

```
# Install YOLOv8
!pip install ultralytics
# Install OpenCV
!pip install opencv-python-headless==4.8.0.74
```

Collecting ultralytics  
 Downloading ultralytics-8.3.49-py3-none-any.whl.metadata (35 kB)  
 Requirement already satisfied: numpy>=1.23.0 in /usr/local/lib/python3.10/dist-packages (from ultralytics) (1.26.4)  
 Requirement already satisfied: matplotlib>=3.3.0 in /usr/local/lib/python3.10/dist-packages (from ultralytics) (3.8.0)  
 Requirement already satisfied: opencv-python>=4.6.0 in /usr/local/lib/python3.10/dist-packages (from ultralytics) (4.8.0.74)  
 Requirement already satisfied: pillow>=7.1.2 in /usr/local/lib/python3.10/dist-packages (from ultralytics) (11.0.0)  
 Requirement already satisfied: pyyaml>=5.3.1 in /usr/local/lib/python3.10/dist-packages (from ultralytics) (6.0.2)  
 Requirement already satisfied: requests>=2.23.0 in /usr/local/lib/python3.10/dist-packages (from ultralytics) (2.32.0)  
 Requirement already satisfied: scipy>=1.4.1 in /usr/local/lib/python3.10/dist-packages (from ultralytics) (1.13.1)  
 Requirement already satisfied: torch>=1.8.0 in /usr/local/lib/python3.10/dist-packages (from ultralytics) (2.5.1+cu121)  
 Requirement already satisfied: torchvision>=0.9.0 in /usr/local/lib/python3.10/dist-packages (from ultralytics) (0.20.1+cu121)  
 Requirement already satisfied: tqdm>=4.64.0 in /usr/local/lib/python3.10/dist-packages (from ultralytics) (4.66.6)  
 Requirement already satisfied: psutil in /usr/local/lib/python3.10/dist-packages (from ultralytics) (5.9.5)  
 Requirement already satisfied: py-cpuinfo in /usr/local/lib/python3.10/dist-packages (from ultralytics) (9.0.0)  
 Requirement already satisfied: pandas>=1.1.4 in /usr/local/lib/python3.10/dist-packages (from ultralytics) (2.2.2)  
 Requirement already satisfied: seaborn>=0.11.0 in /usr/local/lib/python3.10/dist-packages (from ultralytics) (0.13.2)  
 Collecting ultralytics-thop>=2.0.0 (from ultralytics)  
 Downloading ultralytics\_thop-2.0.13-py3-none-any.whl.metadata (9.4 kB)  
 Requirement already satisfied: contourpy>=1.0.1 in /usr/local/lib/python3.10/dist-packages (from matplotlib>=3.3.0->ultralytics) (1.2.1)  
 Requirement already satisfied: cycler>=0.10 in /usr/local/lib/python3.10/dist-packages (from matplotlib>=3.3.0->ultralytics) (0.10.0)  
 Requirement already satisfied: fonttools>=4.22.0 in /usr/local/lib/python3.10/dist-packages (from matplotlib>=3.3.0->ultralytics) (4.53.0)  
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 Requirement already satisfied: packaging>=20.0 in /usr/local/lib/python3.10/dist-packages (from matplotlib>=3.3.0->ultralytics) (24.1)  
 Requirement already satisfied: pyparsing>=2.3.1 in /usr/local/lib/python3.10/dist-packages (from matplotlib>=3.3.0->ultralytics) (3.1.2)  
 Requirement already satisfied: python-dateutil>=2.7 in /usr/local/lib/python3.10/dist-packages (from matplotlib>=3.3.0->ultralytics) (2.9.0.post0)  
 Requirement already satisfied: pytz>=2020.1 in /usr/local/lib/python3.10/dist-packages (from pandas>=1.1.4->ultralytics) (2024.2)  
 Requirement already satisfied: tzdata>=2022.7 in /usr/local/lib/python3.10/dist-packages (from pandas>=1.1.4->ultralytics) (2024.2)  
 Requirement already satisfied: charset-normalizer<4,>=2 in /usr/local/lib/python3.10/dist-packages (from requests>=2.23.0->ultralytics) (3.3.2)  
 Requirement already satisfied: idna<4,>=2.5 in /usr/local/lib/python3.10/dist-packages (from requests>=2.23.0->ultralytics) (3.10)  
 Requirement already satisfied: urllib3<3,>=1.21.1 in /usr/local/lib/python3.10/dist-packages (from requests>=2.23.0->ultralytics) (2.2.3)  
 Requirement already satisfied: certifi>=2017.4.17 in /usr/local/lib/python3.10/dist-packages (from requests>=2.23.0->ultralytics) (2024.12.14)  
 Requirement already satisfied: filelock in /usr/local/lib/python3.10/dist-packages (from torch>=1.8.0->ultralytics) (3.16.1)  
 Requirement already satisfied: typing-extensions>=4.8.0 in /usr/local/lib/python3.10/dist-packages (from torch>=1.8.0->ultralytics) (4.12.2)  
 Requirement already satisfied: networkx in /usr/local/lib/python3.10/dist-packages (from torch>=1.8.0->ultralytics) (3.4.2)  
 Requirement already satisfied: Jinja2 in /usr/local/lib/python3.10/dist-packages (from torch>=1.8.0->ultralytics) (3.1.4)  
 Requirement already satisfied: fsspec in /usr/local/lib/python3.10/dist-packages (from torch>=1.8.0->ultralytics) (2024.12.0)  
 Requirement already satisfied: sympy==1.13.1 in /usr/local/lib/python3.10/dist-packages (from torch>=1.8.0->ultralytics) (1.13.1)  
 Requirement already satisfied: mpmath<1.4,>=1.1.0 in /usr/local/lib/python3.10/dist-packages (from sympy==1.13.1->torch>=1.8.0->ultralytics) (1.3.0)  
 Requirement already satisfied: six>=1.5 in /usr/local/lib/python3.10/dist-packages (from python-dateutil>=2.7->matplotlib>=3.3.0->ultralytics) (1.17.0)  
 Requirement already satisfied: MarkupSafe>=2.0 in /usr/local/lib/python3.10/dist-packages (from Jinja2->torch>=1.8.0->ultralytics) (3.0.2)  
 Downloading ultralytics-8.3.49-py3-none-any.whl (898 kB)  
 898.7/898.7 kB 27.5 MB/s eta 0:00:00  
 Downloading ultralytics\_thop-2.0.13-py3-none-any.whl (26 kB)  
 Installing collected packages: ultralytics-thop, ultralytics  
 Successfully installed ultralytics-8.3.49 ultralytics-thop-2.0.13  
 Collecting opencv-python-headless==4.8.0.74  
 Downloading opencv\_python\_headless-4.8.0.74-cp37-abi3-manylinux\_2\_17\_x86\_64.manylinux2014\_x86\_64.whl.metadata (19 kB)  
 Requirement already satisfied: numpy>=1.21.2 in /usr/local/lib/python3.10/dist-packages (from opencv-python-headless==4.8.0.74) (1.26.4)  
 WARNING: The candidate selected for download or install is a yanked version: 'opencv-python-headless' candidate (version 4.8.0.74) is yanked. Reason for being yanked: deprecated, use 4.8.0.76  
 Downloading opencv\_python\_headless-4.8.0.74-cp37-abi3-manylinux\_2\_17\_x86\_64.manylinux2014\_x86\_64.whl (49.1 MB)  
 49.1/49.1 MB 14.9 MB/s eta 0:00:00  
 Installing collected packages: opencv-python-headless  
 Attempting uninstall: opencv-python-headless  
 Found existing installation: opencv-python-headless 4.10.0.84  
 Uninstalling opencv-python-headless-4.10.0.84:  
 Successfully uninstalled opencv-python-headless-4.10.0.84

```
from google.colab import drive
drive.mount('/content/drive')
```

```
Mounted at /content/drive
```

```
!unzip /content/drive/MyDrive/dataset.zip -d /content/dataset/
```

```
Streaming output truncated to the last 5000 lines.
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```

```

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inflating: /content/dataset/__MACOSX/dataset/train/images/._D13_jpg.rf.1a3dc1b3ba32f5a799de3f43ad095547.jpg
inflating: /content/dataset/dataset/train/images/Y4_jpg.rf.26c328b536ab67549fff202d6c8b57ac.jpg
inflating: /content/dataset/__MACOSX/dataset/train/images/._Y4_jpg.rf.26c328b536ab67549fff202d6c8b57ac.jpg

```

```
# Create the data.yaml file
```

```
data_yaml = """
```

```
train: /content/dataset/train/images
```

```
val: /content/dataset/val/images
```

```
nc: 26
```

```
names: ['A', 'B', 'C', 'D', 'E', 'F', 'G', 'H', 'I', 'J', 'K', 'L', 'M', 'N', 'O', 'P', 'Q', 'R', 'S', 'T', 'U', 'V', 'W', 'X', 'Y', 'Z']
"""
```

```
with open('data.yaml', 'w') as f:
```

```
    f.write(data_yaml)
```

```
# Display the content of the file
```

```
!cat data.yaml
```



```
train: /content/dataset/train/images
val: /content/dataset/val/images
```

```
nc: 26
```

```
names: ['A', 'B', 'C', 'D', 'E', 'F', 'G', 'H', 'I', 'J', 'K', 'L', 'M', 'N', 'O', 'P', 'Q', 'R', 'S', 'T', 'U', 'V', 'W', 'X', 'Y', 'Z']
```

```
!rm -rf /content/dataset/__MACOSX
```

```
!ls /content/dataset/dataset/ # Check if this is the actual dataset folder
```



```
train val
```

```
# Move the training images and labels
```

```
!mv /content/dataset/dataset/train/images/* /content/dataset/train/images/
```

```
!mv /content/dataset/dataset/train/labels/* /content/dataset/train/labels/
```

```
# Move the validation images and labels
```

```
!mv /content/dataset/dataset/val/images/* /content/dataset/val/images/
```

```
!mv /content/dataset/dataset/val/labels/* /content/dataset/val/labels/
```



```
mv: target '/content/dataset/train/images/' is not a directory
mv: target '/content/dataset/train/labels/' is not a directory
mv: target '/content/dataset/val/images/' is not a directory
mv: target '/content/dataset/val/labels/' is not a directory
```

```
!ls /content/dataset/dataset/train/images
!ls /content/dataset/dataset/train/labels
!ls /content/dataset/dataset/val/images
!ls /content/dataset/dataset/val/labels
```

```
A0_jpg.rf.292a080422ba984985192f413101af41.jpg M18_jpg.rf.129826d37d00c7e46376752d8649edaa.jpg
A0_jpg.rf.a79ace20ea42b8f94360cef8aaec4030.jpg M18_jpg.rf.3fae46ff6a91c58fb10a10e854f3768e.jpg
A0_jpg.rf.beea8a405220871911fb117e36526deb.jpg M18_jpg.rf.94b6b179dc7fdb52cd82dfa90c2ec8c7.jpg
A11_jpg.rf.4126b388a474440c970d85a3b2a7bf09.jpg M19_jpg.rf.b6071dc5f662dde1884f3d9258f988f8.jpg
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A12_jpg.rf.84c6afcf18de92ea268db5d3902ca2ba.jpg M1_jpg.rf.411bd85388ef9cb634f3d11439466266.jpg
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A13_jpg.rf.cd081f003a915f5f50ed9e2b3860e1eb8.jpg M21_jpg.rf.99bba85cee72f5d90a28094590ecbbbf.jpg
A15_jpg.rf.3654aa7d6bfc342c9ad99f500fd2aaf9.jpg M22_jpg.rf.2cf0b07c63b1ef20e78df60f6a7b067f.jpg
A15_jpg.rf.864da902c564388b8d55ea151f88cb2f.jpg M22_jpg.rf.999b428265334fcfe5fd0988bfaa8daf.jpg
A15_jpg.rf.ffa648f0ba648df1d2782e75ddea0f9ba.jpg M22_jpg.rf.c8d94dabdd8eb27af53e313b95684480.jpg
A16_jpg.rf.4792e25fda724e4180ae1a9c1513a39a.jpg M23_jpg.rf.2e9dcb0d37abe04cf9f23fe2ee9b2217.jpg
A16_jpg.rf.a7ba528015bfff1d5f076ebc2510082e1.jpg M23_jpg.rf.3e9d7973153921e680fa40d75687c927.jpg
A16_jpg.rf.e7c093d6900f6669ca5b4f16cd01c1e9.jpg M23_jpg.rf.a18313130a192cb95e5bc7edfedebfd7.jpg
A17_jpg.rf.1d8db324964e2d09835b90e5ae59b179.jpg M27_jpg.rf.010d328cdc61a634aec1540863be23b9.jpg
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A19_jpg.rf.7e2d39113f47c5516c279bccc8d4ff305.jpg M3_jpg.rf.421bf4b4026eeffa77eca4eb294ff69ab.jpg
A19_jpg.rf.dd7e736410be65dec70415c3b00500a2.jpg M3_jpg.rf.963dfc5d19252a7898d550e0bee13982.jpg
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A23_jpg.rf.199528cc21bad70f9424a2cfb92d3207.jpg M0_jpg.rf.180e4b19d6df6fc5e3e7d86dbe1ddc51.jpg
A23_jpg.rf.97a11ab11034ee00679a123a8b8cb20.jpg N0_jpg.rf.3fbb2b164f02bc50f8bef8873315dfe5.jpg
A23_jpg.rf.e51d3bcb559b35e4d5ba896de298c380.jpg N0_jpg.rf.42b5818c7451bfff8f1a419d0517bd766.jpg
A24_jpg.rf.0c548e55630ab5b3682e8267ad1daba2.jpg N10_jpg.rf.1e1d01dfd5fb83b817aa27f717ffef77.jpg
A24_jpg.rf.8787463d42728d041d7eb1c6344affa8.jpg N10_jpg.rf.3e94be30757dd080203abd8a966f5a89.jpg
A24_jpg.rf.fab8f98ae5634a08834a054ca706efec.jpg N10_jpg.rf.e4d39b46e9141319333f11815b14261f.jpg
A25_jpg.rf.1ee291da526c10ede77cf69d4cd2c231.jpg N11_jpg.rf.3fa5777283528ad4f276dc62a95a7bbc.jpg
A25_jpg.rf.433d7879c39d43659d5ec56d0d55bb8f.jpg N11_jpg.rf.5e57c05bc09126545c50edcef455fa38.jpg
A25_jpg.rf.b634b38aff4d380480afe15240abffaf.jpg N11_jpg.rf.cbf31312b398614771001104ee946bae.jpg
A26_jpg.rf.1fc964f5ed03b450b754a5427b66ecce.jpg N12_jpg.rf.07b2230fd996de3c8428f58a8d22a3e.jpg
A26_jpg.rf.df50493a9970cad3fc2f942da008969.jpg N12_jpg.rf.9a4c9fb411ede751dc657bba35021044.jpg
A26_jpg.rf.f6ef3e5bd61b99724a5bd52a8bd71a9f.jpg N12_jpg.rf.e0d9a443d10e6bc1dde50d47ff3949e0.jpg
A27_jpg.rf.0c350b038342fd2b593f7cc88589e4bf.jpg N13_jpg.rf.13c8d7c9fa997fd79a3a1ed4392b079a.jpg
A27_jpg.rf.43d15c227b557017a01eec793a1a73f8.jpg N13_jpg.rf.5651d6cf59b38d4bfa691a9e73ca1c05.jpg
A27_jpg.rf.a01fe29d02057b7c0d876bf8ccacd255.jpg N13_jpg.rf.b51614c6e42508cb8623880c906f0fb5.jpg
A28_jpg.rf.6d36fa4cb06007c23a30414814b24507.jpg N14_jpg.rf.ad8c5bb14931850e4f6275728c6649d8.jpg
A28_jpg.rf.89b547e86e0129b28e5ec9a0f0dc2ed2.jpg N14_jpg.rf.d66ec48459ea666c501a97d360d8b769.jpg
A28_jpg.rf.e2214cbbcfad5a30778bc0fccf2fcd0.jpg N14_jpg.rf.d711d4a495f05fb865d419467c561f59.jpg
A2_jpg.rf.3aad5ebc1dc85f9cf81c034e89e427e.jpg N17_jpg.rf.2ae0cad9995923d2a5e732cd45b88a7a.jpg
A2_jpg.rf.4dc4b7c0d6e8d3e1d8bf35ada540b366.jpg N17_jpg.rf.55dba65da797782cfc04964acc7c80a6.jpg
A2_jpg.rf.e4d1f7a2679ab0140ad27a794db563c9.jpg N17_jpg.rf.852a86e64b757de1cef45750896659de.jpg
A4_jpg.rf.6b68517bcc691a09eae8e2567d110cf0.jpg N19_jpg.rf.323481105ccbc19f972588550729931e.jpg
A4_jpg.rf.9369f1aa5b6108a0759d030730700afa.jpg N19_jpg.rf.3cb994dcc8167de968fd41655a85a72b.jpg
A4_jpg.rf.d03522dc177baa9498936c8f8d1ddca7.jpg N19_jpg.rf.919961328272d4434d7e604e11c25005.jpg
A5_jpg.rf.11920540d5a68fdeed4b584fb24cd063.jpg N20_jpg.rf.4cca7e9378f0fed1b5ff0c3ac2f57369.jpg
```

```
# Create the data.yaml file
```

```
data_yaml = """
train: /content/dataset/dataset/train/images
val: /content/dataset/dataset/val/images
```

```
nc: 26
```

```
names: ['A', 'B', 'C', 'D', 'E', 'F', 'G', 'H', 'I', 'J', 'K', 'L', 'M', 'N', 'O', 'P', 'Q', 'R', 'S', 'T', 'U', 'V', 'W', '']
"""
```

```
with open('data.yaml', 'w') as f:
    f.write(data_yaml)
```

```
# Display the content of the file
```

```
!cat data.yaml
```



```
train: /content/dataset/dataset/train/images
val: /content/dataset/dataset/val/images
```

```
nc: 26
```

```
names: ['A', 'B', 'C', 'D', 'E', 'F', 'G', 'H', 'I', 'J', 'K', 'L', 'M', 'N', 'O', 'P', 'Q', 'R', 'S', 'T', 'U', 'V', 'W']
```

```
from ultralytics import YOLO
```

```
# Load a pre-trained YOLOv8 model
```

```
model = YOLO('yolov8n.pt') # Use 'yolov8s.pt' or 'yolov8m.pt' for larger models
```

```
# Train the model
```

```
model.train(data='data.yaml', epochs=50, imgsz=640, batch=16)
```

```
# The best weights will be saved at: 'runs/detect/train/weights/best.pt'
```

```
Ultralytics 8.3.49 Python-3.10.12 torch-2.5.1+cu121 CPU (Intel Xeon 2.20GHz)
engine/trainer: task=detect, mode=train, model=yolov8n.pt, data=data.yaml, epochs=50, time=None, patience=100, batch=16,
Downloading https://ultralytics.com/assets/Arial.ttf to '/root/.config/Ultralytics/Arial.ttf'...
100%|██████████| 755k/755k [00:00<00:00, 85.9MB/s]
Overriding model.yaml nc=80 with nc=26
```

	from	n	params	module	arguments	
0		-1	1	464	ultralytics.nn.modules.conv.Conv	[3, 16, 3, 2]
1		-1	1	4672	ultralytics.nn.modules.conv.Conv	[16, 32, 3, 2]
2		-1	1	7360	ultralytics.nn.modules.block.C2f	[32, 32, 1, True]
3		-1	1	18560	ultralytics.nn.modules.conv.Conv	[32, 64, 3, 2]
4		-1	2	49664	ultralytics.nn.modules.block.C2f	[64, 64, 2, True]
5		-1	1	73984	ultralytics.nn.modules.conv.Conv	[64, 128, 3, 2]
6		-1	2	197632	ultralytics.nn.modules.block.C2f	[128, 128, 2, True]
7		-1	1	295424	ultralytics.nn.modules.conv.Conv	[128, 256, 3, 2]
8		-1	1	460288	ultralytics.nn.modules.block.C2f	[256, 256, 1, True]
9		-1	1	164608	ultralytics.nn.modules.block.SPPF	[256, 256, 5]
10		-1	1	0	torch.nn.modules.upsampling.Upsample	[None, 2, 'nearest']
11		[-1, 6]	1	0	ultralytics.nn.modules.conv.Concat	[1]
12		-1	1	148224	ultralytics.nn.modules.block.C2f	[384, 128, 1]
13		-1	1	0	torch.nn.modules.upsampling.Upsample	[None, 2, 'nearest']
14		[-1, 4]	1	0	ultralytics.nn.modules.conv.Concat	[1]
15		-1	1	37248	ultralytics.nn.modules.block.C2f	[192, 64, 1]
16		-1	1	36992	ultralytics.nn.modules.conv.Conv	[64, 64, 3, 2]
17		[-1, 12]	1	0	ultralytics.nn.modules.conv.Concat	[1]
18		-1	1	123648	ultralytics.nn.modules.block.C2f	[192, 128, 1]
19		-1	1	147712	ultralytics.nn.modules.conv.Conv	[128, 128, 3, 2]
20		[-1, 9]	1	0	ultralytics.nn.modules.conv.Concat	[1]
21		-1	1	493056	ultralytics.nn.modules.block.C2f	[384, 256, 1]
22		[15, 18, 21]	1	756382	ultralytics.nn.modules.head.Detect	[26, [64, 128, 256]]

Model summary: 225 layers, 3,015,918 parameters, 3,015,902 gradients, 8.2 GFLOPs

Transferred 319/355 items from pretrained weights

**TensorBoard:** Start with 'tensorboard --logdir runs/detect/train2', view at <http://localhost:6006/>

Freezing layer 'model.22.dfl.conv.weight'

**train:** Scanning /content/dataset/dataset/train/labels... 1512 images, 0 backgrounds, 0 corrupt: 100%|██████████| 1512/15

**augmentations:** Blur(p=0.01, blur\_limit=(3, 7)), MedianBlur(p=0.01, blur\_limit=(3, 7)), ToGray(p=0.01, num\_output\_channe  
/usr/local/lib/python3.10/dist-packages/albumentations/\_\_init\_\_.py:24: UserWarning: A new version of Albumentations is a  
check\_for\_updates()

**val:** Scanning /content/dataset/dataset/val/labels... 144 images, 0 backgrounds, 0 corrupt: 100%|██████████| 144/144 [00:

Plotting labels to runs/detect/train2/labels.jpg...

**optimizer:** 'optimizer=auto' found, ignoring 'lr0=0.01' and 'momentum=0.937' and determining best 'optimizer', 'lr0' and  
**optimizer:** AdamW(lr=0.000333, momentum=0.9) with parameter groups 57 weight(decay=0.0), 64 weight(decay=0.0005), 63 bias


**TensorBoard:** model graph visualization added 

Image sizes 640 train, 640 val

Using 0 dataloader workers

Logging results to **runs/detect/train2**

Starting training for 50 epochs...

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
1/50	0G	1.021	4.263	1.472	15	640: 100% ██████████  95/95 [20:01<00:00, 12.6
	Class	Images	Instances	Box(P)	R	mAP50 mAP50-95): 100% ██████████  5/5 [00:42<00
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
2/50	0G	0.9023	3.472	1.37	16	640: 100% ██████████  95/95 [20:01<00:00, 12.6
	Class	Images	Instances	Box(P)	R	mAP50 mAP50-95): 100% ██████████  5/5 [00:40<00
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
3/50	0G	0.8969	3.004	1.354	20	640: 100% ██████████  95/95 [20:03<00:00, 12.6
	Class	Images	Instances	Box(P)	R	mAP50 mAP50-95): 100% ██████████  5/5 [00:42<00
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
4/50	0G	0.8765	2.705	1.317	21	640: 100% ██████████  95/95 [19:54<00:00, 12.5
	Class	Images	Instances	Box(P)	R	mAP50 mAP50-95): 100% ██████████  5/5 [00:42<00
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
5/50	0G	0.855	2.401	1.291	19	640: 100% ██████████  95/95 [20:00<00:00, 12.6
	Class	Images	Instances	Box(P)	R	mAP50 mAP50-95): 100% ██████████  5/5 [00:41<00

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size			
6/50	0G	0.8463	2.254	1.288	17	640:	100%	<div></div>	95/95 [19:59<00:00, 12.6
	Class	Images	Instances	Box(P	R	mAP50	mAP50-95):	100%	<div></div> 5/5 [00:41<00