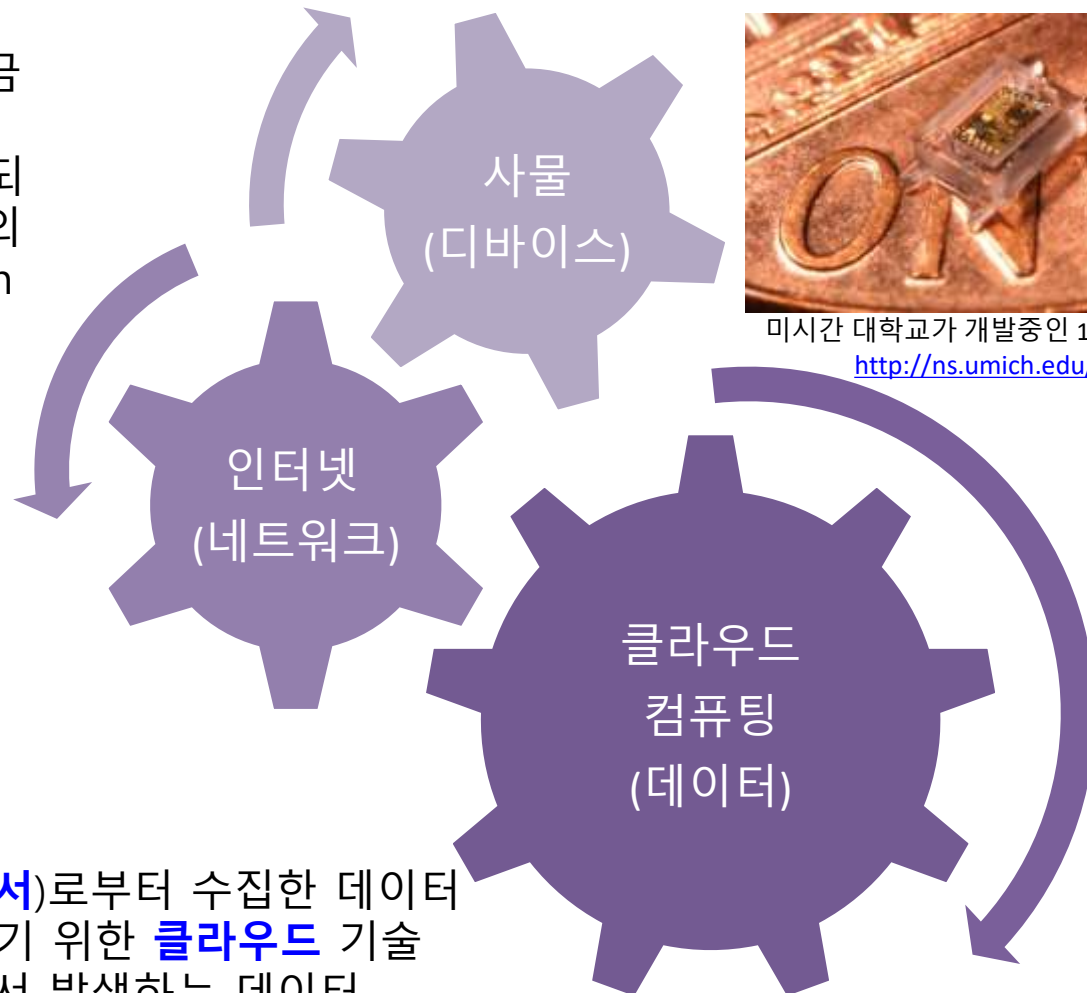
INTERNET OF THINGS

-> HW & SW Connectivity

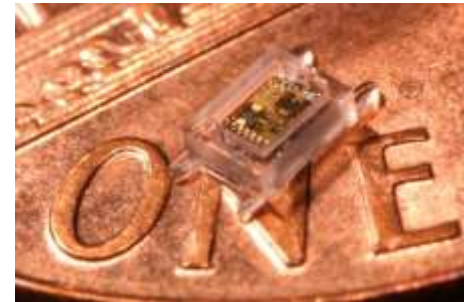


사물인터넷이 가능해진 이유!

- **스마트폰**의 대중화와 함께 무선 인터넷 요금의 현실화
- **블루투스 4.0**로 대변되는 근거리 통신 기술의 **저전력**(BLE: Bluetooth Low Energy) 기술



- 다양한 센서와 소형화 (Nano)



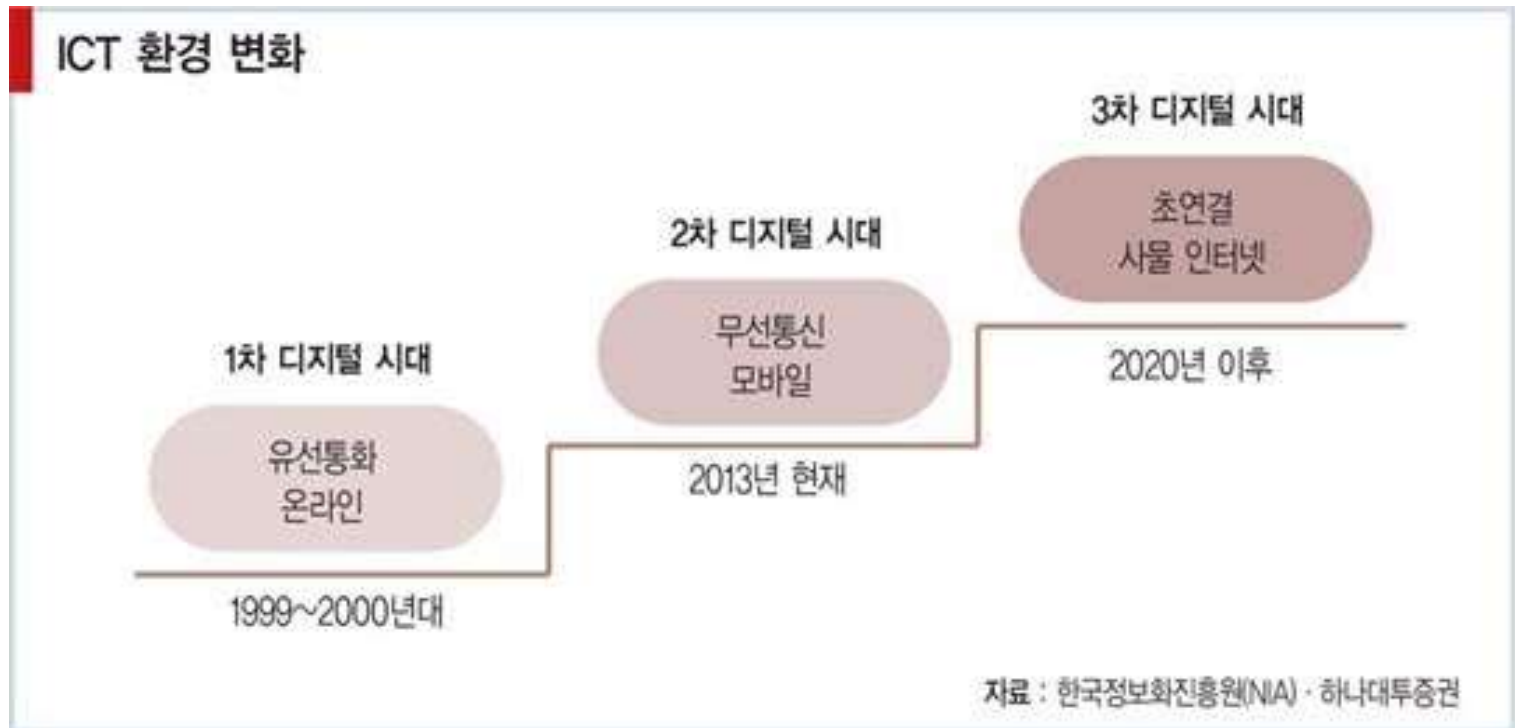
미시간 대학교가 개발중인 1mm 컴퓨터

<http://ns.umich.edu/new/releases/8278>

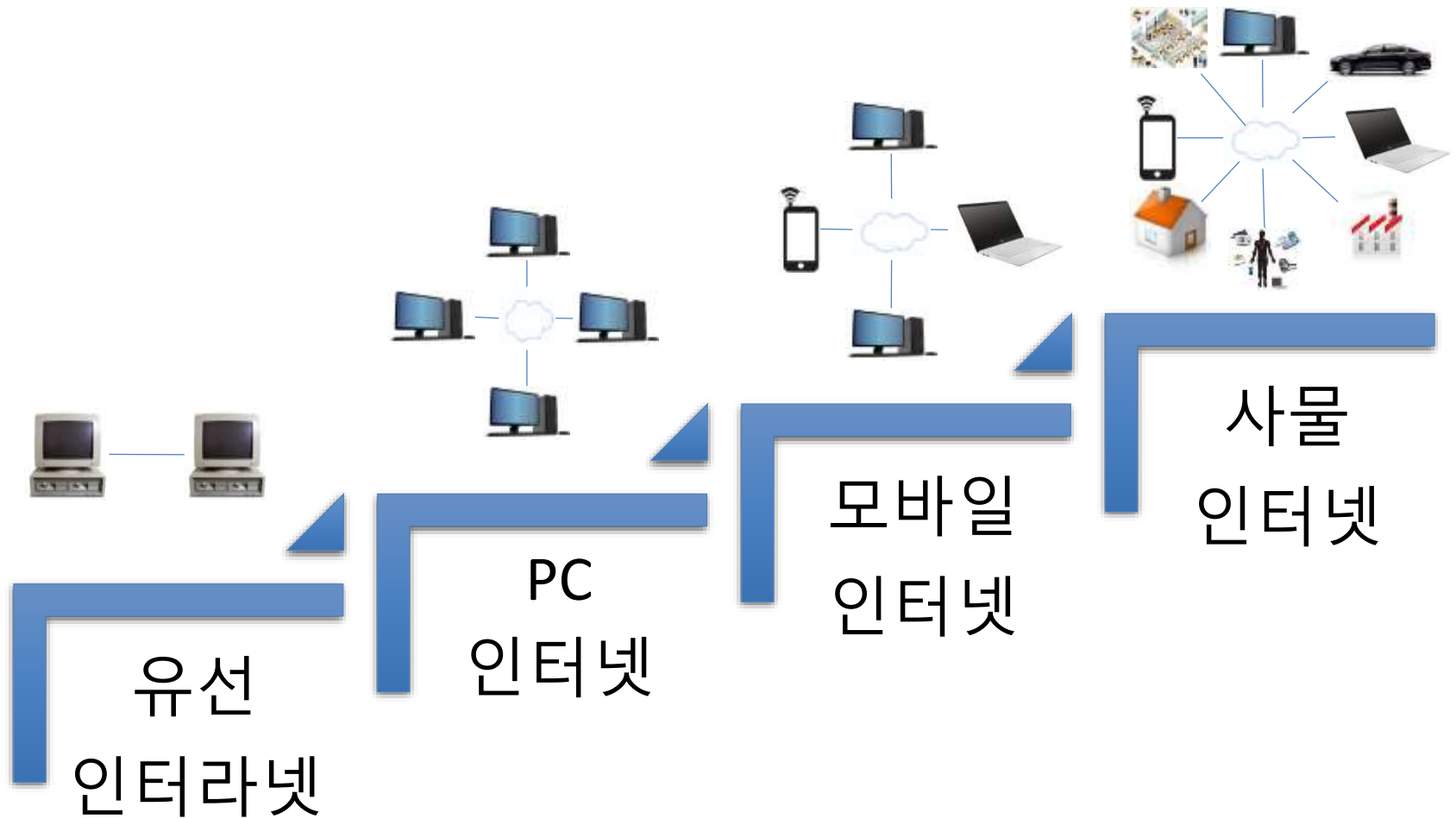
- 다양한 디바이스(**센서**)로부터 수집한 데이터를 저장하고 관리하기 위한 **클라우드** 기술
- **드론, 자율주행차**에서 발생하는 데이터
- **빅데이터** 처리 기술의 발달- noSQL, 하둡,...

자료: <http://blog.lgcns.com/470>

ICT 환경 변화

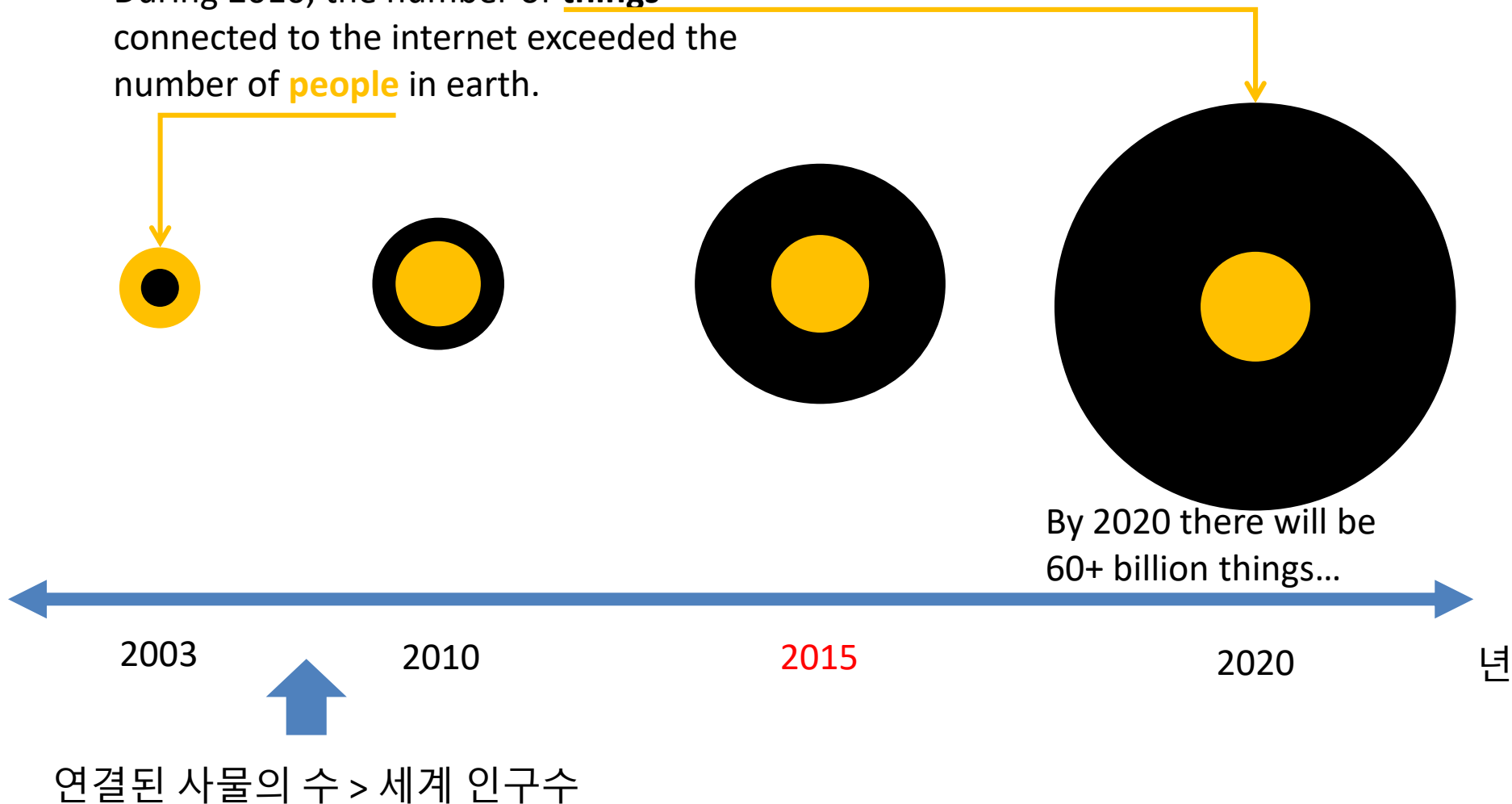


인터넷의 발전



세계인구와 인터넷에 연결된 사물의 개수 변수

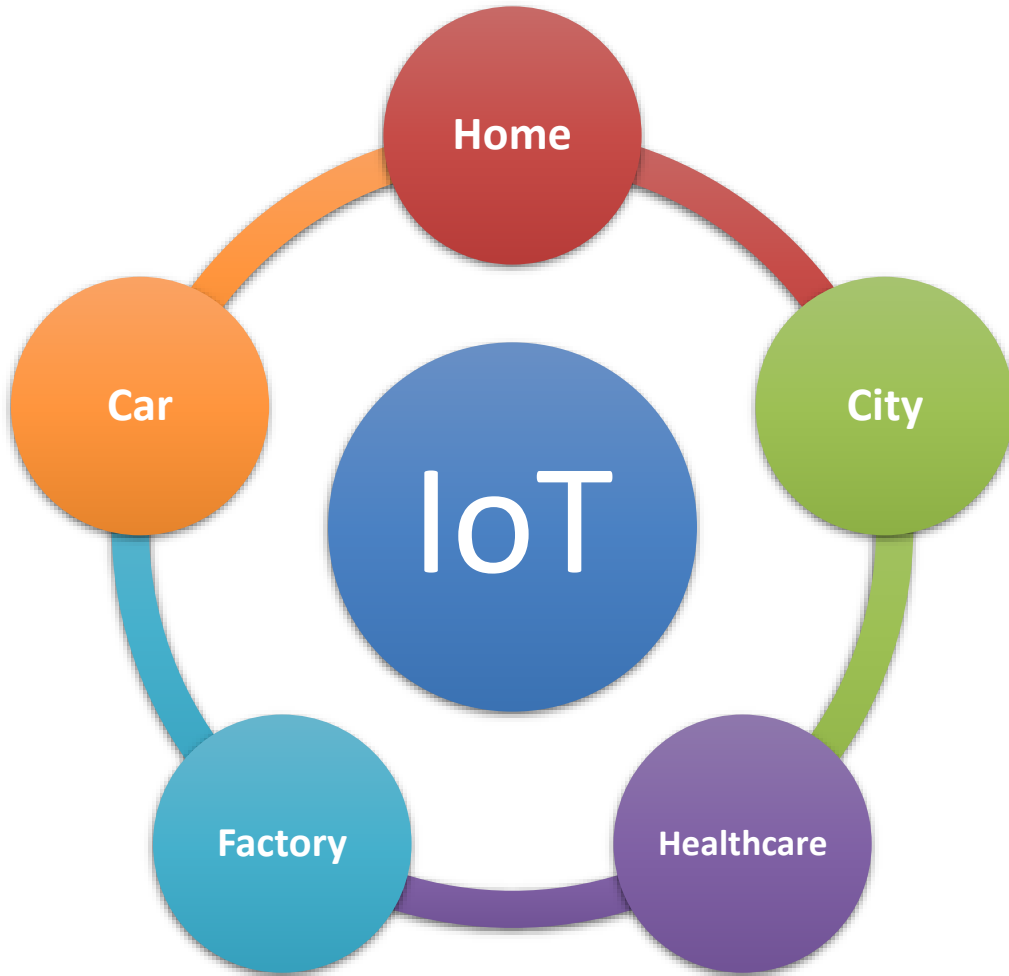
During 2010, the number of **things** connected to the internet exceeded the number of **people** in earth.



세계인구와 인터넷에 연결된 사물의 개수 변수



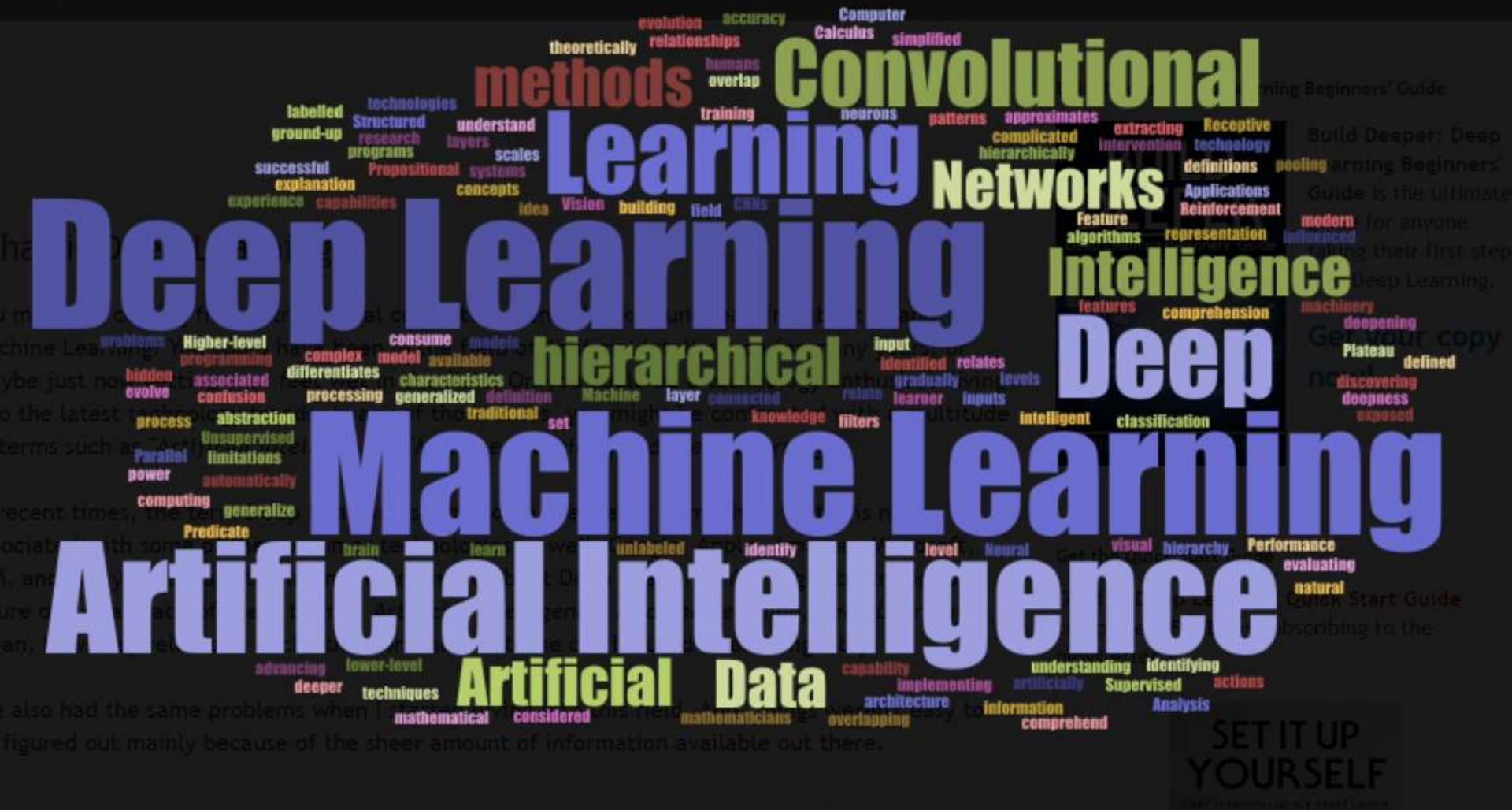
사물인터넷의 응용 분야 (Smart~~)

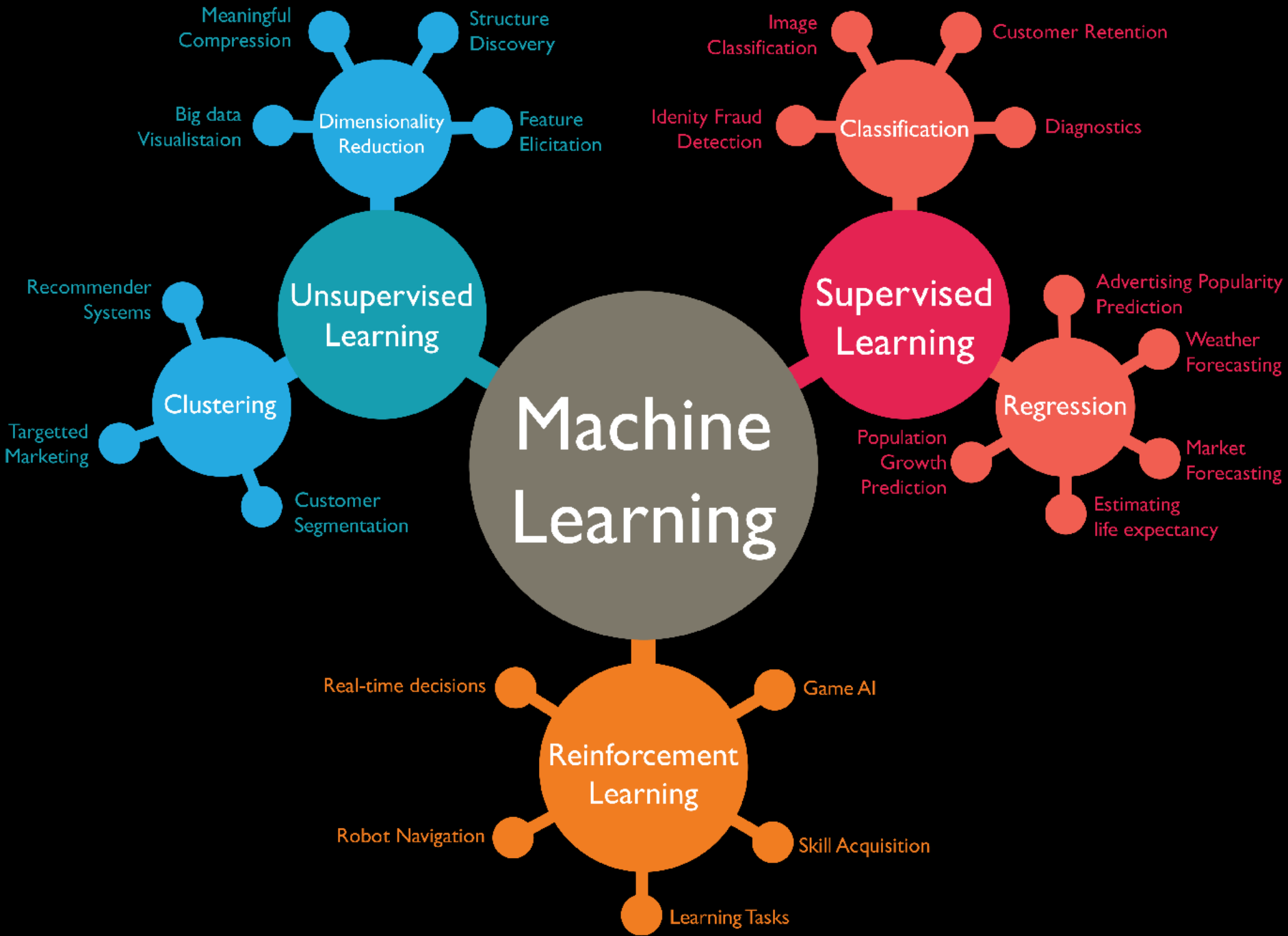


4차 산업혁명의 열쇠, 데이터와 분석

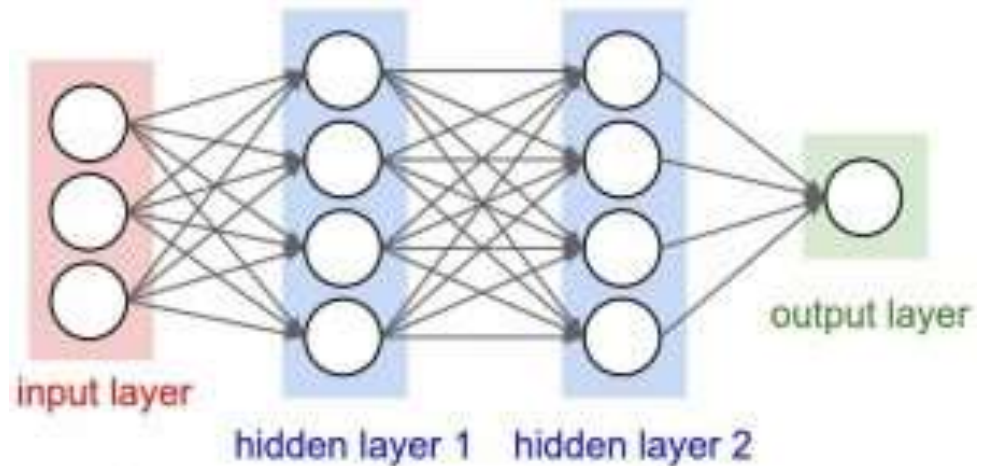
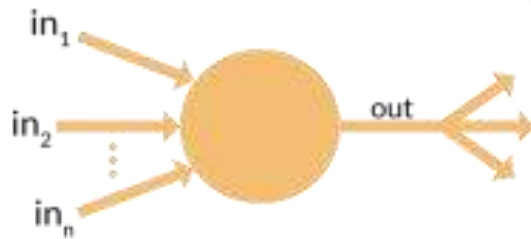
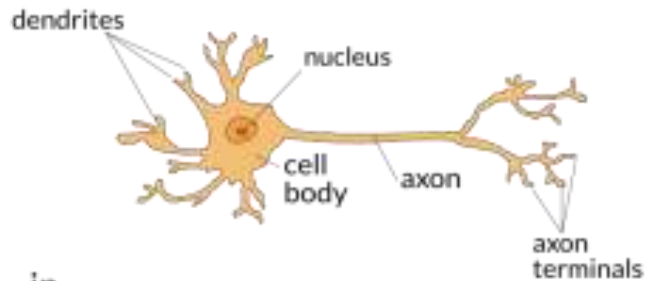


<http://www.bloter.net/archives/280600>



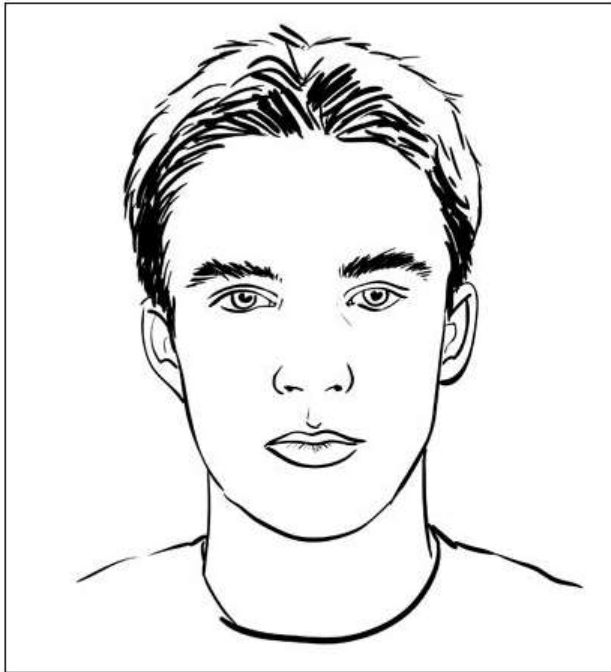


Machine learning: Conventional Neural Networks



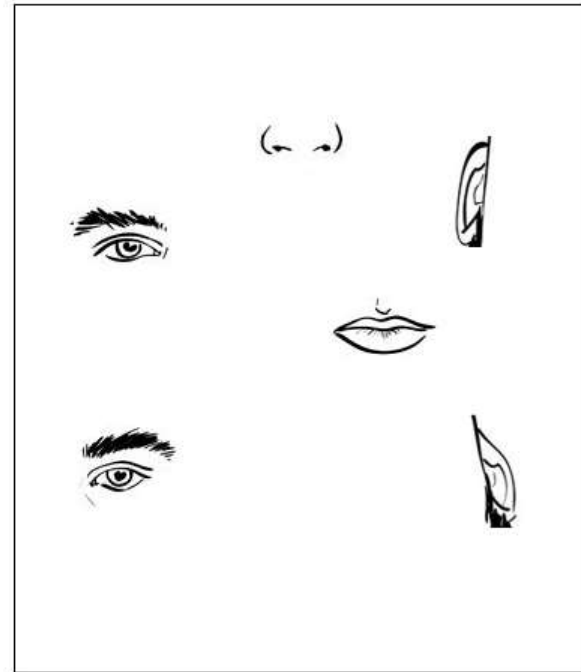
How does DL work on images?

Human



Face

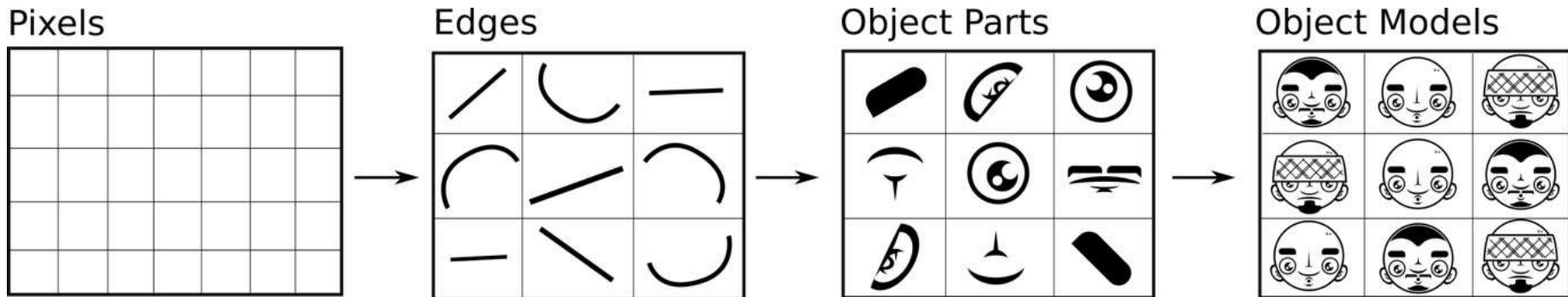
AI



Face

How does DL work on images?

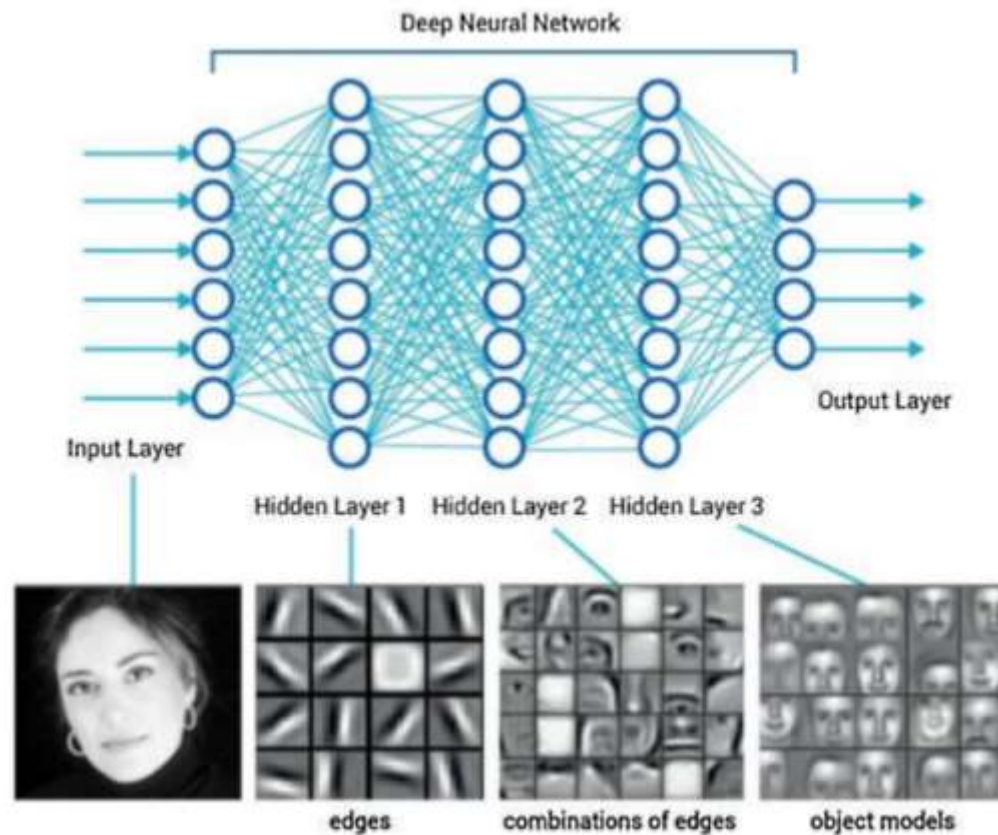
AI는 부분들의 확률을 조합해서 객체를 판단한다.



Series of higher-level representations that begin on input data.

Y. LeCun, Y. Bengio & G. Hinton. "Deep Learning". Nature 521, 436–444 (28 May 2015) doi:10.1038/nature14539

How does DL work on images?



https://miro.medium.com/max/616/1*Uhr-4VDJD0-gnteUNFzZTw.jpeg

Recent state of the art

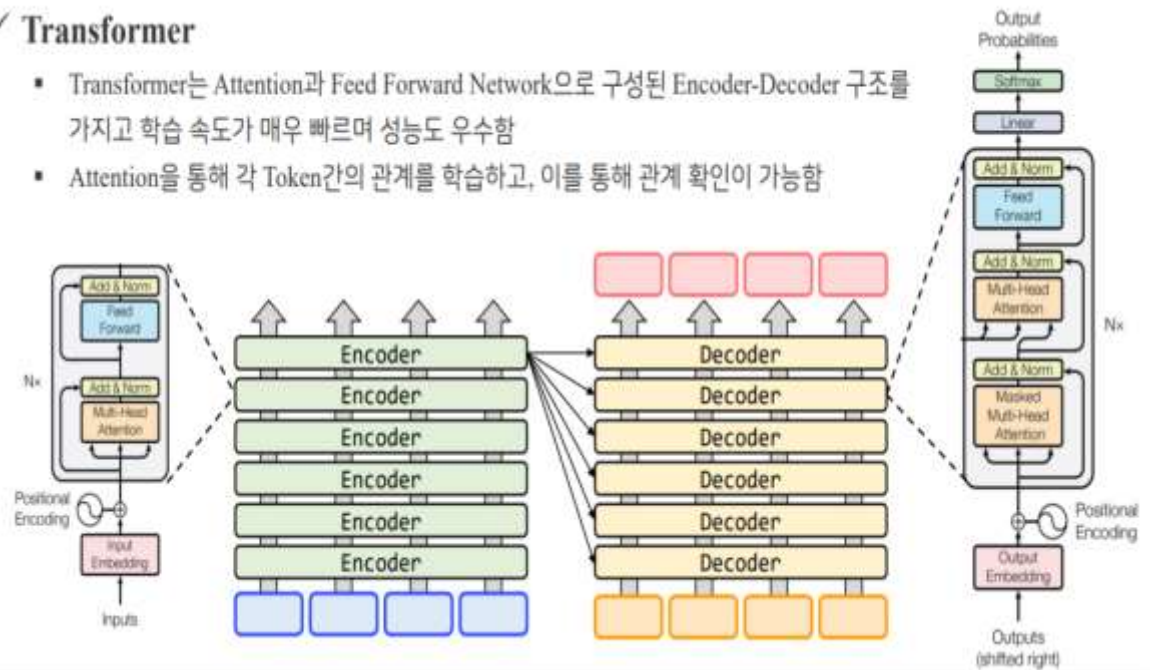
Transformers

Post deep learning models



✓ Transformer

- Transformer는 Attention과 Feed Forward Network으로 구성된 Encoder-Decoder 구조를 가지고 학습 속도가 매우 빠르며 성능도 우수함
- Attention을 통해 각 Token간의 관계를 학습하고, 이를 통해 관계 확인이 가능함





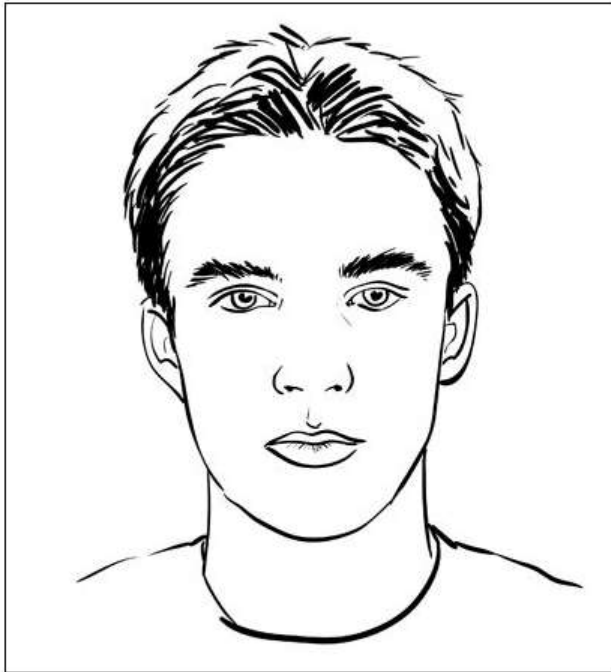
Voice and Language Driven AI



Source: <https://becominghuman.ai/top-5-artificial-intelligence-ai-trends-for-2021-a3075fea6658>

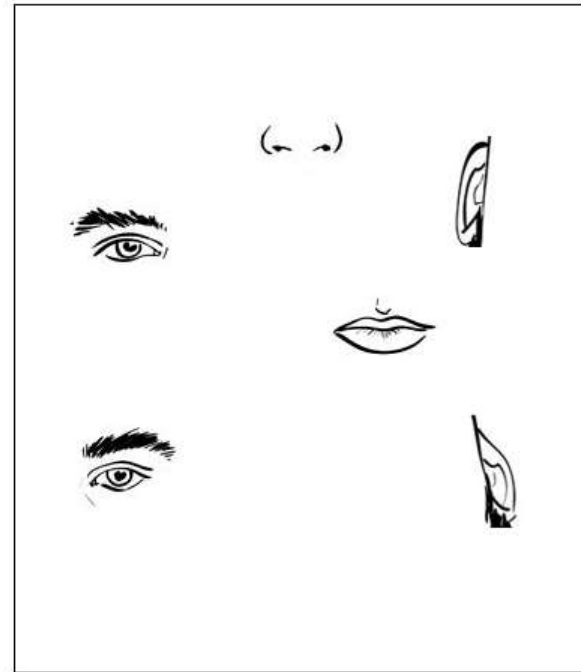
How does DL/Transformer work on images?

Human & AI-Transformer



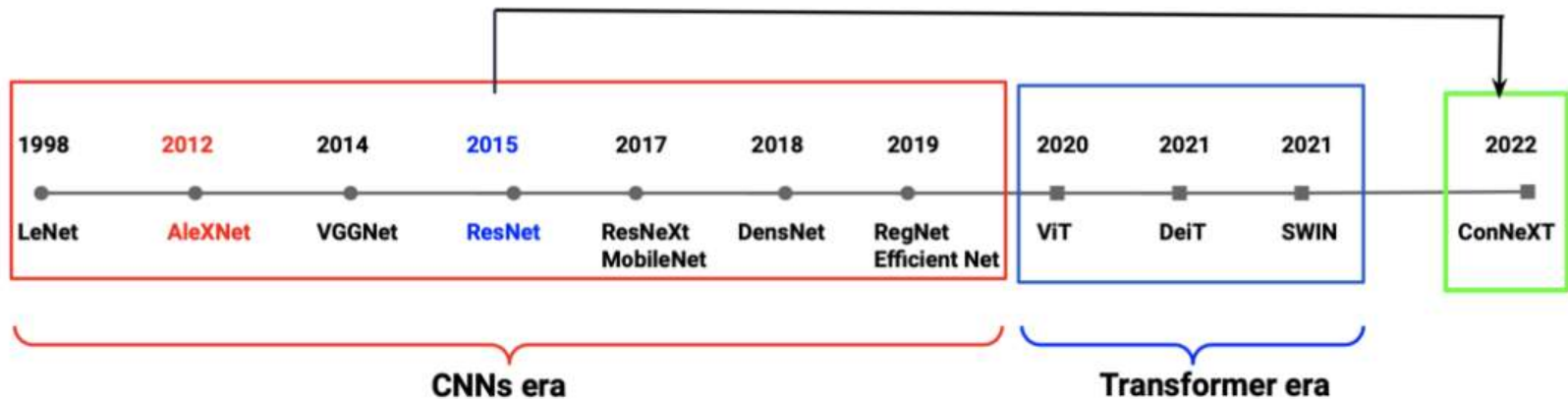
Face

AI-CNN



Face

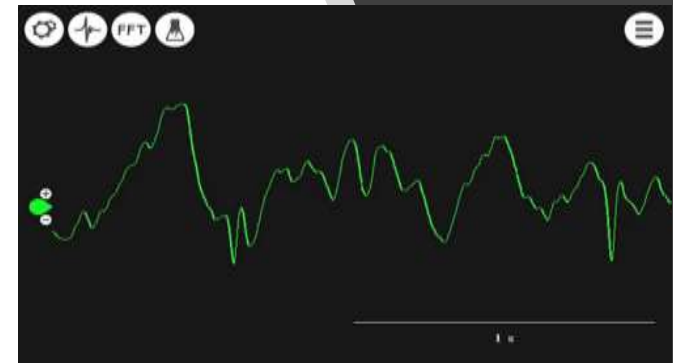
SOTA of Computer Vision



Evolution of Neural architectures in the vision domain

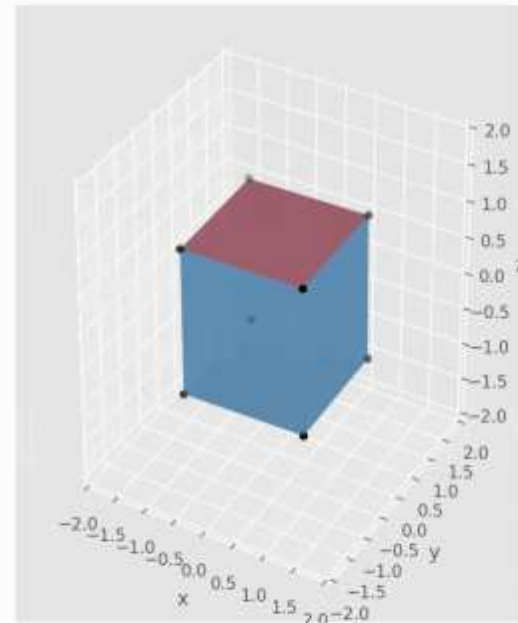
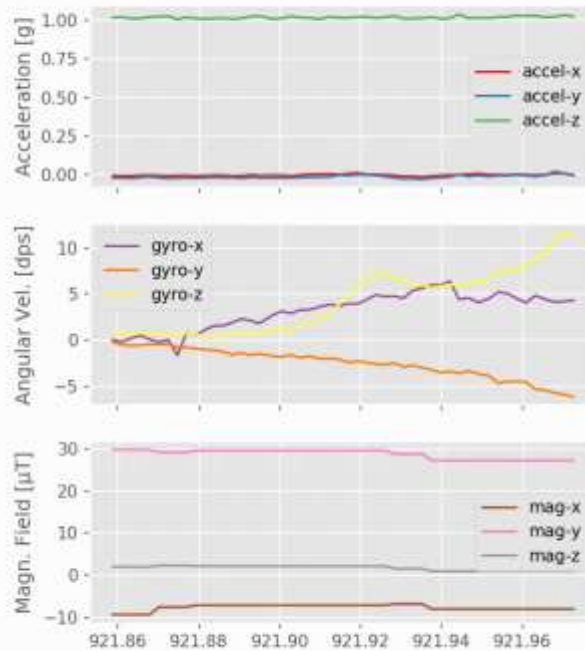
Source: <https://medium.com/aiguys/a-convnet-for-the-2020s-or-2561c9e946e1>

Deep Learning of Signals



Conv1D
Pooling

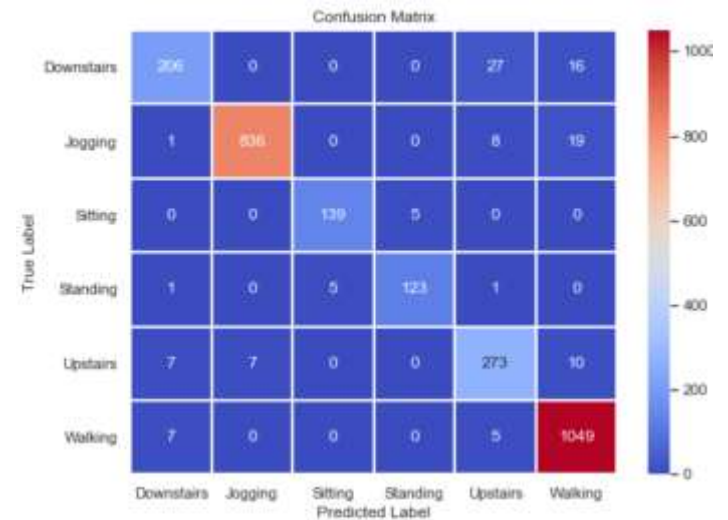
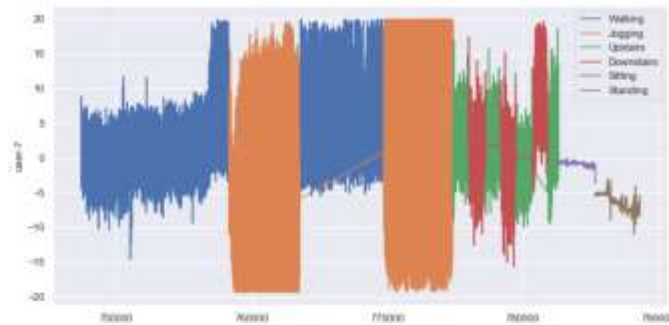
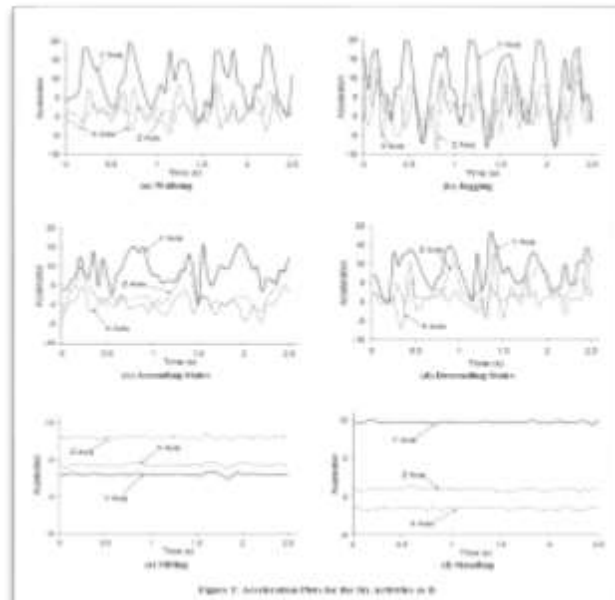
일상활동 인식(3축 가속도)



https://images.squarespace-cdn.com/content/v1/59b037304c0dbfb092f8e894/1573836927118-IS5CS61OW9XH9HSRCMA1/ke17ZwdGBToddI8pDm48kGbFogdxZzB1B7PQq3zm9xl7gQa3H78H3Y0txjaiv_0fDoOvxcdMmMKkDsYUqMSsMWxHk725yiiHCCLfrh8O1z5QPQohDlalelJMHgDF5CVlOqpeNLcl80NK65_fv7S1UQupMlr7Z9cq9PZkRytzEu3SbZmkCxOjksrEup4_K2kPH3bqxw7f48mhrq5Ulr0Hg/mpu9250_cube_rotation_compressed.gif

일상활동 인식(3축 가속도)

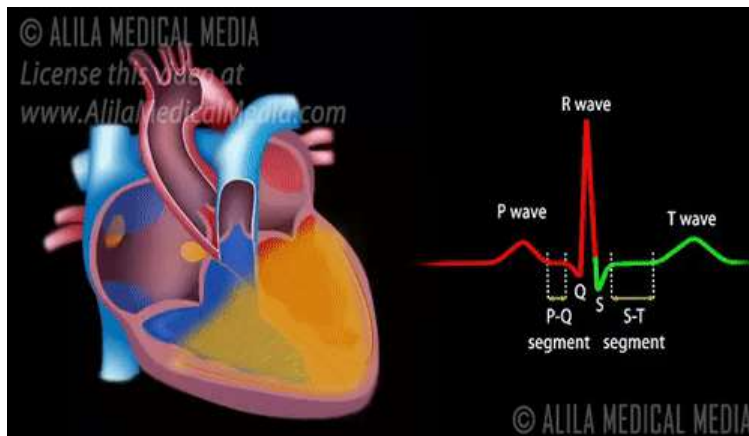
['Downstairs',
'Jogging',
'Sitting',
'Standing',
'Upstairs',
'Walking']



--- ACC_XYZ, 4s: classification report for test data ---

| | precision | recall | f1-score | support |
|--------------|-----------|--------|----------|---------|
| 0 | 0.93 | 0.83 | 0.87 | 249 |
| 1 | 0.99 | 0.97 | 0.98 | 864 |
| 2 | 0.97 | 0.97 | 0.97 | 144 |
| 3 | 0.96 | 0.95 | 0.95 | 138 |
| 4 | 0.87 | 0.92 | 0.89 | 297 |
| 5 | 0.96 | 0.99 | 0.97 | 1061 |
| accuracy | | | 0.96 | 2745 |
| macro avg | 0.95 | 0.94 | 0.94 | 2745 |
| weighted avg | 0.96 | 0.96 | 0.96 | 2745 |

심전도(ECG, heart rhythm)



https://thumbs.gfycat.com/FamiliarWatchfulBlackmamba-size_restricted.gif

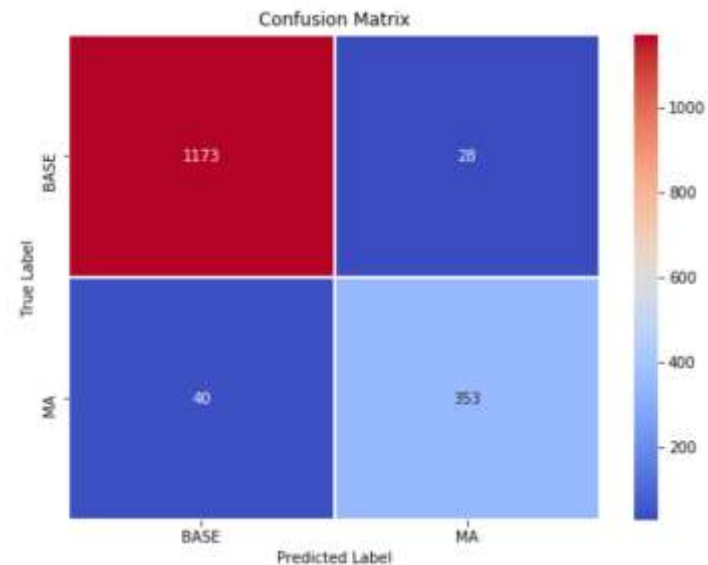
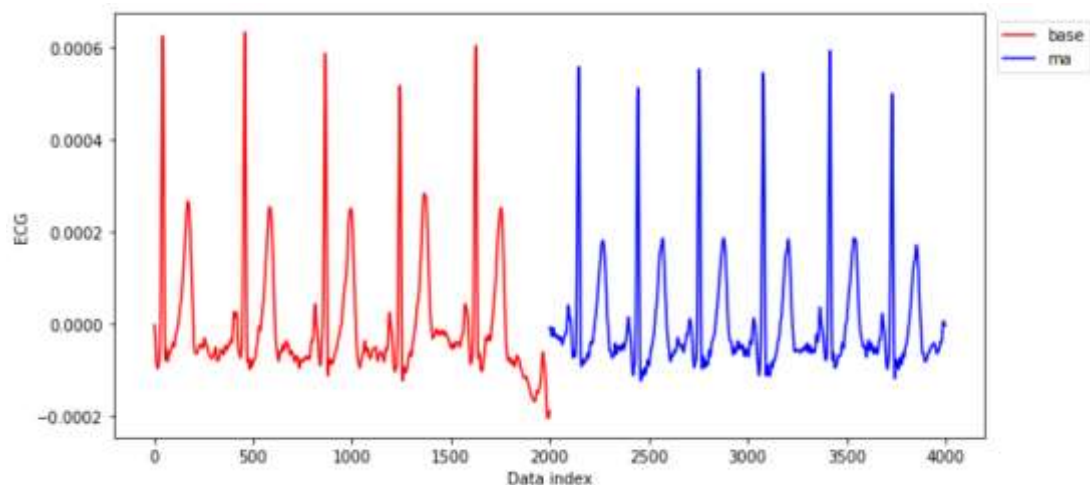


https://thumbs.gfycat.com/CorruptShoddyAmazonreeboa-size_restricted.gif



심전도(ECG, heart rhythm)

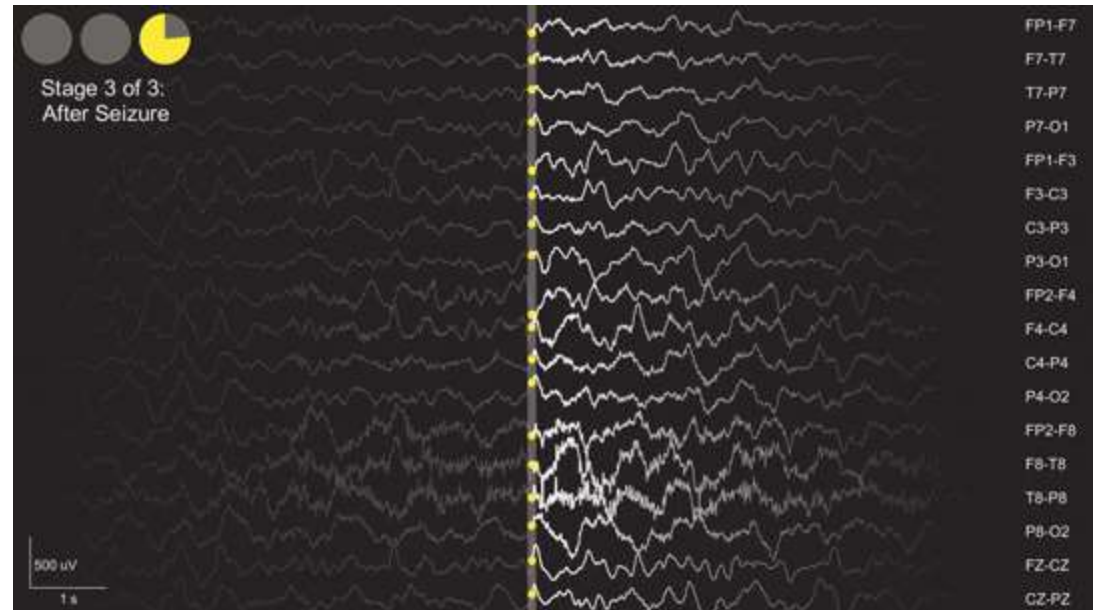
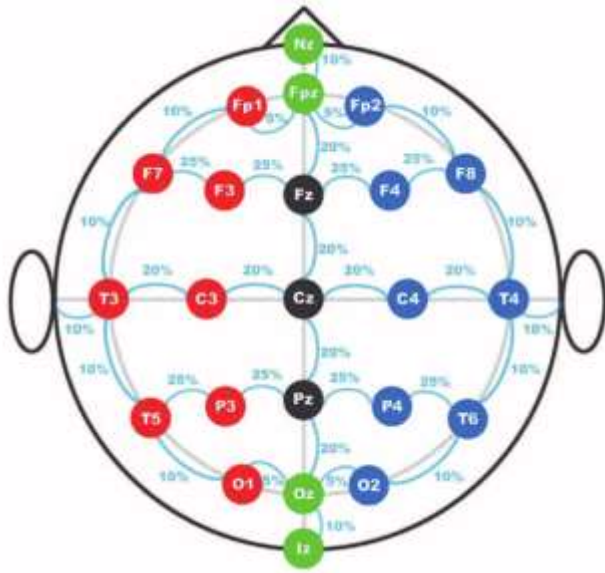
ECG Raw : Base(안정) vs. MA(암산)



--- ECG 1-s rescaled: classification report for test data ---

| | precision | recall | f1-score | support |
|--------------|-----------|--------|----------|---------|
| 0 | 0.97 | 0.98 | 0.97 | 1281 |
| 1 | 0.93 | 0.90 | 0.91 | 393 |
| accuracy | | | 0.96 | 1594 |
| macro avg | 0.95 | 0.94 | 0.94 | 1594 |
| weighted avg | 0.96 | 0.96 | 0.96 | 1594 |

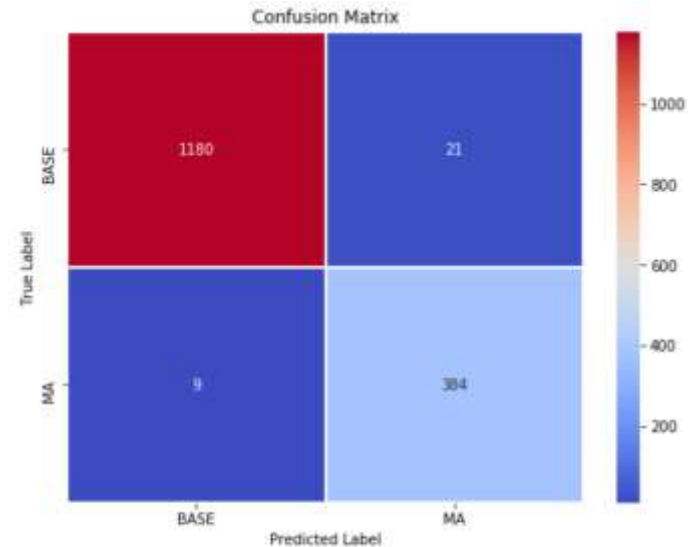
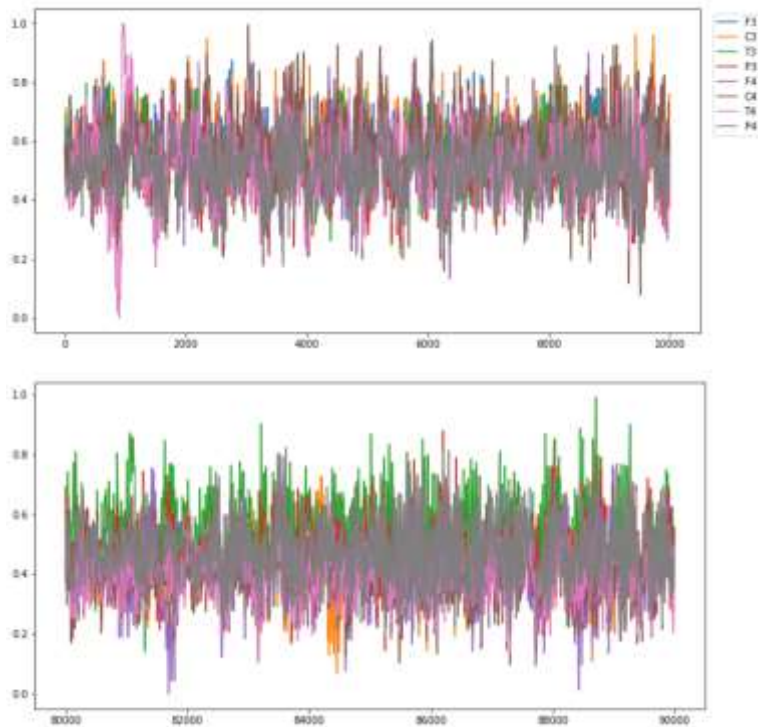
뇌파 (EEG, brain waves)



https://www.researchgate.net/profile/Daisuke_Hamada2/publication/282153913/figure/fig1/AS:706073979797505@1545352563235/The-international-10-20-scalp-positioning-system-showing-the-locations-of-scalp.ppm

<https://media.giphy.com/media/jAM12sDIgf3ry/giphy.gif>

뇌파 (EEG, 8-채널 brain waves)



--- EEG 1-s scaled; classification report for test data ---

| | precision | recall | f1-score | support |
|--------------|-----------|--------|----------|---------|
| 0 | 0.99 | 0.98 | 0.99 | 1201 |
| 1 | 0.95 | 0.98 | 0.96 | 393 |
| accuracy | | | 0.98 | 1594 |
| macro avg | 0.97 | 0.98 | 0.97 | 1594 |
| weighted avg | 0.98 | 0.98 | 0.98 | 1594 |

도
전
!!!

정상 뇌파
?
멘붕 뇌파

4792 - 31

- 31

- 31

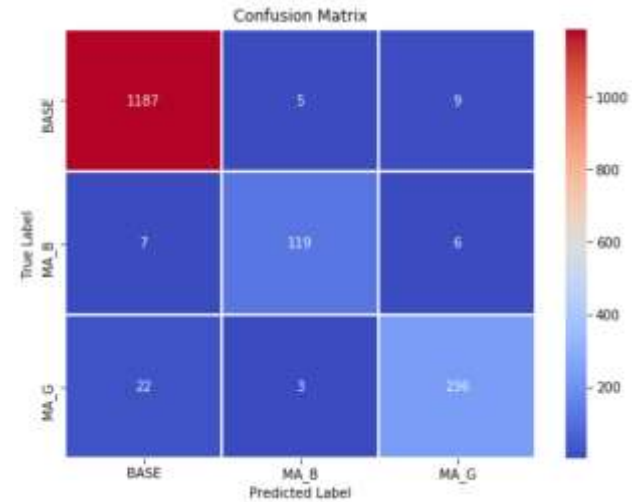
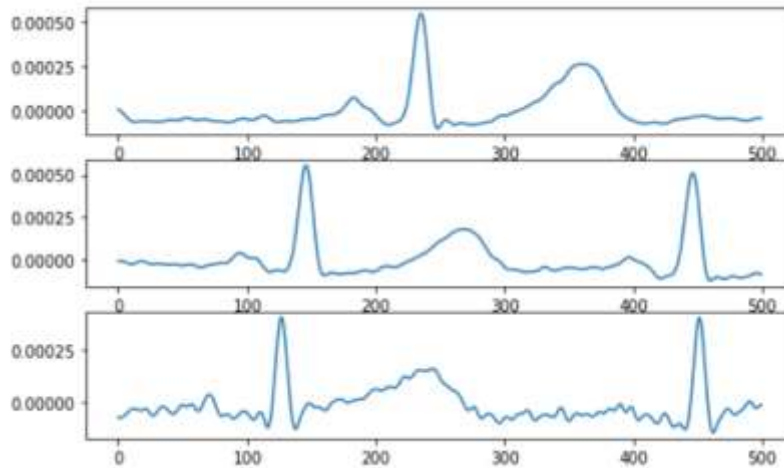
- 31

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1분 동안
암산 실시!

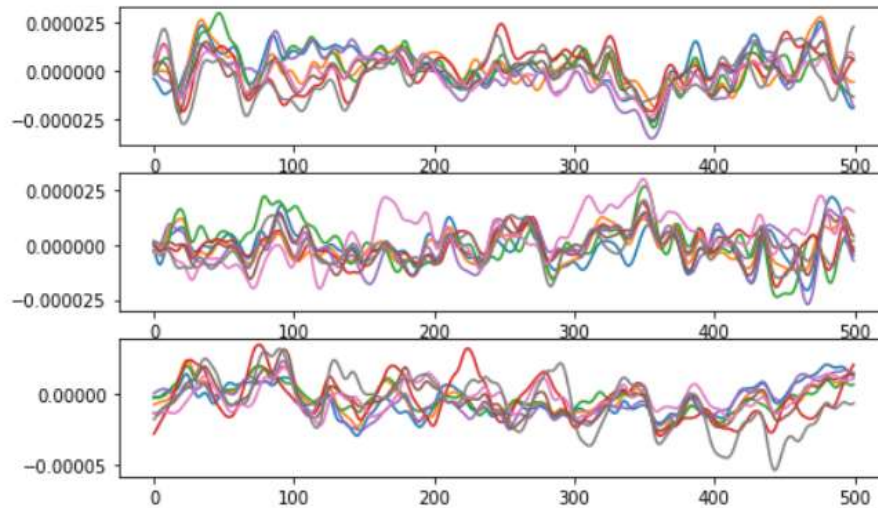
심전도 [안정, 암산, 멘붕]



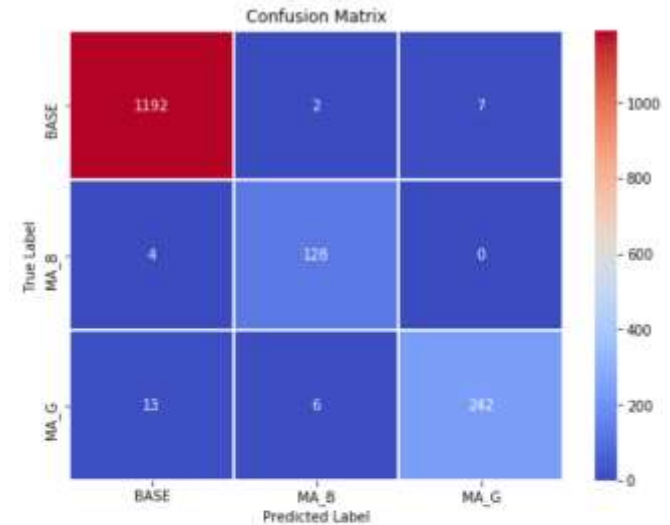
--- ECG scaled 1s: CV1D, MA_B vs. MA_G ---

| | precision | recall | f1-score | support |
|--------------|-----------|--------|----------|---------|
| 0 | 0.98 | 0.99 | 0.98 | 1201 |
| 1 | 0.94 | 0.90 | 0.92 | 132 |
| 2 | 0.94 | 0.90 | 0.92 | 261 |
| accuracy | | | 0.97 | 1594 |
| macro avg | 0.95 | 0.93 | 0.94 | 1594 |
| weighted avg | 0.97 | 0.97 | 0.97 | 1594 |

뇌파 [안정, 암산, 멘붕]

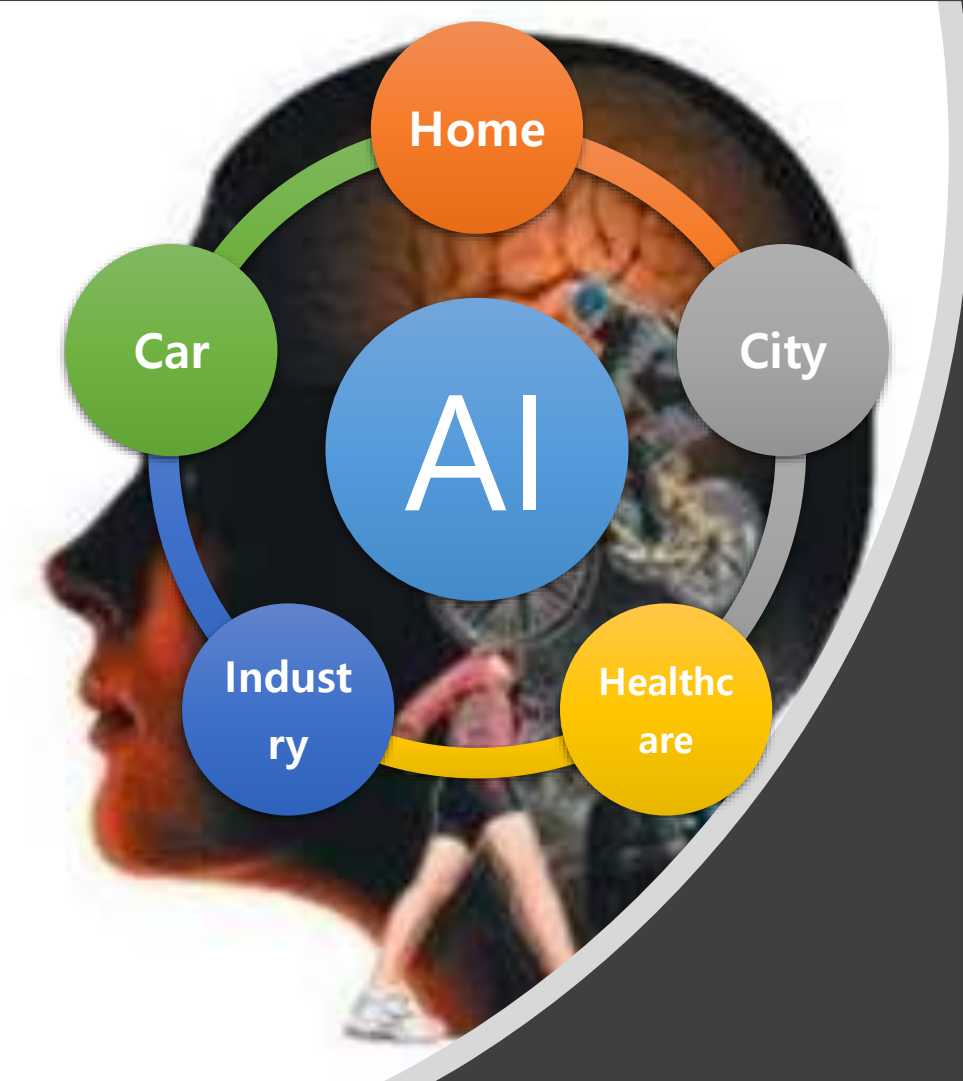


뇌파 (EEG, 8-채널)



--- EEG scaled 1s: CV1D ---

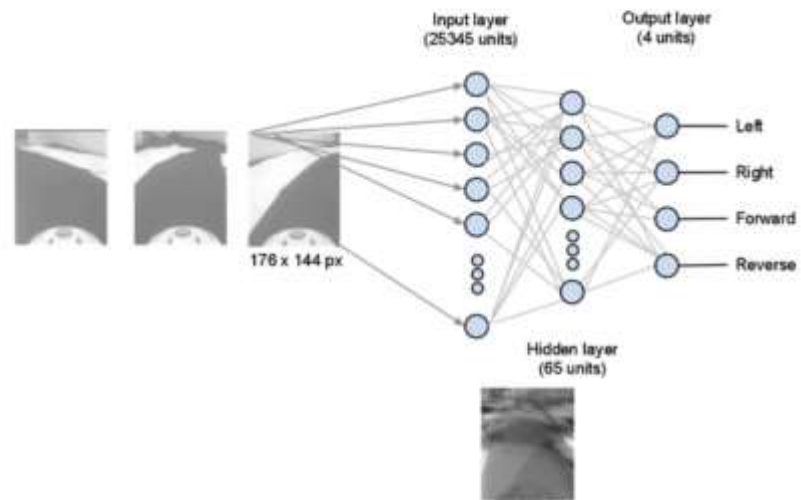
| | precision | recall | f1-score | support |
|--------------|-----------|--------|----------|---------|
| 0 | 0.99 | 0.99 | 0.99 | 1201 |
| 1 | 0.94 | 0.97 | 0.96 | 132 |
| 2 | 0.97 | 0.93 | 0.95 | 261 |
| accuracy | | | 0.98 | 1594 |
| macro avg | 0.97 | 0.96 | 0.96 | 1594 |
| weighted avg | 0.98 | 0.98 | 0.98 | 1594 |



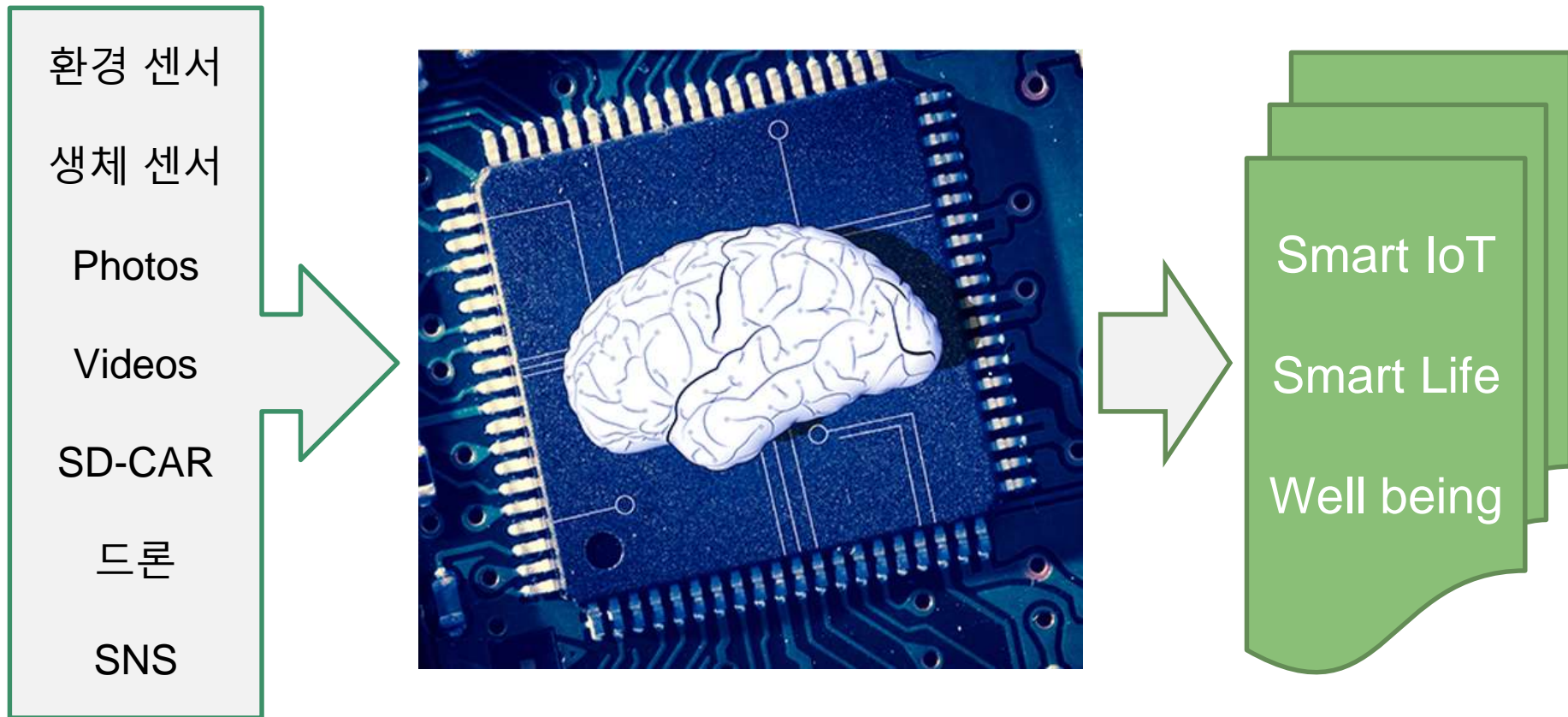
AI Everywhere!

AI Everywhere!

Self Driving Car



Machine(Deep) learning with AI chip



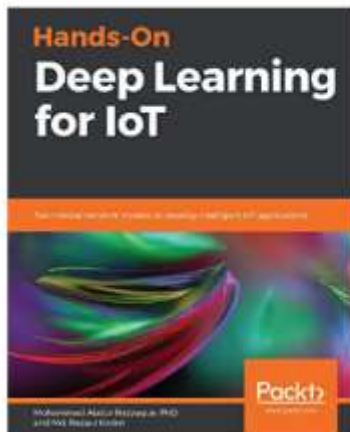
Don't let a lack of math stop you.

Get good at writing code, rely on existing libraries, investigate how others solve problems, and get feedback.

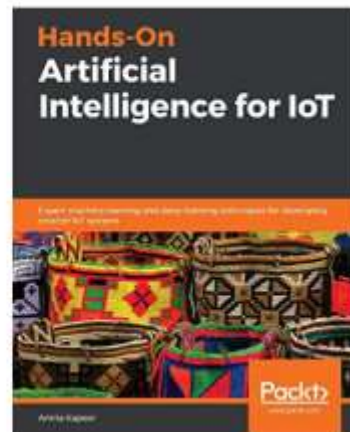
ML engineers and data scientists don't do much math

The real challenge is data, not mathematics.

Deep learning & IoT



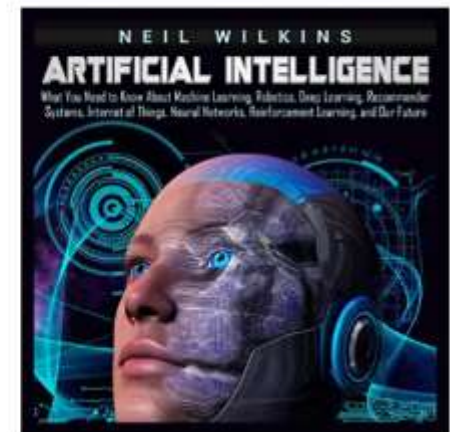
Hands-On Deep Learning for IoT: Train neural network models to develop intelligent IoT applications
by Abdur Razzaque PhD, Mohammad and Md. Rezaul Karim



Hands-On Artificial Intelligence for IoT: Expert machine learning and deep learning techniques for developing smarter IoT systems
by Amita Kapoor

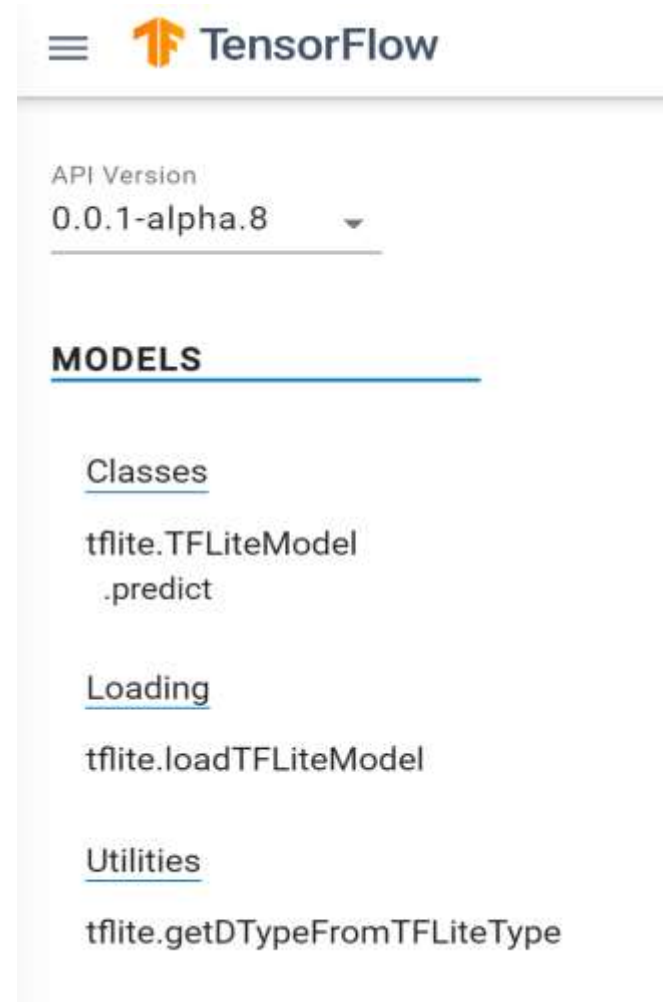
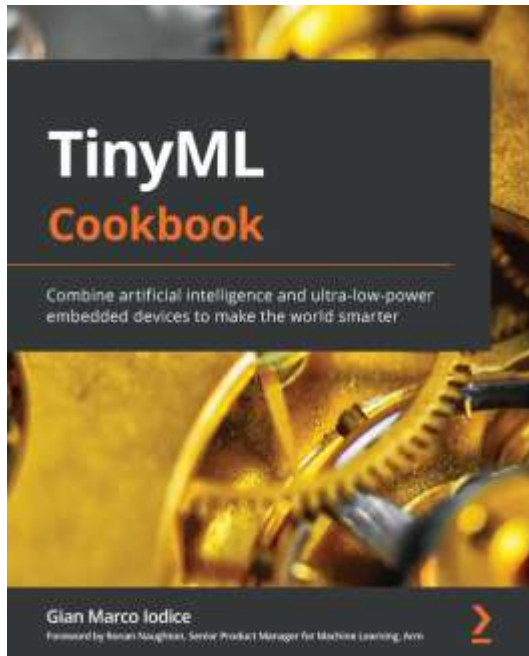


IoT Disruptions 2020: Getting to the Connected World of 2020 with Deep Learning IoT
by Sudha Jamthe
★★★★☆ 7



Artificial Intelligence: What You Need to Know About Machine Learning, Robotics, Deep Learning, Recommender Systems, Internet of Things, Neural...
by Neil Wilkins and Brian R. Scott

Deep learning & IoT

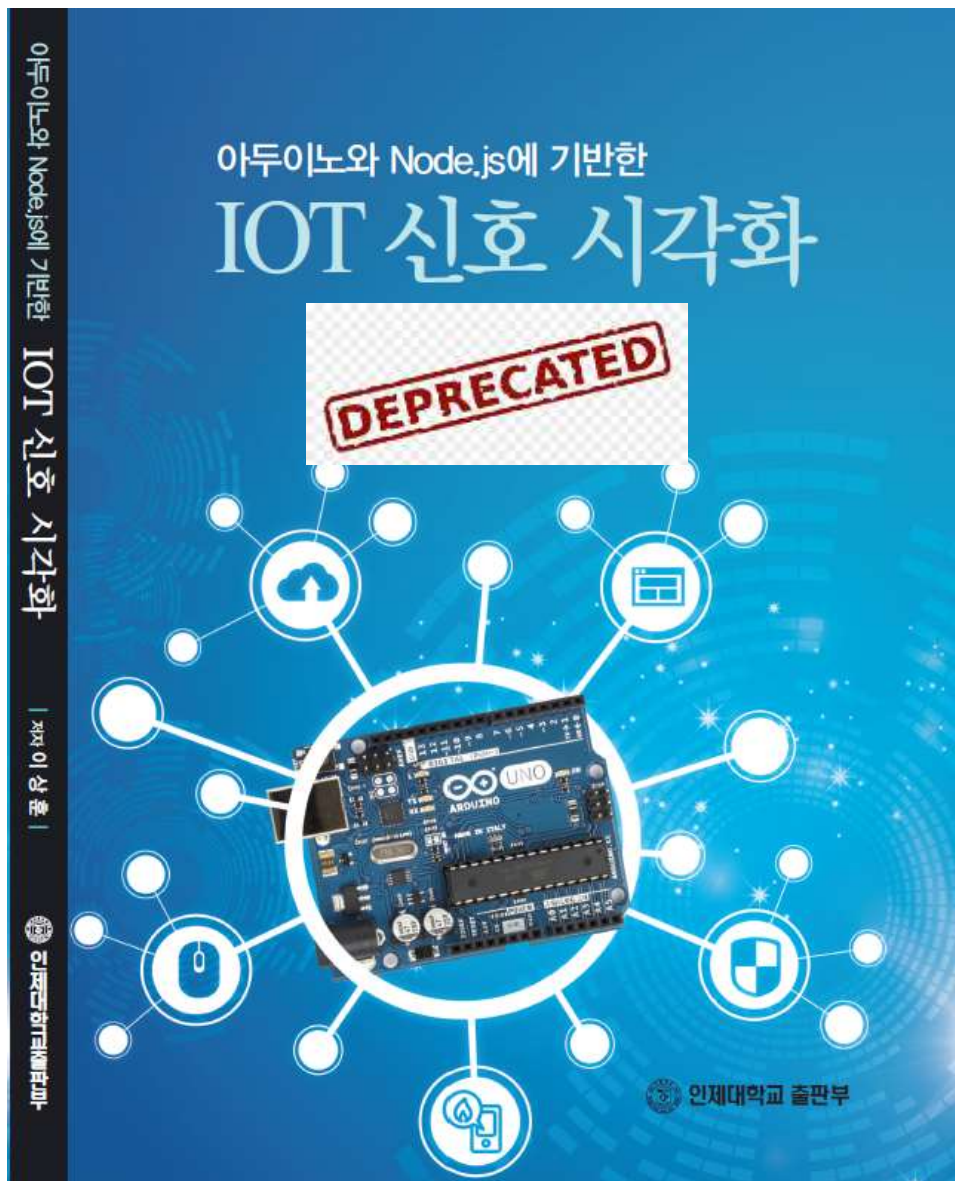


교재

| 교재구분 | 도서명 | 저자명 | 출판사 | 출판년도 | ISBN |
|------|---|-------------|--------|-------------|-------------------|
| 주교재 | 아두이노와 Node.js에 기반한 IoT 신호 시각화 | 이상훈 | 인제대 | 2018 | deprecated |
| 부교재 | 예제로 쉽게 배우는 아두이노 | 장성용, 김진환 | 생능출판사 | 2018 | |
| 기타자료 | https://github.com/Redwoods/Arduino/tree/master/ar-iot | Redwoods Yi | github | 2022 | |

기타 유의사항

- 공식 사유 없이 무단결석이 4회를 초과하면 낙제를 부과한다.
- 수업 중 휴대 전화 통화 및 SNS를 금지한다. 단 수업에 필요한 검색에는 휴대전화를 사용한다.
- 부정 출석을 한 학생은 해당 수업을 무단결석으로 처리한다.
- 아두이노 신호처리 키트는 1인 1조로 이용한다.
- 실습 재료를 고의적으로 훼손하지 않도록 주의하고 실습 후 마무리를 확인한다.
- 수업 중 김해 인근에서 진도 4 이상의 지진이 발생할 경우 담당교수의 허락이 없어도 신속히 건물 밖으로 대피한다. 진도 4 미만의 지진이 발생할 경우 일단 강의실에 대기하면서 대피에 대비한다.



주간계획서

| 주간계획서 | | | |
|-------|----------|--|----------|
| 주차 | 수업방법 | 수업내용 | 과제물 |
| 1 | 강의/실습 | 수업 및 실습 안내 - 포터블 소프트웨어 설치 | |
| 2 | 강의/실습 | Node.js I - Node.js 코드의 기본 구조 - 기초 Node 서버 및 클라이언트 | 실습확인 |
| 3 | 강의/실습 | Node.js II - Node.js Express 서버 설계 및 운용 | 실습확인 |
| 4 | 강의/실습/발표 | Arduino I - 아날로그 신호 회로 - LCD를 이용한 센서 신호 모니터링 | 실습확인 |
| 5 | 강의/실습 | Arduino II - 단일 센서 회로와 Node.js 연결 | 실습확인 |
| 6 | 강의/실습 | 프로젝트 I - 다중 센서 회로와 Node.js 연결 | 프로젝트 I |
| 7 | 강의/실습/발표 | IOT 데이터 시각화 I (Plotly.js) - 데이터 및 시계열 차트 - 데이터 스트리밍 | 실습확인 |
| 8 | 시험 | 중간고사 | |
| 9 | 강의/실습 | IOT 데이터 시각화 II (Plotly.js) - 다중 센서 데이터 시각화 | 실습확인 |
| 10 | 강의/실습/발표 | 프로젝트 II - 다중 센서 데이터 스트리밍 | 프로젝트 II |
| 11 | 강의/실습 | IOT 데이터 저장과 처리 - MongoDB 설치 및 Mongo shell - MongoDB와 Node.js 연결 및 데이터 저장 | 실습확인 |
| 12 | 강의/실습 | 프로젝트 III - MongoDB에 저장된 IOT 데이터 관리 - MongoDB에 저장된 IOT 데이터 모니터링 | 프로젝트 III |
| 13 | 강의/실습 | IOT 데이터 마이닝 - 아두이노에서 발생된 데이터 관리 - 데이터마이닝 소개 | 실습확인 |
| 14 | 강의/실습/발표 | 프로젝트 IV - IoT 데이터 관리 - IoT 데이터 마이닝 | 프로젝트 IV |
| 15 | 시험 | 기말고사 | |

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)





IOT: HSC

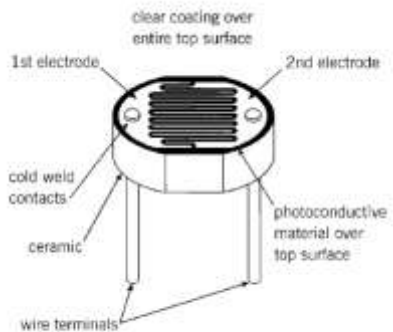
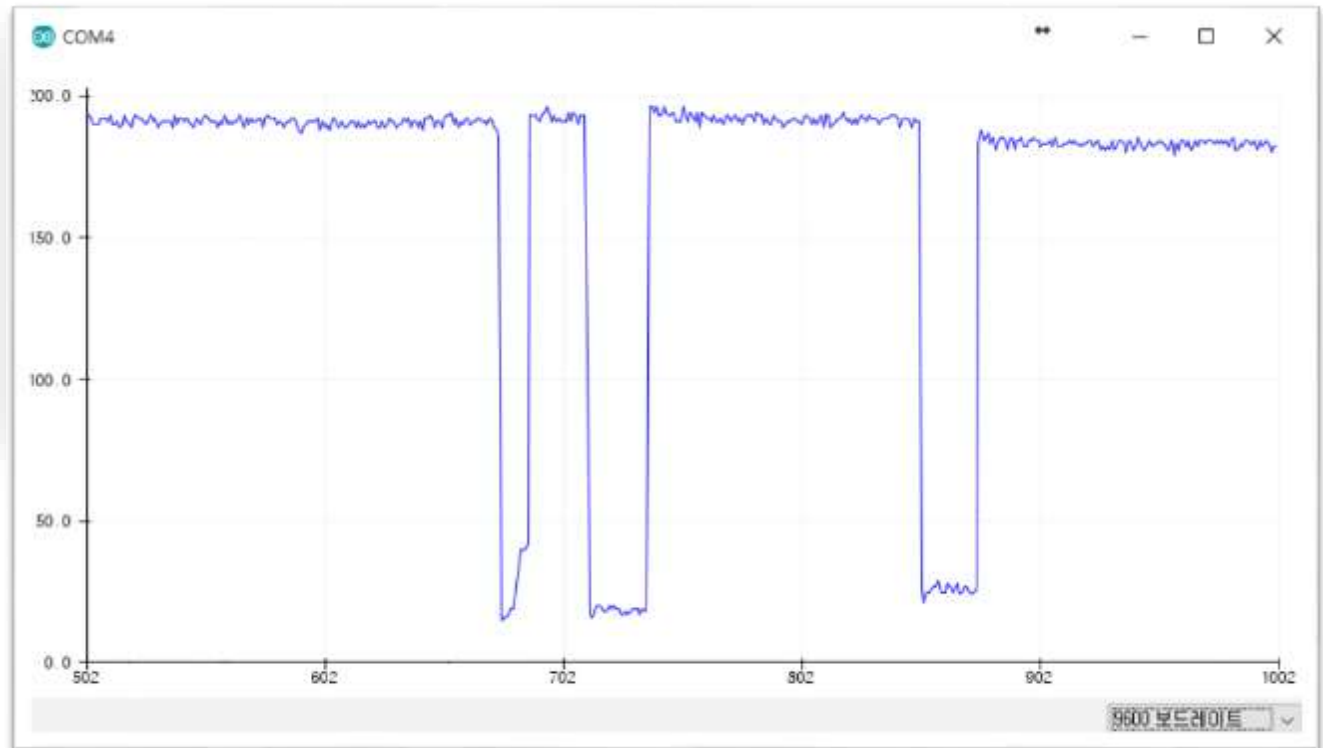


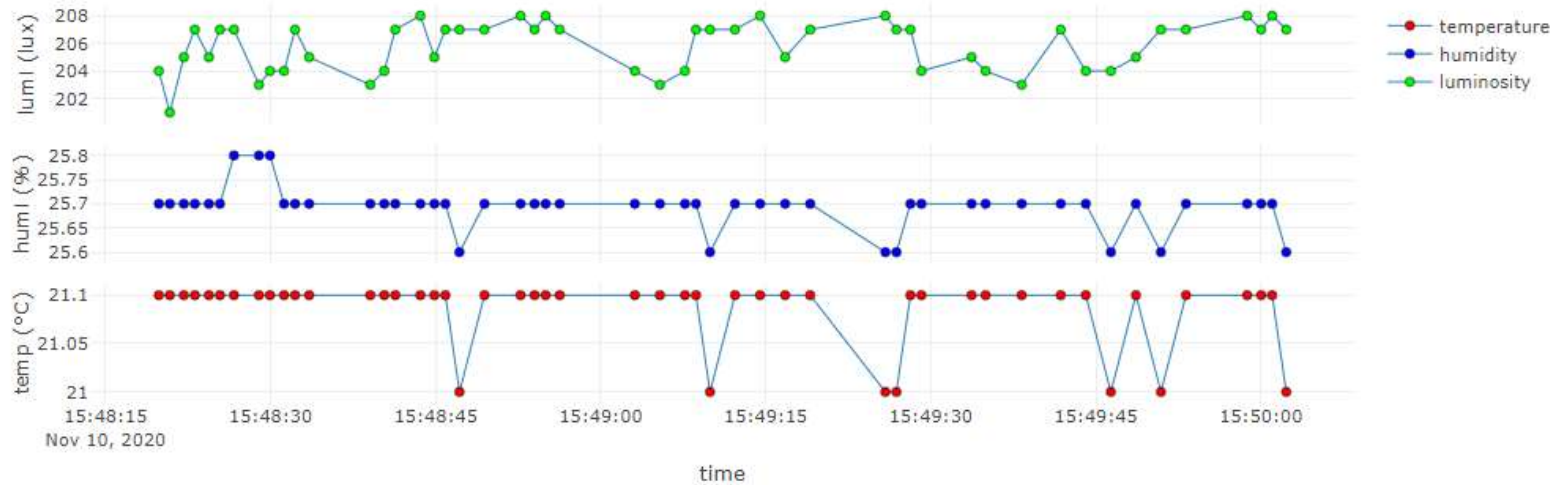
Figure 3
Typical Construction of a Plastic Coated Photocell



Real-time Weather Station from sensors



on Time: 2020-11-10 15:50:02.300

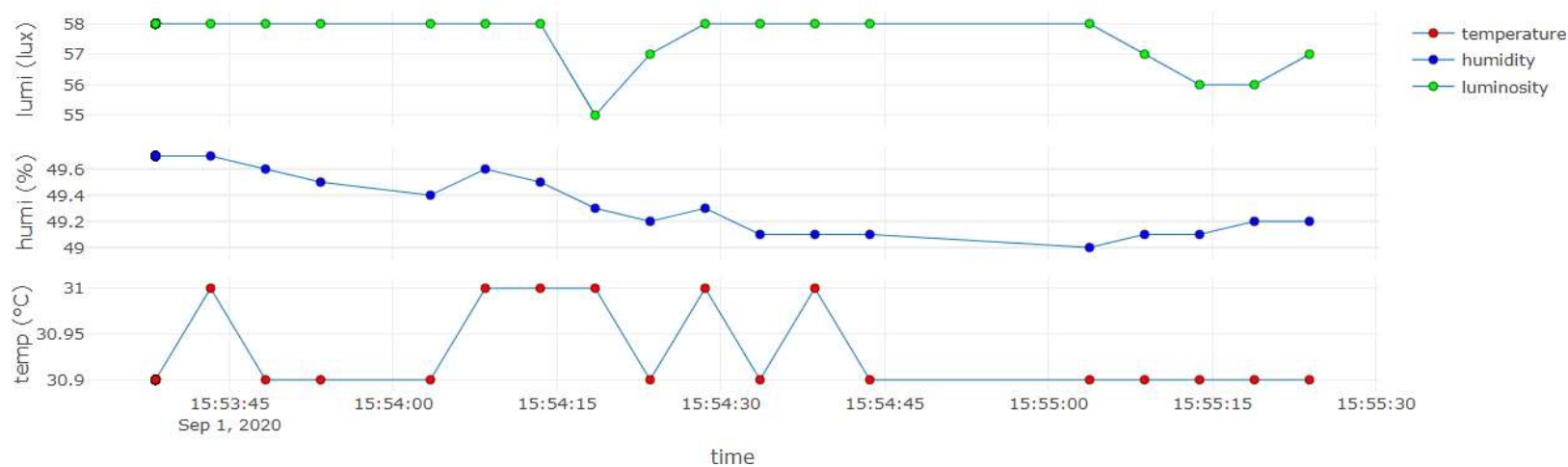


Target of this class

Real-time Weather Station from nano 33 BLE sensors



on Time: 2020-09-01 15:55:23.918

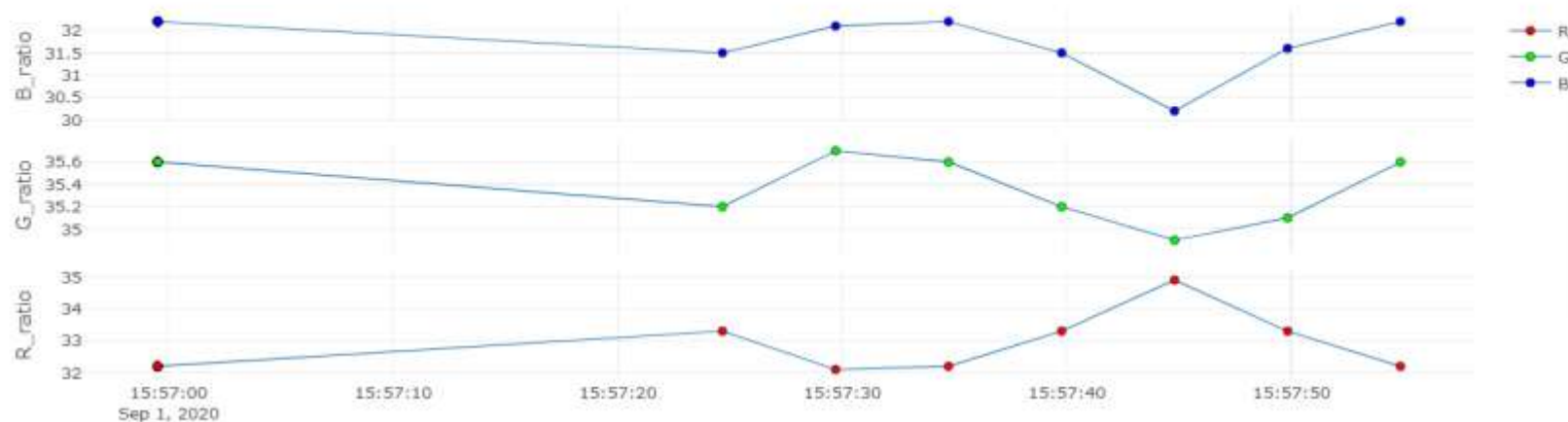


Target of this class

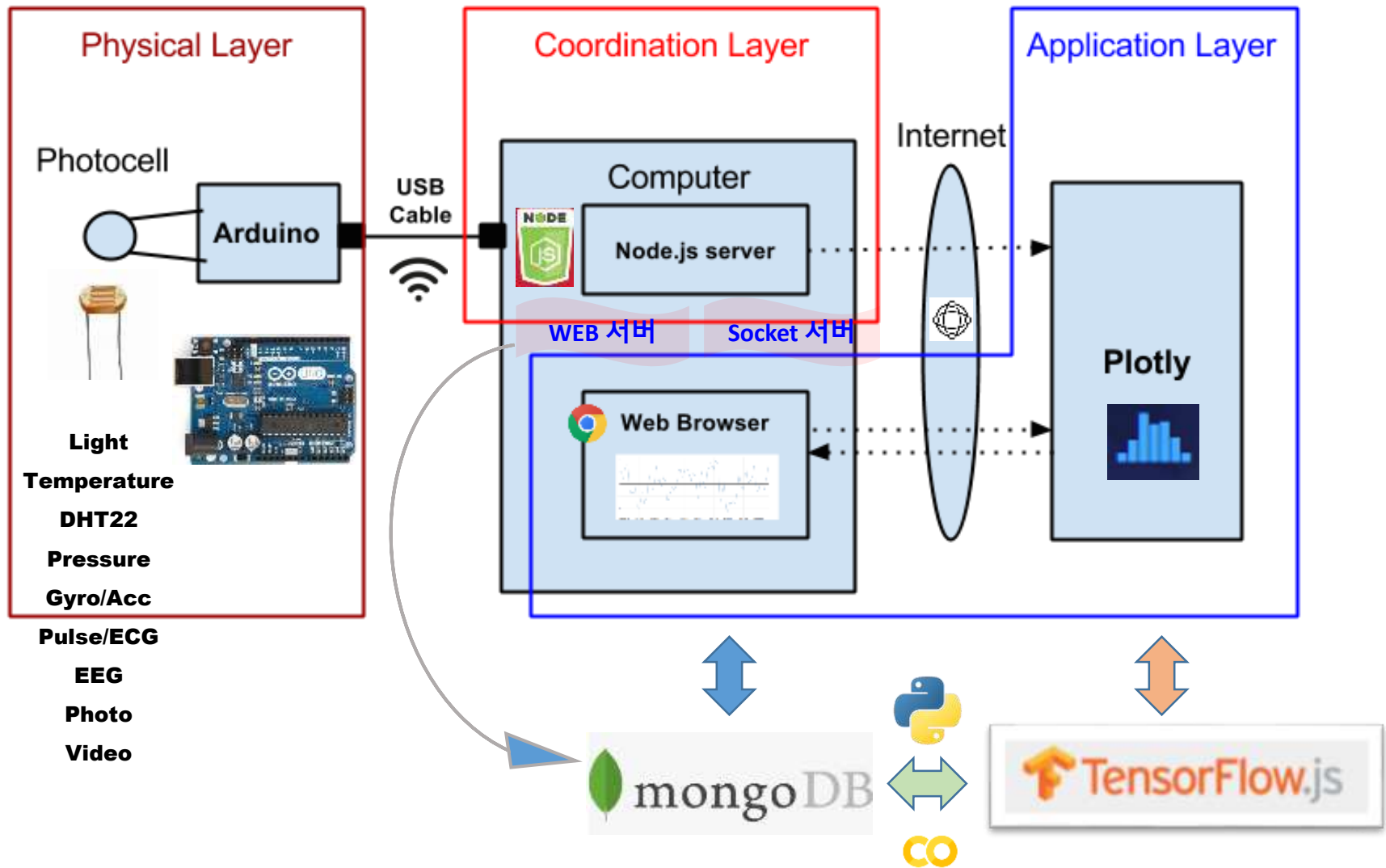
Real-time Ambient Colors from nano 33 BLE sensors



on Time: 2020-09-01 15:57:54.861



Layout [H S C]





A5. Introduction to IoT service

System (Arduino, sDevice, ...)



Data (signal, image, sns, ...)



Visualization & monitoring



Data storing & mining



Service

Github.com/Redwoods/Arduino



Redwoods/Arduino: Lect

GitHub, Inc. [US] | https://github.com/Redwoods/Arduino

Search or jump to...

Pull requests

Issues

Marketplace

Explore

Redwoods / Arduino

Unwatch

1

Star

0

Fork

0

<> Code

Issues 0

Pull requests 0

Projects 0

Wiki

Insights

Settings

Lectures on learning Arduino from scratch to the advanced level in iot environment.

Edit

Add topics

2 commits

1 branch

0 releases

1 contributor

Branch: master

New pull request

Create new file

Upload files

Find file

Clone or download

Redwoods 2018 start

Latest commit 38ca9e0 28 minutes ago

ar-basic

2018 start

28 minutes ago

ar-iot

2018 start

28 minutes ago

README.md

Initial commit

43 minutes ago

README.md

Arduino

Lectures on learning Arduino from scratch to the advanced level in iot environment.



Redwoods / Arduino

Unwatch 1

Star 0

Fork 0

Code

Issues 0

Pull requests 0

Projects 0

Wiki

Insights

Settings

Branch: master

Arduino / ar-iot /

Create new file

Upload files

Find file

History



Redwoods wk01 upload

Latest commit 3fb720a 32 seconds ago

..

README.md

2018 start

an hour ago

wk01_aa_Intro.pdf

wk01 upload

32 seconds ago

README.md



Arduino IoT

Lecture on learning Arduino from scratch to the advanced level in iot environment.



Challenge Stage

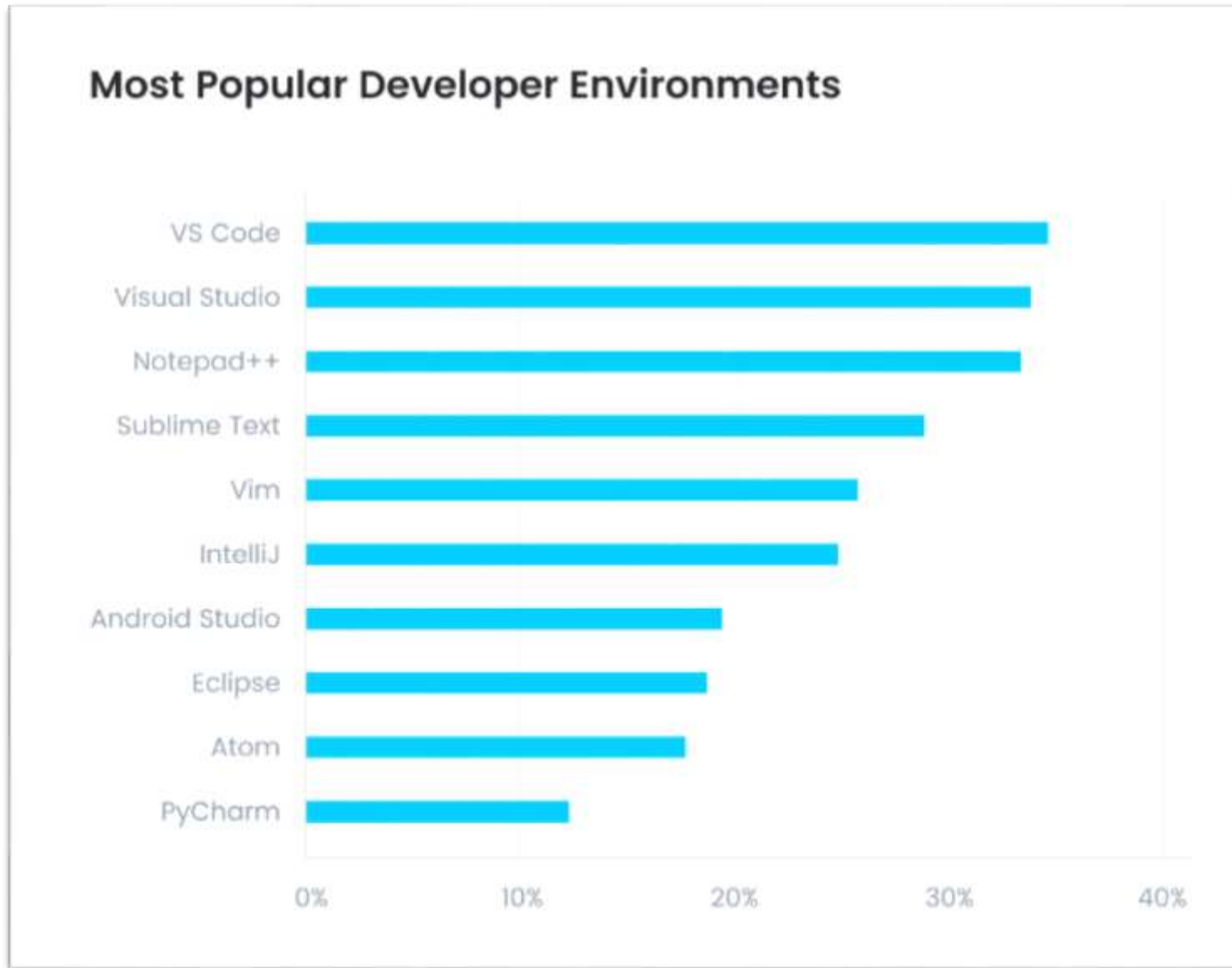
Code editor

50

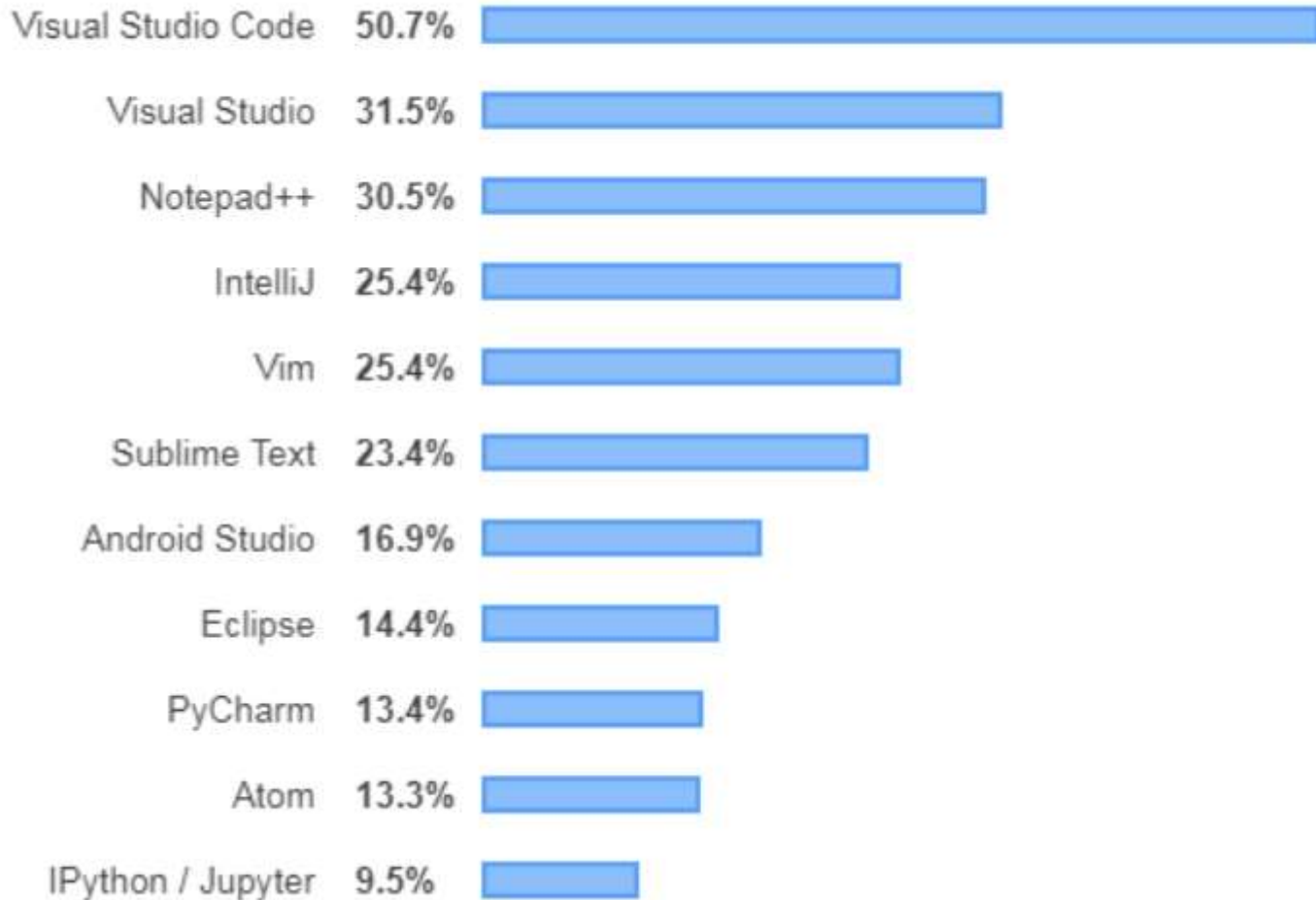
HTML5, node.js, python

- 서브라임 텍스트
- Aptana studio
- Brackets (portable)
- **VSCode (MS Portable)**

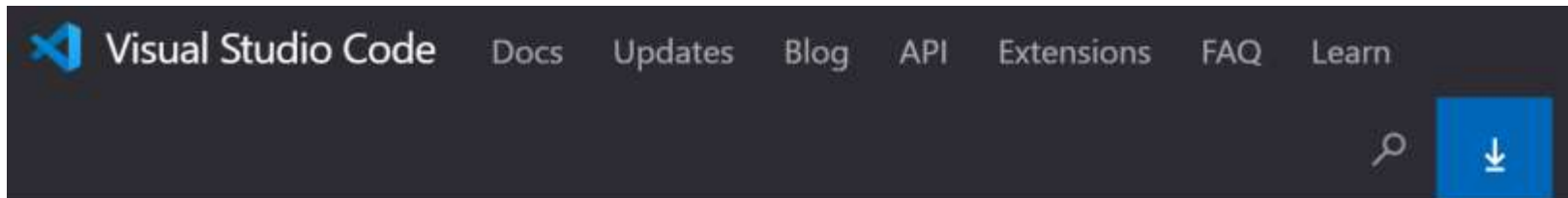
New editor: VScode



New editor: VScode



New editor: Vscode portable by MS



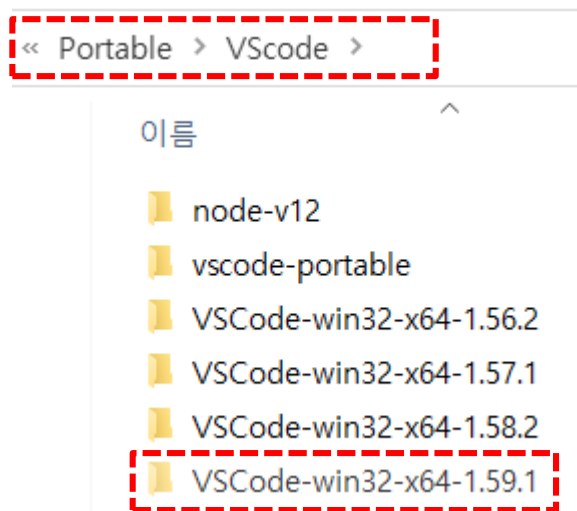
| | | | |
|------------------|--------|--------|-----|
| User Installer | 64 bit | 32 bit | ARM |
| System Installer | 64 bit | 32 bit | ARM |
| .zip | 64 bit | 32 bit | ARM |



| | | | |
|------------|--------|-----|--------|
| .deb | 64 bit | ARM | ARM 64 |
| .rpm | 64 bit | ARM | ARM 64 |
| .tar.gz | 64 bit | ARM | ARM 64 |
| Snap Store | | | |

<https://code.visualstudio.com/download>

New editor: Vscode portable (MS)



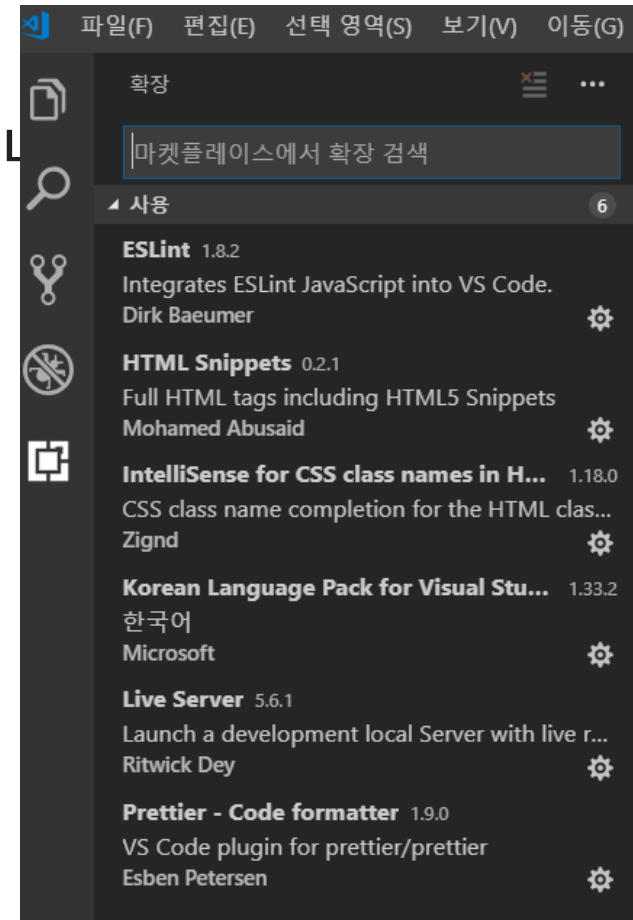
하드디스크 D에 **portable** 폴더를 만들고
vscode 폴더에
압축을 풀어서 사용

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

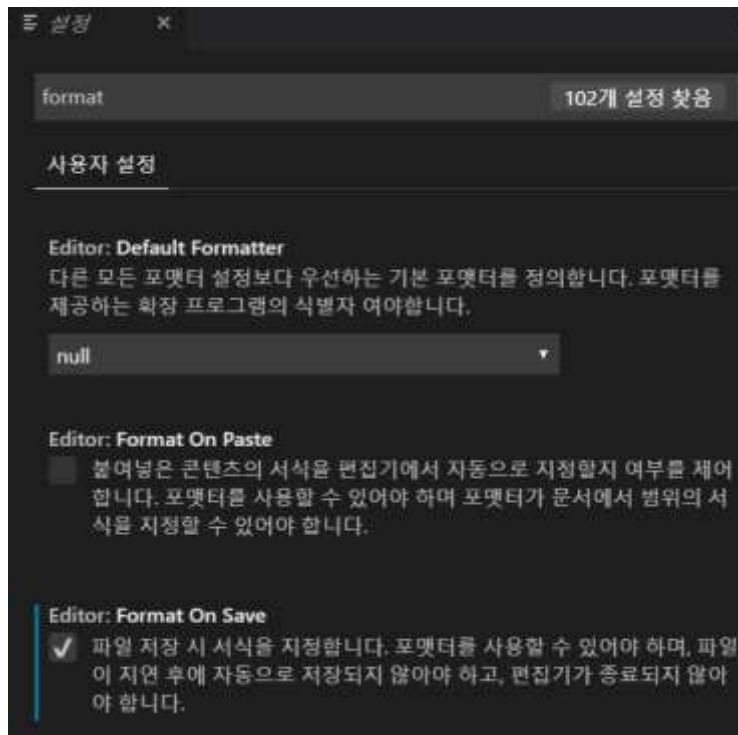
확장프로그램 설정 (각각 설정 후 종료/재시작)

1. Prettier

2. Live server (for HTML preview)

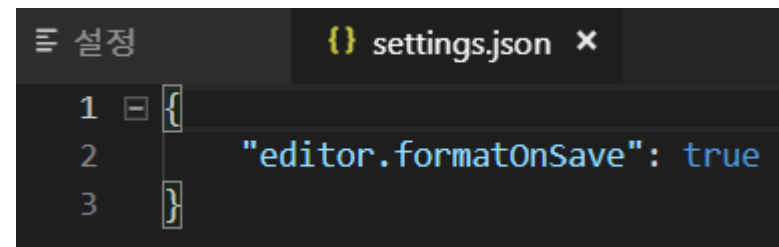
3. GitLens, Git History

파일 > 기본설정 > 설정 → 사용자 설정



검색: format

Editor: Format on Save (check)



설정 → Ctrl + Shift + P

실습 준비: 작업영역 **aann** 설정

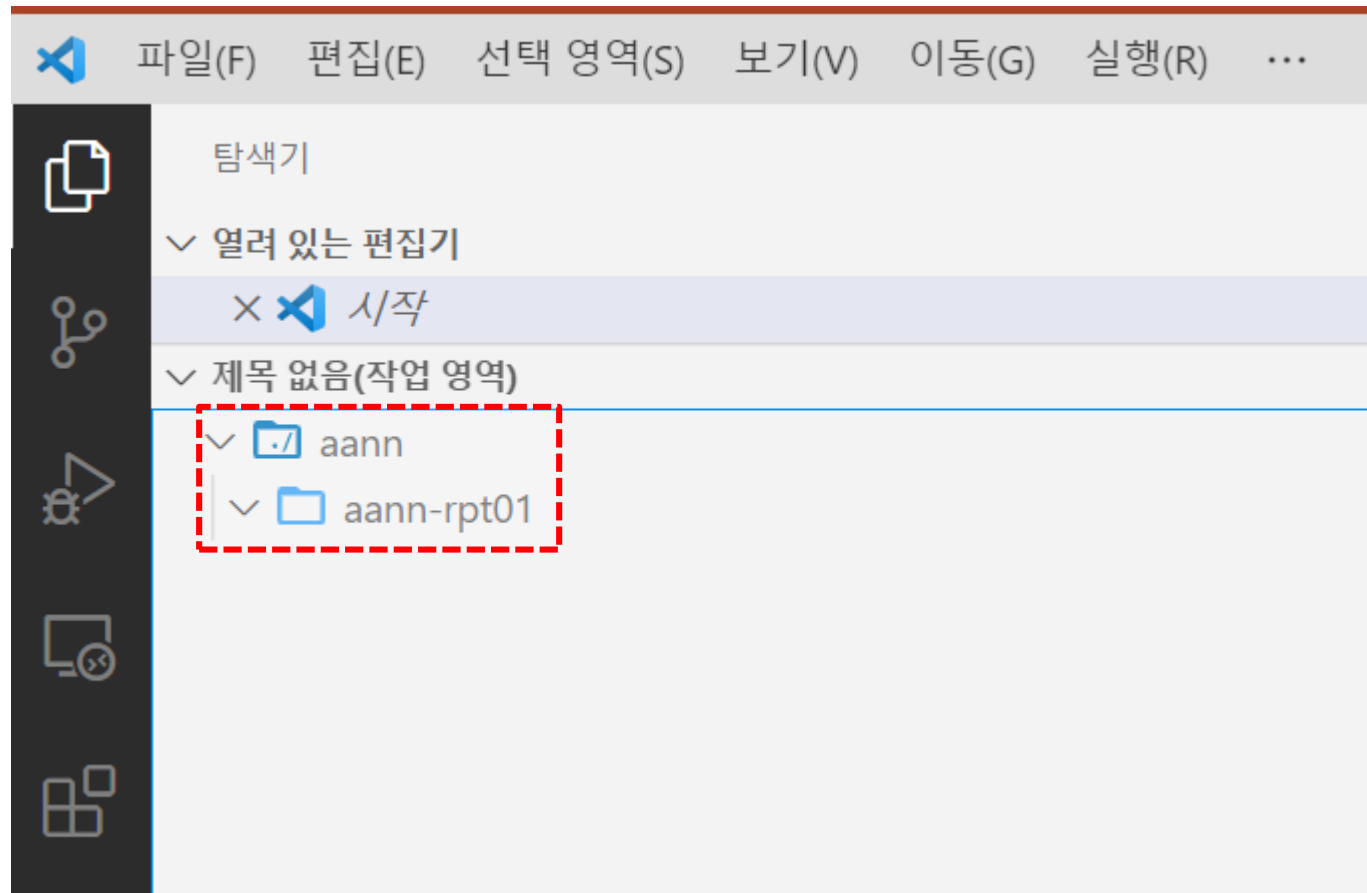
57

[파일] 메뉴
→ 작업영역에 폴더추가

하드디스크 D에 "aann"
폴더 만들기

VSCode 탐색기에서
작업영역 클릭

'aann'에서 오른쪽마우스
클릭하여 새폴더를
aann-rpt01 으로 만든다.



실습 준비: aann/aann-rpt01 폴더에서 js code

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[파일] 메뉴

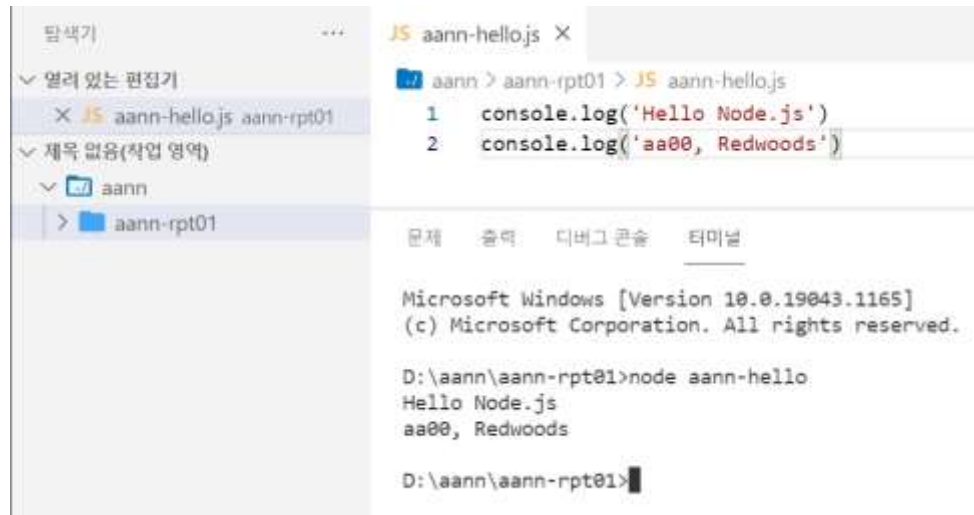
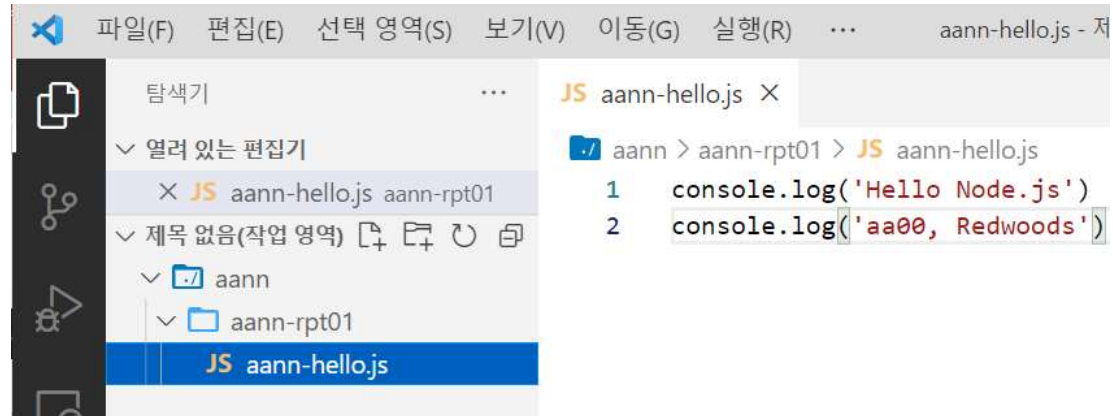
→ Node js 소스 만들기

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

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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

● 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