

YOLO v5를 이용한 실시간 객체 탐지

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- 이미지 전체를 단 한번만 본다 : You Only Look Once
 - YOLO 이전의 모델 중 대표적인 R-CNN 처럼 이미지를 여러장으로 분할해 해석하지 않는다.
 - YOLO는 이미지 전체를 말 그대로 한 번만 본다.
- 통합된 모델을 사용 : one-stage-detection
 - 다른 객체 탐지 모델들은 다양한 전처리 모델과 인공 신경망을 결합하여 사용한다.
 - YOLO는 단 하나의 인공 신경망을 사용하여 처리한다.
- 실시간 객체 탐지 모델
 - 기존 모델보다 빠른 성능으로 실시간 객체 탐지가 가능하다.
 - 작은 객체에 정확도가 낮다.

Quick Start Examples

- 오픈 소스 저장소
 - <https://github.com/ultralytics/yolov5>
- 설치

```
% git clone https://github.com/ultralytics/yolov5 # clone
% cd yolov5
% pip install -r requirements.txt # install
```

Pre-trained 모델 추론

```
import torch

# Model
model = torch.hub.load('ultralytics/yolov5', 'yolov5s') # or yolov5n - y
olov5x6, custom

# Images
img = 'https://ultralytics.com/images/zidane.jpg' # or file, Path, PIL,
OpenCV, numpy, list

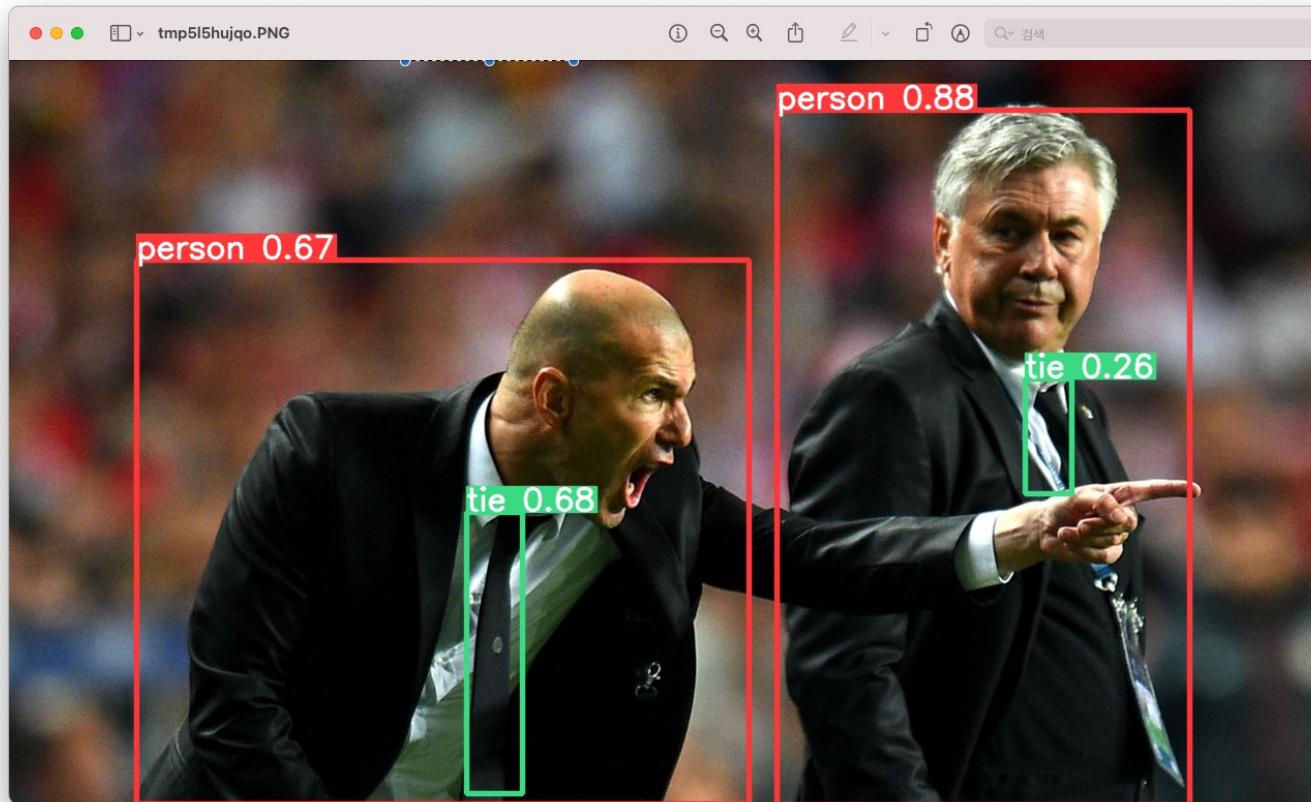
# Inference
results = model(img)

# Results
results.show() # or .print(), .save(), .crop(), .pandas(), etc.
```

Yolo v5 Pre-trained 모델

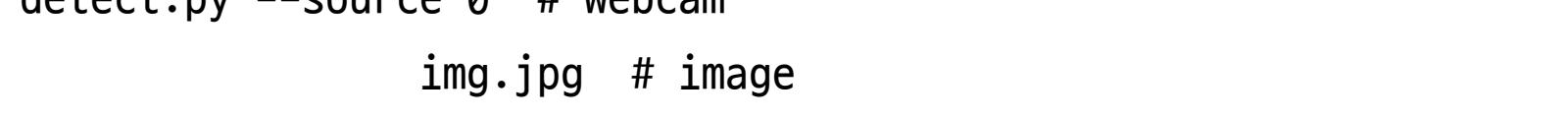
```
nc: 80 # number of classes  
names: ['person', 'bicycle', 'car', 'motorcycle', 'airplane', 'bus', 'train', 'truck', 'boat', 'traffic light',  
'fire hydrant', 'stop sign', 'parking meter', 'bench', 'bird', 'cat', 'dog', 'horse', 'sheep', 'cow',  
'elephant', 'bear', 'zebra', 'giraffe', 'backpack', 'umbrella', 'handbag', 'tie', 'suitcase', 'frisbee',  
'skis', 'snowboard', 'sports ball', 'kite', 'baseball bat', 'baseball glove', 'skateboard', 'surfboard',  
'tennis racket', 'bottle', 'wine glass', 'cup', 'fork', 'knife', 'spoon', 'bowl', 'banana', 'apple',  
'sandwich', 'orange', 'broccoli', 'carrot', 'hot dog', 'pizza', 'donut', 'cake', 'chair', 'couch',  
'potted plant', 'bed', 'dining table', 'toilet', 'tv', 'laptop', 'mouse', 'remote', 'keyboard', 'cell phone',  
'microwave', 'oven', 'toaster', 'sink', 'refrigerator', 'book', 'clock', 'vase', 'scissors', 'teddy bear',  
'hair drier', 'toothbrush'] # class names
```

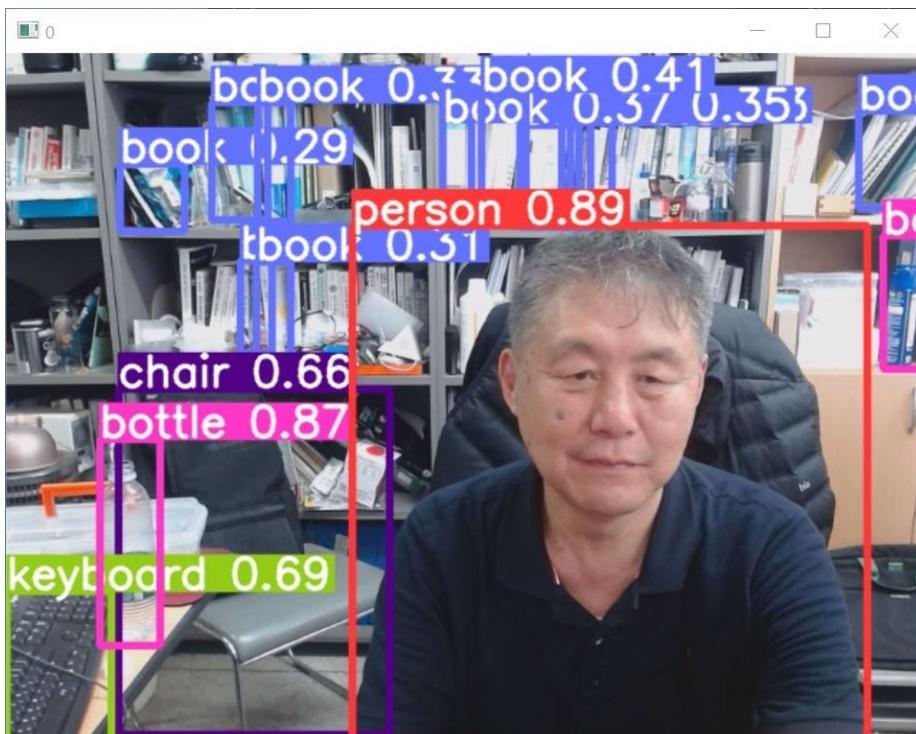
Pre-trained 모델 추론



Pre-trained 모델 추론 : detect.py

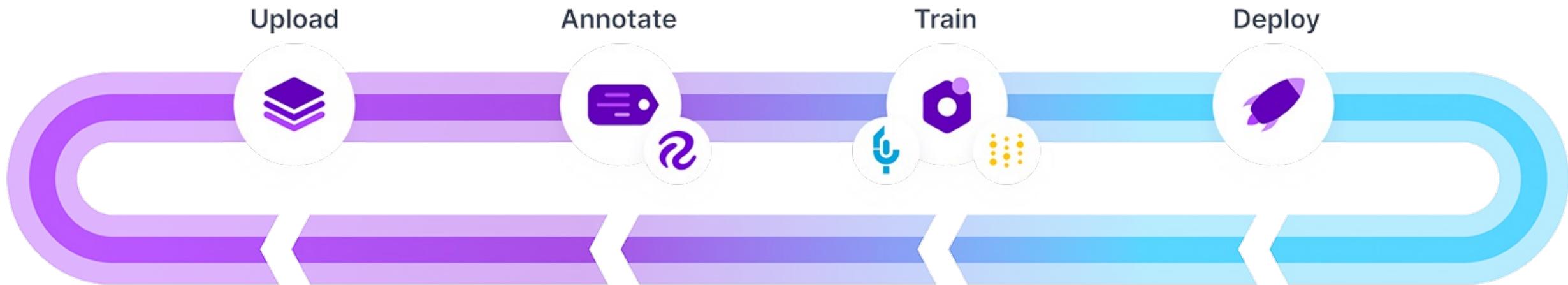
```
% python detect.py --source 0 # webcam  
                      img.jpg # image  
                      vid.mp4 # video  
                      path/ # directory  
                      path/*.jpg # glob  
                      'https://youtu.be/Zgi9g1ksQHc' # YouTube  
                      'rtsp://example.com/media.mp4' # RTSP, RTMP, HTTP stream
```





커스텀 데이터 학습 : Custom Data Training

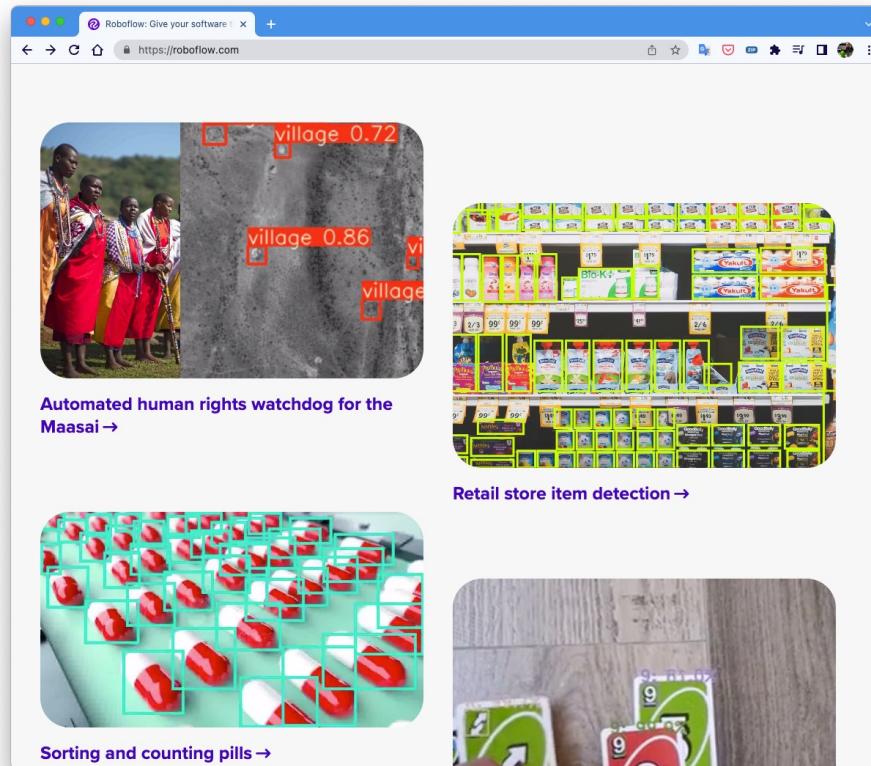
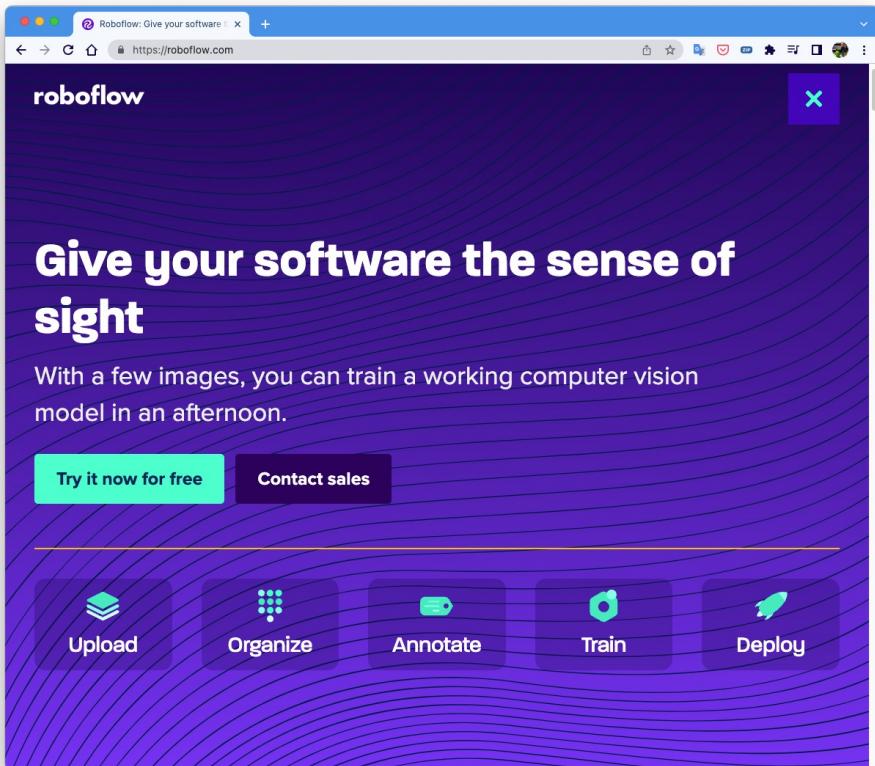
- <https://github.com/ultralytics/yolov5/wiki/Train-Custom-Data>



데이터 수집 및 전처리

- roboflow

- <https://roboflow.com>
- 계정 생성 : Sign up for free



Worksapce/ Project 만들기

The screenshot shows a user interface for creating a workspace or project. At the top, there is a navigation bar with links for Projects, Universe, Documentation, Forum, a notification bell (with 1 notification), and a user profile for JongHyun Kim.

Handwritten annotations in red and blue are present:

- A red arrow points from the text "Workspace" to the "WORKSPACES" section.
- A blue arrow points from the text "Project" to the "yolo5test" project card.
- A red arrow points from the text "workspace 새로 만들기" to the "+ Add Workspace" button.

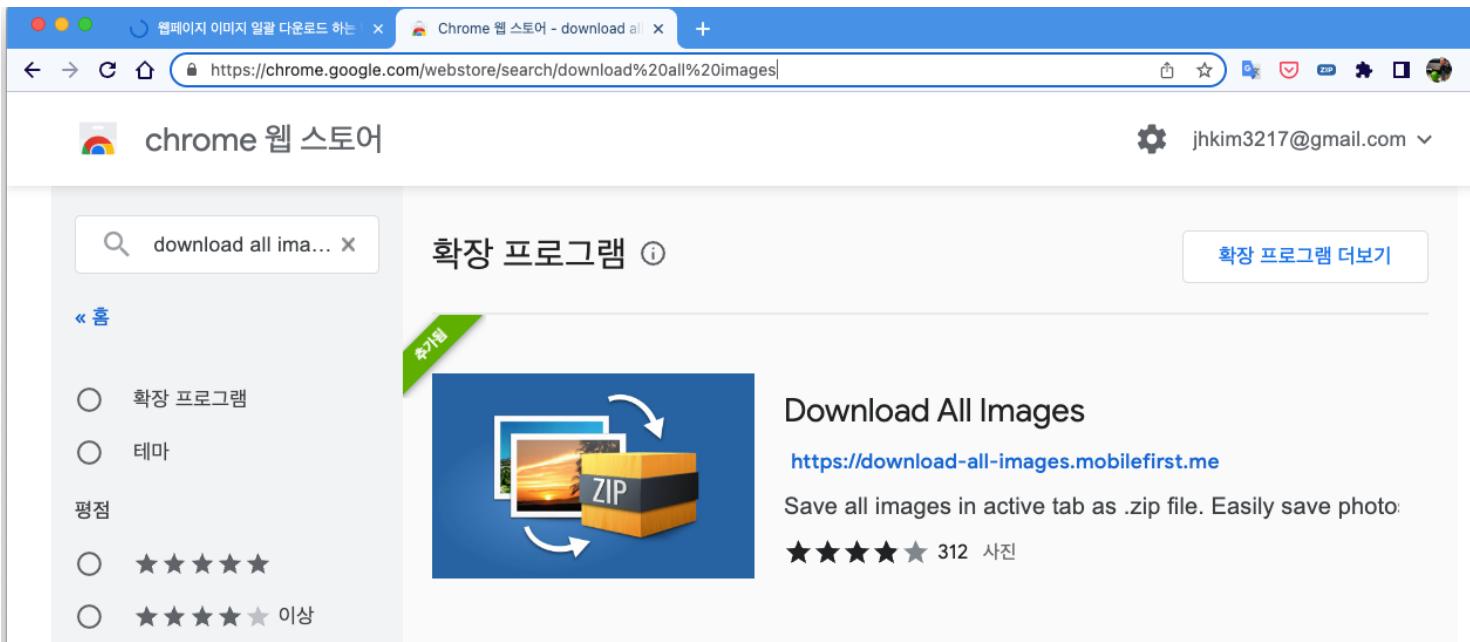
The main area displays the "WORKSPACES" section, which includes:

- 4 Workspaces listed:
 - yolo5test (selected)
 - studentprojects
 - + Add Workspace
- RESOURCES section with links to Getting Started, Tutorials, Public Datasets & Models, Model Library, and Help & Support.
- Project cards for "Mask Wearing" (Private, modified 3 days ago), "COVID-MASK" (Public, modified a month ago), "Car License Plate" (Public, modified a month ago), and "Hard Hat Sample".

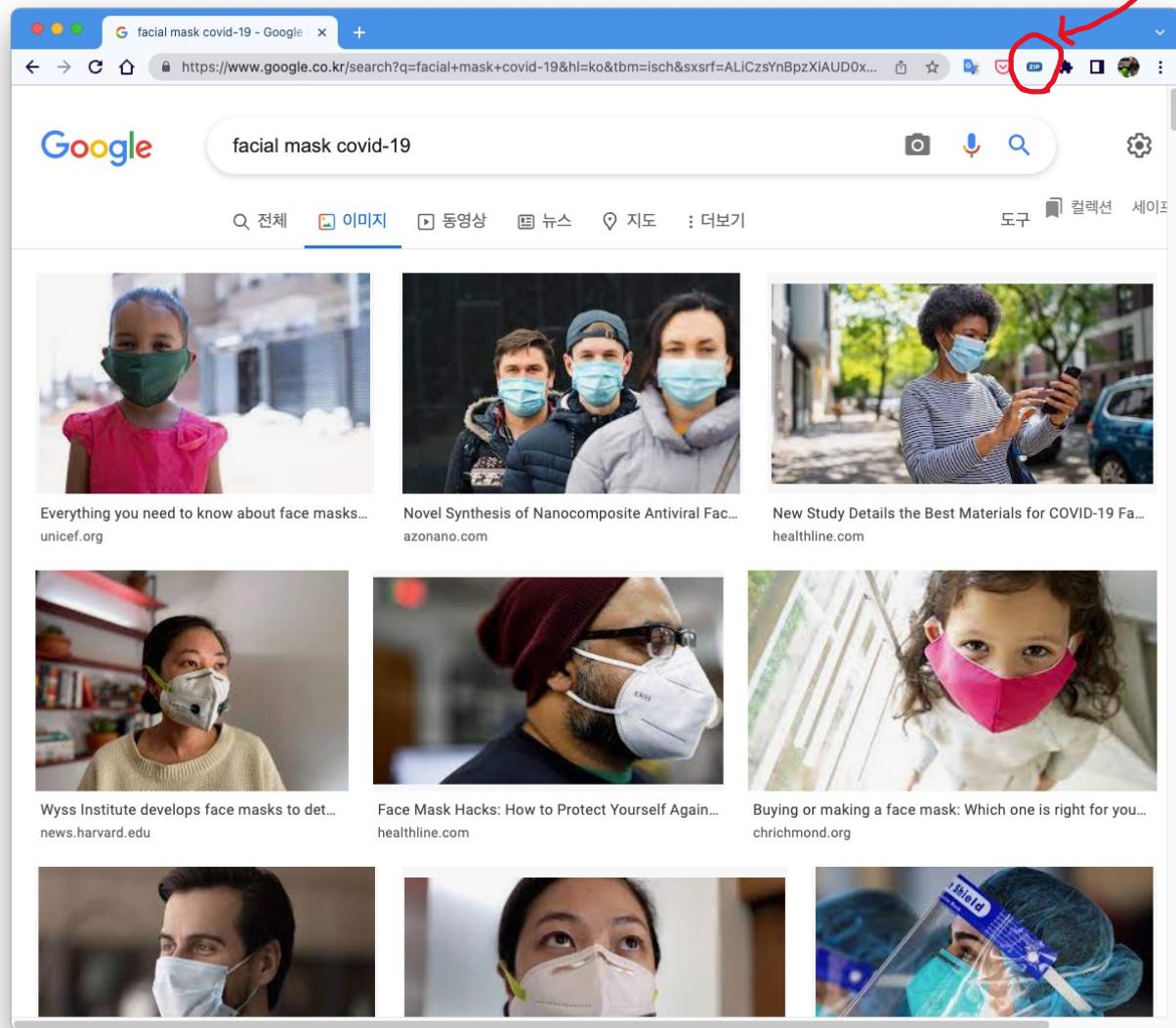
데이터 수집 : 구글 이미지 검색

- Chrome 웹 스토어 : Download All Images

- <https://chrome.google.com/webstore/search/download%20all%20images>

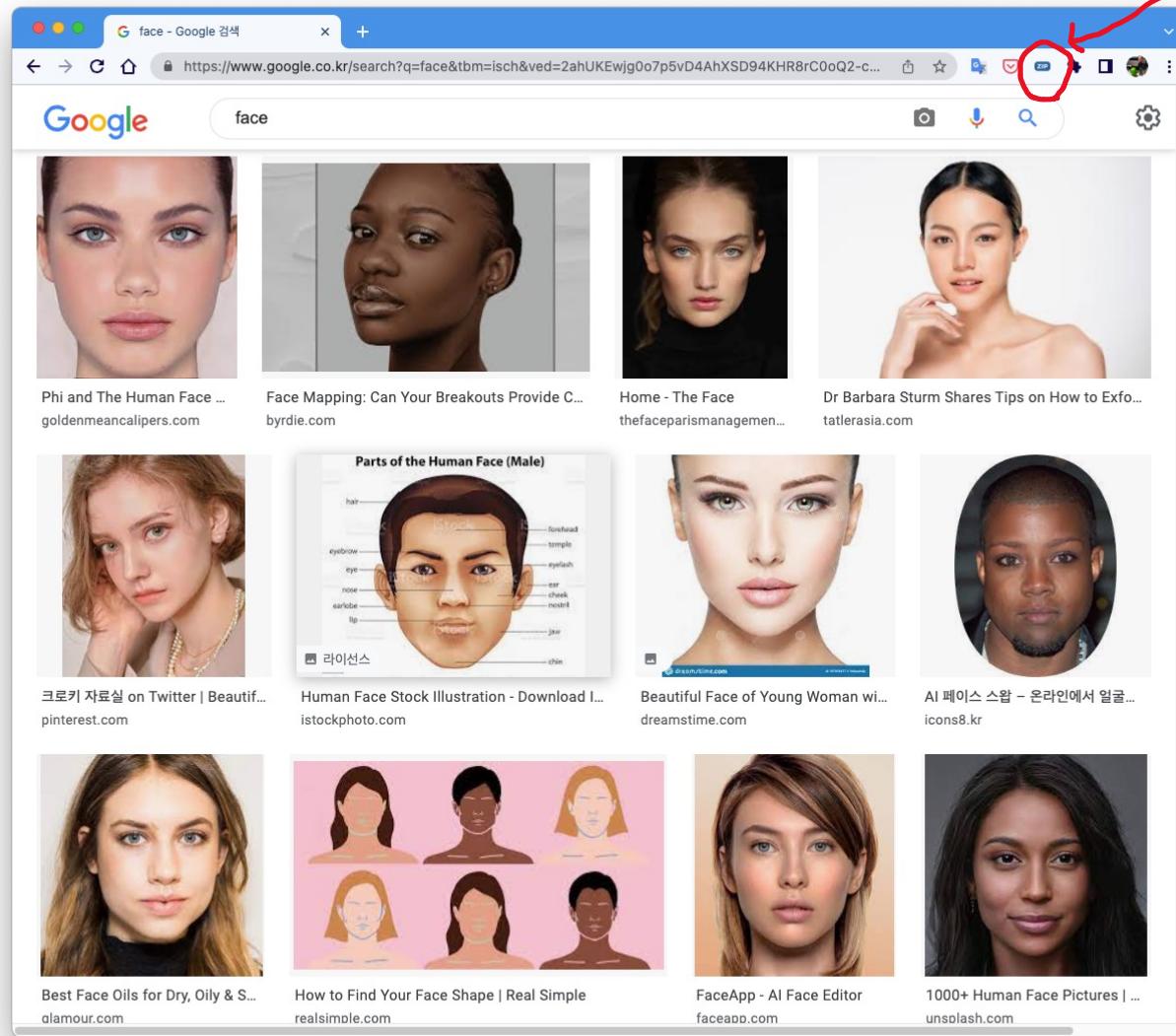


데이터 수집 : 구글 이미지 검색



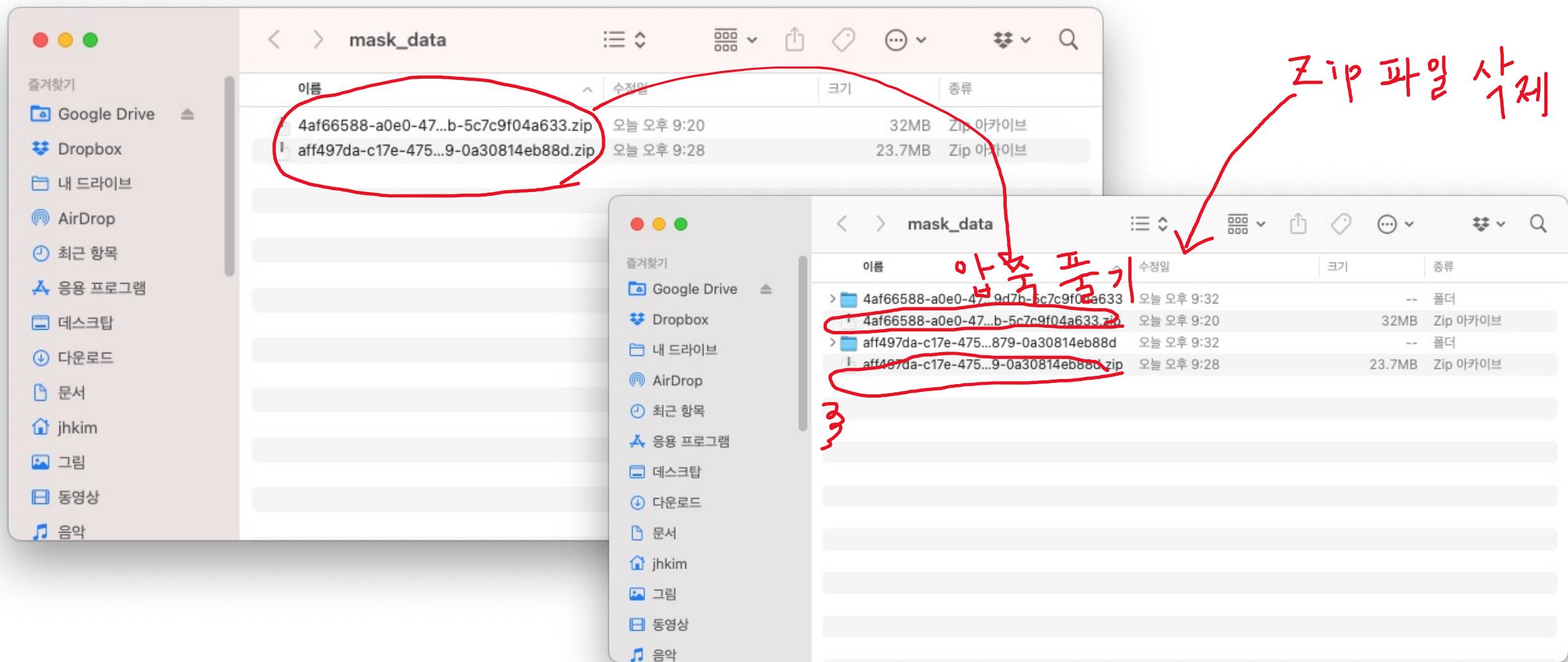
(ZIP)
전체 이미지 다운로드
클릭

데이터 수집 : 구글 이미지 검색



(ZIP)
전체 이미지 다운로드
클릭

데이터 수집 : 구글 이미지 검색

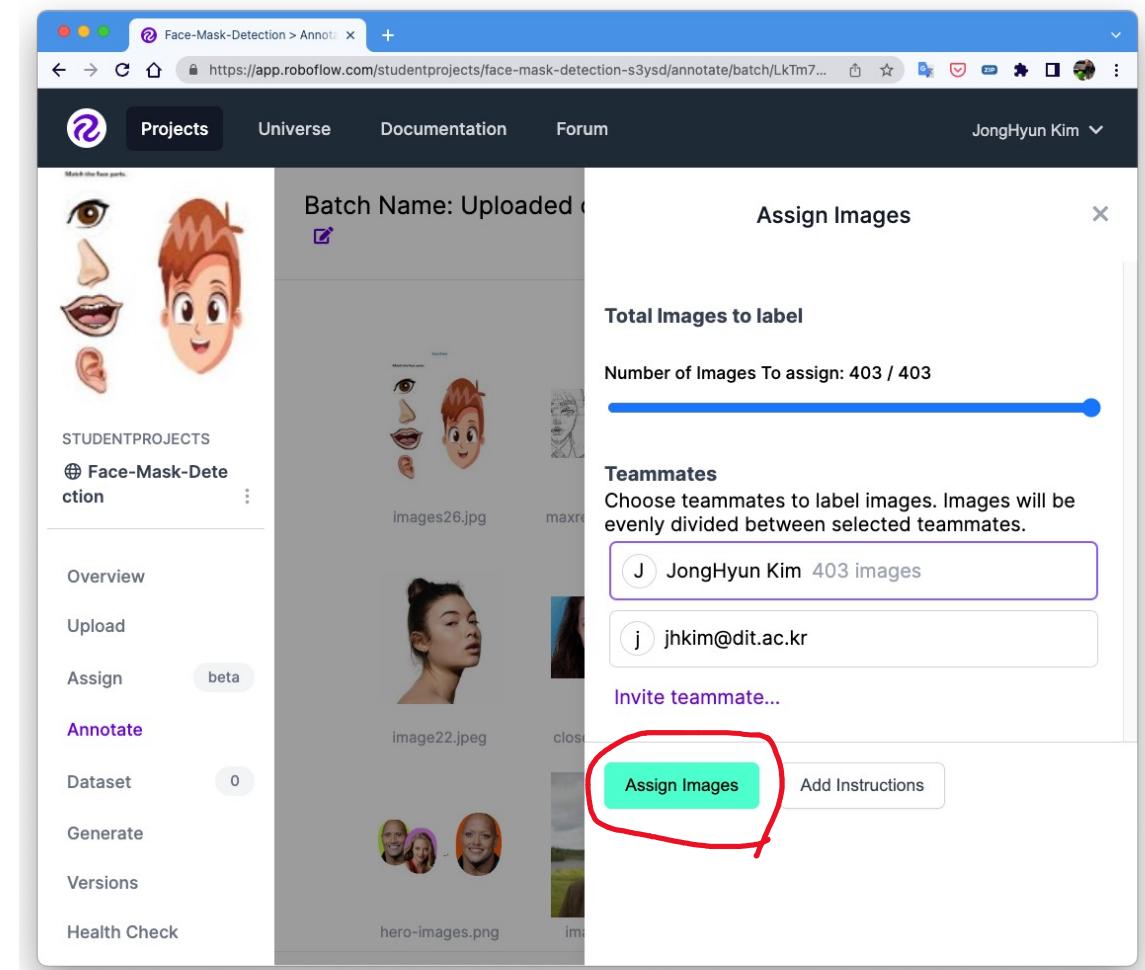
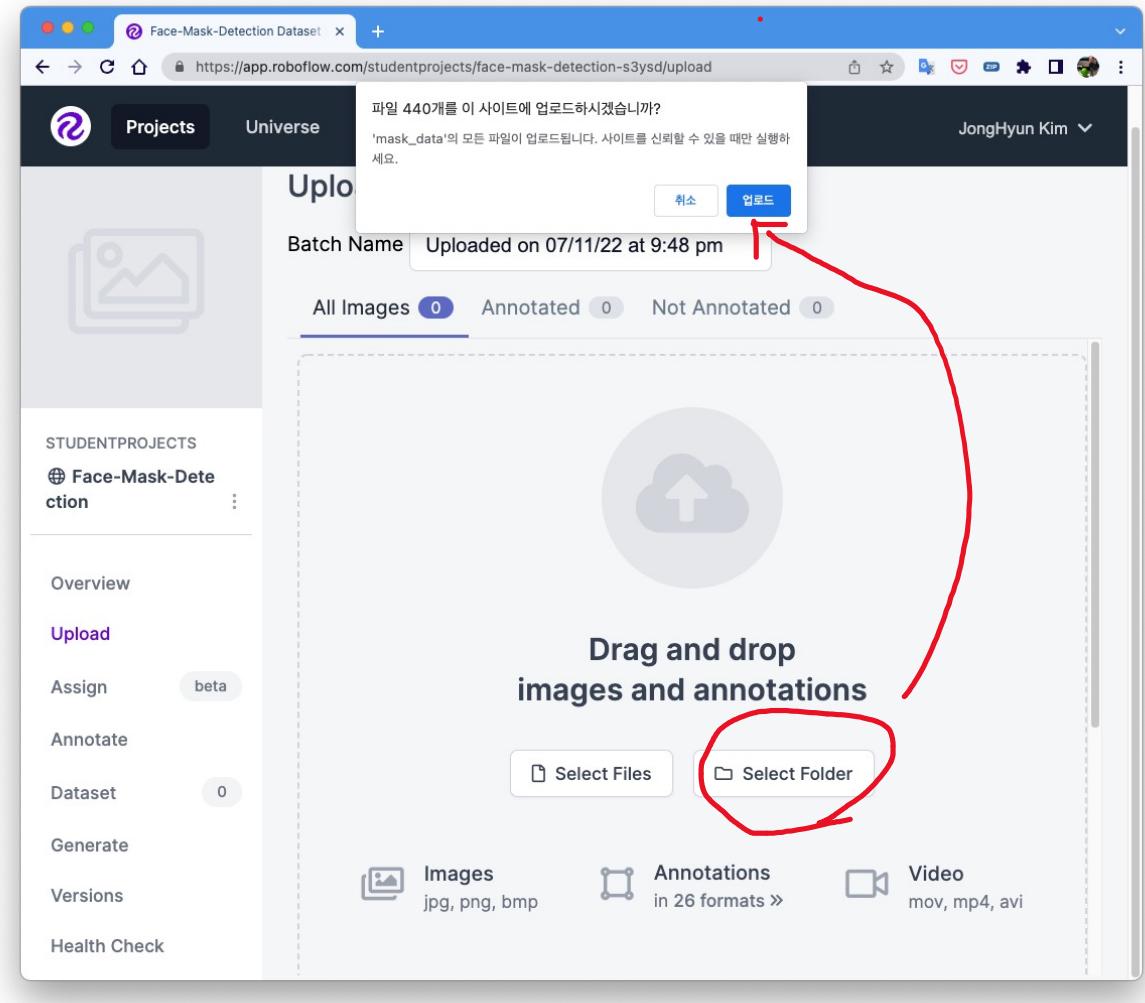


Workspace -> Project 만들기

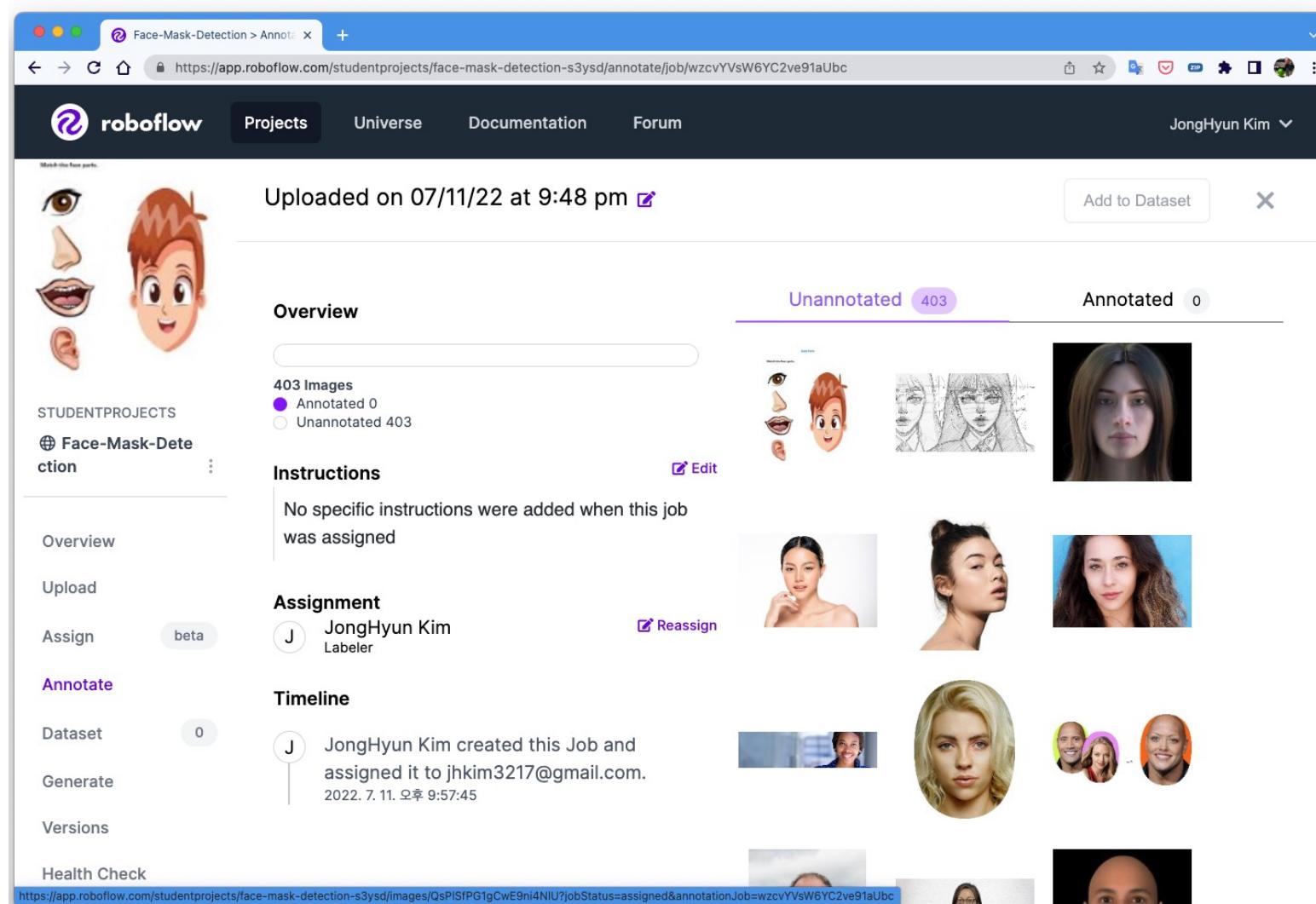
The screenshot shows the Roboflow Workspace Home page. On the left, there's a sidebar with sections for WORKSPACES (yolo5test, New Workspace, studentprojects), RESOURCES (Getting Started, Tutorials, Public Datasets & Models, Model Library, Help & Support), and a link to the Create Project page (<https://app.roboflow.com/studentprojects/create>). The main area displays the 'studentprojects' workspace, which contains a 'Create New Project' button and a thumbnail for the 'Deep Bakery' project.

The screenshot shows the 'Create Project' dialog box. It includes fields for Project Name (Face-Mask-Detection), License (CC BY 4.0), and Project Type (Object Detection (Bounding Box)). A question 'What will your model predict?' has 'mask' typed into its input field. At the bottom are 'Cancel' and 'Create Public Project' buttons.

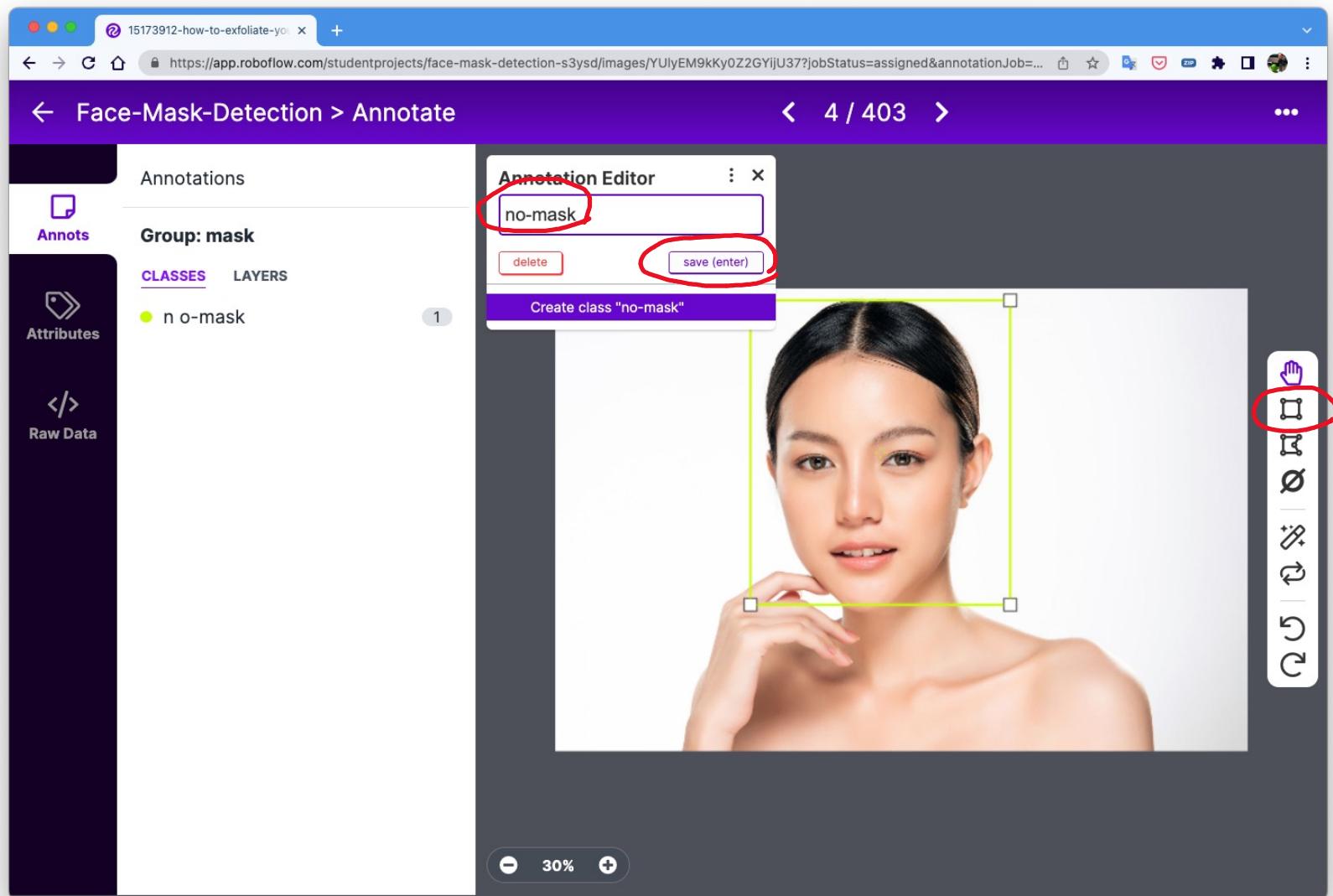
데이터 업로드



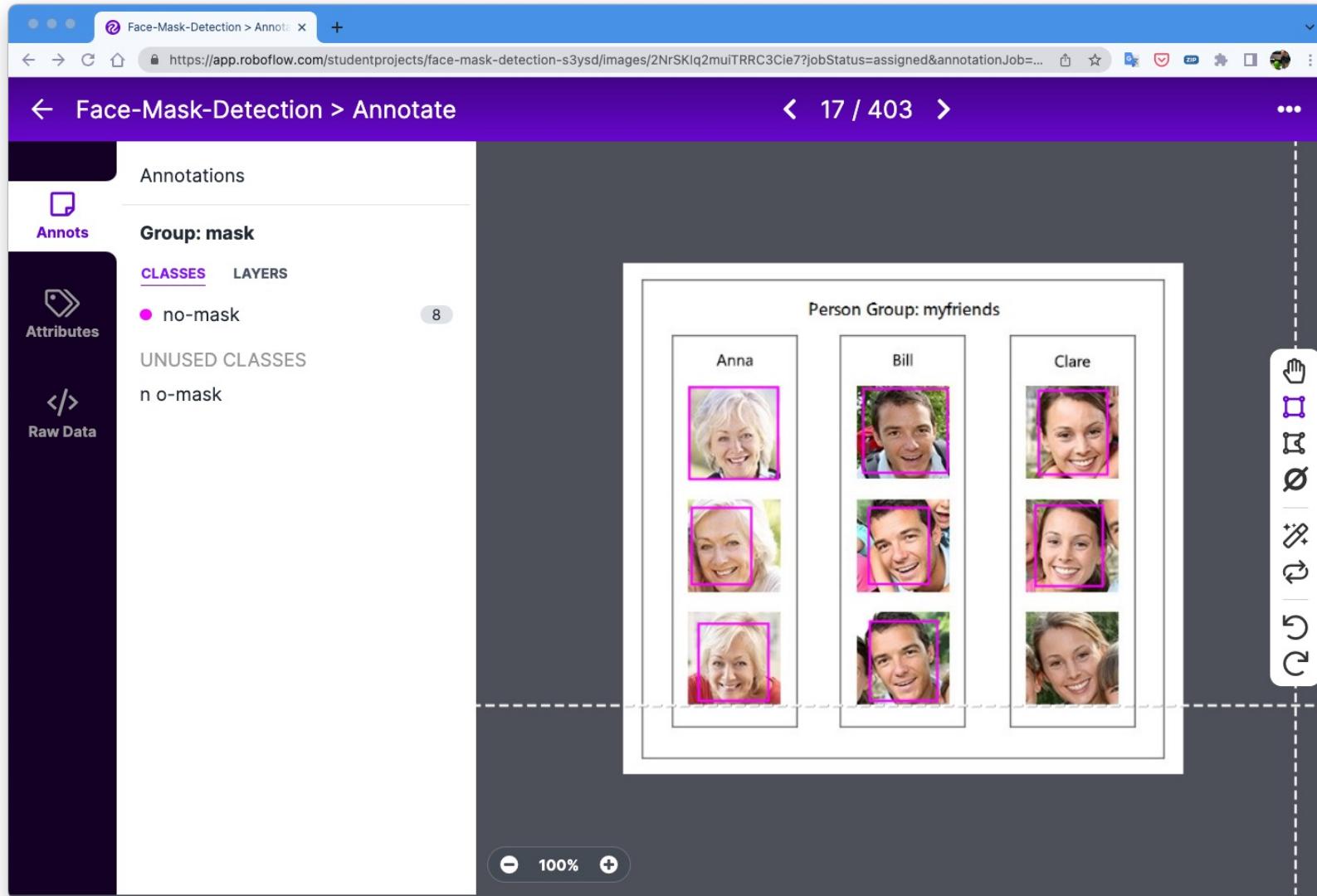
데이터 업로드



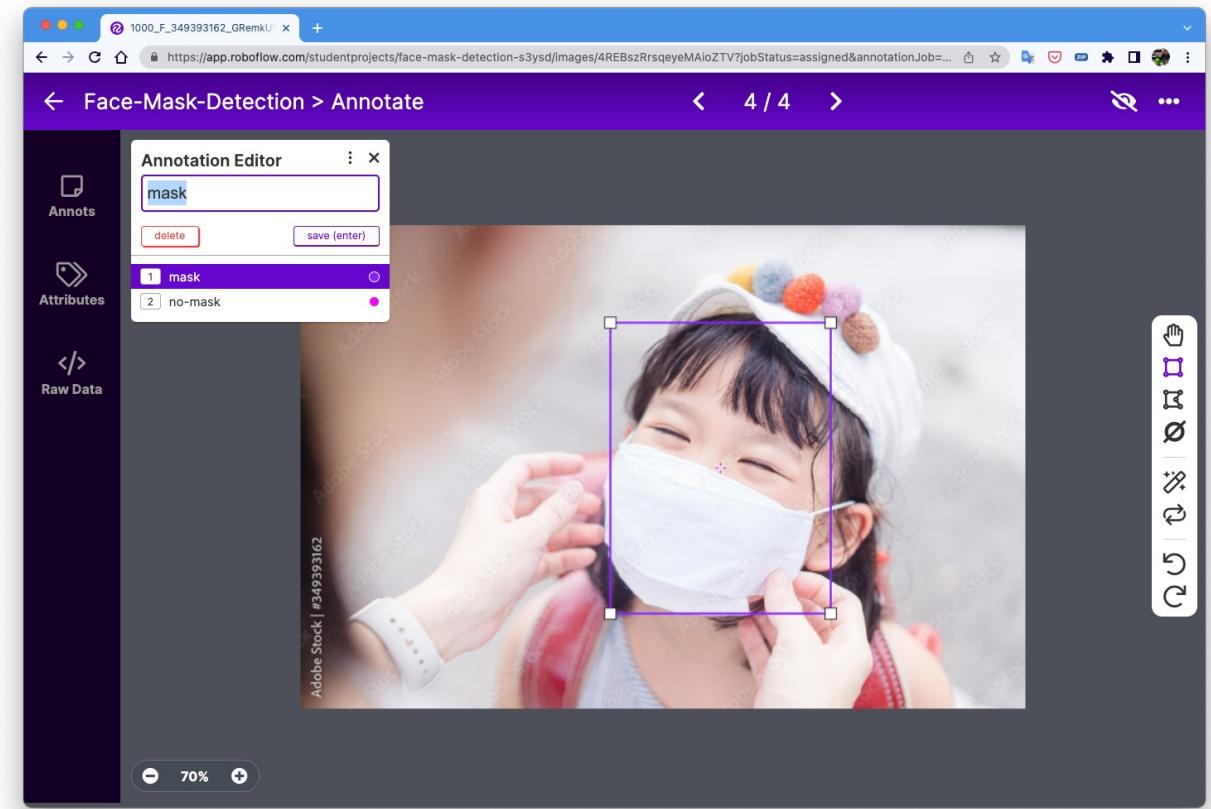
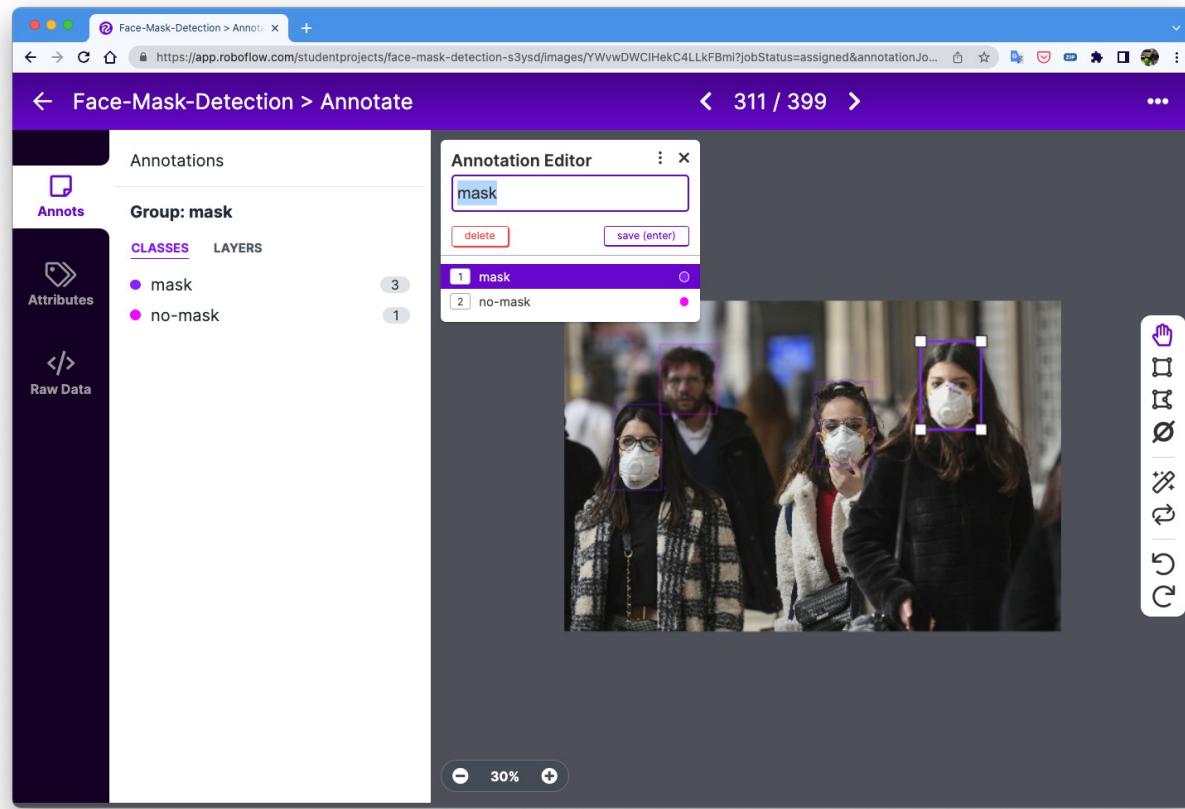
Annotate :데이터 라벨링, 바운딩



Annotate :데이터 라벨링, 바운딩



Annotate : 데이터 라벨링, 바운딩



Annotate : 데이터 라벨링, 바운딩

The screenshot shows the Roboflow Annotate interface. On the left, there are icons for eyes, nose, mouth, and ear, followed by a student project titled "Face-Mask-Detection". The main area is divided into three sections: UNASSIGNED, ANNOTATING, and DATASET. The ANNOTATING section is highlighted with a red circle and contains the following information:

- Uploaded on 07/11/22 at 9:48 pm
- 403 Images:
 - Annotated 68
 - Unannotated 335
- J JongHyun Kim Labeler

The DATASET section contains the instruction: "Approve annotated images to add them to your dataset".

The screenshot shows the Roboflow Job details page for the same project. At the top, it says "Uploaded on 07/11/22 at 9:48 pm". Below that is an "Overview" section with the following data:

- 403 Images:
 - Annotated 68
 - Unannotated 335

The "Annotated" count is circled in red. To the right, there's a preview of several images with bounding boxes around faces. A green button labeled "Add 68 images to Dataset" is also circled in red.

Annotate :데이터 라벨링, 바운딩

The screenshot shows the Roboflow web interface for a project titled "Face-Mask-Detection". On the left sidebar, under "STUDENTPROJECTS", there is a section for "Face-Mask-Detection" with 403 images: 68 annotated and 335 unannotated. The main area displays an "Overview" of a job uploaded on 07/11/22 at 9:48 pm. It includes sections for "Instructions", "Assignment" (to JongHyun Kim), and "Timeline". A modal window titled "Add Images To Dataset" is open, showing "Add 68 images to dataset" using the "Split Images Between Train/Valid/Test" method. The distribution is set to Train: 70%, Valid: 20%, and Test: 10%. Below this, it shows "Image Distribution" with Train: 47 images, Valid: 13 images, and Test: 8 images. A note states: "You are about to add 68 images to the dataset. 335 images will be sent back as part of a new job." At the bottom of the modal is a purple "Add Images" button, which is circled in red.

The screenshot shows the Roboflow web interface after adding images. The main dashboard has a header with "Match the face parts." and "Face-Mask-Detection > Annotate". It features three main sections: "UNASSIGNED" (Upload More Images), "ANNOTATING" (Job 2 by JongHyun Kim, labeled "J" - Labeler, with 339 images total, 0 annotated, and 339 unannotated), and "DATASET" (See all 64 images, 64 images total, JongHyun Kim - Labeler). The "Dataset" section shows a "Dataset" button with the number "64", which is circled in red. The "ANNOTATE" section also has a "Generate New Version" button.

데이터셋 생성

The screenshot shows the Roboflow web interface for a project titled "Face-Mask-Detection". On the left sidebar, there are icons for eyes, nose, mouth, and ear, followed by sections for "STUDENTPROJECTS" and "Dataset" (64 images). The main area is titled "Images" and displays a grid of 64 training set images. Below the grid, it says "Training Set 44", "Validation Set 13", and "Testing Set 7". At the top right, there are buttons for "+ Add Images" and "Generate New Version >". A red circle highlights the "Generate New Version" button.

The screenshot shows the Roboflow web interface for generating a new version of the dataset. It starts with a "New Version" button. Below it is a "VERSIONS" section with a "Source Images" card (64 images, 2 classes, 0 unannotated) and a "Train/Test Split" card (Training Set: 44 images, Validation Set: 13 images, Testing Set: 7 images). A red circle highlights the "Preprocessing" section, which contains a "3" icon and the text: "Decrease training time and increase performance by applying image transformations to all images in this dataset". At the bottom, there are cards for "Auto-Orient" and "Resize" (Stretch to 416x416).

데이터 전처리, 증강

Preprocessing

https://app.roboflow.com/studentprojects/face-mask-detection-s3ysd/generate

roboflow Projects Universe Documentation Forum JongHyun Kim Testing Set: 7 images

Match the two parts:

STUDENTPROJECTS

Face-Mask-Detection

Overview Upload Assign beta Annotate Dataset 64 Generate Versions Health Check

3 Preprocessing

Decrease training time and increase performance by applying image transformations to all images in this dataset.

Auto-Orient Edit

Resize Edit

Stretch to 416x416

+ Add Preprocessing Step

Continue

4 Augmentation

5 Generate

The 'Add Preprocessing Step' button and the 'Augmentation' section are circled in red.

Augmentation

https://app.roboflow.com/studentprojects/face-mask-detection-s3ysd/generate/augmentation/add

roboflow Projects JongHyun Kim

Match the two parts:

STUDENTPROJECTS

Face-Mask-Detection

Overview Upload Assign beta Annotate Dataset 64 Generate Versions Health Check

Set: 44 images
On Set: 13 images
Set: 7 images

Client: Applied
Stretch to 416x416

Augmentations create new training examples for your model to learn from.

IMAGE LEVEL AUGMENTATIONS

Flip	90° Rotate	Crop	Rotation	Shear

Grayscale	Hue	Saturation	Brightness	Exposure

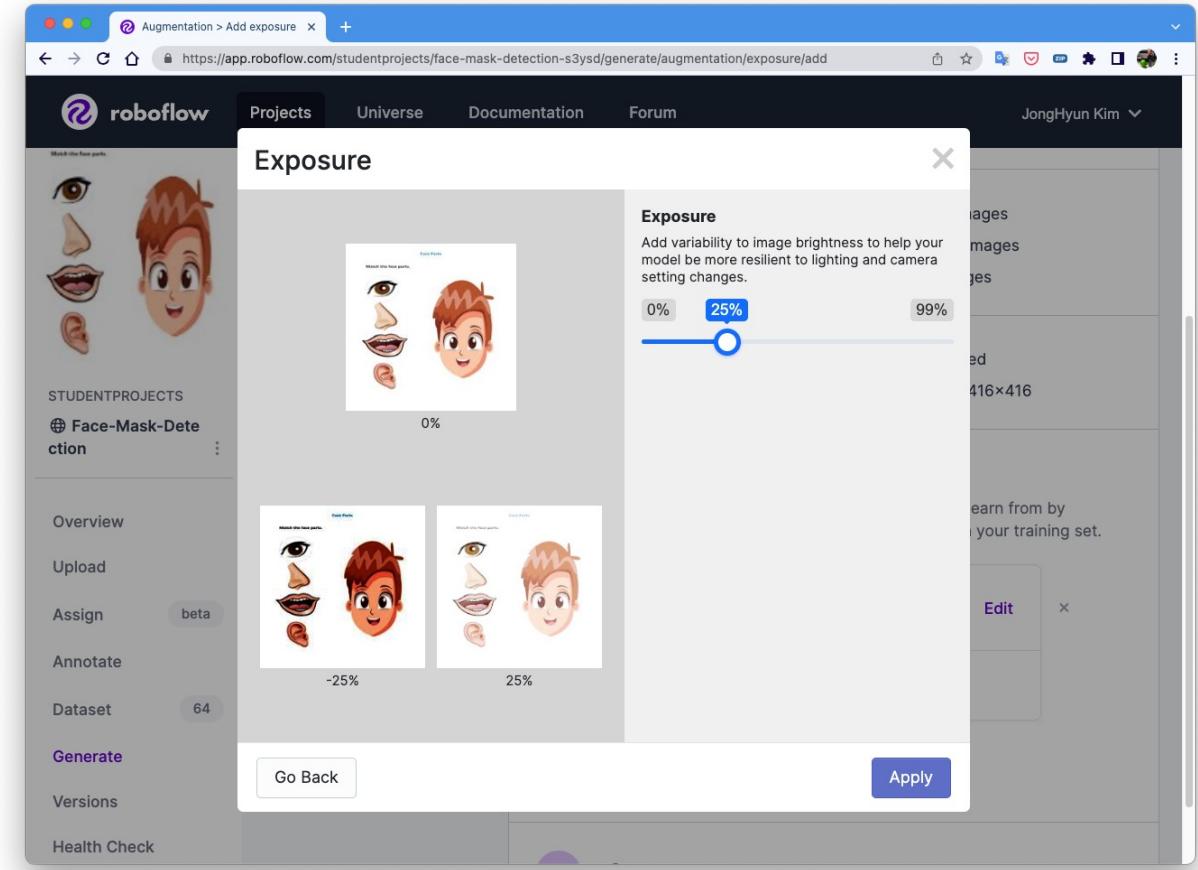
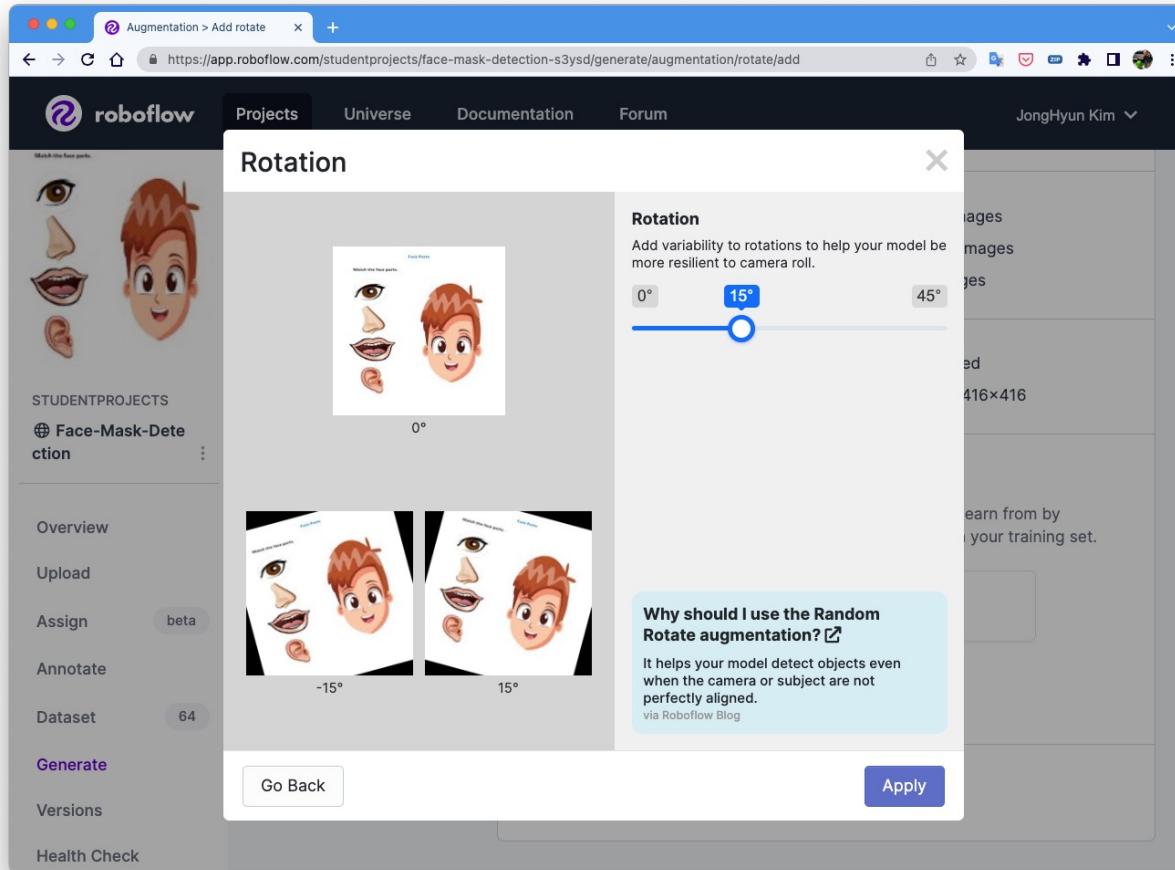
Blur	Noise	Cutout	Mosaic

BOUNDING BOX LEVEL AUGMENTATIONS

Flip	90° Rotate	Crop	Rotation	Shear

Blur	Noise	Cutout	Mosaic

데이터 전처리, 증강



데이터셋 생성

The screenshot shows the Roboflow web interface for generating a dataset. On the left, there's a sidebar with options like Overview, Upload, Assign, Annotate, Dataset (64), Generate (highlighted with a red circle), Versions, and Health Check. The main area displays several processing steps:

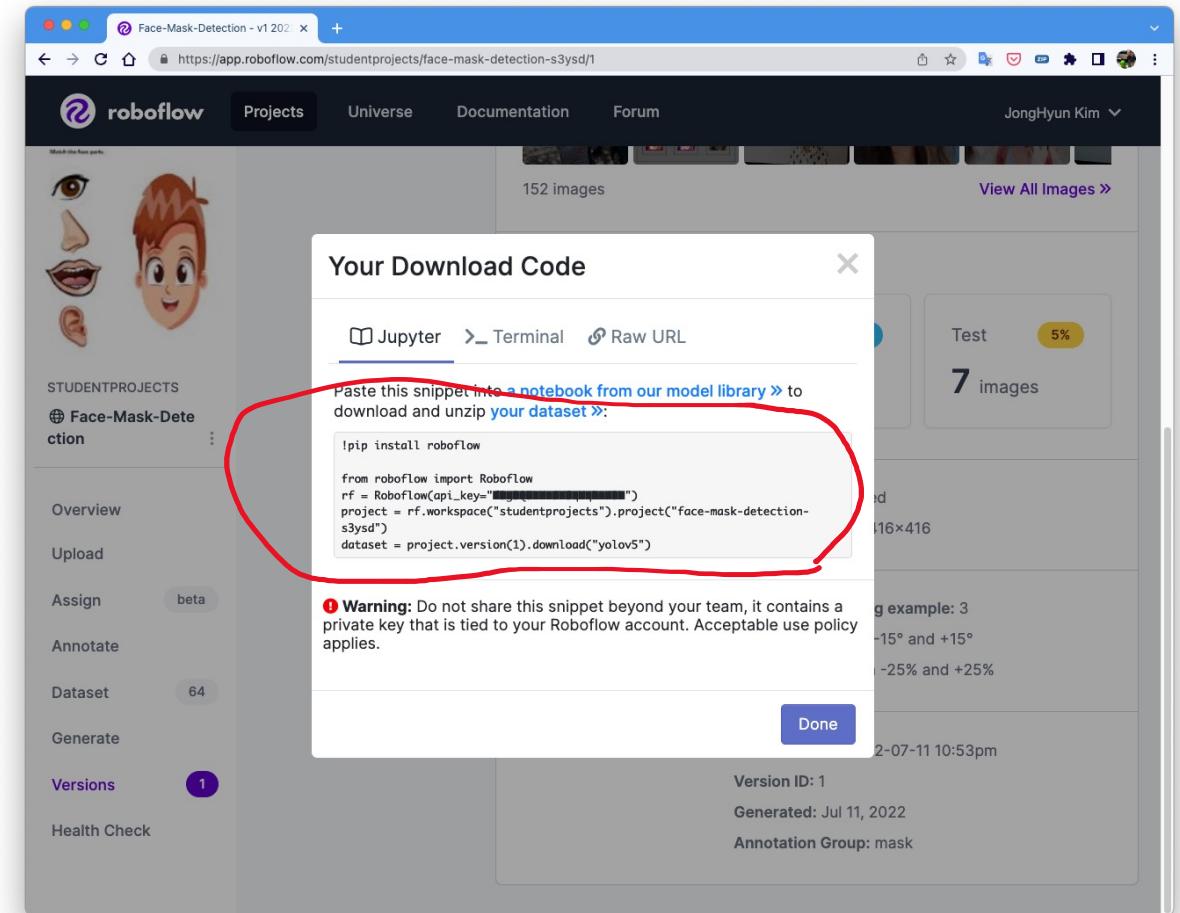
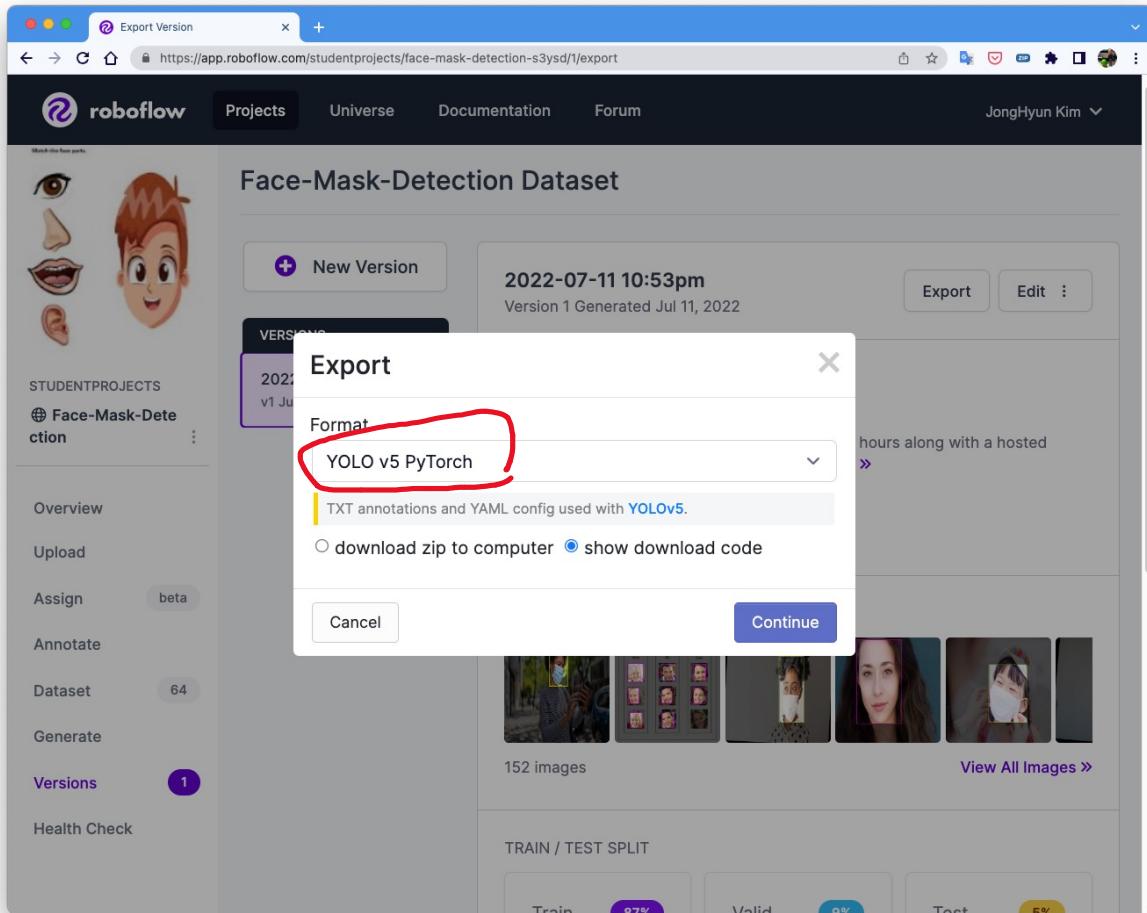
- Train/Test Split:** Training Set: 44 images, Validation Set: 13 images, Testing Set: 7 images.
- Preprocessing:** Auto-Orient: Applied, Resize: Stretch to 416x416.
- Augmentation:** Rotation: Between -15° and +15°, Exposure: Between -25% and +25%.
- Generate:** A step where the user reviews their selections and chooses a version size. A dropdown menu shows "152 images (3x)" and a red circle highlights the "Generate" button below it.

The screenshot shows the Roboflow web interface after the dataset has been generated. The top bar indicates "Face-Mask-Detection - v1 202" and "2022-07-11 10:53pm". The main area includes:

- VERSIONS:** A box showing "2022-07-11 10:53pm" and "v1 Jul 11, 2022".
- TRAINING OPTIONS:** "Use Roboflow Train" and "Start Training" button.
- IMAGES:** A section showing 152 images with a "View All Images" link.
- TRAIN / TEST SPLIT:** A summary of the split: Train 132 images (87%), Valid 13 images (9%), and Test 7 images (5%).

A red circle highlights the "Export" button in the top right corner of the main content area.

데이터셋 내보내기



커스텀 데이터 학습 : Custom Data Training

- <https://github.com/ultralytics/yolov5/wiki/Train-Custom-Data>
- Open in Colab
 - <https://colab.research.google.com/github/roboflow-ai/yolov5-custom-training-tutorial/blob/main/yolov5-custom-training.ipynb>

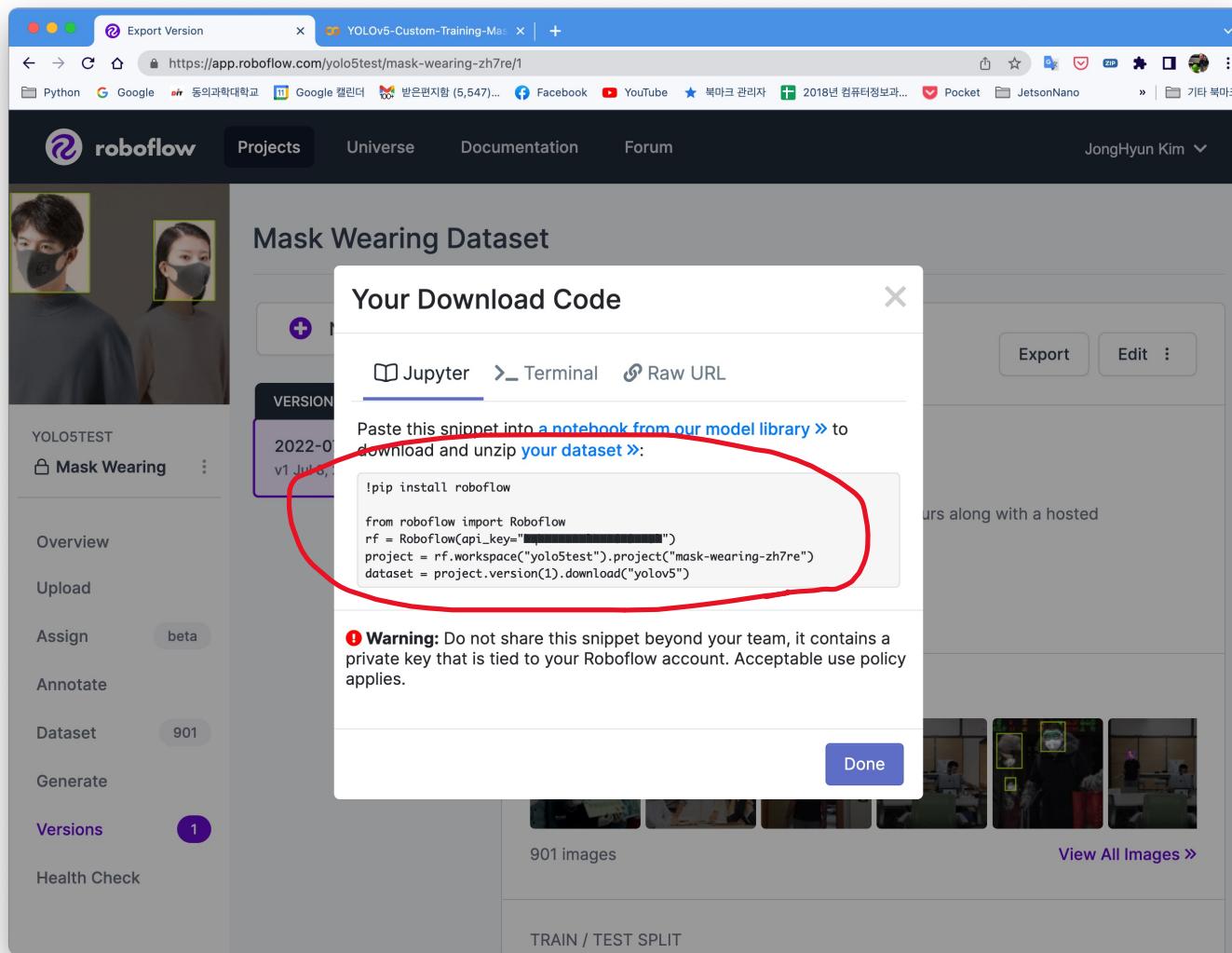


roboflow 데이터셋 import

The screenshot shows the Roboflow web interface for the 'Mask Wearing' dataset. At the top, there are two sample images of people wearing masks. Below them is a 'New Version' button. A sidebar on the left lists 'YOLOTEST' and 'Mask Wearing' under 'Dataset'. The main area displays a version history entry for '2022-07-08 6:56pm' (v1 Jul 8, 2022). It includes 'TRAINING OPTIONS' with a 'Start Training' button, 'IMAGES' section showing 901 images with bounding boxes, and a 'TRAIN / TEST SPLIT' section.

The screenshot shows the Roboflow web interface with an 'Export' dialog box open over the dataset page. The dialog box has a title 'Export' and a dropdown menu set to 'YOLO v5 PyTorch'. It contains two radio buttons: 'download zip to computer' (unchecked) and 'show download code' (checked). The background shows the same dataset details as the first screenshot.

roboflow 데이터셋 import



데이터 학습

```
[ ] 1 from roboflow import Roboflow  
2 rf = Roboflow(api_key='[REDACTED]')  
3 project = rf.workspace("yolo5test").project("mask-wearing-zh7re")  
4 dataset = project.version(1).download("yolov5")  
  
loading Roboflow workspace...  
loading Roboflow project...  
Downloading Dataset Version Zip in /content/datasets/Mask-Wearing-1 to yolov5pytorch: 100% [135938827 / 135938827]  
Extracting Dataset Version Zip to /content/datasets/Mask-Wearing-1 in yolov5pytorch:: 100%|██████████| 181/181
```

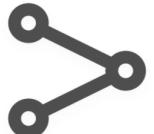
```
[ ] 1 !python train.py --img 416 --batch 16 --epochs 100 --data /content/datasets/Mask-Wearing-1/data.yaml --weights yolov5s.pt  
github: up to date with https://github.com/ultralytics/yolov5 ✓  
YOLOv5 🚀 v6.1-289-g526e650 Python-3.7.13 torch-1.11.0+cu113 CUDA:0 (Tesla T4, 15110MiB)
```

모델 크기, 속도



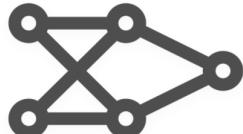
Nano
YOLOv5n

4 MB_{FP16}
6.3 ms_{V100}
28.4 mAP_{coco}



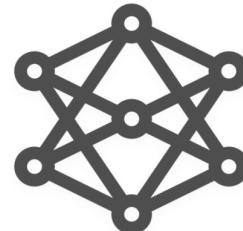
Small
YOLOv5s

14 MB_{FP16}
6.4 ms_{V100}
37.2 mAP_{coco}



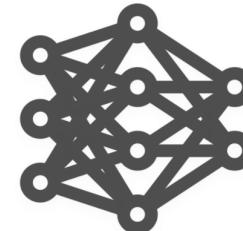
Medium
YOLOv5m

41 MB_{FP16}
8.2 ms_{V100}
45.2 mAP_{coco}



Large
YOLOv5l

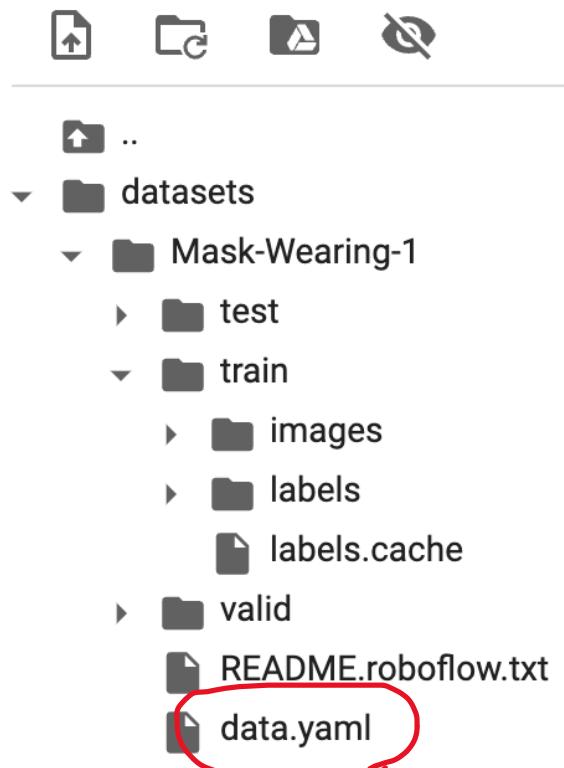
89 MB_{FP16}
10.1 ms_{V100}
48.8 mAP_{coco}



XLarge
YOLOv5x

166 MB_{FP16}
12.1 ms_{V100}
50.7 mAP_{coco}

data.yaml



노트북 **data.yaml** X

```
1 names:  
2 - mask  
3 - no_mask  
4 nc: 2  
5 train: /content/datasets/Mask-Wearing-1/train/images  
6 val: /content/datasets/Mask-Wearing-1/valid/images  
7
```

ultralytics/yolov5: YOLOv5 x YOLOv5-Custom-Training-Mas x +

https://colab.research.google.com/drive/1UsOIV2Ys9V2t3NUWumPqSOHfqOXIQCt6?usp=drive_fs#scrollTo=ZbUn4_b9GCKO

YOLov5-Custom-Training-Mask-detection.ipynb

파일 수정 보기 삽입 런타임 도구 도움말 모든 변경사항이 저장됨

댓글 공유 설정 가능

파일

노트북 data.yaml

+ 코드 + 텍스트

• img: define input image size
• batch: determine batch size
• epochs: define the number of training epochs. (Note: often, 3000+ are common here!)
• data: Our dataset location is saved in the dataset.location
• weights: specify a path to weights to start transfer learning from. Here we choose the generic COCO pretrained checkpoint.
• cache: cache images for faster training

[6] !python train.py --img 416 --batch 16 --epochs 100 --data /content/datasets/Mask-Wearing-1/

Logging results to runs/train/exp
Starting training for 100 epochs...

Epoch	gpu_mem	box	obj	cls	labels	img_size
0/99	1.57G	0.103	0.03618	0.02813	61	416: 100% 41/41 [00:08<00:00, 4.60it/s]
	Class	Images	Labels	P	R	mAP@.5 mAP@.5:.95: 100% 6/6 [00:01<00:00, 4.82it/s]
	all	168	539	0.107	0.159	0.0522 0.0133

Epoch	gpu_mem	box	obj	cls	labels	img_size
1/99	2.19G	0.07933	0.03735	0.02305	100	416: 100% 41/41 [00:06<00:00, 6.66it/s]
	Class	Images	Labels	P	R	mAP@.5 mAP@.5:.95: 100% 6/6 [00:01<00:00, 5.45it/s]
	all	168	539	0.395	0.35	0.294 0.0918

Epoch	gpu_mem	box	obj	cls	labels	img_size
2/99	2.19G	0.07563	0.02815	0.0219	34	416: 100% 41/41 [00:06<00:00, 6.73it/s]
	Class	Images	Labels	P	R	mAP@.5 mAP@.5:.95: 100% 6/6 [00:01<00:00, 5.90it/s]
	all	168	539	0.373	0.391	0.375 0.161

Epoch	gpu_mem	box	obj	cls	labels	img_size
3/99	2.19G	0.06802	0.02601	0.01726	63	416: 100% 41/41 [00:06<00:00, 6.78it/s]
	Class	Images	Labels	P	R	mAP@.5 mAP@.5:.95: 100% 6/6 [00:00<00:00, 6.06it/s]
	all	168	539	0.512	0.484	0.459 0.227

Epoch	gpu_mem	box	obj	cls	labels	img_size
4/99	2.19G	0.05546	0.02543	0.01228	63	416: 100% 41/41 [00:06<00:00, 6.73it/s]
	Class	Images	Labels	P	R	mAP@.5 mAP@.5:.95: 100% 6/6 [00:01<00:00, 5.98it/s]
	all	168	539	0.599	0.633	0.645 0.328

Epoch	gpu_mem	box	obj	cls	labels	img_size
5/99	2.19G	0.05031	0.02352	0.009031	58	416: 100% 41/41 [00:07<00:00, 5.82it/s]
	Class	Images	Labels	P	R	mAP@.5 mAP@.5:.95: 100% 6/6 [00:00<00:00, 6.26it/s]
	all	168	539	0.731	0.692	0.757 0.385

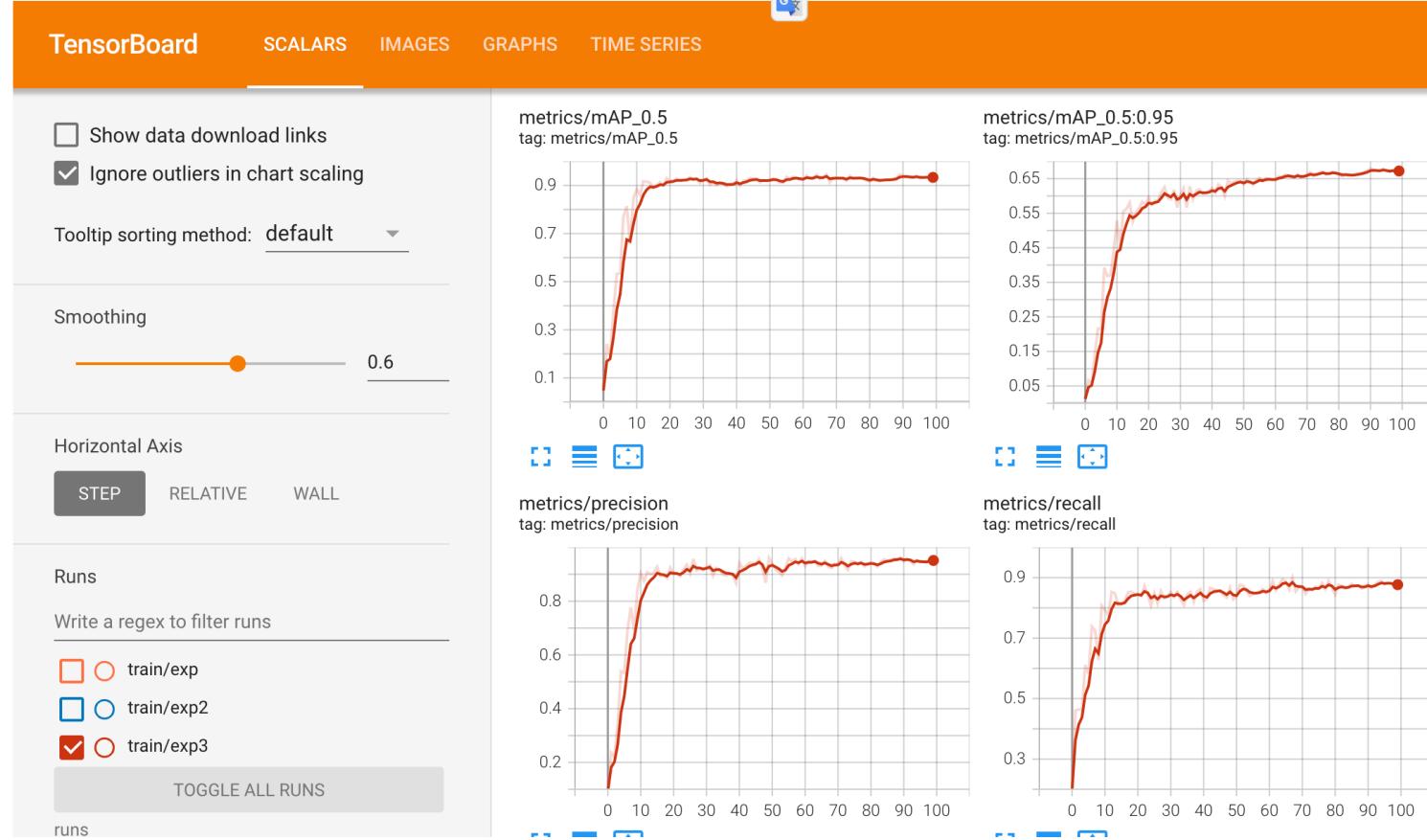
39.02 GB 사용 가능

0초 오후 5:15에 완료됨

Custom YOLOv5 Detector 성능 검증

```
[ ] 1 # Start tensorboard
2 # Launch after you have started training
3 # logs save in the folder "runs"
4 %load_ext tensorboard
5 %tensorboard --logdir runs
```

The tensorboard extension is already loaded. To reload it, use:
 %reload_ext tensorboard
Reusing TensorBoard on port 6006 (pid 344), started 1:08:12 ago. ([!kill 344](#) to kill it.)



Trained Weights 추론

```
[ ] 1 !python detect.py --weights runs/train/exp/weights/best.pt --img 416 --conf 0.1 --source /content/datasets/Mask-Wearing-1/test/images  
  
ct: weights=['runs/train/exp3/weights/best.pt'], source=/content/datasets/Mask-Wearing-1/test/images, data=data/coco128.yaml, imgsz=[416, 416], conf_thres=0.1, iou_thres=0.45, max_det  
v5 🚀 v6.1-289-g526e650 Python-3.7.13 torch-1.11.0+cu113 CUDA:0 (Tesla T4, 15110MiB)  
  
ng layers...  
l summary: 213 layers, 7015519 parameters, 0 gradients, 15.8 GFLOPs  
e 1/83 /content/datasets/Mask-Wearing-1/test/images/0209-00176-076b1.jpg.rf.b5879cb0c604e946fc66e05808863ce1.jpg: 288x416 3 masks, 1 no_mask, Done. (0.014s)  
e 2/83 /content/datasets/Mask-Wearing-1/test/images/0450908675_50159485_mutation-virus-chine-inquietude.jpg.rf.78f7187e33599ea007dfd483d8ffe775.jpg: 288x416 3 masks, 1 no_mask, Done.  
e 3/83 /content/datasets/Mask-Wearing-1/test/images/0_Concern-In-China-As-Mystery-Virus-Spreads.jpg.rf.157ced3ca3a3d948313050b484add80e.jpg: 224x416 4 masks, Done. (0.015s)  
e 4/83 /content/datasets/Mask-Wearing-1/test/images/0_Concern-In-China-As-Mystery-Virus-Spreads.jpg.rf.c7348a3dc8df48c724735c797e86bfe1.jpg: 224x416 4 masks, Done. (0.009s)  
e 5/83 /content/datasets/Mask-Wearing-1/test/images/1224331650_g_400-w_g.jpg.rf.98ae7debb9e5ebc91b3ce4c56d2b2e30.jpg: 416x416 3 masks, Done. (0.011s)  
e 6/83 /content/datasets/Mask-Wearing-1/test/images/1224331650_g_400-w_g.jpg.rf.9fe767c9d05d662400b9bd1b9422e3af.jpg: 416x416 3 masks, Done. (0.009s)  
e 7/83 /content/datasets/Mask-Wearing-1/test/images/126202-untitled-design-13.jpg.rf.065fbc4190cc207a91a46b9fe13e7ea9.jpg: 256x416 5 masks, Done. (0.013s)  
e 8/83 /content/datasets/Mask-Wearing-1/test/images/126202-untitled-design-13.jpg.rf.41757e0c41a5770e63d886b291d4d275.jpg: 256x416 5 masks, Done. (0.009s)
```



Trained Weights 추론



학습 모델 다운로드

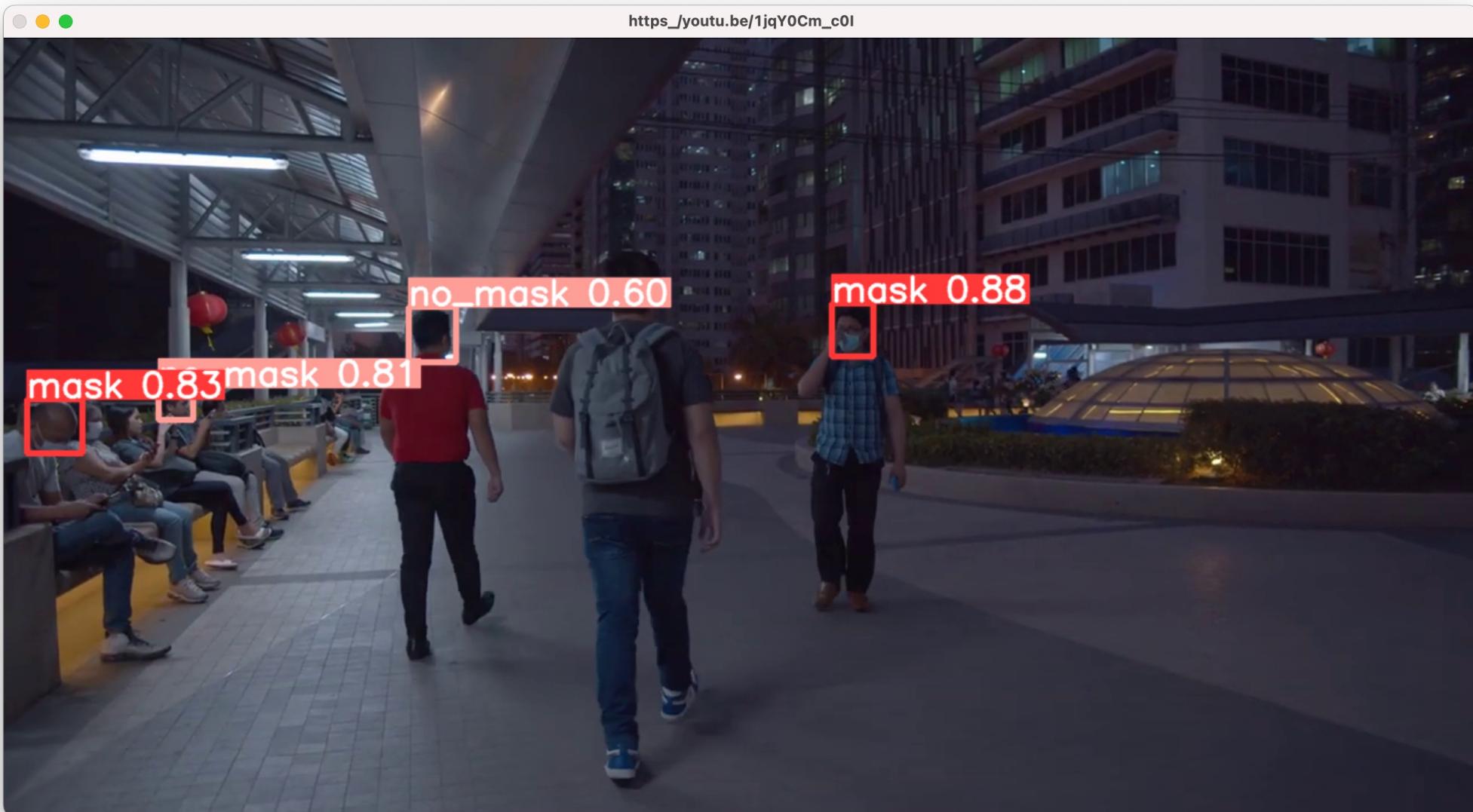
```
[ ] 1 #export your model's weights for future use  
2 from google.colab import files  
3 files.download('/content/yolov5/runs/train/exp3/weights/best.pt')
```

모델 사용하기

- yolov5를 clone 한 local PC 디렉토리에 모델(best.pt) 저장 및 이동
 - git clone https://github.com/ultralytics/yolov5 # clone cd yolov5 pip install -r requirements.txt # install
 - detection 실행

```
% python detect.py --source 0  # webcam
                      img.jpg  # image
                      vid.mp4  # video
                      path/  # directory
                      path/*.jpg  # glob
                      'https://youtu.be/Zgi9g1ksQHc'  # YouTube
                      'rtsp://example.com/media.mp4'  # RTSP, RTMP, HTTP stream
```

실시간 객체(facial mask) 탐지



참고

- <https://github.com/ultralytics/yolov5>
- <https://roboflow.com/>
- <https://www.v7labs.com/blog/object-detection-guide>