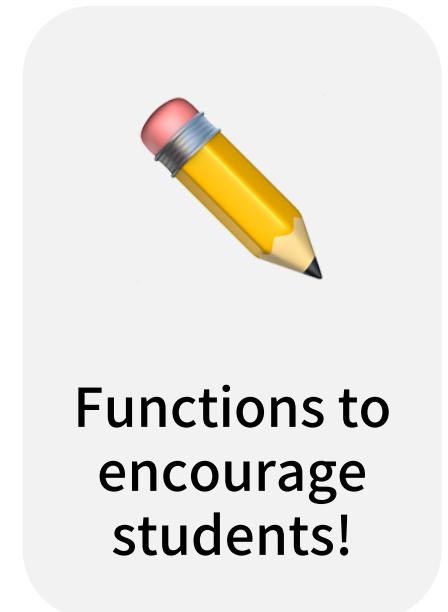
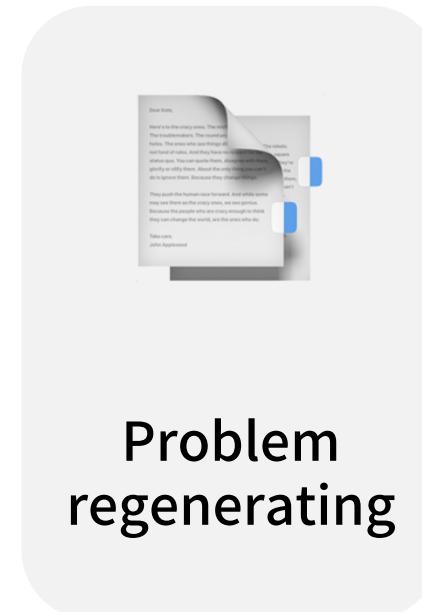
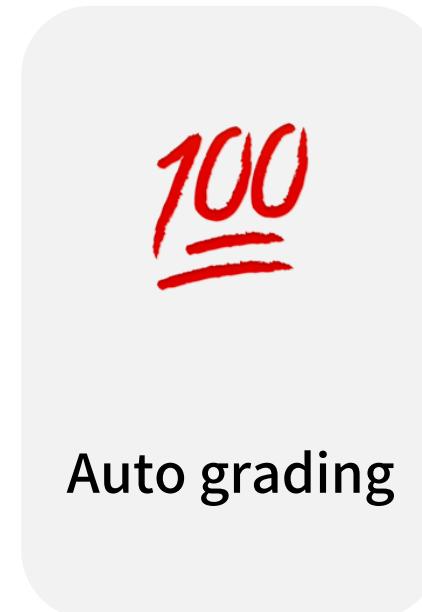


# Project Topic/Objective



Current review notes  
just function as a  
simple storage!

# Capstone Design Project

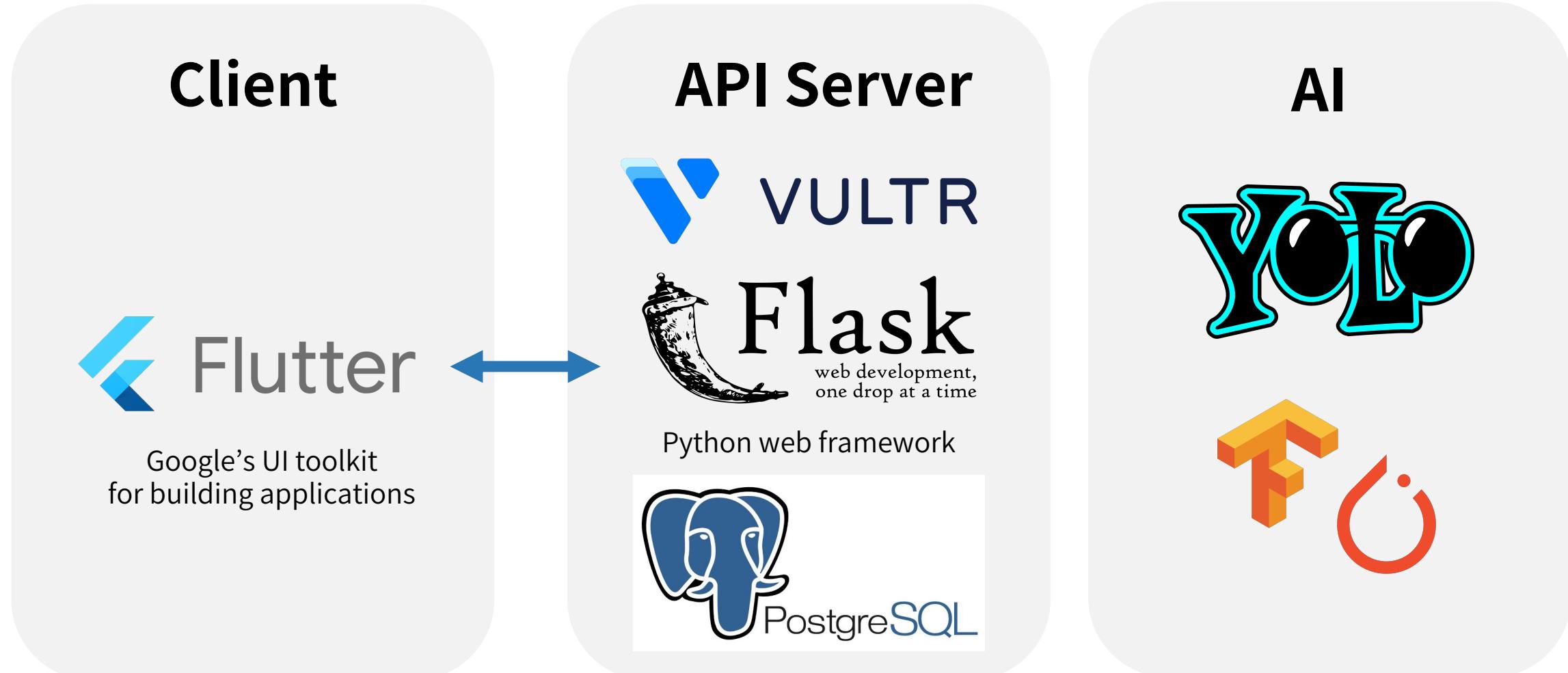
WEEK	Minji	Daehee	Eunji	Daeyeol								
	5 9/27~10/3	6 10/4~10/10	7 10/11~10/17	8 10/18~10/24	9 10/25~10/31	10 11/1~11/7	11 11/8~11/14	12 11/15~11/21	13 11/22~11/28	14 11/29~12/05	15 12/06~12/10	
EVENT	<i>Midterm Presentation</i>										<i>Demo Presentation</i>	<i>Final Presentation</i>
<b>Develop idea</b>	ALL	ALL	ALL	ALL	ALL	ALL	ALL	ALL	ALL	ALL	ALL	ALL
- Design feature for motivation												
- Study core technology												
<b>FRONT / BACK</b>												
- Build server with Flask	Minji											
- DB setting	Minji											
- UI/UX/flow design		Daeyeol / Eunji	Daeyeol / Eunji	Daeyeol / Eunji	Daeyeol / Eunji							
- Frontend implementation		Eunji / Daeyeol	Eunji / Daeyeol	Eunji / Daeyeol	Eunji / Daeyeol	Eunji / Daeyeol						
- App api server implementation		Daeyeol / Eunji	Daeyeol / Eunji	Daeyeol / Eunji	Daeyeol / Eunji	Daeyeol / Eunji						
- Review note generation												
<b>MODEL</b>												
- Image dewraping	Daehee											
- Collect data for object detection(Question)	Daehee/Minji	Daehee/Minji	~									
- Collect data for object detection(answer)		Daehee/Minji	Daehee/Minji									
- Labeling object area				ALL	ALL							
- Detect multiple choice questions				Daehee/Minji	Daehee/Minji	Daehee/Minji						
- Build YOLO model and train												
- Match Question and Answer												
<b>NEXT STEP</b>												
- Regenerate question feature							Minji/Daehee	Minji/Daehee	Minji/Daehee	Minji/Daehee		
- Add feature for motivation												



Done all the things that we have planned!



# System Architecture



## ROLES



### Minji

- Web server / DB Modeling
- Train YOLO
- Data Labeling



### Daehee

- Train YOLO
- Data Labeling



### Daeyeol

- UI/UX design
- Web server / DB Modeling
- Data Labeling



### Eunji

- UI/UX design
- Implement Application Features
- Data Labeling

**Level 1 기초 연습**

www.ebsi.co.kr  
청답과 풀이 5쪽

**1** 함수  $f(x) = \begin{cases} x+1 & (x \leq a) \\ 3x^2 - x & (x > a) \end{cases}$ 에 대하여  $\lim_{x \rightarrow a^-} f(x)$ 의 값이 존재하도록 하는 모든 실수  $a$ 의 값의 합은?  
 ①  $\frac{1}{6}$     ②  $\frac{1}{3}$     ③  $\frac{1}{2}$     ④  $\frac{2}{3}$     ⑤  $\frac{5}{6}$

**2** [21009-0010] 두 함수  $f(x) = \frac{20}{x+3}$ ,  $g(x) = \sqrt{4x+1}$ 에 대하여  $\lim_{x \rightarrow 2} \frac{f(x)+2g(x)}{2f(x)-g(x)}$ 의 값을 구하시오.

**3** [21009-0011]  $\lim_{x \rightarrow 3} \frac{\sqrt{x^2+16}-5}{x-3}$ 의 값은?  
 ①  $\frac{1}{5}$     ②  $\frac{2}{5}$     ③  $\frac{3}{5}$     ④  $\frac{4}{5}$     ⑤ 1

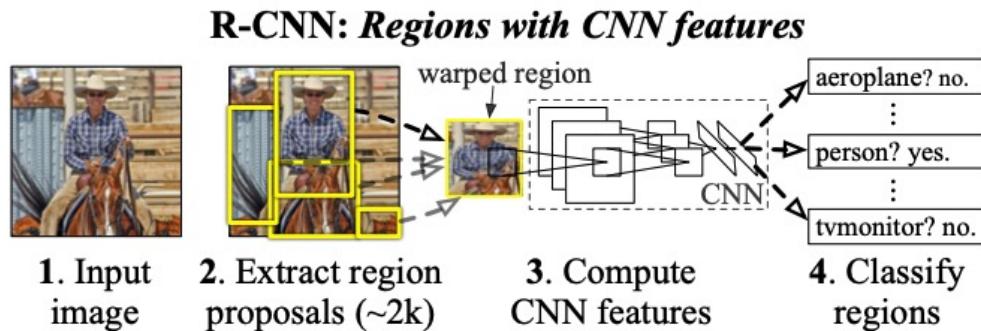
**4** [21009-0012]  $\lim_{x \rightarrow 1} \frac{x^2-4x-5}{2x^2+ax+4} = b$ 일 때,  $a+b$ 의 값을? (단,  $a, b$ 는 상수이고,  $b \neq 0$ 이다.)  
 ① 3    ② 4    ③ 5    ④ 6    ⑤ 7

**5** [21009-0013] 다항함수  $f(x)$ 에 대하여  
 $\lim_{x \rightarrow \infty} \frac{f(x)-x^2}{x+1} = 3$ ,  $\lim_{x \rightarrow 1} \frac{x+1}{f(x)} = 2$   
 일 때,  $f(-1)$ 의 값을?  
 ① -5    ② -4    ③ -3    ④ -2    ⑤ -1

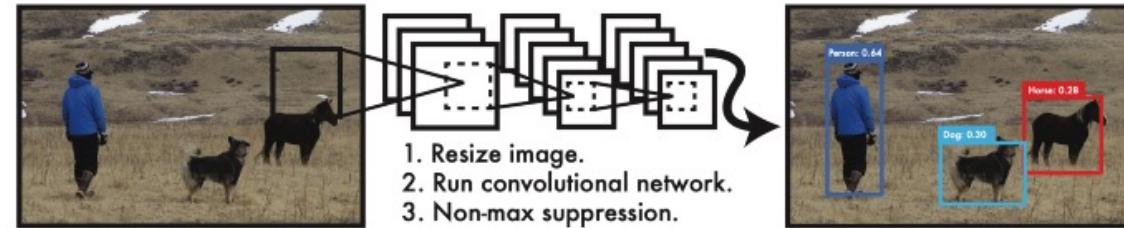
## Methodology : Object Detection Model : YOLOv4 Dataset : CDP\_YOLO(custom dataset)

Use YOLO to detect features in the image  
and auto-grade the problems!

# AI – Why Object Detection and YOLO?



**Figure 1: Object detection system overview.** Our system (1) takes an input image, (2) extracts around 2000 bottom-up region proposals, (3) computes features for each proposal using a large convolutional neural network (CNN), and then (4) classifies each region using class-specific linear SVMs. R-CNN achieves a mean



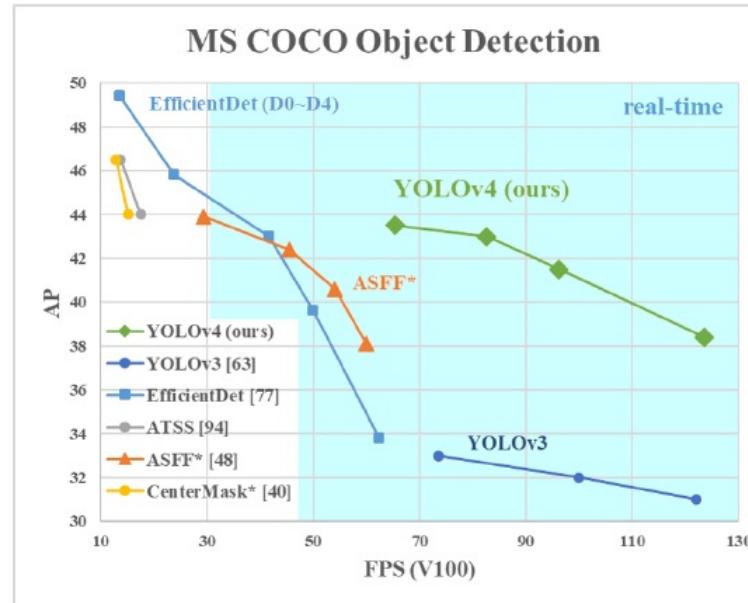
**Figure 1: The YOLO Detection System.** Processing images with YOLO is simple and straightforward. Our system (1) resizes the input image to  $448 \times 448$ , (2) runs a single convolutional network on the image, and (3) thresholds the resulting detections by the model's confidence.

**Should detect all meaningful features to auto grade the image **

We considered all those features: problem number, answer options, ⋯ as a “object”

**YOLO is very fast **

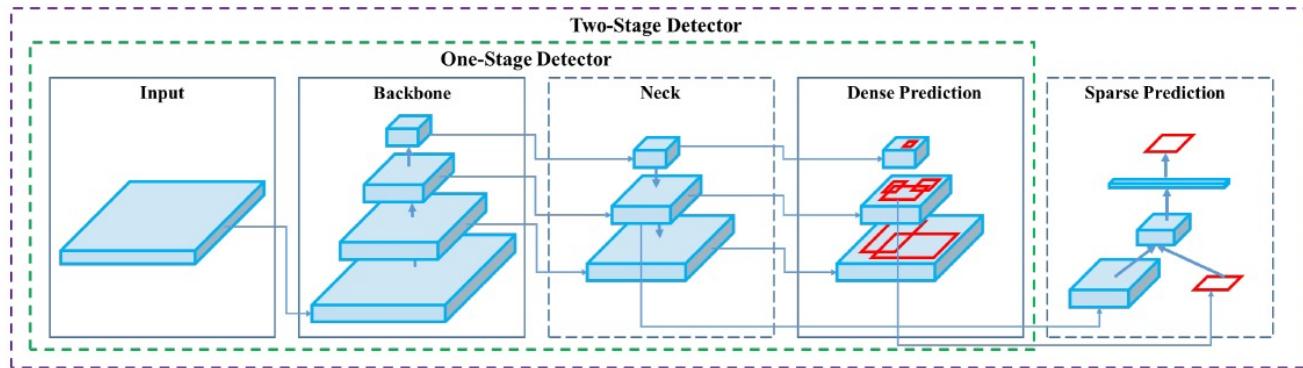
Since it detects object with an algorithm with grid, it is faster than other models



**YOLOv4 = YOLOv3 + CSPDarknet53 + SPP + PAN + BoF + BoS**

### What is YOLOv4?

Basically, YOLOv4 is YOLOv3 with various latest techniques added.  
Unlike the other latest models, it is made with the goal of good performance  
while **smoothly learning with only one GPU**.



**Input:** { Image, Patches, Image Pyramid, ... }

**Backbone:** { VGG16 [68], ResNet-50 [26], ResNeXt-101 [86], Darknet53 [63], ... }

**Neck:** { FPN [44], PANet [49], Bi-FPN [77], ... }

**Head:**

**Dense Prediction:** { RPN [64], YOLO [61, 62, 63], SSD [50], RetinaNet [45], FCOS [78], ... }

**Sparse Prediction:** { Faster R-CNN [64], R-FCN [9], ... }

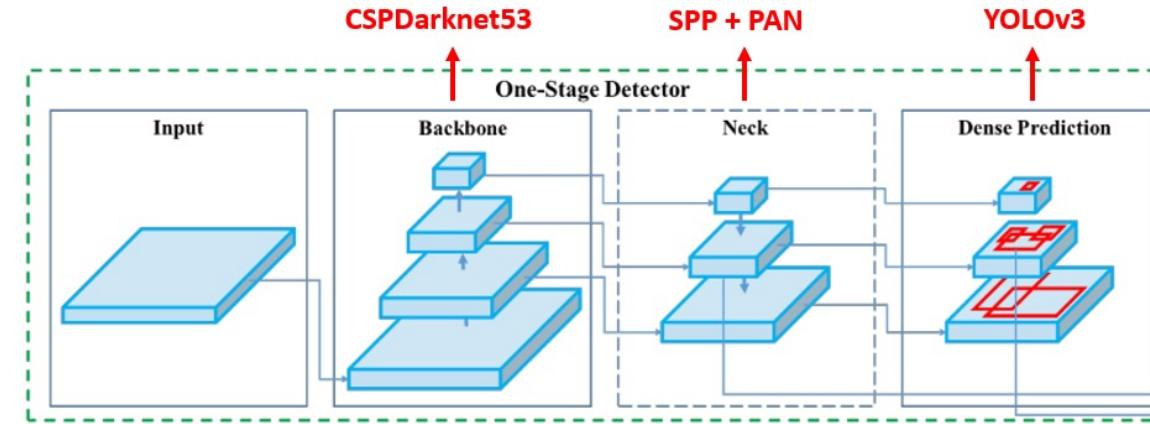
Figure 2: Object detector.

## Rough design of object detection models

**Backbone:** In general, It extract image characteristics by pre-training using ImageNet.

**Head:** Used to predict the class and bounding boxes of an object.

**Neck:** Layers inserted between the backbone and the head, and various techniques to increase the accuracy by assisting the head are applied

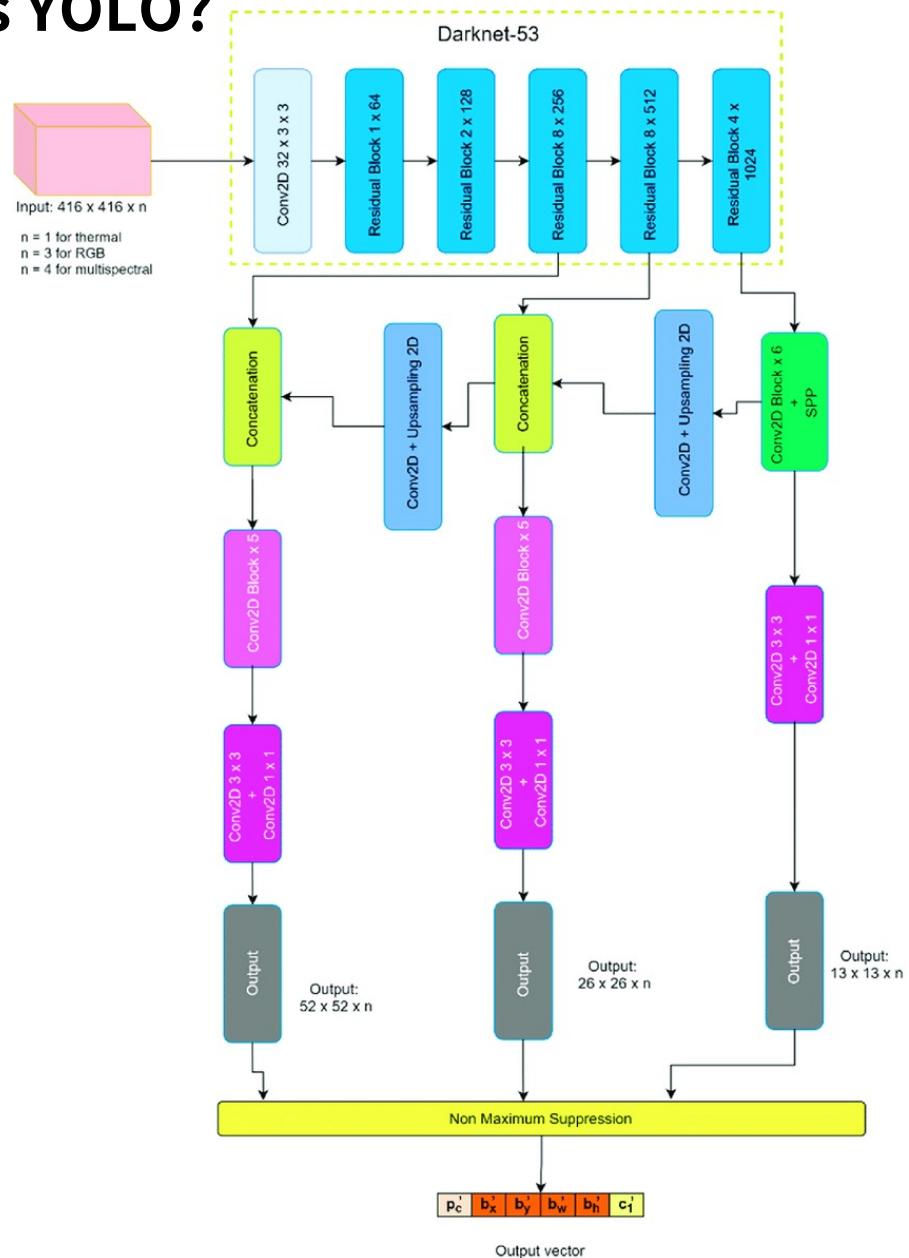


**YOLOv4 = YOLOv3 + CSPDarknet53 + SPP + PAN + BoF + BoS**

↓  
Path Aggregation Network

YOLOv4 created the **best performance combination** by combining various backbone, head, and neck.

# AI – What is YOLO?



## Input& Output

### 1) feature map by Darknet-53(backbone)

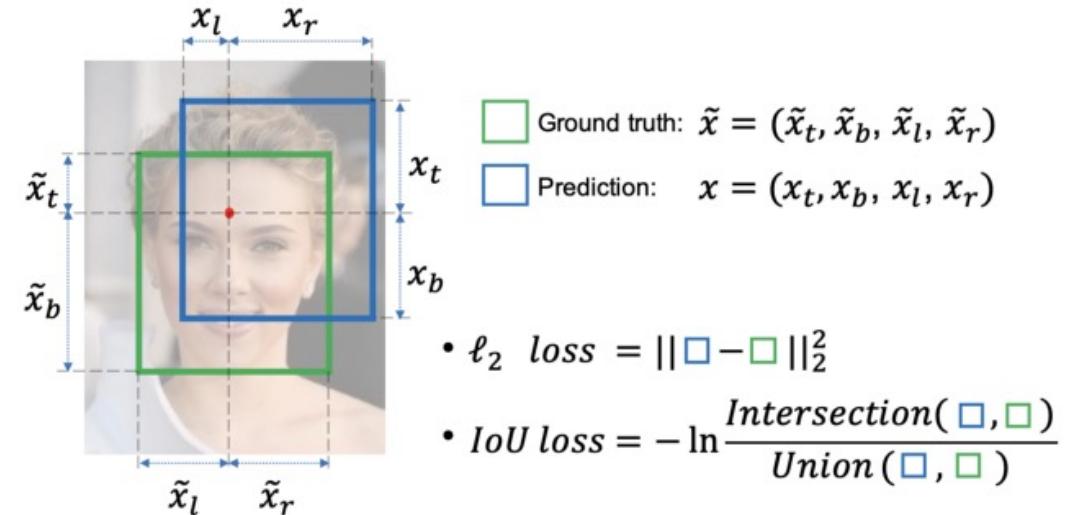
- Input :**  $416 \times 416$  sized image
- Process :** extract feature maps
- Output :**  $52 \times 52$ ,  $26 \times 26$ ,  $13 \times 13$  sized feature maps

### 2) Building feature pyramid by FCNs(neck)

- Input :**  $52 \times 52$ ,  $26 \times 26$ ,  $13 \times 13$  sized feature maps
- Process :** building feature pyramid by FCN
- Output :**  $52 \times 52(x \text{ } n)$ ,  $26 \times 26(x \text{ } n)$ ,  $13 \times 13(x \text{ } n)$  sized feature maps( $n = (5 + \# \text{class}) * \# \text{anchor}$ )

### 3) Loss function

$$\begin{aligned}
 LOSS = & 1 - IoU + \frac{\rho^2(b, b^{gt})}{c^2} + \alpha v - \\
 & \sum_{i=0}^{S^2} \sum_{j=0}^B I_{ij}^{obj} \left[ \hat{C}_i \log(C_i) + \left(1 - \hat{C}_i\right) \log(1 - C_i) \right] - \\
 & \lambda_{noobj} \sum_{i=0}^{S^2} \sum_{j=0}^B I_{ij}^{noobj} \left[ \hat{C}_i \log(C_i) + \left(1 - \hat{C}_i\right) \log(1 - C_i) \right] - \\
 & \sum_{i=0}^{S^2} I_{ij}^{obj} \sum_{c \in classes} \left[ \hat{p}_i(c) \log(p_i(c)) + \left(1 - \hat{p}_i(c)\right) \log(1 - p_i(c)) \right]
 \end{aligned}$$



Method	Backbone	Size	FPS	AP	AP <sub>50</sub>	AP <sub>75</sub>	AP <sub>S</sub>	AP <sub>M</sub>	AP <sub>L</sub>
<b>YOLOv4: Optimal Speed and Accuracy of Object Detection</b>									
YOLOv4	CSPDarknet-53	416	38 (M)	41.2%	62.8%	44.3%	20.4%	44.4%	56.0%
YOLOv4	CSPDarknet-53	512	31 (M)	43.0%	64.9%	46.5%	24.3%	46.1%	55.2%
YOLOv4	CSPDarknet-53	608	23 (M)	43.5%	65.7%	47.3%	26.7%	46.7%	53.3%

**Average Precision (AP) :**

AP % AP at IoU=.50:.05:.95 (primary challenge metric)  
 AP<sup>IoU=.50</sup> % AP at IoU=.50 (PASCAL VOC metric)  
 AP<sup>IoU=.75</sup> % AP at IoU=.75 (strict metric)

**AP Across Scales:**

AP<sup>small</sup> % AP for small objects: area < 32<sup>2</sup>  
 AP<sup>medium</sup> % AP for medium objects: 32<sup>2</sup> < area < 96<sup>2</sup>  
 AP<sup>large</sup> % AP for large objects: area > 96<sup>2</sup>

**Average Recall (AR) :**

AR<sup>max=1</sup> % AR given 1 detection per image  
 AR<sup>max=10</sup> % AR given 10 detections per image  
 AR<sup>max=100</sup> % AR given 100 detections per image

**AR Across Scales:**

AR<sup>small</sup> % AR for small objects: area < 32<sup>2</sup>  
 AR<sup>medium</sup> % AR for medium objects: 32<sup>2</sup> < area < 96<sup>2</sup>  
 AR<sup>large</sup> % AR for large objects: area > 96<sup>2</sup>

## Evaluation Metric

In object detection problem, there are **lots of evaluation metrics.**

However, since it is dependent on the dataset, it is usually used to compare the performance between models with one dataset (coco, etc.).

In the real object detection problem, it is **necessary to qualitatively evaluate** whether unseen data is well detected during actual testing.

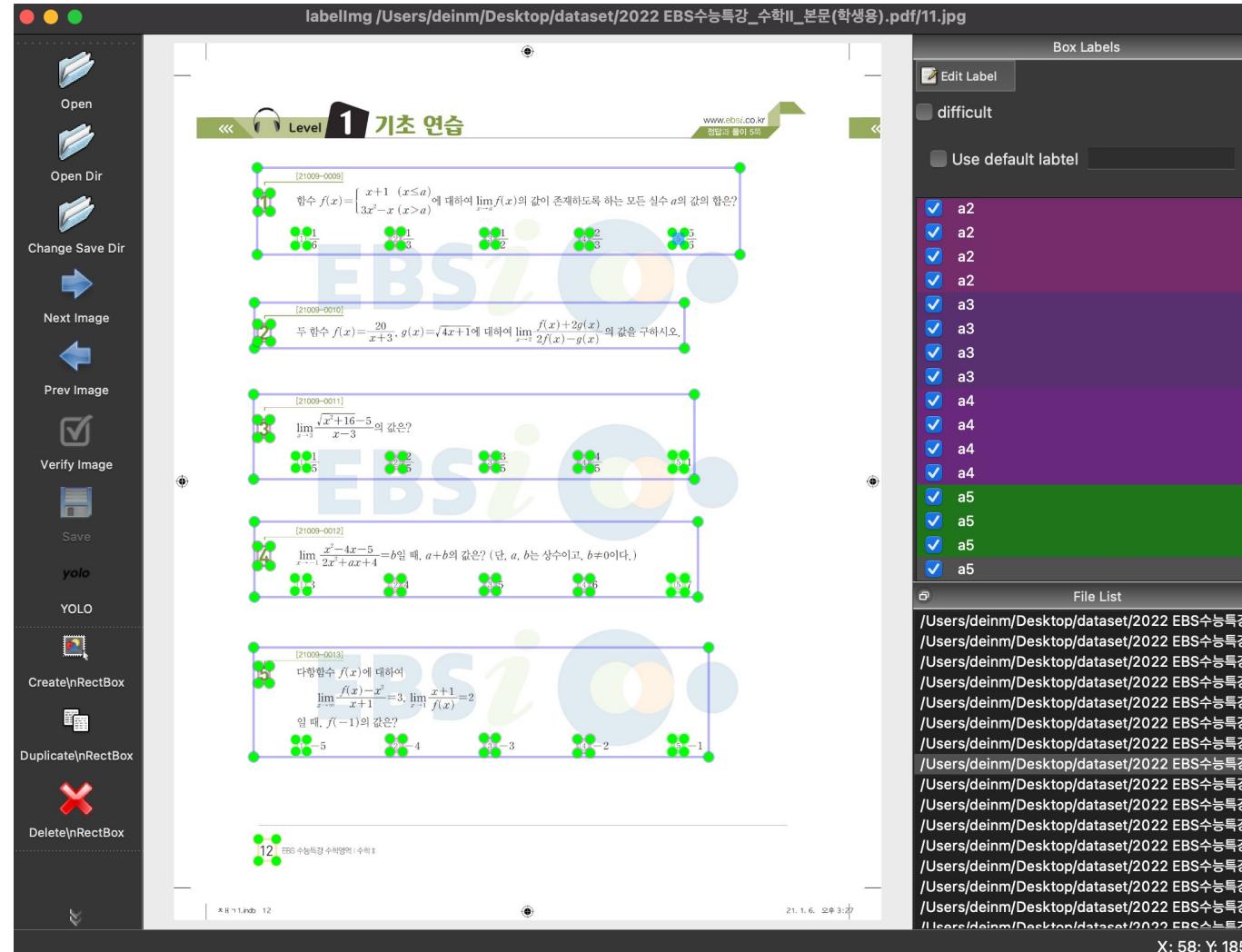
# AI - Data Labeling



민지	수특 수학I, 수학II
대열	수특 기하, 수완 기하
대희	수특 미적, 수완 미적
은지	수특 확통, 수완 확통

Total 400 pages, 1000 questions

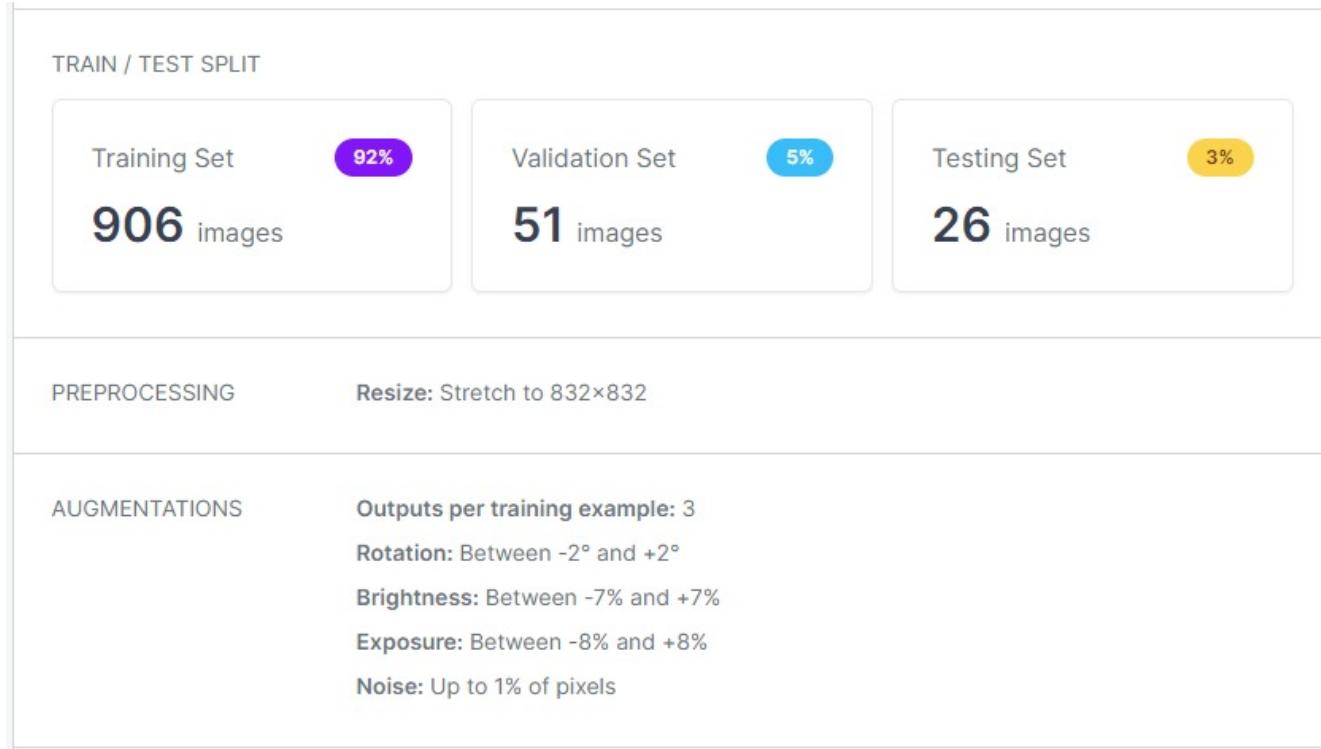
# AI - Data Labeling



- q(question)
- qn(question number)
- a1~a5(answer1~5)
- pn(page number)

<https://github.com/tzutalin/labelImg>

# AI - Data Augmentation



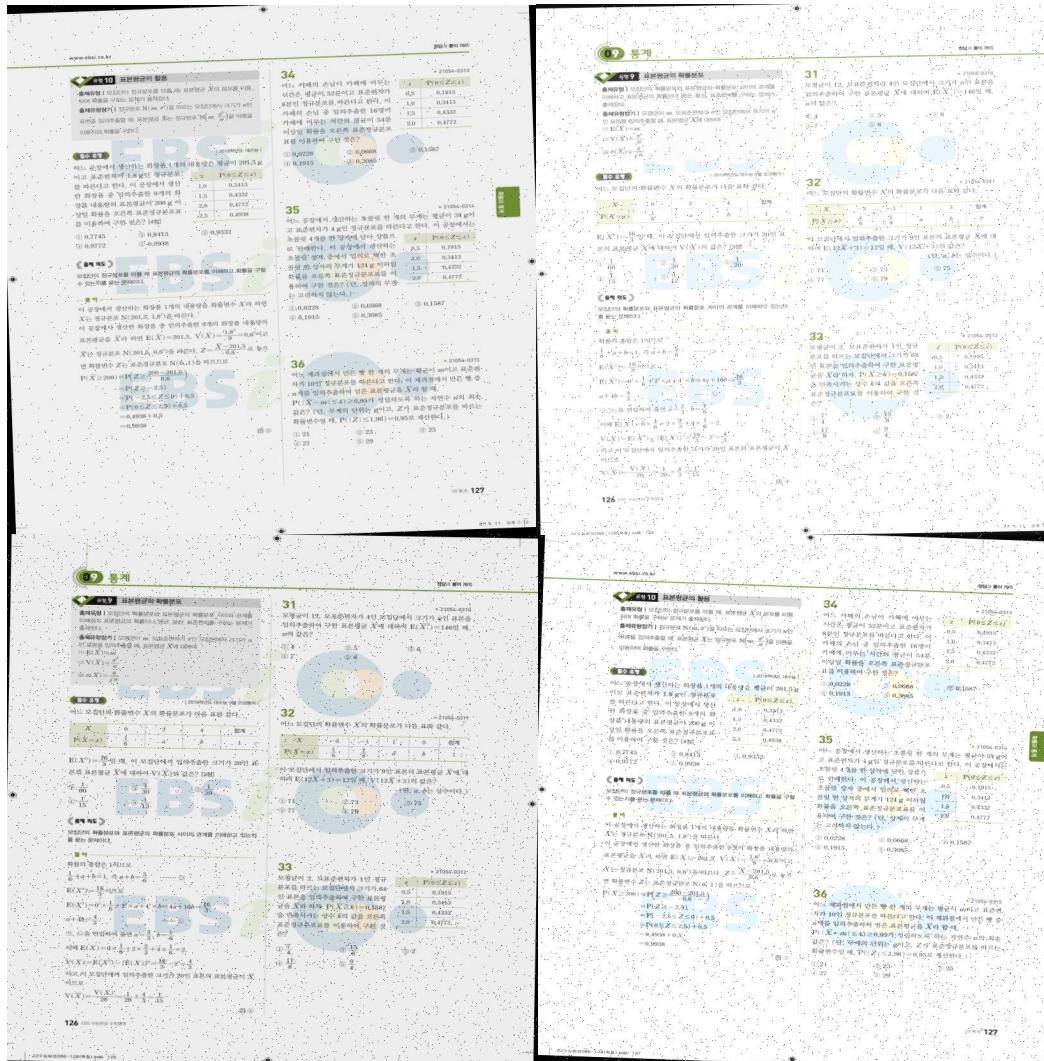
## Dataset

After labeling, we created a dataset by applying train/val/test split and augmentation.

Augmentation was applied for the purpose of increasing the train set and to create a **situation similar to the actual photographed image.**

# AI - Data Augmentation

- 2022\_SW\_3\_126.jpg.rf.b8cdea71be03f7e1590060add95152b3....
- 2022\_SW\_3\_126.jpg.rf.b8cdea71be03f7e1590060add95152b3....
- 2022\_SW\_3\_126.jpg.rf.1769235cb06f1fc5455ca833b0fc7024.txt
- 2022\_SW\_3\_126.jpg.rf.1769235cb06f1fc5455ca833b0fc7024.j...
- 2022\_SW\_3\_125.jpg.rf.9895543084cf4eb30d3b57d9a22f3f8b.txt
- 2022\_SW\_3\_125.jpg.rf.9895543084cf4eb30d3b57d9a22f3f8b.j...
- 2022\_SW\_3\_125.jpg.rf.5441776102c57bcad2d128caff312e1.txt
- 2022\_SW\_3\_125.jpg.rf.5441776102c57bcad2d128caff312e1.j...
- 2022\_SW\_3\_125.jpg.rf.488caf6db585a1b4ad23f5c98b08a2e2.txt
- 2022\_SW\_3\_125.jpg.rf.488caf6db585a1b4ad23f5c98b08a2e2.j...
- 2022\_SW\_3\_124.jpg.rf.7578fed2f9c28e4ba3aeee89f9da6065d.txt
- 2022\_SW\_3\_124.jpg.rf.7578fed2f9c28e4ba3aeee89f9da6065d.jpg
- 2022\_SW\_3\_124.jpg.rf.36daa8e01ee0876b2bfd2ced2e921b81t...
- 2022\_SW\_3\_124.jpg.rf.36daa8e01ee0876b2bfd2ced2e921b81j...
- 2022\_SW\_3\_123.jpg.rf.ffa7d994cab372a0e8ac14df44c1488e.txt
- 2022\_SW\_3\_123.jpg.rf.ffa7d994cab372a0e8ac14df44c1488e.jpg
- 2022\_SW\_3\_123.jpg.rf.444c94d57908ac9af850fe51eb0878f4.txt
- 2022\_SW\_3\_123.jpg.rf.444c94d57908ac9af850fe51eb0878f4.jpg
- 2022\_SW\_3\_123.jpg.rf.40b1770c0e5e62be58d1cd2dfa784c4a.t...
- 2022\_SW\_3\_123.jpg.rf.40b1770c0e5e62be58d1cd2dfa784c4aj...
- 2022\_SW\_3\_122.jpg.rf.ff7b5fd1f0ca785b76bb649bc4dfd4dd.txt
- 2022\_SW\_3\_122.jpg.rf.ff7b5fd1f0ca785b76bb649bc4dfd4dd.jpg
- 2022\_SW\_3\_122.jpg.rf.faf640548f5b8bdab4d7cbd3b28213df.txt
- 2022\_SW\_3\_122.jpg.rf.faf640548f5b8bdab4d7cbd3b28213df.jpg
- 2022\_SW\_3\_122.jpg.rf.460ca4b7ef091d4a099caec1e93534ad.txt
- 2022\_SW\_3\_122.jpg.rf.460ca4b7ef091d4a099caec1e93534ad.j...
- 2022\_SW\_3\_121.jpg.rf.de6338f6ec1ed65c2e9e91b07b06733f.txt
- 2022\_SW\_3\_121.jpg.rf.de6338f6ec1ed65c2e9e91b07b06733f.j...
- 2022\_SW\_3\_121.jpg.rf.42f1545de01d602510ffff5461535187c.txt
- 2022\_SW\_3\_121.jpg.rf.42f1545de01d602510ffff5461535187c.j...



# AI – Main Hyperparameters

## CFG Parameters in the [net] section

Alexey edited this page on 16 Jun 2020 · 5 revisions

### CFG-Parameters in the [net] section:

#### 1. [net] section

- o `batch=1` - number of samples (images, letters, ...) which will be precessed in one batch
- o `subdivisions=1` - number of mini\_batches in one batch, size `mini_batch = batch/subdivisions`, so GPU processes `mini_batch` samples at once, and the weights will be updated for `batch` samples (1 iteration processes `batch` images)
- o `width=416` - network size (width), so every image will be resized to the network size during Training and Detection
- o `height=416` - network size (height), so every image will be resized to the network size during Training and Detection
- o `channels=3` - network size (channels), so every image will be converted to this number of channels during Training and Detection
- o `inputs=256` - network size (inputs) is used for non-image data: letters, prices, any custom data
- o `max_chart_loss=20` - max value of Loss in the image `chart.png`

```
[net]
# Testing
#batch=1
#subdivisions=1
# Training
batch=64
subdivisions=16
width=416
height=416
channels=3
momentum=0.949
decay=0.0005
angle=0
saturation = 1.5
exposure = 1.5
hue=.1

learning_rate=0.001
burn_in=1000
max_batches = 16000
policy=steps
steps=12800,14400
scales=.1,.1

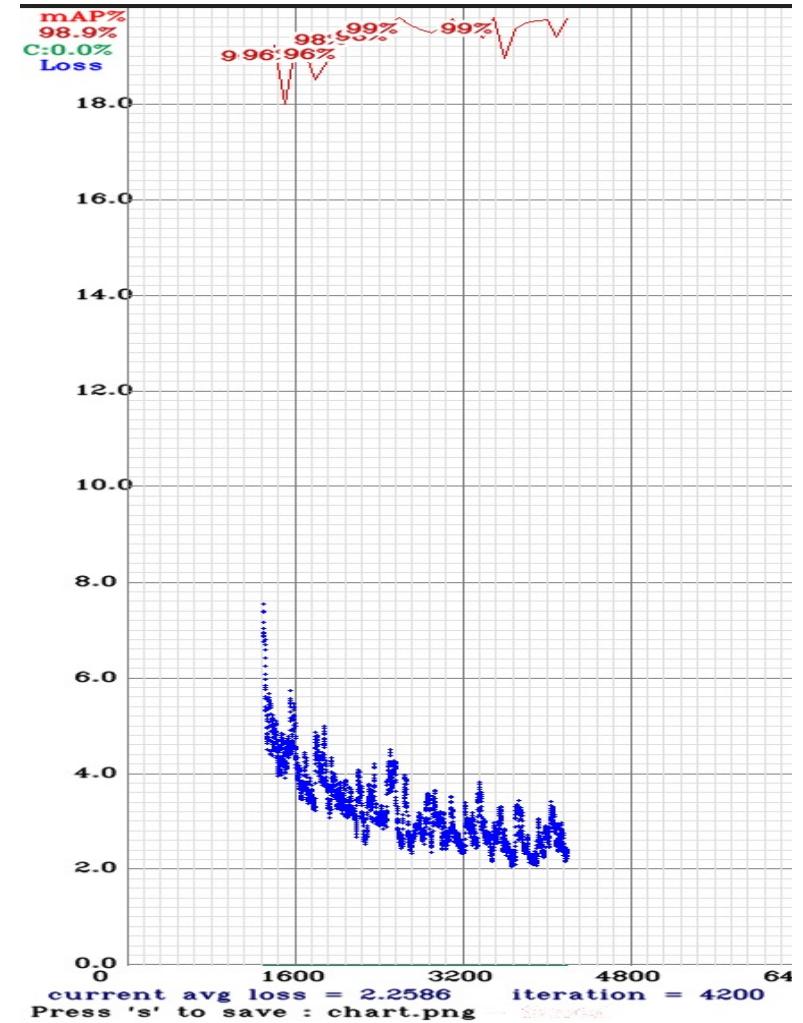
#cutmix=1
mosaic=1
```

# AI – Main Hyperparameters

```
(next mAP calculation at 4200 iterations)
Last accuracy mAP@0.50 = 96.95 %, best = 99.03 %
4200: 2.148810, 2.258631 avg loss, 0.001000 rate, 5.680183 seconds, 268800 images, 18.105155 hours left
Resizing to initial size: 416 x 416 try to allocate additional workspace_size = 52.43 MB
CUDA allocate done!

calculation mAP (mean average precision)...
Detection layer: 139 - type = 28
Detection layer: 150 - type = 28
Detection layer: 161 - type = 28
48
detections_count = 1243, unique_truth_count = 981
class_id = 0, name = a1, ap = 99.93% (TP = 121, FP = 3)
class_id = 1, name = a2, ap = 99.04% (TP = 121, FP = 6)
class_id = 2, name = a3, ap = 98.05% (TP = 119, FP = 2)
class_id = 3, name = a4, ap = 96.55% (TP = 118, FP = 8)
class_id = 4, name = a5, ap = 97.92% (TP = 119, FP = 6)
class_id = 5, name = pn, ap = 99.96% (TP = 44, FP = 0)
class_id = 6, name = q, ap = 99.99% (TP = 161, FP = 1)
class_id = 7, name = qn, ap = 100.00% (TP = 162, FP = 0)

for conf_thresh = 0.25, precision = 0.97, recall = 0.98, F1-score = 0.98
for conf_thresh = 0.25, TP = 965, FP = 26, FN = 16, average IoU = 75.12 %
```



```
"frame_id":2,
"filename":"data/test/16-marked.jpg",
"objects": [
    {"class_id":7, "name":"qn", "relative_coordinates":{"center_x":0.088511, "center_y":0.184436, "width":0.016257, "height":0.019415}, "confidence":0.984140},
    {"class_id":7, "name":"qn", "relative_coordinates":{"center_x":0.089032, "center_y":0.504020, "width":0.020627, "height":0.018493}, "confidence":0.982832},
    {"class_id":7, "name":"qn", "relative_coordinates":{"center_x":0.088125, "center_y":0.683966, "width":0.022226, "height":0.019109}, "confidence":0.980129},
    {"class_id":7, "name":"qn", "relative_coordinates":{"center_x":0.089482, "center_y":0.344396, "width":0.019841, "height":0.020271}, "confidence":0.950412},
    {"class_id":6, "name":"q", "relative_coordinates":{"center_x":0.483181, "center_y":0.220037, "width":0.919415, "height":0.147278}, "confidence":0.999480},
    {"class_id":6, "name":"q", "relative_coordinates":{"center_x":0.473475, "center_y":0.743913, "width":0.832438, "height":0.178773}, "confidence":0.998936},
    {"class_id":6, "name":"q", "relative_coordinates":{"center_x":0.480875, "center_y":0.378378, "width":0.917356, "height":0.136682}, "confidence":0.998782},
    {"class_id":6, "name":"q", "relative_coordinates":{"center_x":0.479361, "center_y":0.545566, "width":0.825833, "height":0.153383}, "confidence":0.995890},
    {"class_id":5, "name":"pn", "relative_coordinates":{"center_x":0.087907, "center_y":0.905967, "width":0.028873, "height":0.017941}, "confidence":0.936690},
    {"class_id":4, "name":"a5", "relative_coordinates":{"center_x":0.318163, "center_y":0.430582, "width":0.021244, "height":0.014300}, "confidence":0.983725},
    {"class_id":4, "name":"a5", "relative_coordinates":{"center_x":0.333444, "center_y":0.813176, "width":0.021405, "height":0.015173}, "confidence":0.973858},
    {"class_id":4, "name":"a5", "relative_coordinates":{"center_x":0.329343, "center_y":0.571078, "width":0.017106, "height":0.015231}, "confidence":0.964385},
    {"class_id":4, "name":"a5", "relative_coordinates":{"center_x":0.343615, "center_y":0.273188, "width":0.019345, "height":0.014749}, "confidence":0.957099},
    {"class_id":3, "name":"a4", "relative_coordinates":{"center_x":0.147253, "center_y":0.272463, "width":0.019646, "height":0.014591}, "confidence":0.972564},
    {"class_id":3, "name":"a4", "relative_coordinates":{"center_x":0.147105, "center_y":0.431366, "width":0.019852, "height":0.013975}, "confidence":0.881207},
    {"class_id":3, "name":"a4", "relative_coordinates":{"center_x":0.145730, "center_y":0.572350, "width":0.018171, "height":0.014369}, "confidence":0.824575},
    {"class_id":3, "name":"a4", "relative_coordinates":{"center_x":0.142539, "center_y":0.813598, "width":0.020920, "height":0.014761}, "confidence":0.521491},
    {"class_id":2, "name":"a3", "relative_coordinates":{"center_x":0.510761, "center_y":0.550358, "width":0.019185, "height":0.014818}, "confidence":0.958232},
    {"class_id":2, "name":"a3", "relative_coordinates":{"center_x":0.489552, "center_y":0.412049, "width":0.020466, "height":0.012769}, "confidence":0.928133},
    {"class_id":1, "name":"a2", "relative_coordinates":{"center_x":0.317887, "center_y":0.410908, "width":0.020438, "height":0.012071}, "confidence":0.989291},
    {"class_id":1, "name":"a2", "relative_coordinates":{"center_x":0.329175, "center_y":0.549998, "width":0.017544, "height":0.013789}, "confidence":0.981069},
    {"class_id":1, "name":"a2", "relative_coordinates":{"center_x":0.333100, "center_y":0.792784, "width":0.022226, "height":0.013306}, "confidence":0.977361},
    {"class_id":1, "name":"a2", "relative_coordinates":{"center_x":0.343630, "center_y":0.253631, "width":0.018945, "height":0.012571}, "confidence":0.956280},
    {"class_id":0, "name":"a1", "relative_coordinates":{"center_x":0.147870, "center_y":0.251824, "width":0.018447, "height":0.012919}, "confidence":0.969067},
    {"class_id":0, "name":"a1", "relative_coordinates":{"center_x":0.146556, "center_y":0.549848, "width":0.017012, "height":0.014766}, "confidence":0.955346},
    {"class_id":0, "name":"a1", "relative_coordinates":{"center_x":0.147713, "center_y":0.411763, "width":0.017547, "height":0.013414}, "confidence":0.938136},
    {"class_id":0, "name":"a1", "relative_coordinates":{"center_x":0.142855, "center_y":0.792399, "width":0.020920, "height":0.014034}, "confidence":0.798333}
]
}
]
```

**EBS**

www.ebsi.co.kr

5지선다형  
q: 1.00 0.99

기하  
23  
21054-1083  
좌표공간의 두 점 A(3, 0, 2), B(6, 4, -2)에 대하여 삼각형 OAB의 xy평면 위모의 정사영의 넓이는?  
a1: 0.99 a2: 0.98 a3: 0.97  
a4: 0.70 a5: 0.77 a6: 0.8  
① 10 ② 12 ③ 8

q: 1.00 0.97  
25  
21054-1085  
좌표평면 위의 두 점 A(-4, 1), B(0, 8)과 직선  $y=2x-3$  위의 첫 P에 대하여 선분 AP를 2:1로 내분하는 점을 Q라 하자. 점 Q가 다음 조건을 만족시킬 때,  $\overline{PA} \cdot \overline{PQ}$ 의 값은? [3점]  
(P) 점 Q는 제1사분면의 점이다.  
a1: 0.97 a2: 0.96 a3: 0.73  
a4: 0.75 a5: 0.97 a6: 0.8  
① 39 ② 40 ③ 18

q: 1.00 0.99  
26  
21054-1086  
[그림 1]과 같이  $AB=AC=4\sqrt{3}$ 인 직각이등변삼각형 ABC 모양의 종이와  $AD=AE=6\sqrt{3}$ 인 직각이등변삼각형 ADE 모양의 종이가 한 평면에 놓여 있고 첨 D는 변 AC 위에 있다. 선분 BC 위의 점 F와 선분 DE 위의 점 G에 대하여  $\angle FAC = \angle GAE = 30^\circ$ 이다. [그림 2]와 같이 삼각형 ABC를 선분 AE를 접는 선으로 하여 평면 ABF와 평면 AFC가 수직이 되도록 접고, 삼각형 ADE를 선분 AG를 접는 선으로 하여 평면 AGE와 평면 ADG가 수직이 되도록 접었다. [그림 3]에서 선분 BE의 길이는? (단, [그림 2]에서 선분 BE는 평면 AFC와 만나지 않고, 종이의 두께는 고려하지 않는다.) [3점]  
a1: 0.98 a2: 0.89 a3: 0.99  
a4: 0.62 a5: 0.46 a6: 0.8  
① 36/2 ② 45/2 ③ 32/2

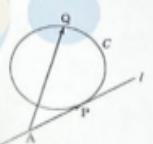
q: 0.97  
152 EBS 수능진단 수학영역

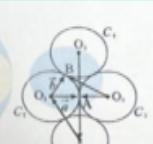
22수능영역1-29-168(국어-기하)-9.indd 152  
21. 5. 11. 20 7:11

**EBS**

Level 1 기초 연습  
q: 1.00  
21012-0098  
1 그림과 같이 한 평면에 한 번의 길이가 1인 정삼각형 4개를 한 평면에 붙여 만든 도형이다. 정삼각형들의 꼭짓점 6개 중 한 점을 시험으로 하고 다른 한 점을 풍점으로 하는 벡터의 크기를 k라 할 때, 모든 k의 값은?  
a1: 0.99 a2: 0.97 a3: 0.95  
a4: 0.97 a5: 0.98 a6: 3/4  
① 4/3 ② 5/3 ③ 3/4  


q: 1.00  
21012-0099  
2 그림과 같이 한 평면에 한 번의 길이가 2인 정삼각형 ABC와 한 번의 길이가 1인 정삼각형 CDEF가 있다. 선분 BC의 중점을 M이라 할 때,  $|\overline{FM} + \overline{CA}|^2$ 의 값은? (단, M과 C는 평면 B, C, D, E 위에 있다.)  
a1: 0.88 a2: 0.99 a3: 0.99  
a4: 0.81 a5: 0.99 a6: 8/23  
① 9+7/3 ② 10+2/3 ③ 8-2/3

q: 0.99  
21012-0099  
3 그림과 같이 한 평면에 반지름의 길이가 3인 원 C와 직선 l이 점 P에서 접한다. 직선 l과 원 C 위의 점 Q, 원 C 위의 점 R에 대하여  $\overline{AP}$ ,  $\overline{AQ}$ ,  $\overline{AR}$ 의 합 m+n의 값은?  
a1: 0.99 a2: 0.99 a3: 0.99  
a4: 0.97 a5: 0.90 a6: 8  
① 9 ② 10 ③ 8  


q: 1.00  
21012-0098  
4 그림과 같이 반지름의 길이가 같은 네 원  $C_1$ ,  $C_2$ ,  $C_3$ ,  $C_4$ 의 중심이 각각  $O_1$ ,  $O_2$ ,  $O_3$ ,  $O_4$ 이고 두 원  $C_1$ ,  $C_2$ 의 교점을 A, 두 원  $C_3$ ,  $C_4$ 의 교점을 B라 하자.  $\overline{O_1A} = \vec{a}$ ,  $\overline{O_1B} = \vec{b}$ 라 할 때,  $\overline{O_1O_2} + \overline{O_3O_4} + \overline{O_1B} - \overline{O_1A} = m\vec{a} + n\vec{b}$ 를 만족시키는 두 실수 m, n의 합 m+n의 값은?  
a1: 0.99 a2: 0.97 a3: 0.95  
a4: 0.98 a5: 0.97 a6: 0  
① 1 ② 2 ③ 0  


pn: 0.95  
46 EBS 수능진단 수학영역 : 기하

21. 1. 8. 모  
1 1.indd 46  
21. 5. 11. 20 7:11

www.ebsi.co.kr  
성균관대학교 25주년

q: 0.91  
qn: 0.98<sub>(0073)</sub>  
6 a1: 0.82  $\sin 25x$  a2: 0.95  $\sin \theta + \cos \theta$ , a3: 0.97  $\sin \theta$ , a4: 0.97  $\sin \theta$ , a5: 0.91  
(① 1) (② 3) (③ 5) (④ 7) (⑤ 9)

q: 0.99  
qn: 0.95<sub>(0074)</sub>  
7 a1: 0.92  $\sin 6\pi x$  a2: 0.99  $\sin y = \frac{1}{2}$  a3: 0.99  $\sin^2 \theta$ , a4: 0.98 a5: 0.92  
(① 31) (② 33) (③ 35) (④ 37) (⑤ 39)

q: 0.99  
qn: 0.98<sub>(0075)</sub>  
8 a1: 0.95  $\sin \theta$ , a2: 0.97  $\sin x + 2$ , a3: 0.98  $\sin x + 2$ , a4: 0.99 a5: 0.88  
(① 1) (② 2) (③ 3) (④ 4) (⑤ 5)

q: 0.98  
qn: 0.97<sub>(0076)</sub>  
9 a1: 0.99  $\sin x - \cos x$ , a2: 0.98  $\sin x - \cos x$ , a3: 0.99  $\sin x + \cos x$ , a4: 0.99 a5: 0.97  
(①  $\frac{1}{12}$ ) (②  $\frac{1}{6}$ ) (③  $\frac{1}{4}$ ) (④  $\frac{1}{3}$ ) (⑤  $\frac{5}{12}$ )

q: 1.00  
qn: 0.98<sub>(0077)</sub>  
10 a1: 0.90  $\sin 420^\circ$ , a2: 0.97  $\cos 315^\circ$ , a3: 0.97 a4: 0.97 a5: 0.55  
(①  $\frac{1}{2}$ ) (② 1) (③  $\frac{3}{2}$ ) (④ 2) (⑤  $\frac{5}{2}$ )

pn: 0.90  
03 실직함수의 빛과 그림 47

101.indd 47 21. 1. 6. 2014

www.ebsi.co.kr  
성균관대학교 25주년

q: 0.93  
qn: 0.98<sub>(0073)</sub>  
6 a1: 0.97  $\sin 25x$  a2: 0.92  $\sin \theta + \cos \theta$ , a3: 0.96  $\sin \theta$ , a4: 0.96  $\sin \theta$ , a5: 0.93  
(① 1) (② 3) (③ 5) (④ 7) (⑤ 9)

q: 0.99  
qn: 0.97<sub>(0074)</sub>  
7 a1: 0.94  $\sin 6\pi x$  a2: 0.97  $\sin y = \frac{1}{2}$  a3: 0.99  $\sin^2 \theta$ , a4: 0.95 a5: 0.95  
(① 31) (② 33) (③ 35) (④ 37) (⑤ 39)

q: 0.99  
qn: 0.98<sub>(0075)</sub>  
8 a1: 0.99  $\sin \theta$ , a2: 0.94  $\sin x + 2$ , a3: 0.98  $\sin x + 2$ , a4: 0.98 a5: 0.98  
(① 1) (② 2) (③ 3) (④ 4) (⑤ 5)

q: 0.99  
qn: 0.98<sub>(0076)</sub>  
9 a1: 0.99  $\sin x - \cos x - 1$ , a2: 0.99  $\sin x - \cos x - 1$ , a3: 0.99  $\sin x + \cos x$ , a4: 0.96 a5: 0.97  
(①  $\frac{1}{12}$ ) (②  $\frac{1}{6}$ ) (③  $\frac{1}{4}$ ) (④  $\frac{1}{3}$ ) (⑤  $\frac{5}{12}$ )

q: 1.00  
qn: 0.98<sub>(0077)</sub>  
10 a1: 0.96  $\sin 420^\circ$ , a2: 0.77  $\cos 315^\circ$ , a3: 0.98 a4: 0.96 a5: 0.96  
(①  $\frac{1}{2}$ ) (② 1) (③  $\frac{3}{2}$ ) (④ 2) (⑤  $\frac{5}{2}$ )

pn: 0.96  
03 실직함수의 빛과 그림 47

101.indd 47 21. 1. 6. 2014

## Challenges & Ideas(todo)

- Very occasionally, some answer numbers are not recognized.  
→ Mostly it is caused by rolling against paper crumpling. so, additional augmentation of this will be help.
- Marking answers may not be recognized.  
→ After removing the label of the made number, making an additional train set
- Inference time problem  
→ It is expected that it will be possible even in the CPU situation, but if it is impossible, use YOLOv4-tiny model

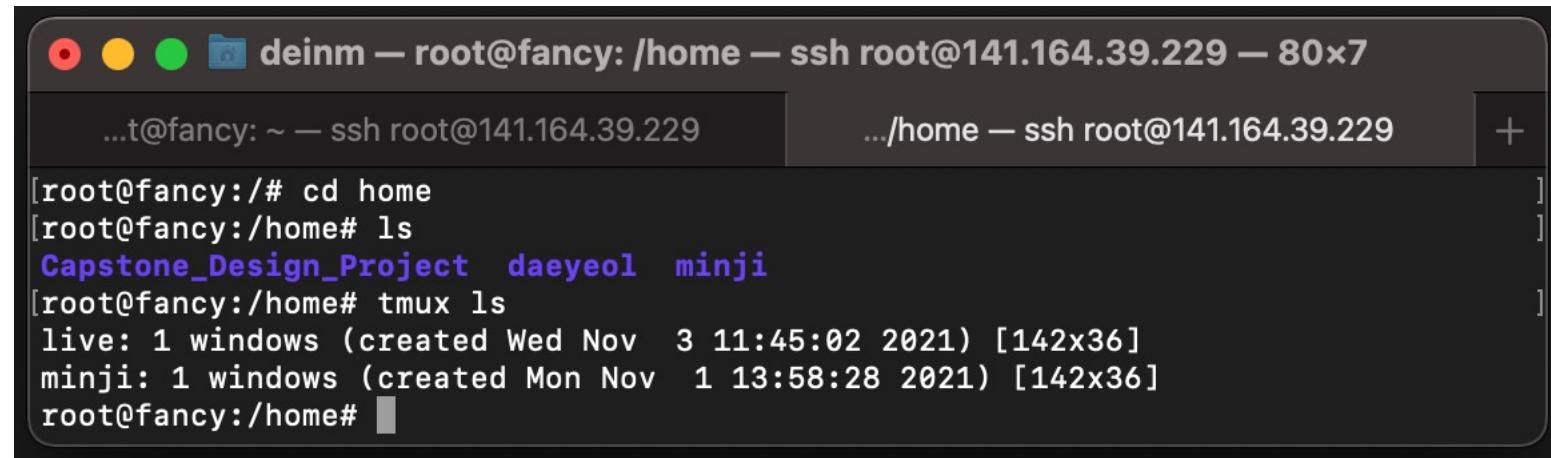
## Limitation & Assumption

- The user must take a good photo.  
→ Provide a guide, request a re-shoot if the recognition result is below a certain level

# API SERVER - Settings



Server	OS	Location	Charges	Status	...
<input type="checkbox"/> fancy 1024 MB High Frequency - 141.164.39.229		 Seoul	\$0.68	 Running	



```
deinm — root@fancy: /home — ssh root@141.164.39.229 — 80x7
...t@fancy: ~ — ssh root@141.164.39.229           .../home — ssh root@141.164.39.229 +[+]
[root@fancy:/# cd home
[root@fancy:/home# ls
Capstone_Design_Project  daeyeol  minji
[root@fancy:/home# tmux ls
live: 1 windows (created Wed Nov  3 11:45:02 2021) [142x36]
minji: 1 windows (created Mon Nov  1 13:58:28 2021) [142x36]
root@fancy:/home# ]]
```

Our API server is always running on server with tmux!

# API SERVER - Database



**Android - 1**



오답노트

2021 수능특강 18 문제

변수학 18 문제

2021 수능특강 18 문제

2021 수능특강 18 문제

업적

모답노트

학습기록

**Android - 3**



2021 수능특강

문제 촬영

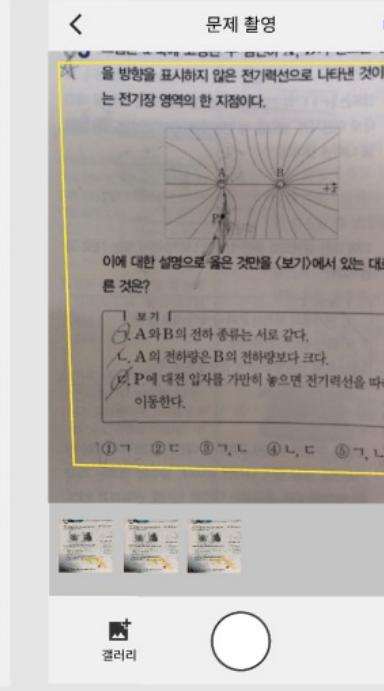
다음

삼각함수 2021.10.03

삼각함수 2021.10.03

업적

**Android - 2**



문제 촬영

다음

을 방향을 표시하지 않은 전기력선으로 나타낸 것이다. P는 전기장 영역의 한 지점이다.

A와 B의 전하 종류는 서로 같다.  
A의 전하량은 B의 전하량보다 크다.  
P에 대전 입자를 가만히 놓으면 전기력선을 따라 이동한다.

① ㄱ ② ㄴ ③ ㄱ, ㄴ ④ ㄴ, ㄷ ⑤ ㄱ, ㄴ, ㄷ

보기

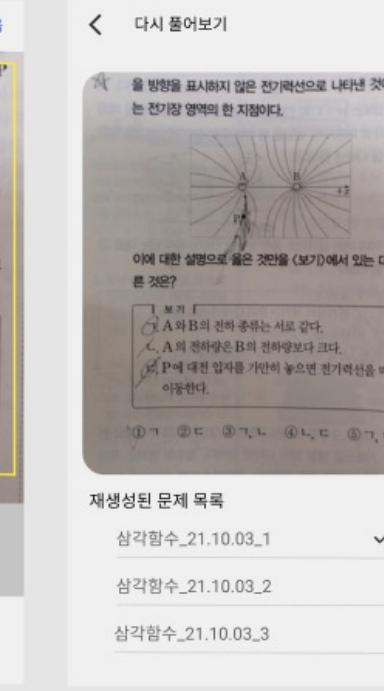
재생성된 문제 목록

삼각함수\_21.10.03\_1

삼각함수\_21.10.03\_2

삼각함수\_21.10.03\_3

**Android - 13**



다시 풀어보기

을 방향을 표시하지 않은 전기력선으로 나타낸 것이다. P는 전기장 영역의 한 지점이다.

A와 B의 전하 종류는 서로 같다.  
A의 전하량은 B의 전하량보다 크다.  
P에 대전 입자를 가만히 놓으면 전기력선을 따라 이동한다.

① ㄱ ② ㄴ ③ ㄱ, ㄴ ④ ㄴ, ㄷ ⑤ ㄱ, ㄴ, ㄷ

시작이반

3일연속!

7일연속!

한달연속!

목표달성

성적떡상

대기만성

바꿔바꿔

천재만재

**Android - 10**



나의 업적

2021년 10월

일	월	화	수	목	금	토
26	27	28	29	30	1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31	1	2	3	4	5	6

이번 달 출석 일수 4일

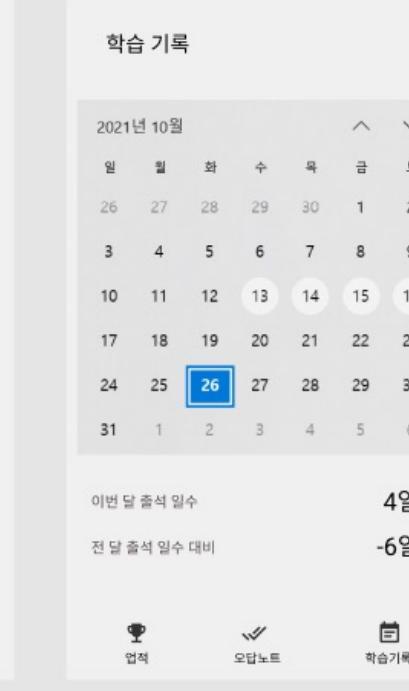
전 달 출석 일수 대비 6일

업적

모답노트

학습기록

**Android - 11**



학습 기록

2021년 10월

업적

모답노트

학습기록

# UI/UX Design based on Figma

## Done

- Sign up/Sign in Page

## In Progress

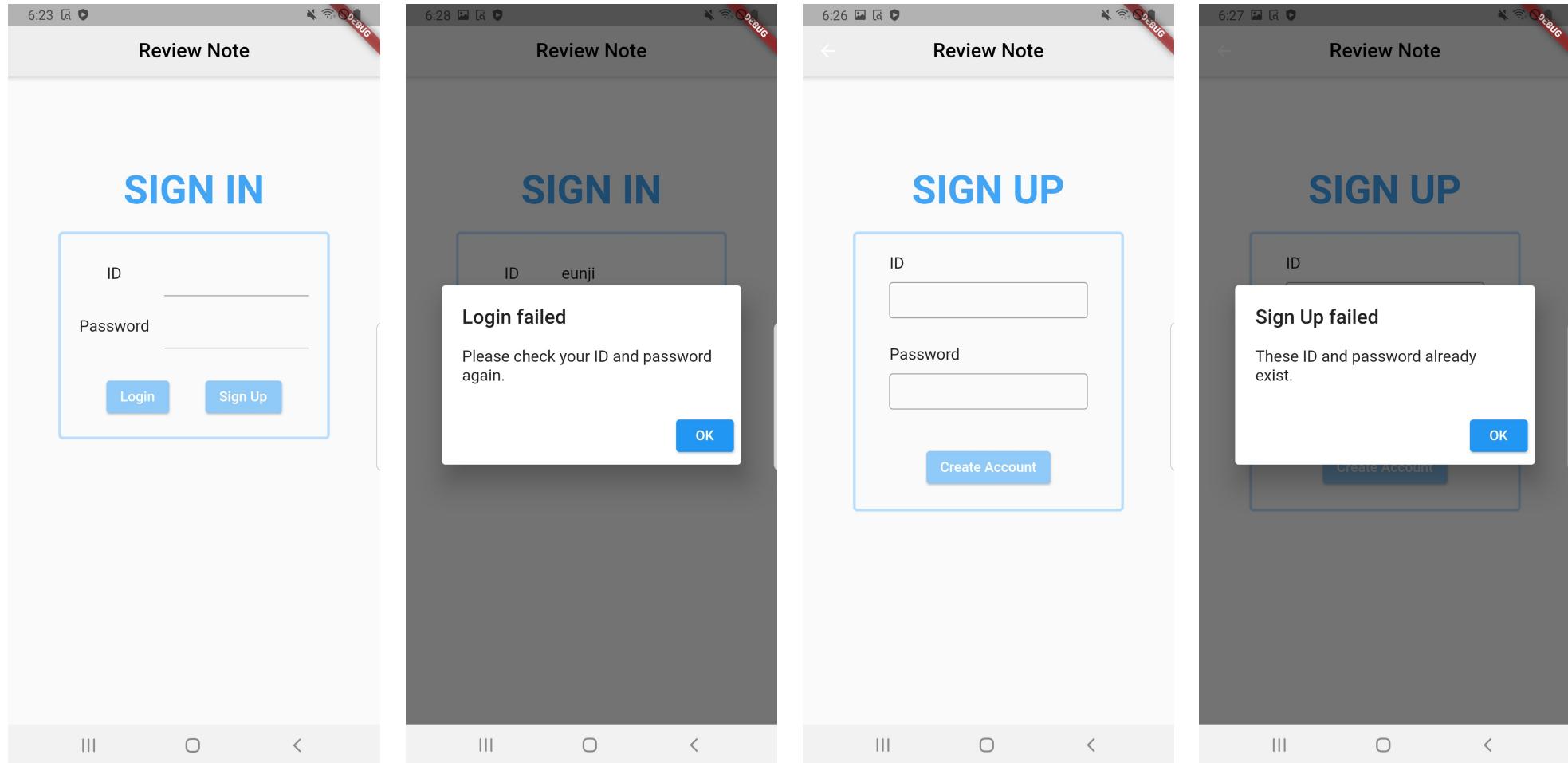
- Study log page
- Review note page
- Camera functions

## To-do

- Achievement page
- Detailed question page
- Regenerated question page

## APP – Sign up/Sign in

Done



Show alert or navigate user according to API server response code

## APP – Sign up/Sign in

Done

- POST /user

- Parameters

Name	Type	Description
header user_id	string	유저의 로그인 아이디입니다.
header user_pw	string	유저의 로그인 비밀번호입니다.

- Responses

Status Code	Values	Description
200	{user_ssd: 12}	유저의 ssd 정보를 반환합니다.
409		이미 존재하는 id입니다.
500		

- GET /user

- Parameters

Name	Type	Description
header user_id	string	유저의 로그인 아이디입니다.
header user_pw	string	유저의 로그인 비밀번호입니다.

- Responses

Status Code	Values	Description
200	{user_ssd: 12}	유저의 ssd 정보를 반환합니다.
401		등록되지 않은 유저입니다.
500		

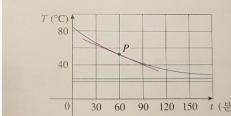
6:28 DEBUG

### Review Note

- 2021 수능특강 미적분**
- 2021 수능완성 모의고사**
- 2020 수능특강 확통**

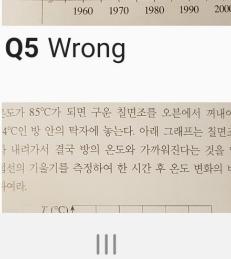
**Q3 Correct**

도가  $85^{\circ}\text{C}$ 가 되면 구운 칠면조를 오븐에서 꺼내어 온  $4^{\circ}\text{C}$ 인 방 안의 박자에 놓는다. 아래 그레프는 칠면조의 내려가서 결국 밤의 온도와 가까워진다는 것을 알려진 기울기를 측정하여 한 시간 후 온도 변화의 비율을 구하라.



**Q5 Wrong**

도가  $85^{\circ}\text{C}$ 가 되면 구운 칠면조를 오븐에서 꺼내어 온  $4^{\circ}\text{C}$ 인 방 안의 박자에 놓는다. 아래 그레프는 칠면조의 내려가서 결국 밤의 온도와 가까워진다는 것을 알려진 기울기를 측정하여 한 시간 후 온도 변화의 비율을 구하라.



**Study Log** **Review Note** **Achievement**

6:28 DEBUG

### 2021 수능특강 미적분

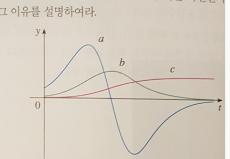
별 실업률을  $U(t)$ 라 하자. 아래는 1995년부터 2004년에 대한 실업률을 나타낸 표이다.

$t$	$U(t)$	$t$	$U(t)$
1995	8.1	2000	6.2
1996	8.0	2001	6.9
1997	8.2	2002	6.5
1998	7.9	2003	6.2
1999	6.7	2004	5.6

$U'(t)$ 는 어떤 의미인가? 이것의 단위는 무엇인가?  
 $U'(t)$ 의 값을 추측하여 표를 만들어라.

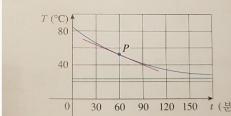
**Q1 Correct**

별 세 개의 함수의 그레프가 있다. 자동차의 위치함수, 차의 속도, 자동차의 가속도인데, 각각이 어떤 과선인지를 그 이유를 설명하여라.



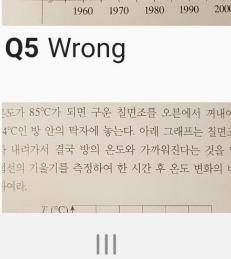
**Q2 Wrong**

도가  $85^{\circ}\text{C}$ 가 되면 구운 칠면조를 오븐에서 꺼내어 온  $4^{\circ}\text{C}$ 인 방 안의 박자에 놓는다. 아래 그레프는 칠면조의 내려가서 결국 밤의 온도와 가까워진다는 것을 알려진 기울기를 측정하여 한 시간 후 온도 변화의 비율을 구하라.



**Q4 Correct**

도가  $85^{\circ}\text{C}$ 가 되면 구운 칠면조를 오븐에서 꺼내어 온  $4^{\circ}\text{C}$ 인 방 안의 박자에 놓는다. 아래 그레프는 칠면조의 내려가서 결국 밤의 온도와 가까워진다는 것을 알려진 기울기를 측정하여 한 시간 후 온도 변화의 비율을 구하라.



**Q6 Correct**

6:28 DEBUG

### Review Note

- 2021 수능특강 미적분 Review**
- 2021 수능완성 모의고사 Review**
- 2020 수능특강 확통 Review**

**Study Log** **Review Note** **Achievement**

6:28 DEBUG

### 2021 수능특강 미적분 Review

별 실업률을  $U(t)$ 라 하자. 아래는 1995년부터 2004년에 대한 실업률을 나타낸 표이다.

$t$	$U(t)$	$t$	$U(t)$
1995	8.1	2000	6.2
1996	8.0	2001	6.9
1997	8.2	2002	6.5
1998	7.9	2003	6.2
1999	6.7	2004	5.6

$U'(t)$ 는 어떤 의미인가? 이것의 단위는 무엇인가?  
 $U'(t)$ 의 값을 추측하여 표를 만들어라.

**Q2 Wrong**

도가  $85^{\circ}\text{C}$ 가 되면 구운 칠면조를 오븐에서 꺼내어 온  $4^{\circ}\text{C}$ 인 방 안의 박자에 놓는다. 아래 그레프는 칠면조의 내려가서 결국 밤의 온도와 가까워진다는 것을 알려진 기울기를 측정하여 한 시간 후 온도 변화의 비율을 구하라.

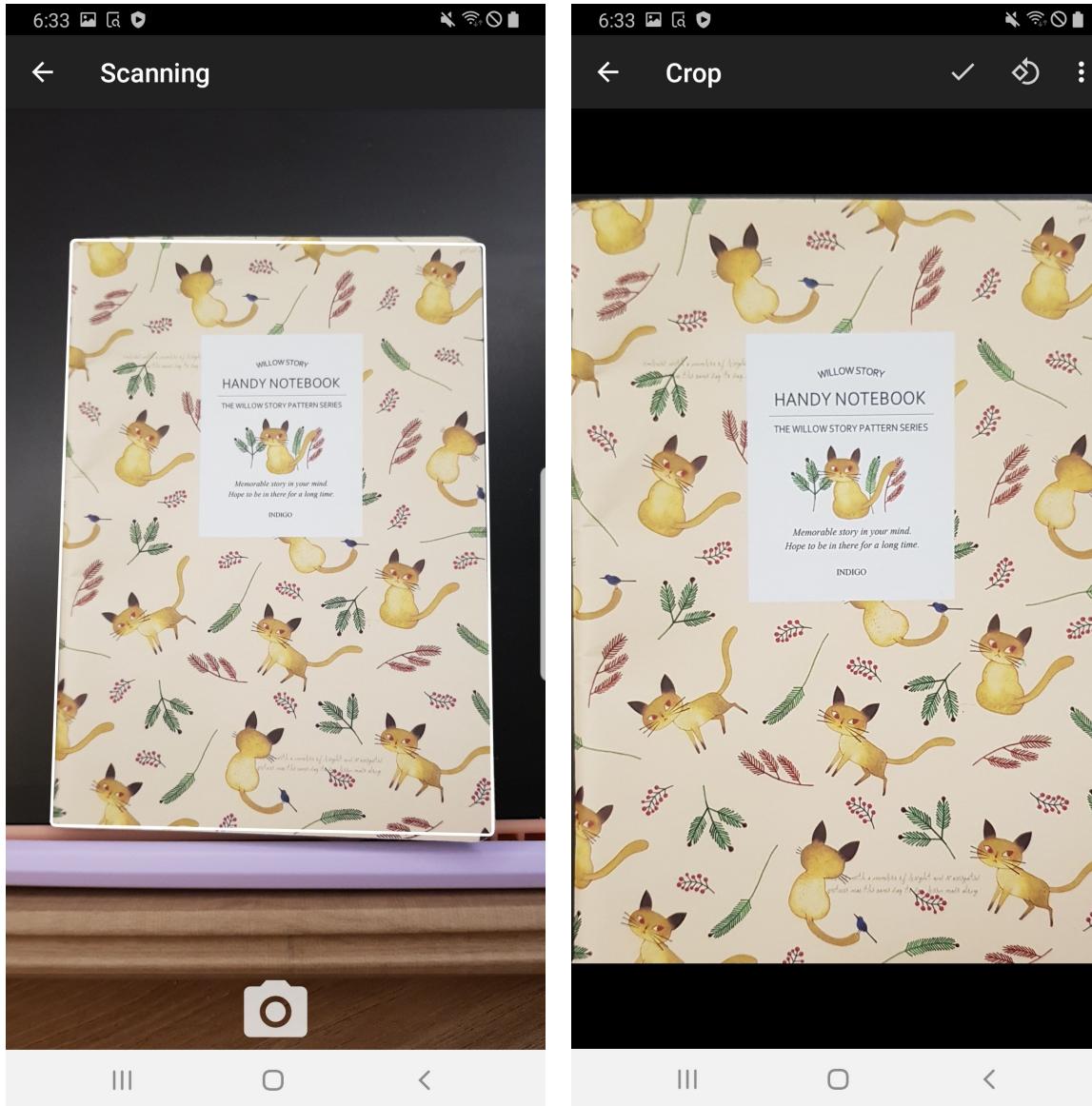


**Q5 Wrong**

도가  $85^{\circ}\text{C}$ 가 되면 구운 칠면조를 오븐에서 꺼내어 온  $4^{\circ}\text{C}$ 인 방 안의 박자에 놓는다. 아래 그레프는 칠면조의 내려가서 결국 밤의 온도와 가까워진다는 것을 알려진 기울기를 측정하여 한 시간 후 온도 변화의 비율을 구하라.



**Q10 Wrong**

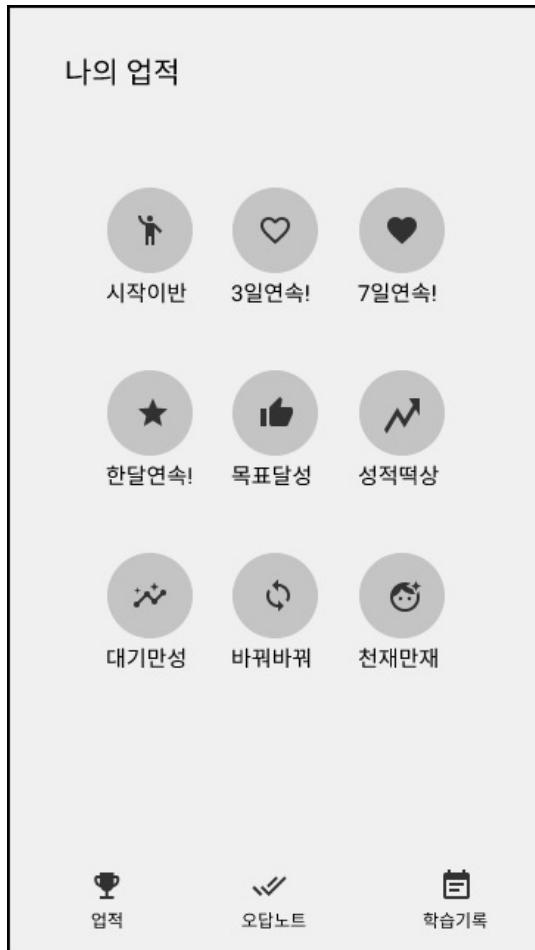


## Implemented

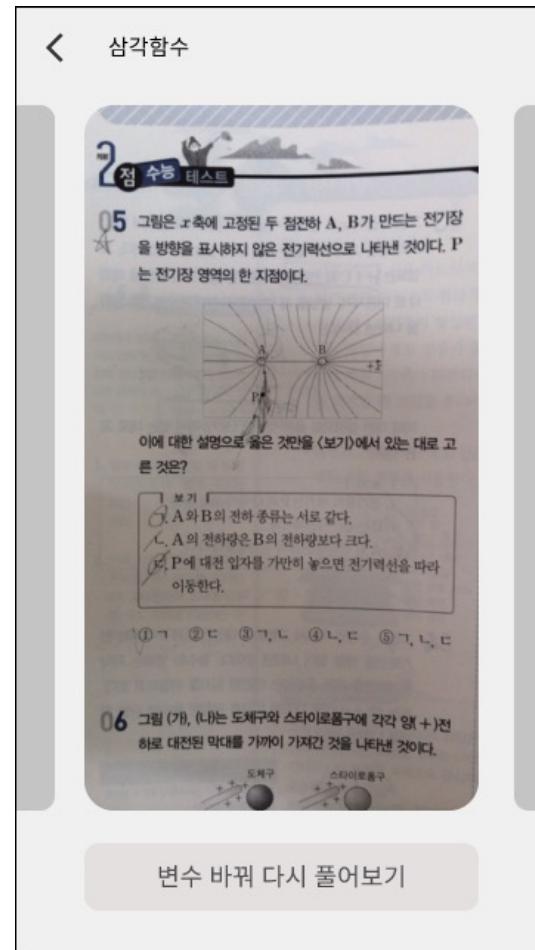
- Take picture, and crop/scan image

## To-Do

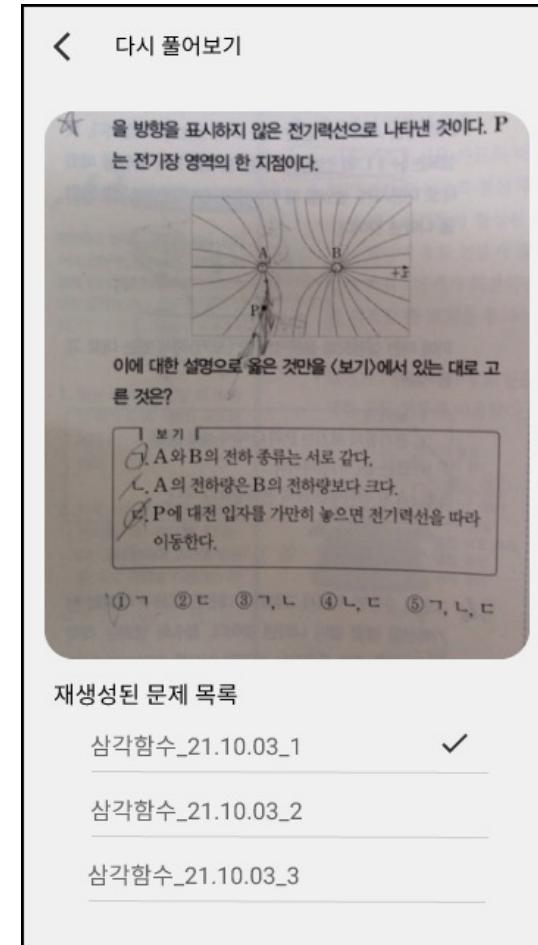
- Make user take the image according to our flow



Achievement



Detailed Question



Regenerated Question

## Challenges

We had some misunderstandings between the app functionalities  
-> But we aligned our understandings by communication while developing our database scheme and UI/UX flow!

How can we make user to take a “good” picture? How can we crop interested area easily?  
-> Decided to make user to select four points to crop and process image by using Flutter library “edge\_detection”

## Limitations

We have not tried to save images in the Database yet  
-> First, we will try to save binary code of images in database.  
If it is too heavy or impossible, we will save images in our API server.

It was hard to modify “edge\_detection” library as we want  
-> Couldn’t change the view layout as we wanted  
-> Maybe we can add a new guideline page to show user the current progress

Capstone Design Project

# DEMO VIDEO



Thanks