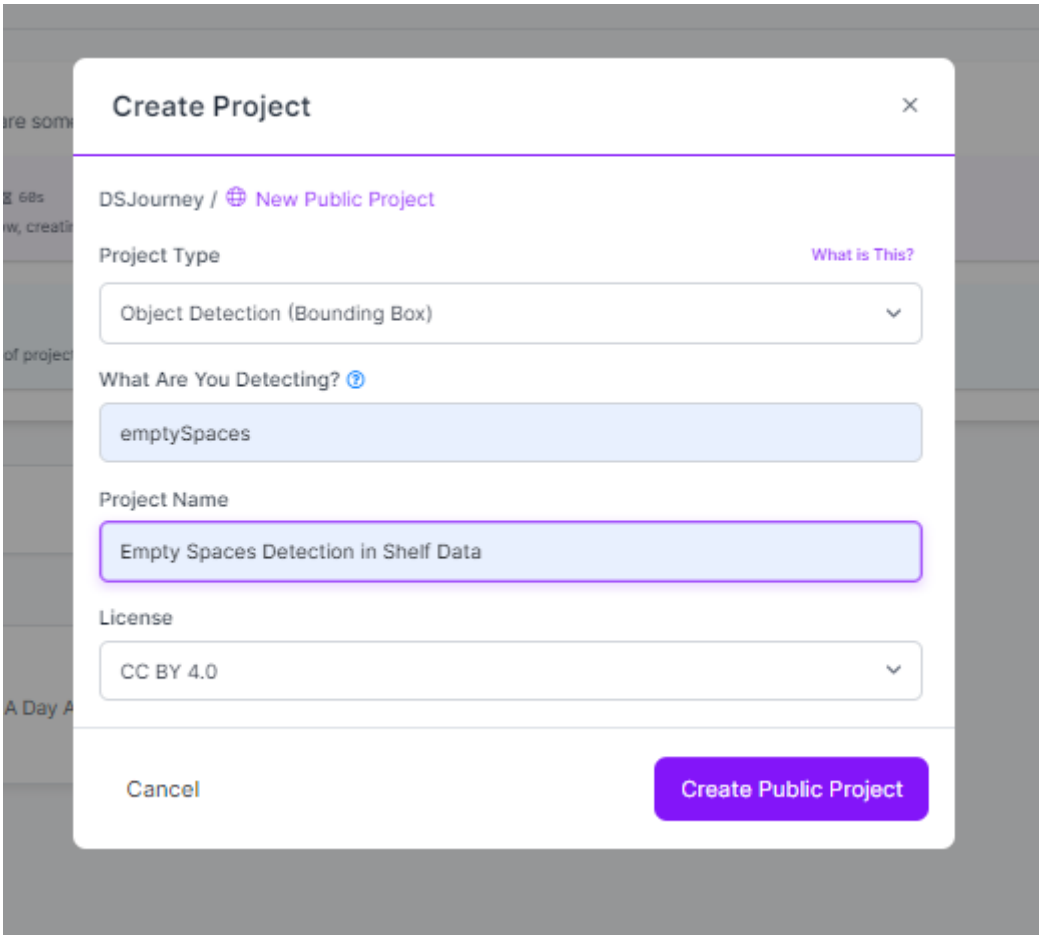
ShelfSightDocumentary

August 3, 2023

I will be using Roboflow to implement this project. Building a custom dataset can be a painful process. It might take dozens or even hundreds of hours to collect images, label them, and export them in the proper format. Fortunately, Roboflow makes this process as straightforward and fast as possible. You can visit my Roboflow page to see the results of this project.

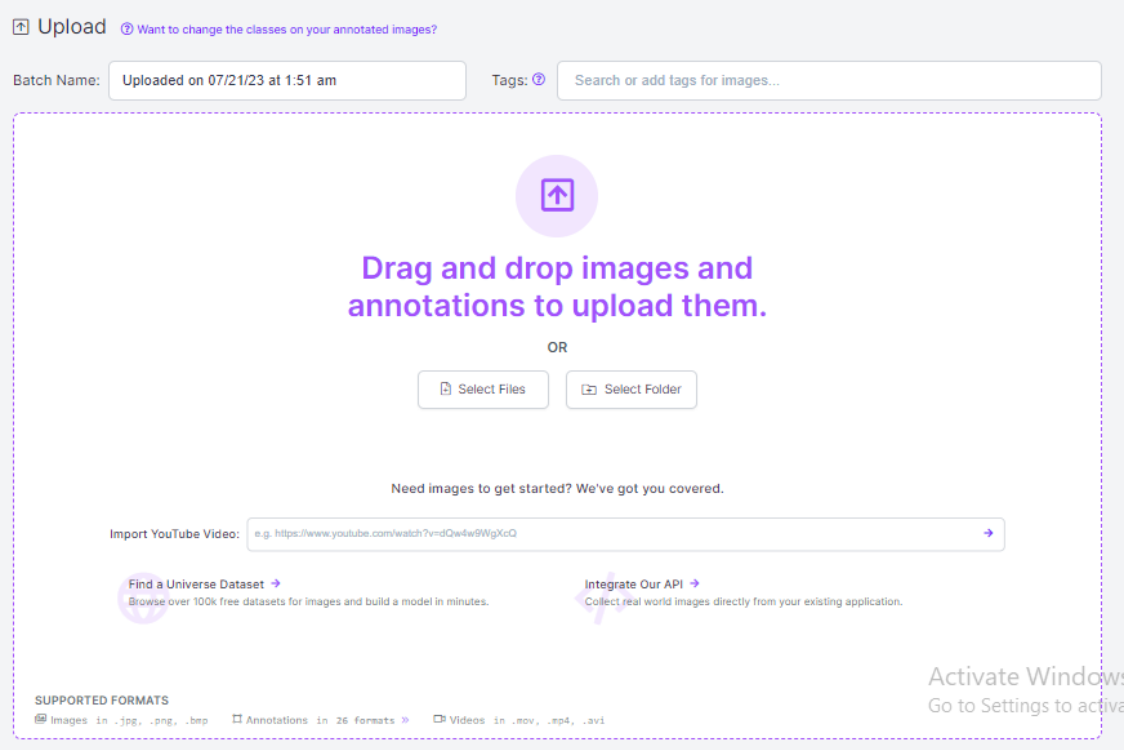
0.1 Step 1: Creating the Project

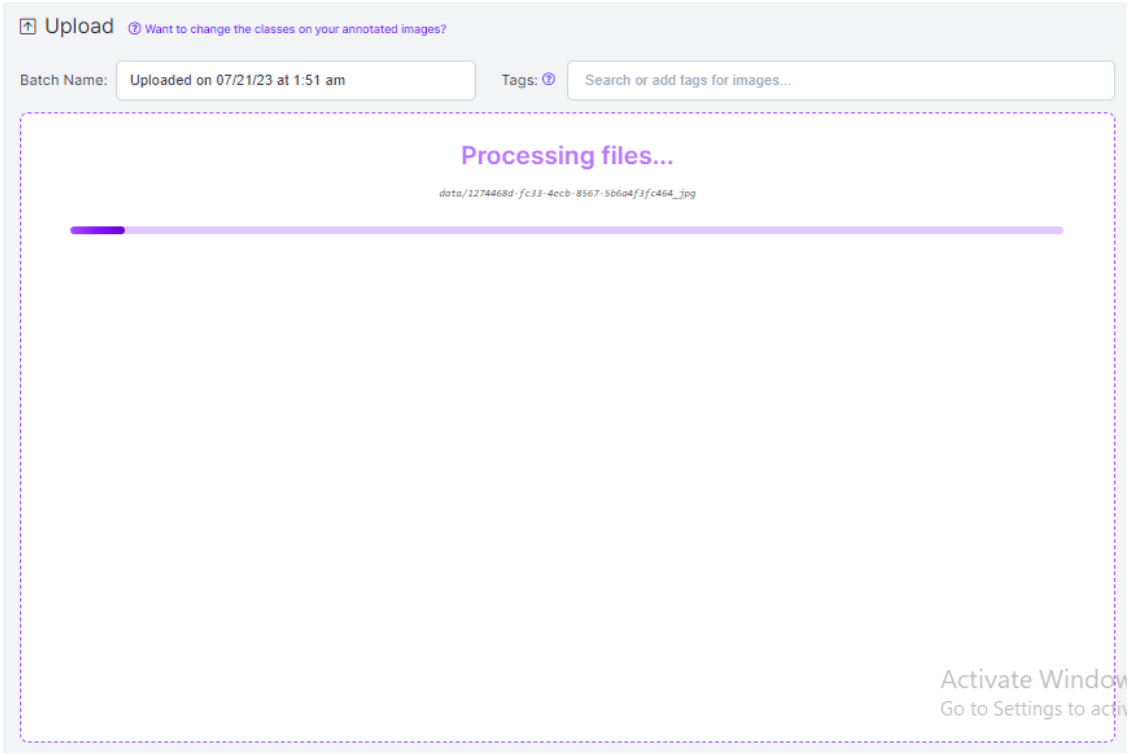
Before I start, I created a Roboflow account. Once I did that, I created a new project in the Roboflow dashboard. The project type is "Object Detection". The class I will be detecting is 'emptySpaces and the project name is "Empty Spaces Detection in Shelf Data".

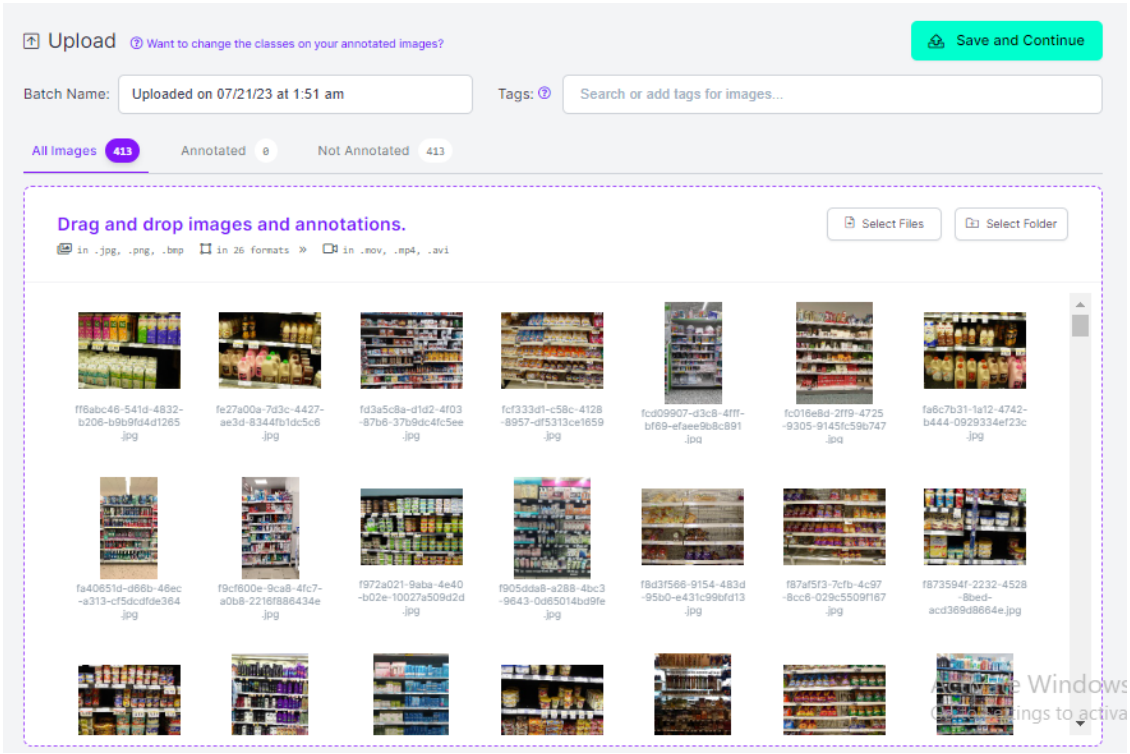


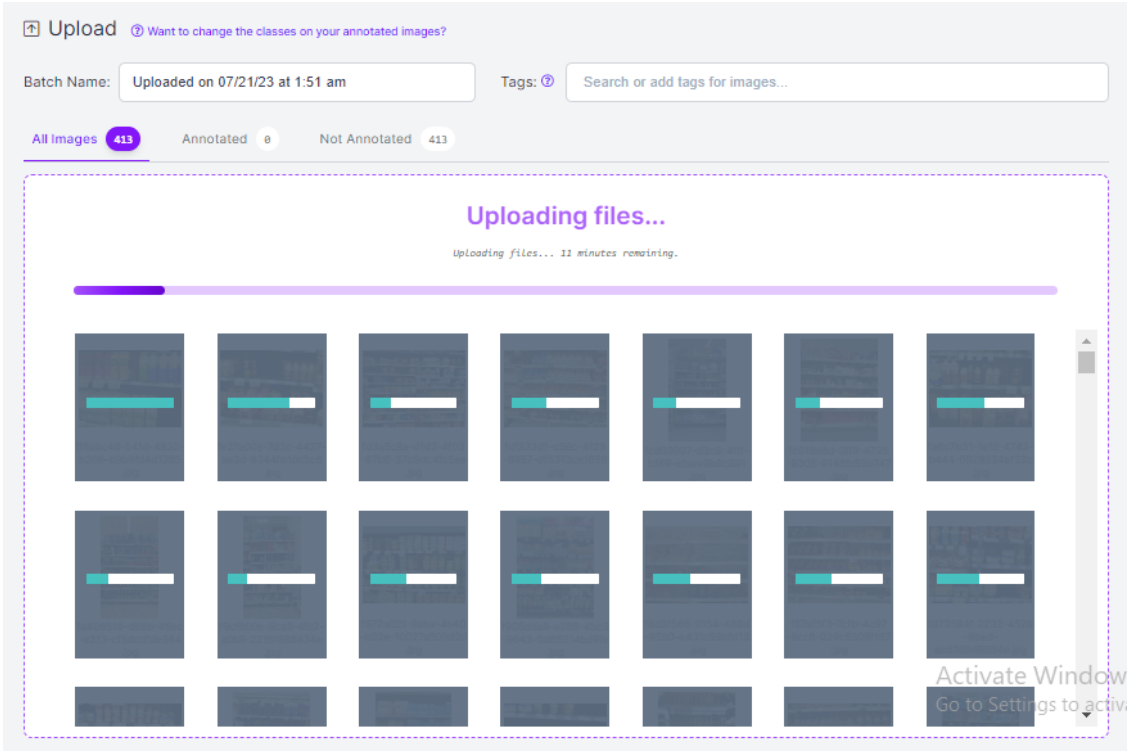
0.2 Step 2: Uploading images

Next, I added the data to my newly created project. I drag and drop'd my directory /data , which contains all the images in .jpg format. There are total 412 images for the dataset of shelves. The dataset not only contains pictures from different supermarkets in a place, but also different countries so it is really diverse. Roboflow dashboard automatically processed and uploaded the images and the next step is annotations. Link: https://dataverse.harvard.edu/dataset.xhtml?persistentId=doi:10.7910/DVN/8RET7B




Upload
Want to change the classes on your annotated images?
Batch Name:
Uploaded on 07/21/23 at 1:51 am
Tags:
Search or add tags for images...
Processing files...
data/1274468d-fc33-4ecb-8567-5b6a4f3fc464_jpg
Activate Windows
Go to Settings to activ


Upload
Want to change the classes on your annotated images?
Save and Continue
Batch Name:
Uploaded on 07/21/23 at 1:51 am
Tags:
Search or add tags for images...
All Images 413
Annotated 0
Not Annotated 413
Drag and drop images and annotations.
Select Files
Select Folder
in .jpg, .png, .bmp
in 26 formats
in .mov, .mp4, .avi
ff6abc46-541d-4832-b206-b9b9fd4d1265.jpg
fe27a00a-7d3c-4427-ae3d-8344fb1dc5c6.jpg
fd3a5c8a-d1d2-4f03-87b6-37b9dc4fc5ee.jpg
fcf333d1-c58c-4128-8957-df5313ce1659.jpg
fcd09907-d3c8-4fff-bf69-efaee9b8c891.jpg
fc016e8d-2ff9-4725-9305-9145fc59b747.jpg
fa6c7b31-1a12-4742-b444-0929334ef23c.jpg
fa40651d-d66b-46ec-a313-cf5dcdfde364.jpg
f9cf600e-9ca8-4fc7-a0b8-2216f886434e.jpg
f972a021-9aba-4e40-b02e-10027a509d2d.jpg
f905dda8-a288-4bc3-9643-0d65014bd9fe.jpg
f8d3f568-9154-483d-95b0-e431c99bfd13.jpg
f87af5f3-7cfb-4c97-8cc6-029c5509f187.jpg
f873594f-2232-4528-8bed-acd369d8664e.jpg
Activate Windows
Go to Settings to activa

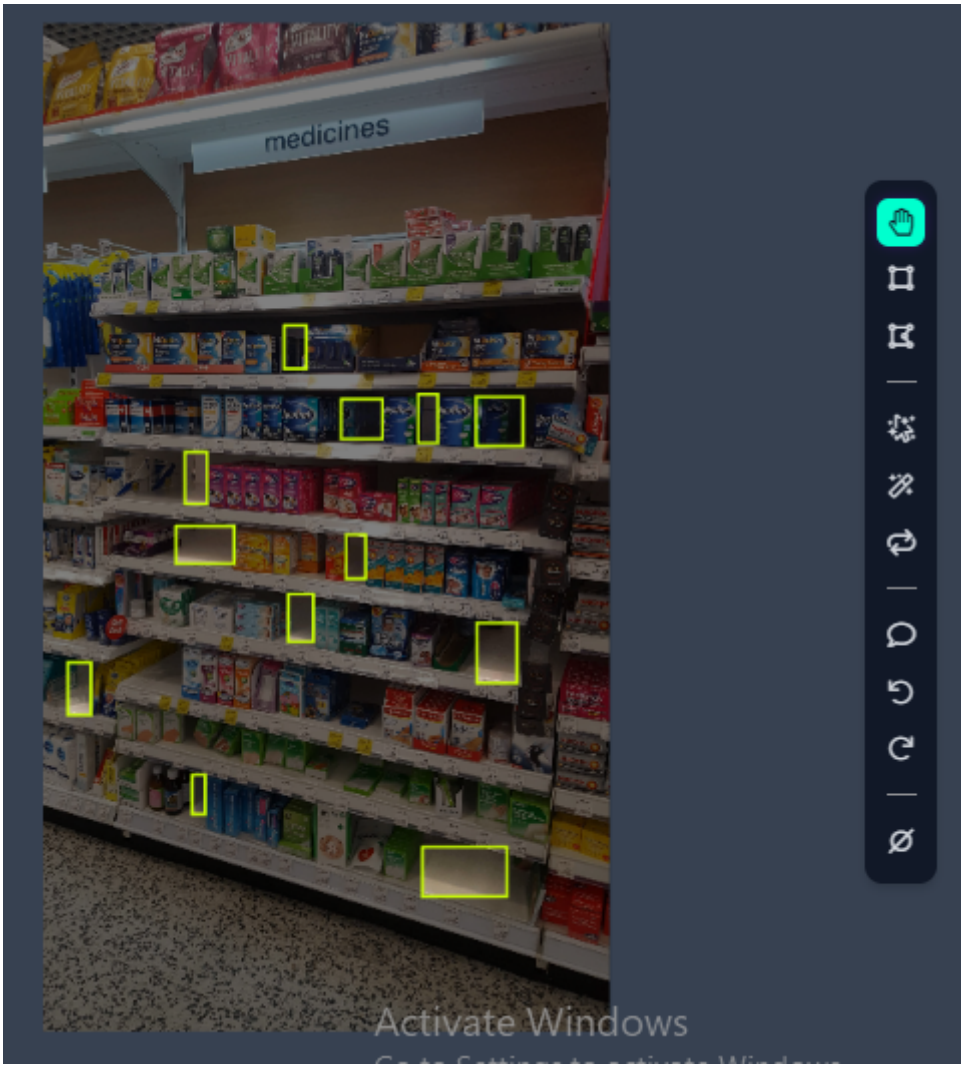

Upload
Want to change the classes on your annotated images?
Batch Name:
Uploaded on 07/21/23 at 1:51 am
Tags:
Search or add tags for images...
All Images 413
Annotated 0
Not Annotated 413
Uploading files...
Uploading files... 11 minutes remaining.
Activate Window
Go to Settings to activ

Samples:

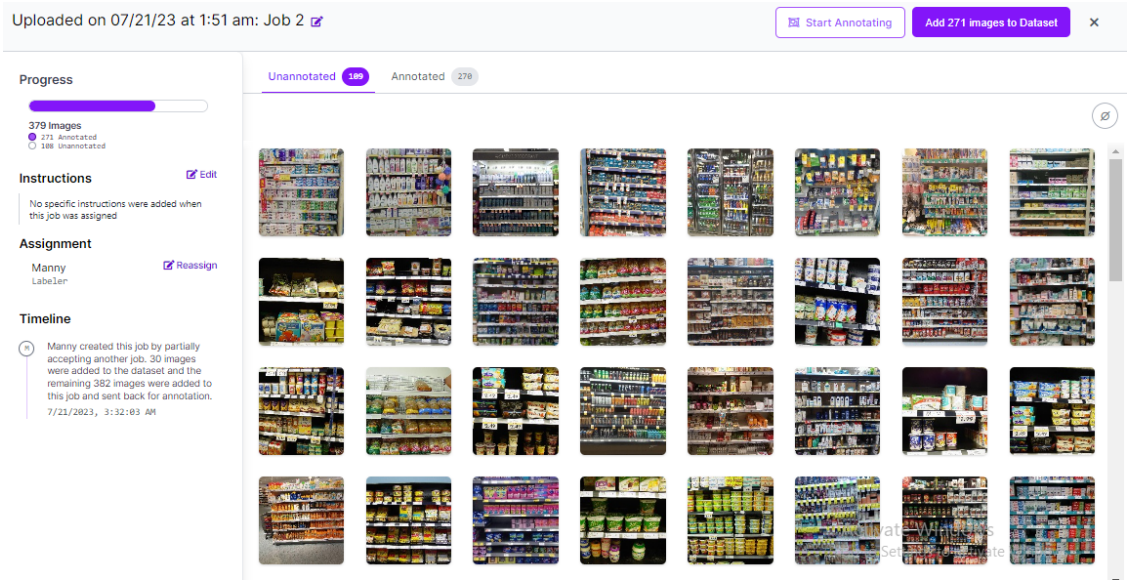

medicines
NiQuitin
EXTRA FRESH MINT
NEW
NEW
nicorette
Nicotinell
Calpol
NUROFEN
Elastoplast
Feminax
SKYN
Teetha
Roll Back
Kool'n Soothe
FIRST AID
Latex Gloves
Bazuka
WARTNER

0.3 Step 3: Labeling

I labelled the uploaded images in Roboflow Annotate. There were total 421 images, out of which I decided to annotate 300 because annotating is a tideous process. I labelled about 2 images per minute. Here are some annotations of the sample I provided earlier.

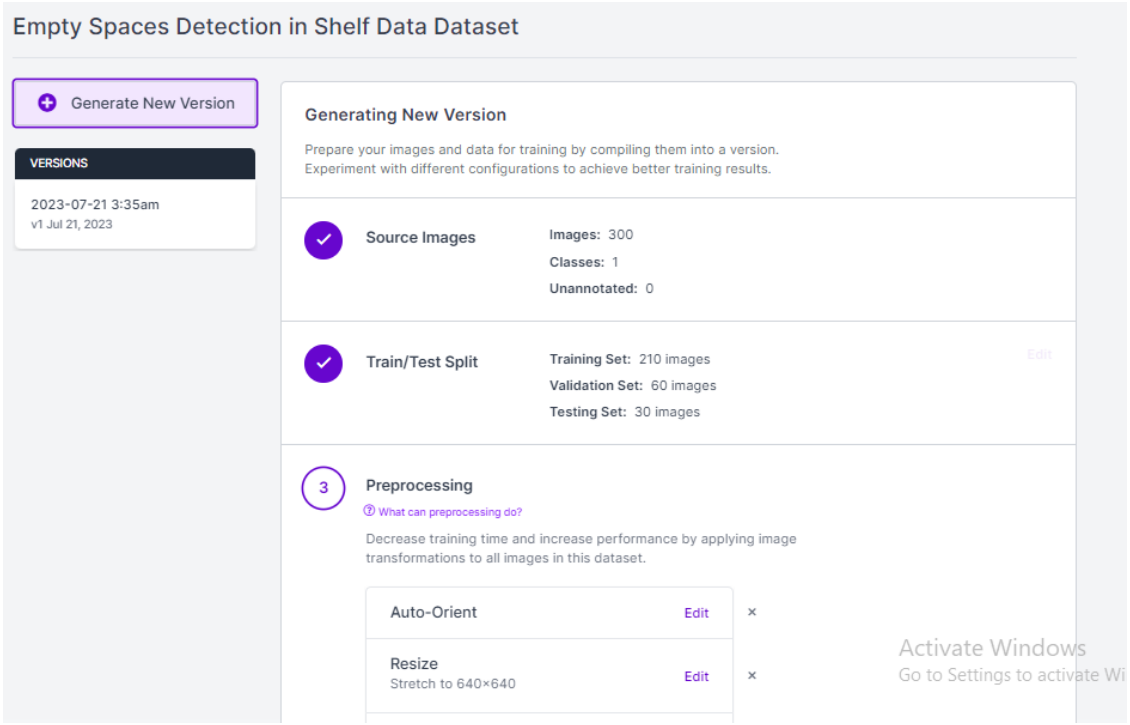


I firstly annoted 30 images seperately, so I annoted the rest 270 images here, while ignoring the unannotated ones. And, added it into my dataset of 300 images.



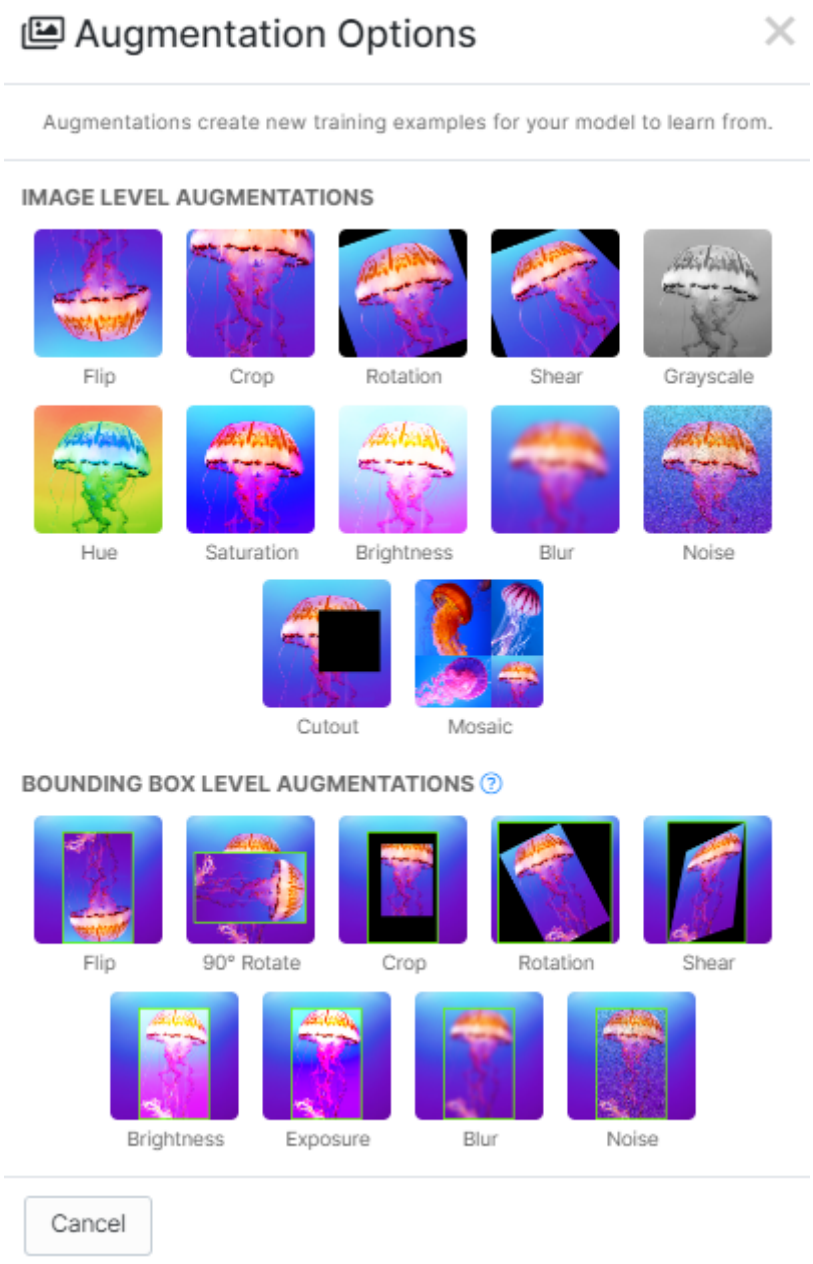
0.4 Step 4: Generate new dataset version

Now that I have the images and annotations added, I generated a new dataset version. I used train-test split, by splitting 70% training, 20% validation and 10% testing. When generating a new version of data, you can elect to add preprocessing and augmentations. This step is completely optional, however, it can allow to significantly improve the robustness of the model.



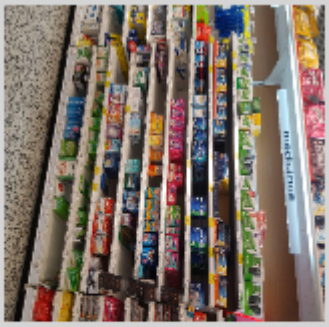
The preprocessing includes Resize, which downsizes the image for smaller file sizes and faster training. Auto-Orient discards any orientated images. The augmentation is a crucial process. It

helps us create more images of the same dataset by generating augmented version of each images. Firstly, I used 90 Rotate, which adds 90-degree rotations to help the model be insensitive to camera orientations because a picture can be taken vertically and horizontally. And, Exposure includes adding variability to image brightness to help the model be more resilient to lighting and camera settings, because a good quality image isn't always available.



90° Rotate

preprocessed



clockwise

90° Rotate

Add 90-degree rotations to help your model be insensitive to camera orientation.

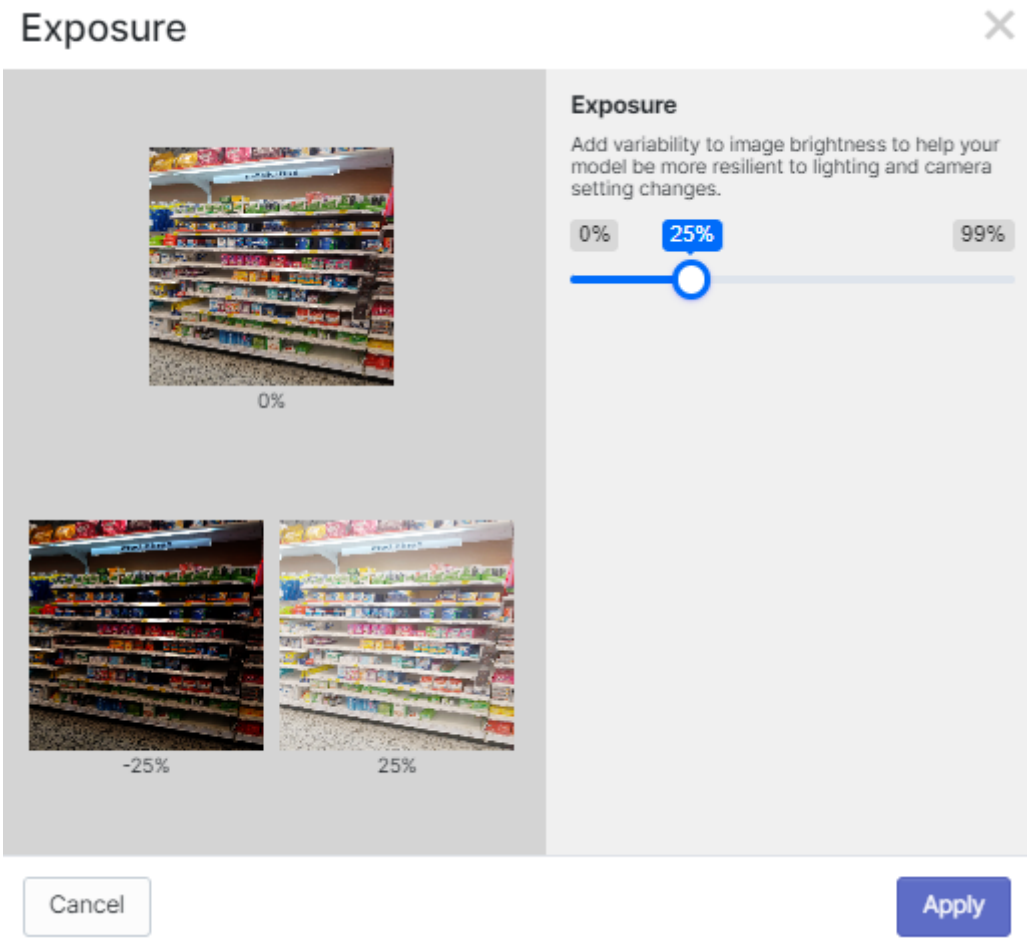
- [x] Clockwise
- [ ] Counter-Clockwise
- [ ] Upside Down

When should I rotate my images?

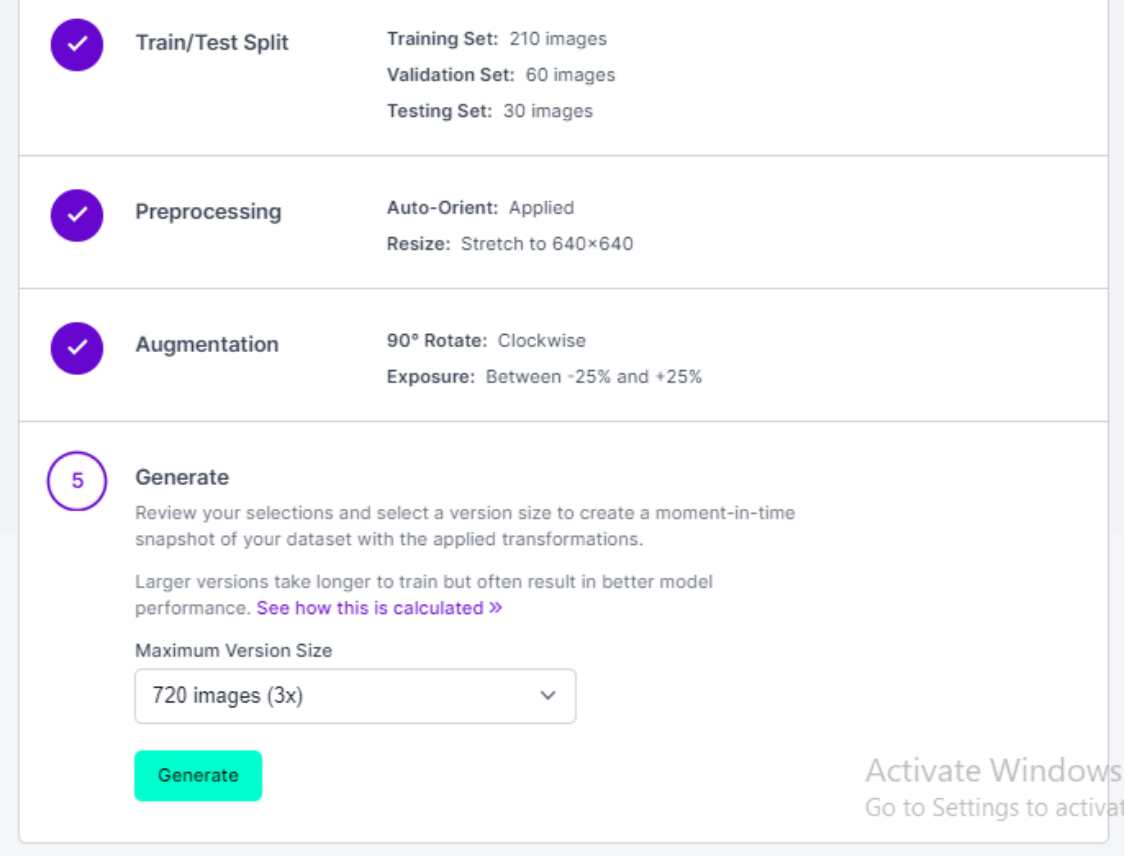
If orientation doesn't matter (eg they may be taken in portrait/landscape mode or from above).
via Roboflow Blog

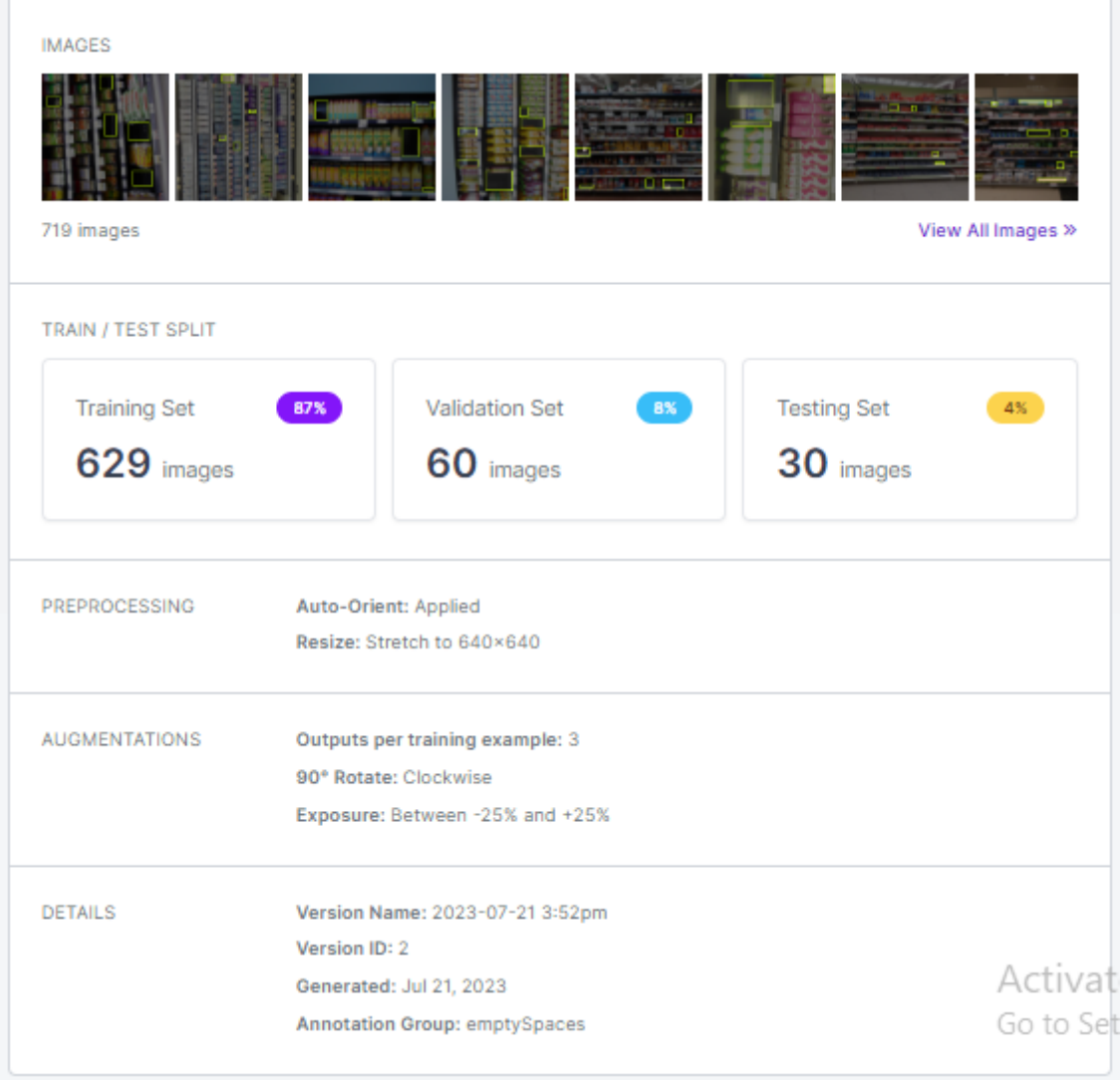
Cancel

Apply



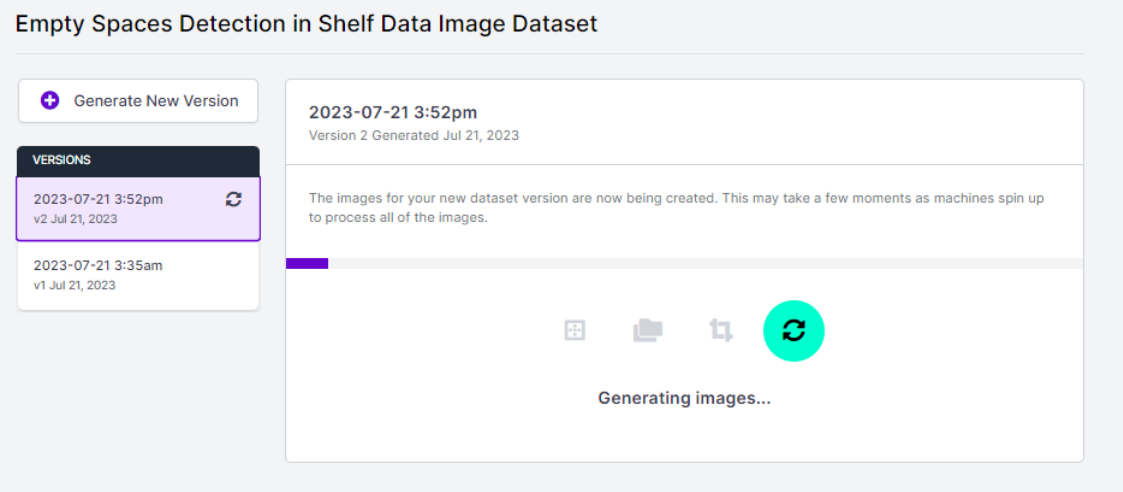
Through the augmentation steps, we are able to convert 300 images into 720 (there were more but they can only be used with a purchase of subscription).

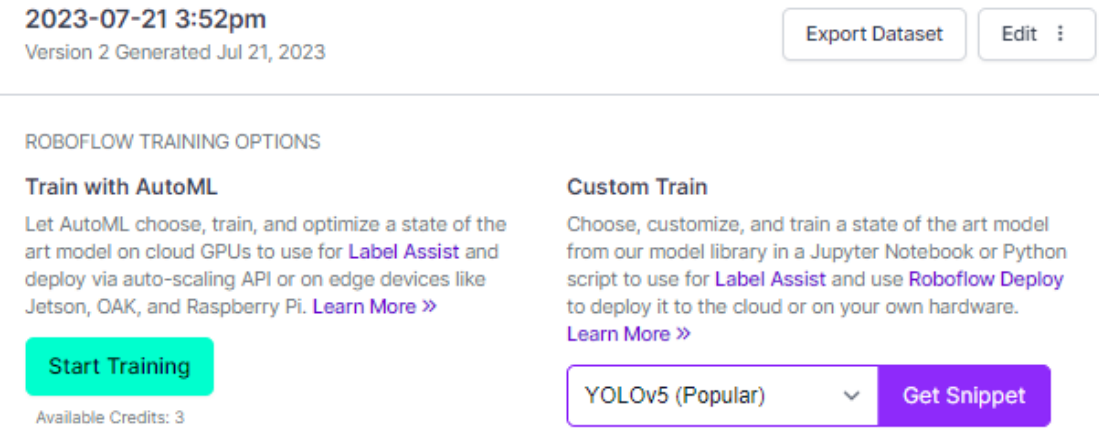

Train/Test Split
Training Set: 210 images
Validation Set: 60 images
Testing Set: 30 images
Preprocessing
Auto-Orient: Applied
Resize: Stretch to 640×640
Augmentation
90° Rotate: Clockwise
Exposure: Between -25% and +25%
5
Generate
Review your selections and select a version size to create a moment-in-time snapshot of your dataset with the applied transformations.
Larger versions take longer to train but often result in better model performance. See how this is calculated »
Maximum Version Size
720 images (3x)
Generate
Activate Windows
Go to Settings to activat

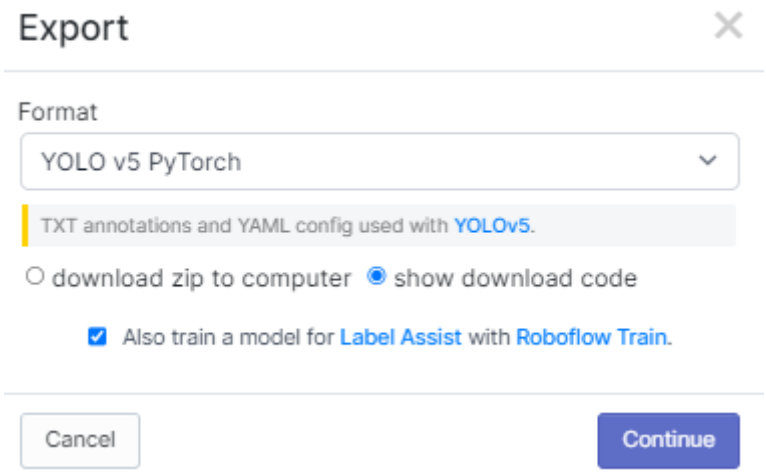


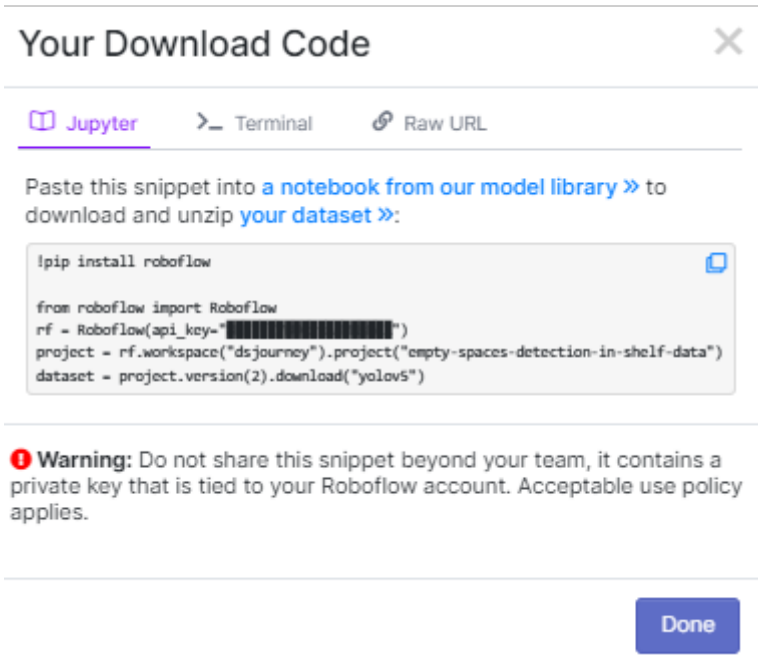
0.5 Step 5: Exporting dataset

Once the dataset version is generated, I clicked Export and select the YOLO v5 PyTorch dataset format.


Empty Spaces Detection in Shelf Data Image Dataset
Generate New Version
VERSIONS
2023-07-21 3:52pm
v2 Jul 21, 2023
2023-07-21 3:35am
v1 Jul 21, 2023
2023-07-21 3:52pm
Version 2 Generated Jul 21, 2023
The images for your new dataset version are now being created. This may take a few moments as machines spin up to process all of the images.
Generating images...


2023-07-21 3:52pm
Version 2 Generated Jul 21, 2023
Export Dataset
Edit
ROBOFLOW TRAINING OPTIONS
Train with AutoML
Let AutoML choose, train, and optimize a state of the art model on cloud GPUs to use for Label Assist and deploy via auto-scaling API or on edge devices like Jetson, OAK, and Raspberry Pi. Learn More »
Start Training
Available Credits: 3
Custom Train
Choose, customize, and train a state of the art model from our model library in a Jupyter Notebook or Python script to use for Label Assist and use Roboflow Deploy to deploy it to the cloud or on your own hardware.
Learn More »
YOLOv5 (Popular)
Get Snippet


Export
Format
YOLO v5 PyTorch
TXT annotations and YAML config used with YOLOv5.
download zip to computer
show download code
Also train a model for Label Assist with Roboflow Train.
Cancel
Continue



0.6 Step 6: Loading the custom dataset and labels

0.7 The rest of the code is run in colab, because their free GPUs (type T4). The notebook is copied from Colab and pasted here.

[1]:
```
!nvidia-smi
```

```
Fri Jul 21 11:25:59 2023
+-----------------------------------------------------------------------------+
| NVIDIA-SMI 525.105.17   Driver Version: 525.105.17   CUDA Version: 12.0     |
|-------------------------------+----------------------+----------------------+
| GPU  Name        Persistence-M| Bus-Id        Disp.A | Volatile Uncorr. ECC |
| Fan  Temp  Perf  Pwr:Usage/Cap|         Memory-Usage | GPU-Util  Compute M. |
|                               |                      |               MIG M. |
|===============================+======================+======================|
|   0  Tesla T4            Off  | 00000000:00:04.0 Off |                    0 |
| N/A   59C    P8    11W /  70W |      0MiB / 15360MiB |      0%      Default |
|                               |                      |                  N/A |
+-------------------------------+----------------------+----------------------+

+-----------------------------------------------------------------------------+
| Processes:                                                                  |
|  GPU   GI   CI        PID   Type   Process name                  GPU Memory |
|        ID   ID                                                   Usage      |
|=============================================================================|
|  No running processes found                                                 |
+-----------------------------------------------------------------------------+
```

[3]:
```
!pip install ultralytics==8.0.20
!pip install roboflow --quiet

from IPython import display
display.clear_output()

import ultralytics
ultralytics.checks()

from ultralytics import YOLO

from IPython.display import display, Image
```

```
Ultralytics YOLOv8.0.20  Python-3.10.6 torch-2.0.1+cu118 CUDA:0 (Tesla T4,
15102MiB)
Setup complete  (2 CPUs, 12.7 GB RAM, 24.3/78.2 GB disk)
```

[4]:
```
import os
HOME = os.getcwd()

!mkdir {HOME}/datasets
%cd {HOME}/datasets

from roboflow import Roboflow
rf = Roboflow(api_key="8B5TfIVBUCxvAsWWsNqX")
project = rf.workspace("dsjourney").
 ↪project("empty-spaces-detection-in-shelf-data")
dataset = project.version(2).download("yolov5")
```

```
/content/datasets
loading Roboflow workspace…
loading Roboflow project…
Downloading Dataset Version Zip in Empty-Spaces-Detection-in-Shelf-Data-2 to
yolov5pytorch: 100% [64723946 / 64723946] bytes

Extracting Dataset Version Zip to Empty-Spaces-Detection-in-Shelf-Data-2 in
yolov5pytorch:: 100%|      | 1450/1450 [00:00<00:00, 1658.49it/s]
```

0.8 Step 7: Training the YOLO model

[5]:
```
%cd {HOME}

!yolo task=detect mode=train model=yolov8s.pt data={dataset.location}/data.yaml␣
 ↪epochs=25 imgsz=800 plots=True
```

```
/content
Downloading
https://github.com/ultralytics/assets/releases/download/v0.0.0/yolov8s.pt to
yolov8s.pt…
```

```
100% 21.5M/21.5M [00:00<00:00, 71.9MB/s]

Ultralytics YOLOv8.0.20  Python-3.10.6 torch-2.0.1+cu118 CUDA:0 (Tesla T4,
15102MiB)
yolo/engine/trainer: task=detect, mode=train, model=yolov8s.yaml,
data=/content/datasets/Empty-Spaces-Detection-in-Shelf-Data-2/data.yaml,
epochs=25, patience=50, batch=16, imgsz=800, save=True, cache=False, device=,
workers=8, project=None, name=None, exist_ok=False, pretrained=False,
optimizer=SGD, verbose=True, seed=0, deterministic=True, single_cls=False,
image_weights=False, rect=False, cos_lr=False, close_mosaic=10, resume=False,
overlap_mask=True, mask_ratio=4, dropout=False, val=True, save_json=False,
save_hybrid=False, conf=0.001, iou=0.7, max_det=300, half=False, dnn=False,
plots=True, source=ultralytics/assets/, show=False, save_txt=False,
save_conf=False, save_crop=False, hide_labels=False, hide_conf=False,
vid_stride=1, line_thickness=3, visualize=False, augment=False,
agnostic_nms=False, classes=None, retina_masks=False, boxes=True,
format=torchscript, keras=False, optimize=False, int8=False, dynamic=False,
simplify=False, opset=17, workspace=4, nms=False, lr0=0.01, lrf=0.01,
momentum=0.937, weight_decay=0.001, warmup_epochs=3.0, warmup_momentum=0.8,
warmup_bias_lr=0.1, box=7.5, cls=0.5, dfl=1.5, fl_gamma=0.0,
label_smoothing=0.0, nbs=64, hsv_h=0.015, hsv_s=0.7, hsv_v=0.4, degrees=0.0,
translate=0.1, scale=0.5, shear=0.0, perspective=0.0, flipud=0.0, fliplr=0.5,
mosaic=1.0, mixup=0.0, copy_paste=0.0, cfg=None, v5loader=False,
save_dir=runs/detect/train
Downloading https://ultralytics.com/assets/Arial.ttf to
/root/.config/Ultralytics/Arial.ttf…
100% 755k/755k [00:00<00:00, 22.6MB/s]
2023-07-21 11:38:56.015350: I tensorflow/core/platform/cpu_feature_guard.cc:182]
This TensorFlow binary is optimized to use available CPU instructions in
performance-critical operations.
To enable the following instructions: AVX2 FMA, in other operations, rebuild
TensorFlow with the appropriate compiler flags.
2023-07-21 11:38:56.989837: W
tensorflow/compiler/tf2tensorrt/utils/py_utils.cc:38] TF-TRT Warning: Could not
find TensorRT
Overriding model.yaml nc=80 with nc=1

                  from  n    params  module
arguments
  0                 -1  1       928  ultralytics.nn.modules.Conv
[3, 32, 3, 2]
  1                 -1  1     18560  ultralytics.nn.modules.Conv
[32, 64, 3, 2]
  2                 -1  1     29056  ultralytics.nn.modules.C2f
[64, 64, 1, True]
  3                 -1  1     73984  ultralytics.nn.modules.Conv
[64, 128, 3, 2]
  4                 -1  2    197632  ultralytics.nn.modules.C2f
```

```
[128, 128, 2, True]
  5                  -1  1    295424  ultralytics.nn.modules.Conv
[128, 256, 3, 2]
  6                  -1  2    788480  ultralytics.nn.modules.C2f
[256, 256, 2, True]
  7                  -1  1   1180672  ultralytics.nn.modules.Conv
[256, 512, 3, 2]
  8                  -1  1   1838080  ultralytics.nn.modules.C2f
[512, 512, 1, True]
  9                  -1  1    656896  ultralytics.nn.modules.SPPF
[512, 512, 5]
 10                  -1  1         0  torch.nn.modules.upsampling.Upsample
[None, 2, 'nearest']
 11             [-1, 6]  1         0  ultralytics.nn.modules.Concat
[1]
 12                  -1  1    591360  ultralytics.nn.modules.C2f
[768, 256, 1]
 13                  -1  1         0  torch.nn.modules.upsampling.Upsample
[None, 2, 'nearest']
 14             [-1, 4]  1         0  ultralytics.nn.modules.Concat
[1]
 15                  -1  1    148224  ultralytics.nn.modules.C2f
[384, 128, 1]
 16                  -1  1    147712  ultralytics.nn.modules.Conv
[128, 128, 3, 2]
 17            [-1, 12]  1         0  ultralytics.nn.modules.Concat
[1]
 18                  -1  1    493056  ultralytics.nn.modules.C2f
[384, 256, 1]
 19                  -1  1    590336  ultralytics.nn.modules.Conv
[256, 256, 3, 2]
 20             [-1, 9]  1         0  ultralytics.nn.modules.Concat
[1]
 21                  -1  1   1969152  ultralytics.nn.modules.C2f
[768, 512, 1]
 22        [15, 18, 21]  1   2116435  ultralytics.nn.modules.Detect
[1, [128, 256, 512]]
Model summary: 225 layers, 11135987 parameters, 11135971 gradients, 28.6 GFLOPs

Transferred 349/355 items from pretrained weights
optimizer: SGD(lr=0.01) with parameter groups 57 weight(decay=0.0),
64 weight(decay=0.001), 63 bias
train: Scanning /content/datasets/Empty-Spaces-Detection-in-Shelf-
Data-2/train/labels… 629 images, 6 backgrounds, 0 corrupt: 100% 629/629
[00:00<00:00, 2115.09it/s]
train: New cache created: /content/datasets/Empty-Spaces-Detection-
in-Shelf-Data-2/train/labels.cache
WARNING  Box and segment counts should be equal, but got len(segments) = 51,
```

```
len(boxes) = 3007. To resolve this only boxes will be used and all segments will
be removed. To avoid this please supply either a detect or segment dataset, not
a detect-segment mixed dataset.
albumentations: Blur(p=0.01, blur_limit=(3, 7)), MedianBlur(p=0.01,
blur_limit=(3, 7)), ToGray(p=0.01), CLAHE(p=0.01, clip_limit=(1, 4.0),
tile_grid_size=(8, 8))
val: Scanning /content/datasets/Empty-Spaces-Detection-in-Shelf-
Data-2/valid/labels… 60 images, 0 backgrounds, 0 corrupt: 100% 60/60
[00:00<00:00, 2667.59it/s]
val: New cache created: /content/datasets/Empty-Spaces-Detection-
in-Shelf-Data-2/valid/labels.cache
WARNING  Box and segment counts should be equal, but got len(segments) = 4,
len(boxes) = 293. To resolve this only boxes will be used and all segments will
be removed. To avoid this please supply either a detect or segment dataset, not
a detect-segment mixed dataset.
Image sizes 800 train, 800 val
Using 2 dataloader workers
Logging results to runs/detect/train
Starting training for 25 epochs…

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
       1/25      7.25G      2.488      3.858      2.078         31        800:
100% 40/40 [00:40<00:00,  1.01s/it]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100% 2/2 [00:02<00:00,  1.33s/it]
                   all         60        293      0.281      0.406      0.271
0.111

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
       2/25      7.25G      1.822      1.852      1.563         40        800:
100% 40/40 [00:36<00:00,  1.10it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100% 2/2 [00:01<00:00,  1.33it/s]
                   all         60        293      0.429      0.457      0.384
0.153

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
       3/25      7.25G      1.737      1.644       1.43         20        800:
100% 40/40 [00:36<00:00,  1.10it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100% 2/2 [00:01<00:00,  1.37it/s]
                   all         60        293      0.557      0.485        0.5
0.206

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
       4/25      7.25G      1.712       1.51       1.36         20        800:
100% 40/40 [00:35<00:00,  1.13it/s]
                 Class     Images  Instances      Box(P          R      mAP50
```

```
mAP50-95): 100% 2/2 [00:02<00:00,  1.00s/it]
                   all         60        293      0.606      0.451      0.476
0.219

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
       5/25      7.25G      1.675      1.427      1.325         38        800:
100% 40/40 [00:36<00:00,  1.09it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100% 2/2 [00:02<00:00,  1.03s/it]
                   all         60        293      0.555      0.502      0.493
0.205

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
       6/25      7.25G      1.673      1.326       1.32         37        800:
100% 40/40 [00:35<00:00,  1.13it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100% 2/2 [00:01<00:00,  1.27it/s]
                   all         60        293      0.539      0.553      0.544
0.246

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
       7/25      7.86G      1.623      1.227      1.283         46        800:
100% 40/40 [00:35<00:00,  1.13it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100% 2/2 [00:01<00:00,  1.37it/s]
                   all         60        293      0.636      0.537      0.551
0.253

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
       8/25      7.86G      1.605       1.23      1.285         19        800:
100% 40/40 [00:35<00:00,  1.13it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100% 2/2 [00:01<00:00,  1.38it/s]
                   all         60        293      0.657      0.509      0.535
0.223

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
       9/25      7.86G      1.577      1.144      1.284         40        800:
100% 40/40 [00:36<00:00,  1.10it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100% 2/2 [00:01<00:00,  1.37it/s]
                   all         60        293      0.598      0.553      0.543
0.24

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      10/25      7.86G      1.538      1.087      1.235         27        800:
100% 40/40 [00:36<00:00,  1.11it/s]
                 Class     Images  Instances      Box(P          R      mAP50
```

```
mAP50-95): 100% 2/2 [00:01<00:00,  1.38it/s]
                   all         60        293      0.634      0.527      0.554
0.235

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      11/25      7.86G      1.532      1.074      1.251         49        800:
100% 40/40 [00:36<00:00,  1.09it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100% 2/2 [00:01<00:00,  1.09it/s]
                   all         60        293      0.576      0.589      0.552
0.235

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      12/25      7.86G      1.497       1.02      1.229         52        800:
100% 40/40 [00:34<00:00,  1.15it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100% 2/2 [00:01<00:00,  1.27it/s]
                   all         60        293      0.682      0.512      0.555
0.237

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      13/25      7.86G      1.444     0.9582        1.2         34        800:
100% 40/40 [00:35<00:00,  1.12it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100% 2/2 [00:01<00:00,  1.38it/s]
                   all         60        293      0.592      0.584      0.571
0.239

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      14/25      7.86G      1.426     0.9409      1.202         52        800:
100% 40/40 [00:35<00:00,  1.11it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100% 2/2 [00:01<00:00,  1.37it/s]
                   all         60        293      0.645      0.505      0.553
0.256

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      15/25      7.86G      1.403     0.9317      1.177         31        800:
100% 40/40 [00:36<00:00,  1.10it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100% 2/2 [00:01<00:00,  1.39it/s]
                   all         60        293      0.675      0.543      0.572
0.242
Closing dataloader mosaic
albumentations: Blur(p=0.01, blur_limit=(3, 7)), MedianBlur(p=0.01,
blur_limit=(3, 7)), ToGray(p=0.01), CLAHE(p=0.01, clip_limit=(1, 4.0),
tile_grid_size=(8, 8))
```

```
      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      16/25      7.86G      1.399     0.9042        1.2         19        800:
100% 40/40 [00:24<00:00,  1.63it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100% 2/2 [00:01<00:00,  1.38it/s]
                   all         60        293      0.604      0.587      0.578
0.258

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      17/25      7.86G      1.351     0.8289      1.164         22        800:
100% 40/40 [00:22<00:00,  1.79it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100% 2/2 [00:01<00:00,  1.36it/s]
                   all         60        293      0.619       0.57      0.572
0.257

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      18/25      7.86G      1.328     0.8065      1.149         25        800:
100% 40/40 [00:20<00:00,  1.91it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100% 2/2 [00:01<00:00,  1.02it/s]
                   all         60        293      0.675       0.56      0.555
0.254

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      19/25      7.86G      1.288     0.7554      1.144         34        800:
100% 40/40 [00:21<00:00,  1.90it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100% 2/2 [00:01<00:00,  1.37it/s]
                   all         60        293      0.678      0.538      0.579
0.251

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      20/25      7.86G      1.282     0.7641      1.138         18        800:
100% 40/40 [00:22<00:00,  1.77it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100% 2/2 [00:01<00:00,  1.39it/s]
                   all         60        293      0.697      0.512      0.565
0.255

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      21/25      7.86G       1.23     0.7157      1.108         34        800:
100% 40/40 [00:22<00:00,  1.79it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100% 2/2 [00:01<00:00,  1.39it/s]
                   all         60        293      0.679      0.526      0.582
0.276
```

```
      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      22/25      7.86G      1.217     0.7132      1.109         14        800:
100% 40/40 [00:21<00:00,  1.89it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100% 2/2 [00:01<00:00,  1.06it/s]
                   all         60        293      0.601       0.56      0.565
0.271

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      23/25      7.86G      1.174     0.6655      1.083         19        800:
100% 40/40 [00:20<00:00,  1.92it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100% 2/2 [00:01<00:00,  1.40it/s]
                   all         60        293      0.733      0.505      0.588
0.27

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      24/25      7.86G      1.151     0.6497       1.08         32        800:
100% 40/40 [00:22<00:00,  1.81it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100% 2/2 [00:01<00:00,  1.39it/s]
                   all         60        293      0.695      0.509       0.57
0.259

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      25/25      7.86G      1.114     0.6189      1.058         23        800:
100% 40/40 [00:22<00:00,  1.80it/s]
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100% 2/2 [00:02<00:00,  1.13s/it]
                   all         60        293      0.714      0.488      0.556
0.256

25 epochs completed in 0.230 hours.
Optimizer stripped from runs/detect/train/weights/last.pt, 22.5MB
Optimizer stripped from runs/detect/train/weights/best.pt, 22.5MB

Validating runs/detect/train/weights/best.pt…
Ultralytics YOLOv8.0.20  Python-3.10.6 torch-2.0.1+cu118 CUDA:0 (Tesla T4,
15102MiB)
Model summary (fused): 168 layers, 11125971 parameters, 0 gradients, 28.4 GFLOPs
                 Class     Images  Instances      Box(P          R      mAP50
mAP50-95): 100% 2/2 [00:02<00:00,  1.18s/it]
                   all         60        293      0.675      0.525      0.582
0.276
Speed: 0.3ms pre-process, 9.1ms inference, 0.0ms loss, 2.1ms post-process per
image
Results saved to runs/detect/train
```

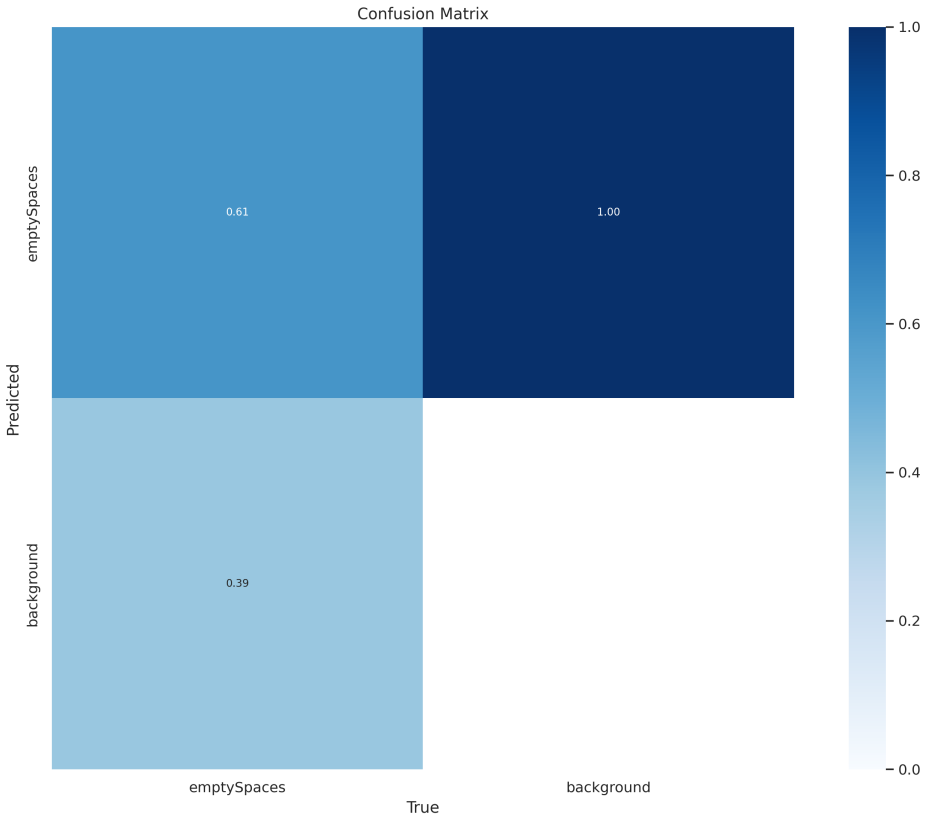
0.9 Step 8: Tables and Graphs

As you can see from the result of our training cell, we get a recall of 0.525 and precision of 0.675. Here are some images of the confusion matrix, F1 curve, Percision Curve, Recall Curve and some other results producted by the model.

[21]:
```
%cd {HOME}
Image(filename=f'{HOME}/runs/detect/train/confusion_matrix.png', width=1000)
```

```
/content
```

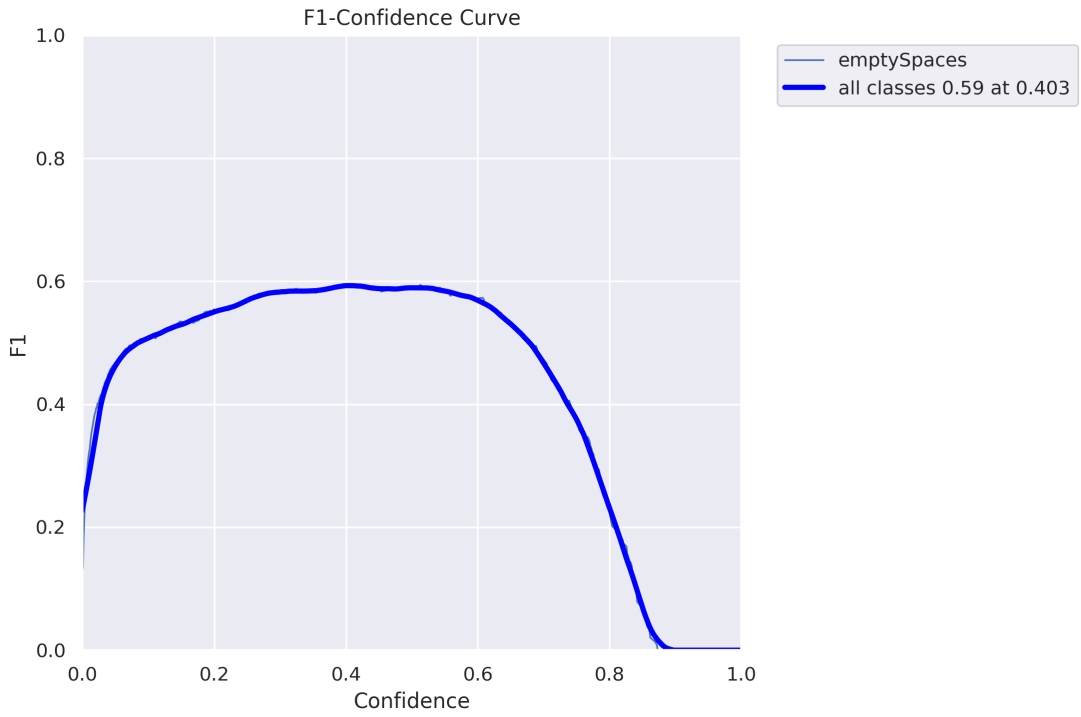
[21]:



[20]:
```
%cd {HOME}
Image(filename=f'{HOME}/runs/detect/train/F1_curve.png', width=1000)
```

```
/content
```

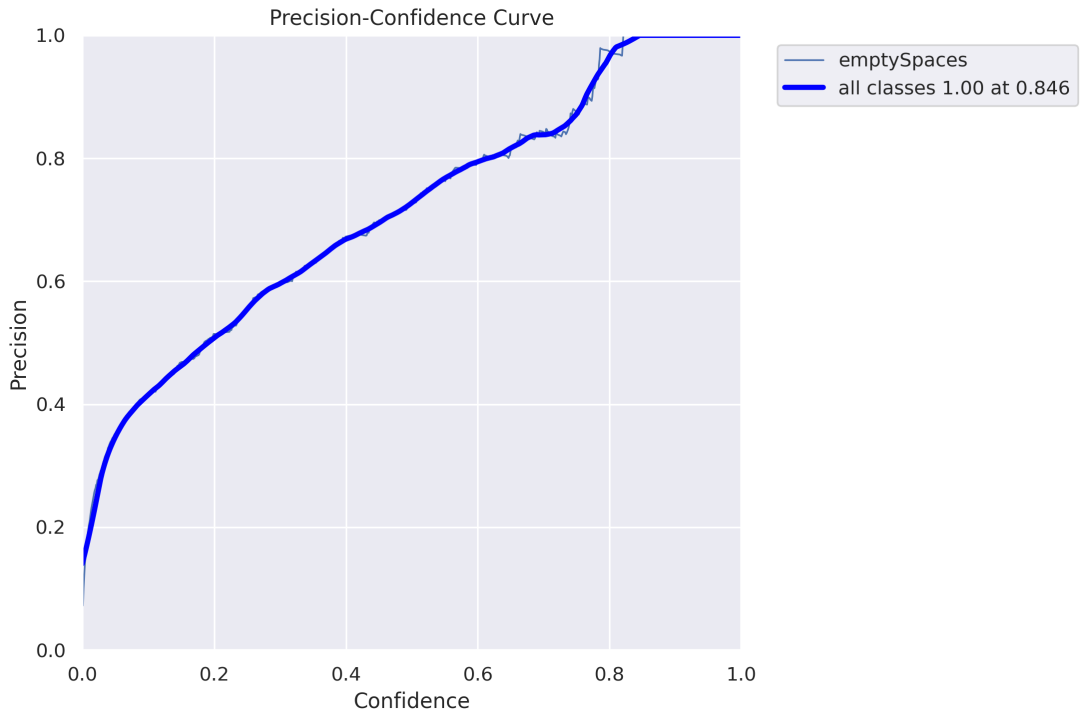
[20]:



[19]:
```
%cd {HOME}
Image(filename=f'{HOME}/runs/detect/train/P_curve.png', width=1000)
```

```
/content
```

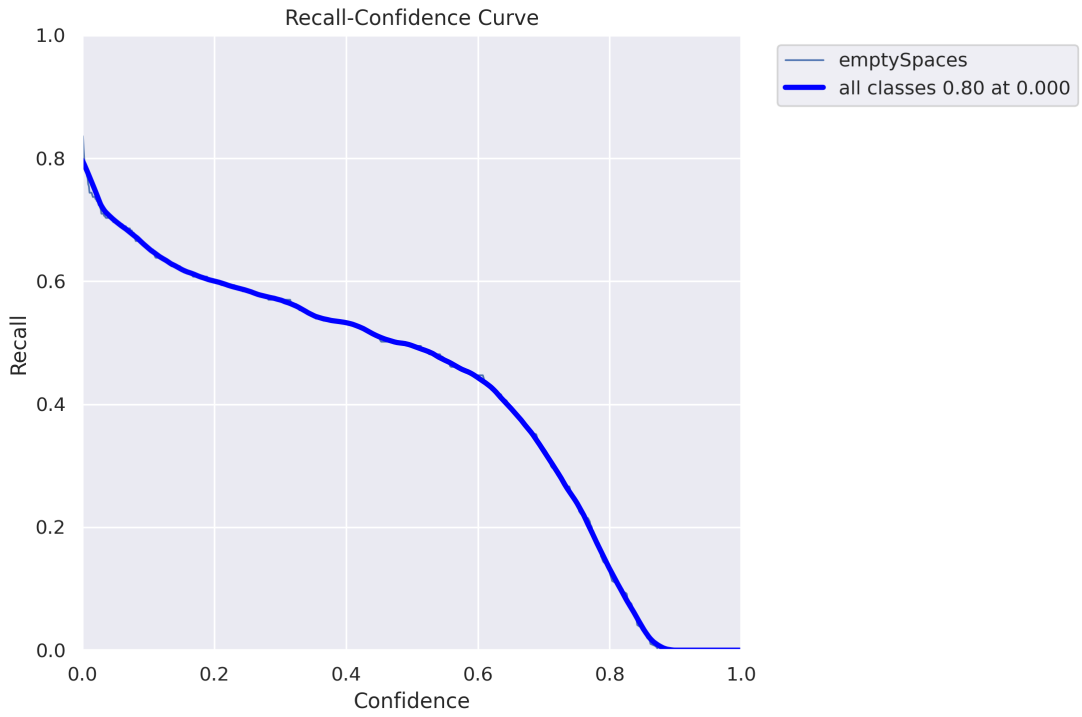
[19]:



[18]:
```
%cd {HOME}
Image(filename=f'{HOME}/runs/detect/train/R_curve.png', width=1000)
```

```
/content
```

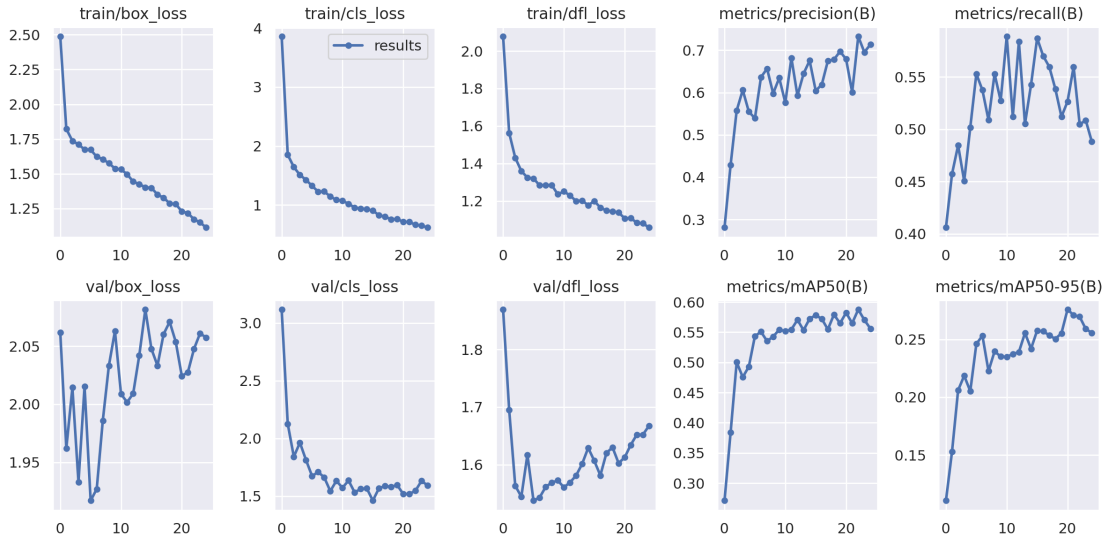
[18]:



[17]:
```
%cd {HOME}
Image(filename=f'{HOME}/runs/detect/train/results.png', width=1000)
```

```
/content
```

[17]:



0.10 Step 9: Inference with Custom Model

In this final step, we will test our model on the testing data to see how well does it identify empty spaces in shelves.

[11]:
```
%cd {HOME}
!yolo task=detect mode=predict model={HOME}/runs/detect/train/weights/best.pt␣
 ↪conf=0.25 source={dataset.location}/test/images save=True
```

```
/content
2023-07-21 11:54:28.195482: I tensorflow/core/platform/cpu_feature_guard.cc:182]
This TensorFlow binary is optimized to use available CPU instructions in
performance-critical operations.
To enable the following instructions: AVX2 FMA, in other operations, rebuild
TensorFlow with the appropriate compiler flags.
2023-07-21 11:54:29.091344: W
tensorflow/compiler/tf2tensorrt/utils/py_utils.cc:38] TF-TRT Warning: Could not
find TensorRT
Ultralytics YOLOv8.0.20  Python-3.10.6 torch-2.0.1+cu118 CUDA:0 (Tesla T4,
15102MiB)
Model summary (fused): 168 layers, 11125971 parameters, 0 gradients, 28.4 GFLOPs
image 1/30 /content/datasets/Empty-Spaces-Detection-in-Shelf-Data-2/test/images/
0e09c4a1-cbee-4c54-9b63-cf7e15ba790c_jpg.rf.612dffc03f6ec9edbc1d6b1b795fc844.jpg
: 800x800 5 emptySpacess, 24.6ms
image 2/30 /content/datasets/Empty-Spaces-Detection-in-Shelf-Data-2/test/images/
0fcb6387-fa50-4cb8-ae85-7b9dff316cfc_jpg.rf.e59967dfb2f1f439bf59b61d567f2f76.jpg
: 800x800 5 emptySpacess, 24.6ms
image 3/30 /content/datasets/Empty-Spaces-Detection-in-Shelf-Data-2/test/images/
13718415-4874-4c9d-a81b-6f9ba461bd29_jpg.rf.681adcb29163c397bc021e2b084577d9.jpg
: 800x800 6 emptySpacess, 24.6ms
image 4/30 /content/datasets/Empty-Spaces-Detection-in-Shelf-Data-2/test/images/
1ad3e791-8ac9-4fb8-813c-16d99d657bfe_jpg.rf.0f28b172de47364754f11da4ccecab42.jpg
: 800x800 4 emptySpacess, 24.6ms
image 5/30 /content/datasets/Empty-Spaces-Detection-in-Shelf-Data-2/test/images/
1e8e7906-193d-4f54-8407-3cdf51506b05_jpg.rf.a63fdb45dabe4ffe48a39197903fe72e.jpg
: 800x800 3 emptySpacess, 24.6ms
image 6/30 /content/datasets/Empty-Spaces-Detection-in-Shelf-Data-2/test/images/
2185caa3-8fcb-41c7-8137-2732d873b60d_jpg.rf.a59c8d76655c4c51483e5c6131b7b279.jpg
: 800x800 3 emptySpacess, 24.6ms
image 7/30 /content/datasets/Empty-Spaces-Detection-in-Shelf-Data-2/test/images/
2a061a07-3b61-49bb-81c0-aaf876f262d8_jpg.rf.e777b164d34bbac1baacac8797a2ed7a.jpg
: 800x800 8 emptySpacess, 24.6ms
image 8/30 /content/datasets/Empty-Spaces-Detection-in-Shelf-Data-2/test/images/
2c05fc47-d1d3-412c-bf0f-b5db2708a551_jpg.rf.759883faf3b2872f040b18792d5889f7.jpg
: 800x800 5 emptySpacess, 24.6ms
image 9/30 /content/datasets/Empty-Spaces-Detection-in-Shelf-Data-2/test/images/
2e7d046b-c330-4c13-afc8-13fba209d949_jpg.rf.fa771f16f3ec0067845e885c5c9564c3.jpg
: 800x800 7 emptySpacess, 20.4ms
image 10/30 /content/datasets/Empty-Spaces-Detection-in-Shelf-Data-2/test/images
```

```
/2ff6b184-9bef-4eda-8675-00a2484fb0f6_jpg.rf.793e4b196840b42f6ffdfa34fe993a2b.jp
g: 800x800 4 emptySpacess, 20.4ms
image 11/30 /content/datasets/Empty-Spaces-Detection-in-Shelf-Data-2/test/images
/36b9f651-03cd-4966-9569-d69eab889c54_jpg.rf.a8a507f7c925d6864dfd65af3b587628.jp
g: 800x800 7 emptySpacess, 20.4ms
image 12/30 /content/datasets/Empty-Spaces-Detection-in-Shelf-Data-2/test/images
/3f3e2d83-254a-44a0-95b1-539e13f30f71_jpg.rf.3ccdcb900af71538ff1b9b6322219729.jp
g: 800x800 8 emptySpacess, 20.4ms
image 13/30 /content/datasets/Empty-Spaces-Detection-in-Shelf-Data-2/test/images
/4963396f-18f0-45bd-b2f8-a35a575b54f5_jpg.rf.4230dd48aa5edfaabfa84cedd4e28841.jp
g: 800x800 7 emptySpacess, 20.4ms
image 14/30 /content/datasets/Empty-Spaces-Detection-in-Shelf-Data-2/test/images
/4f7c5da0-62f5-45fa-8c31-0af091449c60_jpg.rf.99c032c39d223c7caf20b88029ae6381.jp
g: 800x800 4 emptySpacess, 16.9ms
image 15/30 /content/datasets/Empty-Spaces-Detection-in-Shelf-Data-2/test/images
/5acc4732-8051-405a-924c-1c173613010f_jpg.rf.317e34ed795b86aa81acaa4a2d002bb2.jp
g: 800x800 10 emptySpacess, 16.8ms
image 16/30 /content/datasets/Empty-Spaces-Detection-in-Shelf-Data-2/test/images
/5ba059dd-733c-4444-ac1f-4199f716c328_jpg.rf.e8ef0503475b96539098b3b8f7d8abc7.jp
g: 800x800 7 emptySpacess, 16.8ms
image 17/30 /content/datasets/Empty-Spaces-Detection-in-Shelf-Data-2/test/images
/61ccce3d-e6c1-4313-95fa-d37767340830_jpg.rf.7e88e4a715246e01ffb8f1c074570c7c.jp
g: 800x800 2 emptySpacess, 16.8ms
image 18/30 /content/datasets/Empty-Spaces-Detection-in-Shelf-Data-2/test/images
/63ba7fda-b4b8-4d7b-a682-41b0fae022e5_jpg.rf.d3d7678142cf75f4524bf1af01405440.jp
g: 800x800 5 emptySpacess, 16.8ms
image 19/30 /content/datasets/Empty-Spaces-Detection-in-Shelf-Data-2/test/images
/6c10a547-3bf1-4ed9-9f78-e6fbf677ca7c_jpg.rf.5a66163b34575e32eff2631f1738b7ce.jp
g: 800x800 10 emptySpacess, 15.7ms
image 20/30 /content/datasets/Empty-Spaces-Detection-in-Shelf-Data-2/test/images
/7326acf0-a68a-4c19-8f0a-bbbc9284ba54_jpg.rf.9da86167ff5253f9f5db57166c8b0a25.jp
g: 800x800 5 emptySpacess, 15.7ms
image 21/30 /content/datasets/Empty-Spaces-Detection-in-Shelf-Data-2/test/images
/737cd616-f19b-4f92-a4ce-1c2603ec1300_jpg.rf.a9bed287a91210c755622dde299e3cc8.jp
g: 800x800 13 emptySpacess, 15.5ms
image 22/30 /content/datasets/Empty-Spaces-Detection-in-Shelf-Data-2/test/images
/74b8c91a-eb6c-4538-b18f-bb6c0714ff12_jpg.rf.7a6bd9ce1d142cdc3e0522cdbb4726da.jp
g: 800x800 5 emptySpacess, 15.5ms
image 23/30 /content/datasets/Empty-Spaces-Detection-in-Shelf-
Data-2/test/images/77174fda-
bd99-4530-86c3-855b1fde40a6_jpg.rf.aa026bc31455644850636a02a006a03d.jpg: 800x800
4 emptySpacess, 15.4ms
image 24/30 /content/datasets/Empty-Spaces-Detection-in-Shelf-Data-2/test/images
/7df836f9-82b7-424f-930c-df093a787a0d_jpg.rf.c198668ad3a31cdc314f71f999c07071.jp
g: 800x800 2 emptySpacess, 15.5ms
image 25/30 /content/datasets/Empty-Spaces-Detection-in-Shelf-
Data-2/test/images/7eb702f6-ca46-47de-
bdbf-666e61f80281_jpg.rf.3478caab0b66e1e8dfae1d8d10c25a75.jpg: 800x800 12
```

```
emptySpacess, 15.5ms
image 26/30 /content/datasets/Empty-Spaces-Detection-in-Shelf-Data-2/test/images
/8c74f497-a8e5-43c5-bc72-6e38381c1cde_jpg.rf.b2b503134d9fe4997d1151cbc5e855e9.jp
g: 800x800 1 emptySpaces, 15.5ms
image 27/30 /content/datasets/Empty-Spaces-Detection-in-Shelf-Data-2/test/images
/8d18f03f-9117-4371-824c-89e0bb0e55fb_jpg.rf.4f4072bf0ffaac9fd56a99f0c4f34f98.jp
g: 800x800 5 emptySpacess, 15.5ms
image 28/30 /content/datasets/Empty-Spaces-Detection-in-Shelf-Data-2/test/images
/8fee3d7f-0303-4b96-baa0-8cd74e5bc742_jpg.rf.c5816ad3f8d978ec6bfc62c1f25043dd.jp
g: 800x800 10 emptySpacess, 15.5ms
image 29/30 /content/datasets/Empty-Spaces-Detection-in-Shelf-Data-2/test/images
/a0fab832-2398-474b-950e-3df8cc7828c3_jpg.rf.b1ef8d259bd494f5ab74058bd94d0d14.jp
g: 800x800 4 emptySpacess, 15.5ms
image 30/30 /content/datasets/Empty-Spaces-Detection-in-Shelf-Data-2/test/images
/b6ebe448-c166-486c-a244-88fbd69349d1_jpg.rf.c896a36c8fc60aa002c71e3103fd83a8.jp
g: 800x800 2 emptySpacess, 15.5ms
Speed: 0.7ms pre-process, 19.0ms inference, 4.5ms postprocess per image at shape
(1, 3, 800, 800)
Results saved to runs/detect/predict
```

[13]:
```
import glob
from IPython.display import Image, display

for image_path in glob.glob(f'{HOME}/runs/detect/predict/*.jpg'):
      display(Image(filename=image_path, width=600))
      print("\n")
```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$2.48


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This sheif is for colleague use only
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yoplait
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