

# YOLOV8m

December 18, 2024

```
[1]: from ultralytics import YOLO
from ultralytics.engine.results import Results
from IPython.display import display, Image
```

```
[2]: import torch
torch.cuda.empty_cache()
assert torch.cuda.is_available()
print(torch.cuda.is_available()) # Should return True
print(torch.cuda.get_device_name(0)) # Confirm your GPU name
```

True  
NVIDIA GeForce RTX 4060 Laptop GPU

```
[3]: model = YOLO('yolov8m.pt');
model.to('cuda');
```

```
[4]: data = "D:\Academics and University\Python\Intelligent Systems\Project 2\Welding Dataset\data.yaml"
```

```
[5]: results = model.train(data=data, batch=8, epochs=100, imgsz=640, workers=0, device=0)
```

New https://pypi.org/project/ultralytics/8.3.51 available Update with 'pip install -U ultralytics'  
Ultralytics 8.3.40 Python-3.11.11 torch-2.5.1 CUDA:0 (NVIDIA GeForce RTX 4060 Laptop GPU, 8188MiB)  
`engine\trainer:` task=detect, mode=train, model=yolov8m.pt, data=D:\Academics and University\Python\Intelligent Systems\Project 2\Welding Dataset\data.yaml, epochs=100, time=None, patience=100, batch=8, imgsz=640, save=True, save\_period=-1, cache=False, device=0, workers=0, project=None, name=train34, exist\_ok=False, pretrained=True, optimizer=auto, verbose=True, seed=0, deterministic=True, single\_cls=False, rect=False, cos\_lr=False, close\_mosaic=10, resume=False, amp=True, fraction=1.0, profile=False, freeze=None, multi\_scale=False, overlap\_mask=True, mask\_ratio=4, dropout=0.0, val=True, split=val, save\_json=False, save\_hybrid=False, conf=None, iou=0.7, max\_det=300, half=False, dnn=False, plots=True, source=None, vid\_stride=1, stream\_buffer=False, visualize=False, augment=False, agnostic\_nms=False, classes=None, retina\_masks=False, embed=None, show=False, save\_frames=False, save\_txt=False, save\_conf=False, save\_crop=False, show\_labels=True, show\_conf=True, show\_boxes=True, line\_width=None, format=torchscript,

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keras=False, optimize=False, int8=False, dynamic=False, simplify=True,
opset=None, workspace=None, nms=False, lr0=0.01, lrf=0.01, momentum=0.937,
weight_decay=0.0005, warmup_epochs=3.0, warmup_momentum=0.8, warmup_bias_lr=0.1,
box=7.5, cls=0.5, dfl=1.5, pose=12.0, kobj=1.0, 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, bgr=0.0, mosaic=1.0, mixup=0.0, copy_paste=0.0,
copy_paste_mode=flip, auto_augment=randaugment, erasing=0.4, crop_fraction=1.0,
cfg=None, tracker=botsort.yaml, save_dir=runs\detect\train34
Overriding model.yaml nc=80 with nc=3

```

	from	n	params	module
arguments				
0		-1 1	1392	ultralytics.nn.modules.conv.Conv
[3, 48, 3, 2]				
1		-1 1	41664	ultralytics.nn.modules.conv.Conv
[48, 96, 3, 2]				
2		-1 2	111360	ultralytics.nn.modules.block.C2f
[96, 96, 2, True]				
3		-1 1	166272	ultralytics.nn.modules.conv.Conv
[96, 192, 3, 2]				
4		-1 4	813312	ultralytics.nn.modules.block.C2f
[192, 192, 4, True]				
5		-1 1	664320	ultralytics.nn.modules.conv.Conv
[192, 384, 3, 2]				
6		-1 4	3248640	ultralytics.nn.modules.block.C2f
[384, 384, 4, True]				
7		-1 1	1991808	ultralytics.nn.modules.conv.Conv
[384, 576, 3, 2]				
8		-1 2	3985920	ultralytics.nn.modules.block.C2f
[576, 576, 2, True]				
9		-1 1	831168	ultralytics.nn.modules.block.SPPF
[576, 576, 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 2	1993728	ultralytics.nn.modules.block.C2f
[960, 384, 2]				
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 2	517632	ultralytics.nn.modules.block.C2f
[576, 192, 2]				
16		-1 1	332160	ultralytics.nn.modules.conv.Conv
[192, 192, 3, 2]				
17		[-1, 12] 1	0	ultralytics.nn.modules.conv.Concat
[1]				

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18          -1  2   1846272 ultralytics.nn.modules.block.C2f
[576, 384, 2]
19          -1  1   1327872 ultralytics.nn.modules.conv.Conv
[384, 384, 3, 2]
20         [-1, 9] 1        0 ultralytics.nn.modules.conv.Concat
[1]
21          -1  2   4207104 ultralytics.nn.modules.block.C2f
[960, 576, 2]
22         [15, 18, 21] 1   3777433 ultralytics.nn.modules.head.Detect
[3, [192, 384, 576]]
Model summary: 295 layers, 25,858,057 parameters, 25,858,041 gradients

```

Transferred 469/475 items from pretrained weights

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

**AMP:** running Automatic Mixed Precision (AMP) checks...

**AMP:** checks passed

**train:** Scanning D:\Academics and University\Python\Intelligent Systems\Project 2\Welding Dataset\train\labels.cache...

**val:** Scanning D:\Academics and University\Python\Intelligent Systems\Project 2\Welding Dataset\valid\labels.cache... 28

Plotting labels to runs\detect\train34\labels.jpg...

**optimizer:** 'optimizer=auto' found, ignoring 'lr0=0.01' and 'momentum=0.937' and determining best 'optimizer', 'lr0' and 'momentum' automatically...

**optimizer:** AdamW(lr=0.001429, momentum=0.9) with parameter groups  
77 weight(decay=0.0), 84 weight(decay=0.0005), 83 bias(decay=0.0)

Image sizes 640 train, 640 val

Using 0 dataloader workers

Logging results to runs\detect\train34

Starting training for 100 epochs...

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
1/100	3.62G	2.01	2.835	1.861	14	640:
100%	203/203 [01:43<00:00,					
	Class	Images	Instances	Box(P	R	mAP50
mAP50-95): 100%	18/18 [00:08					
	all	283	802	0.522	0.136	0.107
0.0456						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
2/100	3.9G	2.174	2.81	2.026	5	640:
100%	203/203 [01:35<00:00,					
	Class	Images	Instances	Box(P	R	mAP50

mAP50-95): 100%	18/18 [00:08					
	all	283	802	0.0955	0.147	0.0556
0.0215						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
3/100	3.9G	2.167	2.791	2.035	14	640:
100%	203/203 [01:34<00:00,	Class	Images	Instances	Box(P	R
mAP50-95): 100%	18/18 [00:08					mAP50
	all	283	802	0.46	0.184	0.0789
0.0313						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
4/100	3.87G	2.108	2.697	1.976	7	640:
100%	203/203 [01:33<00:00,	Class	Images	Instances	Box(P	R
mAP50-95): 100%	18/18 [00:08					mAP50
	all	283	802	0.225	0.261	0.18
0.0742						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
5/100	3.89G	2.026	2.641	1.92	10	640:
100%	203/203 [01:33<00:00,	Class	Images	Instances	Box(P	R
mAP50-95): 100%	18/18 [00:08					mAP50
	all	283	802	0.241	0.261	0.175
0.077						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
6/100	3.89G	1.984	2.559	1.894	8	640:
100%	203/203 [01:34<00:00,	Class	Images	Instances	Box(P	R
mAP50-95): 100%	18/18 [00:08					mAP50
	all	283	802	0.329	0.279	0.206
0.0862						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
7/100 100%	3.89G   203/203 [01:34<00:00, mAP50-95): 100%	1.927 Class   18/18 [00:08 0.0969	2.459	1.833	17	640: R mAP50
		all	283	802	0.279	0.327
						0.228

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
8/100 100%	3.82G   203/203 [01:33<00:00, mAP50-95): 100%	1.886 Class   18/18 [00:08 0.109	2.397	1.817	13	640: R mAP50
		all	283	802	0.581	0.314
						0.242

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
9/100 100%	3.9G   203/203 [01:34<00:00, mAP50-95): 100%	1.868 Class   18/18 [00:08 0.103	2.339	1.786	17	640: R mAP50
		all	283	802	0.303	0.34
						0.236

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
10/100 100%	3.88G   203/203 [01:33<00:00, mAP50-95): 100%	1.869 Class   18/18 [00:08 0.118	2.328	1.783	17	640: R mAP50
		all	283	802	0.587	0.33
						0.251

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
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Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
11/100	3.9G	1.832	2.281	1.762	9	640:
100%	203/203 [01:33<00:00,					
	Class	Images	Instances	Box(P)	R	mAP50
mAP50-95): 100%	18/18 [00:08					
	all	283	802	0.405	0.304	0.282
0.133						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
12/100	3.9G	1.819	2.252	1.725	13	640:
100%	203/203 [01:33<00:00,					
	Class	Images	Instances	Box(P)	R	mAP50
mAP50-95): 100%	18/18 [00:08					
	all	283	802	0.401	0.345	0.278
0.134						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
13/100	3.88G	1.805	2.232	1.744	19	640:
100%	203/203 [01:33<00:00,					
	Class	Images	Instances	Box(P)	R	mAP50
mAP50-95): 100%	18/18 [00:08					
	all	283	802	0.372	0.358	0.278
0.126						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
14/100	3.89G	1.793	2.213	1.725	19	640:
100%	203/203 [01:33<00:00,					
	Class	Images	Instances	Box(P)	R	mAP50
mAP50-95): 100%	18/18 [00:08					
	all	283	802	0.393	0.357	0.285
0.131						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
15/100	3.88G	1.761	2.141	1.703	13	640:
100%	203/203 [01:34<00:00,					
	Class	Images	Instances	Box(P)	R	mAP50
mAP50-95): 100%	18/18 [00:08					

	all	283	802	0.53	0.336	0.329
0.159						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
16/100 100%	3.81G   203/203 [01:33<00:00,	1.747	2.082	1.703	19	640: mAP50-95): 100%   18/18 [00:08
		Class	Images	Instances	Box(P	R
						mAP50
	all	283	802	0.639	0.378	0.35
0.168						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
17/100 100%	3.9G   203/203 [01:33<00:00,	1.748	2.129	1.705	4	640: mAP50-95): 100%   18/18 [00:08
		Class	Images	Instances	Box(P	R
						mAP50
	all	283	802	0.355	0.483	0.361
0.175						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
18/100 100%	3.92G   203/203 [01:34<00:00,	1.7	2.02	1.654	14	640: mAP50-95): 100%   18/18 [00:08
		Class	Images	Instances	Box(P	R
						mAP50
	all	283	802	0.393	0.425	0.35
0.172						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
19/100 100%	3.89G   203/203 [01:37<00:00,	1.694	2.006	1.667	22	640: mAP50-95): 100%   18/18 [00:08
		Class	Images	Instances	Box(P	R
						mAP50
	all	283	802	0.368	0.44	0.345
0.172						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
20/100 100%	3.87G   203/203 [01:35<00:00, mAP50-95): 100%	1.73 Class   18/18 [00:08 0.174	2.039	1.679	11	640:
			Box(P)	R	mAP50	
	all	283	802	0.408	0.449	0.363

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
21/100 100%	3.89G   203/203 [01:36<00:00, mAP50-95): 100%	1.674 Class   18/18 [00:08 0.204	2.02	1.646	14	640:
			Box(P)	R	mAP50	
	all	283	802	0.468	0.453	0.395

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
22/100 100%	3.89G   203/203 [01:34<00:00, mAP50-95): 100%	1.673 Class   18/18 [00:08 0.208	1.949	1.634	9	640:
			Box(P)	R	mAP50	
	all	283	802	0.455	0.482	0.412

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
23/100 100%	3.89G   203/203 [01:33<00:00, mAP50-95): 100%	1.674 Class   18/18 [00:08 0.203	1.946	1.659	12	640:
			Box(P)	R	mAP50	
	all	283	802	0.421	0.484	0.421

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
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24/100	3.81G	1.652	1.911	1.627	9	640:
100%	203/203 [01:33<00:00,					
	Class	Images	Instances	Box(P)	R	mAP50
mAP50-95): 100%	18/18 [00:08					
	all	283	802	0.444	0.47	0.427
0.226						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
25/100	3.9G	1.63	1.876	1.611	16	640:
100%	203/203 [01:33<00:00,					
	Class	Images	Instances	Box(P)	R	mAP50
mAP50-95): 100%	18/18 [00:08					
	all	283	802	0.43	0.482	0.404
0.211						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
26/100	3.89G	1.6	1.857	1.583	17	640:
100%	203/203 [01:33<00:00,					
	Class	Images	Instances	Box(P)	R	mAP50
mAP50-95): 100%	18/18 [00:08					
	all	283	802	0.585	0.46	0.477
0.255						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
27/100	3.9G	1.604	1.814	1.598	12	640:
100%	203/203 [01:37<00:00,					
	Class	Images	Instances	Box(P)	R	mAP50
mAP50-95): 100%	18/18 [00:08					
	all	283	802	0.454	0.523	0.455
0.251						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
28/100	3.9G	1.606	1.809	1.57	25	640:
100%	203/203 [01:34<00:00,					
	Class	Images	Instances	Box(P)	R	mAP50
mAP50-95): 100%	18/18 [00:08					

	all	283	802	0.487	0.473	0.45
0.238						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
29/100	3.88G	1.591	1.808	1.581	9	640:
100%	203/203 [01:35<00:00,					
	Class	Images	Instances	Box(P)	R	mAP50
mAP50-95): 100%		18/18 [00:08				
	all	283	802	0.452	0.482	0.46
0.243						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
30/100	3.9G	1.606	1.772	1.579	20	640:
100%	203/203 [01:35<00:00,					
	Class	Images	Instances	Box(P)	R	mAP50
mAP50-95): 100%		18/18 [00:08				
	all	283	802	0.504	0.508	0.491
0.26						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
31/100	3.9G	1.541	1.735	1.54	18	640:
100%	203/203 [01:34<00:00,					
	Class	Images	Instances	Box(P)	R	mAP50
mAP50-95): 100%		18/18 [00:08				
	all	283	802	0.542	0.5	0.49
0.272						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
32/100	3.83G	1.549	1.727	1.558	17	640:
100%	203/203 [01:35<00:00,					
	Class	Images	Instances	Box(P)	R	mAP50
mAP50-95): 100%		18/18 [00:08				
	all	283	802	0.499	0.532	0.48
0.25						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
33/100 100%	3.9G   203/203 [01:34<00:00, mAP50-95): 100%	1.572 Class   18/18 [00:08 0.257	1.713	1.557	13	640:
			Box(P)	R	mAP50	
	all	283	802	0.508	0.505	0.469

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
34/100 100%	3.86G   203/203 [01:48<00:00, mAP50-95): 100%	1.549 Class   18/18 [00:09 0.271	1.707	1.55	5	640:
			Box(P)	R	mAP50	
	all	283	802	0.506	0.499	0.485

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
35/100 100%	3.88G   203/203 [01:45<00:00, mAP50-95): 100%	1.523 Class   18/18 [00:09 0.271	1.653	1.514	9	640:
			Box(P)	R	mAP50	
	all	283	802	0.529	0.528	0.507

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
36/100 100%	3.89G   203/203 [01:37<00:00, mAP50-95): 100%	1.522 Class   18/18 [00:08 0.265	1.667	1.536	13	640:
			Box(P)	R	mAP50	
	all	283	802	0.465	0.558	0.489

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
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37/100	3.88G	1.496	1.646	1.522	13	640:
100%	203/203 [01:34<00:00,					
	Class	Images	Instances	Box(P)	R	mAP50
mAP50-95): 100%	18/18 [00:08					
	all	283	802	0.56	0.511	0.522
0.289						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
38/100	3.88G	1.507	1.628	1.502	7	640:
100%	203/203 [01:36<00:00,					
	Class	Images	Instances	Box(P)	R	mAP50
mAP50-95): 100%	18/18 [00:08					
	all	283	802	0.515	0.537	0.519
0.281						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
39/100	3.87G	1.486	1.606	1.515	18	640:
100%	203/203 [01:33<00:00,					
	Class	Images	Instances	Box(P)	R	mAP50
mAP50-95): 100%	18/18 [00:08					
	all	283	802	0.513	0.578	0.556
0.312						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
40/100	3.81G	1.474	1.59	1.49	15	640:
100%	203/203 [01:46<00:00,					
	Class	Images	Instances	Box(P)	R	mAP50
mAP50-95): 100%	18/18 [00:09					
	all	283	802	0.519	0.571	0.527
0.298						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
41/100	3.9G	1.481	1.583	1.496	18	640:
100%	203/203 [01:44<00:00,					
	Class	Images	Instances	Box(P)	R	mAP50
mAP50-95): 100%	18/18 [00:09					

	all	283	802	0.53	0.557	0.528
0.302						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
42/100	3.88G	1.454	1.562	1.478	16	640:
100%	203/203 [01:44<00:00,	Class	Images	Instances	Box(P	R
mAP50-95): 100%	18/18 [00:08					mAP50
	all	283	802	0.512	0.606	0.554
0.311						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
43/100	3.89G	1.455	1.533	1.48	13	640:
100%	203/203 [01:34<00:00,	Class	Images	Instances	Box(P	R
mAP50-95): 100%	18/18 [00:09					mAP50
	all	283	802	0.575	0.562	0.559
0.316						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
44/100	3.89G	1.457	1.509	1.474	13	640:
100%	203/203 [01:44<00:00,	Class	Images	Instances	Box(P	R
mAP50-95): 100%	18/18 [00:09					mAP50
	all	283	802	0.557	0.606	0.583
0.342						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
45/100	3.89G	1.451	1.509	1.48	27	640:
100%	203/203 [01:41<00:00,	Class	Images	Instances	Box(P	R
mAP50-95): 100%	18/18 [00:08					mAP50
	all	283	802	0.601	0.551	0.584
0.332						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
46/100 100%	3.88G   203/203 [01:33<00:00, mAP50-95): 100%	1.414 Class   18/18 [00:08 0.329	1.481	1.442	4	640:
			Box(P)	R	mAP50	
	all	283	802	0.569	0.597	0.57

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
47/100 100%	3.89G   203/203 [01:33<00:00, mAP50-95): 100%	1.413 Class   18/18 [00:08 0.327	1.473	1.45	16	640:
			Box(P)	R	mAP50	
	all	283	802	0.557	0.597	0.568

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
48/100 100%	3.81G   203/203 [01:43<00:00, mAP50-95): 100%	1.405 Class   18/18 [00:08 0.348	1.443	1.452	9	640:
			Box(P)	R	mAP50	
	all	283	802	0.573	0.596	0.59

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
49/100 100%	3.88G   203/203 [01:43<00:00, mAP50-95): 100%	1.375 Class   18/18 [00:09 0.347	1.421	1.437	11	640:
			Box(P)	R	mAP50	
	all	283	802	0.586	0.589	0.598

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
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50/100	3.89G	1.394	1.432	1.437	17	640:
100%	203/203 [01:43<00:00,					
	Class	Images	Instances	Box(P)	R	mAP50
mAP50-95): 100%	18/18 [00:09					
	all	283	802	0.565	0.591	0.573
0.326						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
51/100	3.9G	1.398	1.411	1.444	10	640:
100%	203/203 [01:42<00:00,					
	Class	Images	Instances	Box(P)	R	mAP50
mAP50-95): 100%	18/18 [00:09					
	all	283	802	0.626	0.556	0.605
0.366						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
52/100	3.9G	1.363	1.378	1.415	23	640:
100%	203/203 [01:38<00:00,					
	Class	Images	Instances	Box(P)	R	mAP50
mAP50-95): 100%	18/18 [00:09					
	all	283	802	0.613	0.616	0.625
0.38						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
53/100	3.89G	1.365	1.364	1.405	18	640:
100%	203/203 [01:43<00:00,					
	Class	Images	Instances	Box(P)	R	mAP50
mAP50-95): 100%	18/18 [00:08					
	all	283	802	0.607	0.561	0.604
0.365						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
54/100	3.88G	1.353	1.354	1.407	13	640:
100%	203/203 [01:43<00:00,					
	Class	Images	Instances	Box(P)	R	mAP50
mAP50-95): 100%	18/18 [00:08					

	all	283	802	0.61	0.634	0.62
0.374						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
55/100	3.89G	1.36	1.347	1.412	11	640:
100%	203/203 [01:40<00:00,					
	Class	Images	Instances		Box(P)	R
mAP50-95): 100%		18/18 [00:09				mAP50
	all	283	802	0.621	0.643	0.627
0.38						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
56/100	3.8G	1.328	1.324	1.404	26	640:
100%	203/203 [01:44<00:00,					
	Class	Images	Instances		Box(P)	R
mAP50-95): 100%		18/18 [00:09				mAP50
	all	283	802	0.627	0.652	0.64
0.383						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
57/100	3.9G	1.328	1.33	1.398	18	640:
100%	203/203 [01:40<00:00,					
	Class	Images	Instances		Box(P)	R
mAP50-95): 100%		18/18 [00:10				mAP50
	all	283	802	0.646	0.645	0.649
0.388						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
58/100	3.87G	1.329	1.316	1.406	11	640:
100%	203/203 [01:55<00:00,					
	Class	Images	Instances		Box(P)	R
mAP50-95): 100%		18/18 [00:09				mAP50
	all	283	802	0.685	0.612	0.662
0.401						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
59/100 100%	3.9G   203/203 [01:51<00:00,	1.33	1.316	1.406	28	640: mAP50-95): 100%
		Class	Images	Instances	Box(P	R
		18/18 [00:09				mAP50
	all	283	802	0.589	0.62	0.625
0.383						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
60/100 100%	3.88G   203/203 [01:49<00:00,	1.298	1.287	1.38	16	640: mAP50-95): 100%
		Class	Images	Instances	Box(P	R
		18/18 [00:09				mAP50
	all	283	802	0.665	0.618	0.645
0.389						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
61/100 100%	3.88G   203/203 [01:49<00:00,	1.299	1.262	1.375	20	640: mAP50-95): 100%
		Class	Images	Instances	Box(P	R
		18/18 [00:08				mAP50
	all	283	802	0.622	0.652	0.63
0.381						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
62/100 100%	3.89G   203/203 [01:35<00:00,	1.293	1.226	1.35	12	640: mAP50-95): 100%
		Class	Images	Instances	Box(P	R
		18/18 [00:08				mAP50
	all	283	802	0.609	0.648	0.655
0.39						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
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63/100	3.89G	1.284	1.217	1.348	19	640:
100%	203/203 [01:39<00:00,					
	Class	Images	Instances	Box(P)	R	mAP50
mAP50-95): 100%	18/18 [00:08					
	all	283	802	0.656	0.621	0.649
0.402						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
64/100	3.81G	1.255	1.223	1.354	23	640:
100%	203/203 [01:39<00:00,					
	Class	Images	Instances	Box(P)	R	mAP50
mAP50-95): 100%	18/18 [00:09					
	all	283	802	0.617	0.652	0.65
0.398						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
65/100	3.89G	1.256	1.18	1.342	20	640:
100%	203/203 [01:36<00:00,					
	Class	Images	Instances	Box(P)	R	mAP50
mAP50-95): 100%	18/18 [00:08					
	all	283	802	0.627	0.656	0.657
0.408						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
66/100	3.86G	1.237	1.191	1.328	8	640:
100%	203/203 [01:38<00:00,					
	Class	Images	Instances	Box(P)	R	mAP50
mAP50-95): 100%	18/18 [00:08					
	all	283	802	0.64	0.656	0.666
0.407						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
67/100	3.9G	1.246	1.164	1.333	17	640:
100%	203/203 [01:39<00:00,					
	Class	Images	Instances	Box(P)	R	mAP50
mAP50-95): 100%	18/18 [00:08					

	all	283	802	0.678	0.623	0.657
0.4						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
68/100	3.92G	1.236	1.161	1.326	12	640:
100%	203/203 [01:38<00:00,	Class	Images	Instances	Box(P	R
mAP50-95): 100%	18/18 [00:08					mAP50
	all	283	802	0.619	0.683	0.676
0.419						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
69/100	3.89G	1.22	1.143	1.318	12	640:
100%	203/203 [01:34<00:00,	Class	Images	Instances	Box(P	R
mAP50-95): 100%	18/18 [00:08					mAP50
	all	283	802	0.628	0.67	0.66
0.407						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
70/100	3.87G	1.207	1.125	1.313	12	640:
100%	203/203 [01:36<00:00,	Class	Images	Instances	Box(P	R
mAP50-95): 100%	18/18 [00:08					mAP50
	all	283	802	0.662	0.669	0.674
0.418						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
71/100	3.89G	1.18	1.098	1.288	8	640:
100%	203/203 [01:36<00:00,	Class	Images	Instances	Box(P	R
mAP50-95): 100%	18/18 [00:08					mAP50
	all	283	802	0.678	0.636	0.687
0.427						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
72/100 100%	3.83G   203/203 [01:34<00:00, mAP50-95): 100%	1.187 Class   18/18 [00:08 0.413	1.109 Images   18/18 [00:08	1.303 Instances all	23 Box(P R	640: mAP50 0.666

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
73/100 100%	3.88G   203/203 [01:35<00:00, mAP50-95): 100%	1.172 Class   18/18 [00:08 0.43	1.084 Images   18/18 [00:08	1.3 Instances all	6 Box(P R	640: mAP50 0.688

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
74/100 100%	3.89G   203/203 [01:36<00:00, mAP50-95): 100%	1.181 Class   18/18 [00:08 0.43	1.102 Images   18/18 [00:08	1.297 Instances all	13 Box(P R	640: mAP50 0.691

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
75/100 100%	3.89G   203/203 [01:36<00:00, mAP50-95): 100%	1.143 Class   18/18 [00:08 0.442	1.06 Images   18/18 [00:08	1.269 Instances all	6 Box(P R	640: mAP50 0.697

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
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76/100	3.9G	1.16	1.066	1.277	5	640:
100%	203/203 [01:34<00:00,					
	Class	Images	Instances	Box(P)	R	mAP50
mAP50-95): 100%		18/18 [00:08				
	all	283	802	0.666	0.694	0.693
0.443						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
77/100	3.89G	1.16	1.053	1.288	20	640:
100%	203/203 [01:34<00:00,					
	Class	Images	Instances	Box(P)	R	mAP50
mAP50-95): 100%		18/18 [00:08				
	all	283	802	0.691	0.642	0.687
0.437						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
78/100	3.89G	1.143	1.015	1.26	13	640:
100%	203/203 [01:38<00:00,					
	Class	Images	Instances	Box(P)	R	mAP50
mAP50-95): 100%		18/18 [00:08				
	all	283	802	0.661	0.695	0.706
0.451						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
79/100	3.89G	1.13	1.01	1.254	10	640:
100%	203/203 [01:36<00:00,					
	Class	Images	Instances	Box(P)	R	mAP50
mAP50-95): 100%		18/18 [00:08				
	all	283	802	0.703	0.694	0.718
0.455						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
80/100	3.83G	1.11	0.9943	1.253	10	640:
100%	203/203 [01:35<00:00,					
	Class	Images	Instances	Box(P)	R	mAP50
mAP50-95): 100%		18/18 [00:08				

	all	283	802	0.698	0.703	0.718
0.455						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
81/100	3.88G	1.123	0.9899	1.245	18	640:
100%	203/203 [01:39<00:00,					
	Class	Images	Instances		Box(P)	R
mAP50-95): 100%		18/18 [00:08				mAP50
	all	283	802	0.695	0.674	0.71
0.45						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
82/100	3.89G	1.102	0.9934	1.245	14	640:
100%	203/203 [01:35<00:00,					
	Class	Images	Instances		Box(P)	R
mAP50-95): 100%		18/18 [00:08				mAP50
	all	283	802	0.644	0.714	0.71
0.455						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
83/100	3.91G	1.096	0.9512	1.234	11	640:
100%	203/203 [01:35<00:00,					
	Class	Images	Instances		Box(P)	R
mAP50-95): 100%		18/18 [00:08				mAP50
	all	283	802	0.694	0.689	0.714
0.459						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
84/100	3.9G	1.085	0.9539	1.237	11	640:
100%	203/203 [01:36<00:00,					
	Class	Images	Instances		Box(P)	R
mAP50-95): 100%		18/18 [00:08				mAP50
	all	283	802	0.664	0.691	0.706
0.452						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
85/100 100%	3.89G   203/203 [01:36<00:00,	1.078	0.9586	1.235	15	640: mAP50-95): 100%   18/18 [00:08
		Class	Images	Instances	Box(P	R
		all	283	802	0.709	0.669
0.457						0.707

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
86/100 100%	3.89G   203/203 [01:36<00:00,	1.078	0.9339	1.225	24	640: mAP50-95): 100%   18/18 [00:08
		Class	Images	Instances	Box(P	R
		all	283	802	0.679	0.7
0.467						0.716

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
87/100 100%	3.87G   203/203 [01:37<00:00,	1.047	0.9188	1.209	7	640: mAP50-95): 100%   18/18 [00:08
		Class	Images	Instances	Box(P	R
		all	283	802	0.685	0.709
0.477						0.727

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
88/100 100%	3.8G   203/203 [01:36<00:00,	1.042	0.9149	1.203	18	640: mAP50-95): 100%   18/18 [00:08
		Class	Images	Instances	Box(P	R
		all	283	802	0.707	0.698
0.475						0.728

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
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	89/100	3.9G	1.02	0.897	1.195	14	640:
100%	203/203 [01:35<00:00,	Class	Images	Instances	Box(P)	R	mAP50
mAP50-95): 100%	18/18 [00:08	all	283	802	0.67	0.729	0.733
0.482							

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size	
90/100	3.89G	1.031	0.8985	1.197	4	640:	
100%	203/203 [01:35<00:00,	Class	Images	Instances	Box(P)	R	mAP50
mAP50-95): 100%	18/18 [00:08	all	283	802	0.678	0.724	0.727
0.482							

Closing dataloader mosaic

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size	
91/100	3.88G	0.9736	0.7997	1.194	16	640:	
100%	203/203 [01:34<00:00,	Class	Images	Instances	Box(P)	R	mAP50
mAP50-95): 100%	18/18 [00:08	all	283	802	0.705	0.717	0.733
0.489							

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size	
92/100	3.89G	0.9537	0.7675	1.184	4	640:	
100%	203/203 [01:32<00:00,	Class	Images	Instances	Box(P)	R	mAP50
mAP50-95): 100%	18/18 [00:08	all	283	802	0.68	0.744	0.732
0.484							

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
93/100	3.89G	0.9356	0.7504	1.167	6	640:
100%	203/203 [01:33<00:00,					

	Class	Images	Instances	Box(P)	R	mAP50
mAP50-95) : 100%	18/18 [00:08					
	all	283	802	0.698	0.708	0.728
0.486						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
94/100	3.89G	0.9295	0.7307	1.157	7	640:
100%	203/203 [01:33<00:00,					
mAP50-95) : 100%	18/18 [00:08					
	all	283	802	0.716	0.713	0.732
0.491						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
95/100	3.86G	0.9172	0.7262	1.154	6	640:
100%	203/203 [01:38<00:00,					
mAP50-95) : 100%	18/18 [00:09					
	all	283	802	0.709	0.712	0.731
0.489						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
96/100	3.82G	0.9016	0.7106	1.151	4	640:
100%	203/203 [01:38<00:00,					
mAP50-95) : 100%	18/18 [00:08					
	all	283	802	0.712	0.718	0.74
0.496						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
97/100	3.9G	0.891	0.7037	1.144	10	640:
100%	203/203 [01:33<00:00,					
mAP50-95) : 100%	18/18 [00:08					

	all	283	802	0.725	0.711	0.743
0.498						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
98/100	3.89G	0.8868	0.6879	1.137	6	640:
100%	203/203 [01:34<00:00,					
	Class	Images	Instances	Box(P)	R	mAP50
mAP50-95): 100%	18/18 [00:08					
	all	283	802	0.717	0.706	0.74
0.498						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
99/100	3.9G	0.8734	0.6807	1.132	9	640:
100%	203/203 [01:36<00:00,					
	Class	Images	Instances	Box(P)	R	mAP50
mAP50-95): 100%	18/18 [00:08					
	all	283	802	0.72	0.718	0.743
0.497						

Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	Size
100/100	3.9G	0.8737	0.6905	1.134	5	640:
100%	203/203 [01:34<00:00,					
	Class	Images	Instances	Box(P)	R	mAP50
mAP50-95): 100%	18/18 [00:08					
	all	283	802	0.725	0.718	0.743
0.497						

100 epochs completed in 2.997 hours.

Optimizer stripped from runs\detect\train34\weights\last.pt, 52.0MB  
 Optimizer stripped from runs\detect\train34\weights\best.pt, 52.0MB

Validating runs\detect\train34\weights\best.pt...  
 Ultralytics 8.3.40 Python-3.11.11 torch-2.5.1 CUDA:0 (NVIDIA GeForce RTX 4060 Laptop GPU, 8188MiB)  
 Model summary (fused): 218 layers, 25,841,497 parameters, 0 gradients

```
[6] : model.val(data=data)
```

```
Ultralytics 8.3.40 Python-3.11.11 torch-2.5.1 CUDA:0 (NVIDIA GeForce RTX 4060
Laptop GPU, 8188MiB)
Model summary (fused): 218 layers, 25,841,497 parameters, 0 gradients

val: Scanning D:\Academics and University\Python\Intelligent
Systems\Project 2\Welding Dataset\valid\labels.cache... 28
mAP50-95): 100% | 36/36 [00:10]

          Class    Images Instances   Box(P)      R    mAP50
0.499          all     283       802   0.724   0.711   0.743
0.577        Bad Weld    141       194   0.705   0.784   0.8
0.627        Good Weld   175       335   0.766   0.845   0.864
0.292        Defect     128       273   0.703   0.505   0.565
Speed: 0.4ms preprocess, 14.5ms inference, 0.0ms loss, 2.4ms postprocess per
image
Results saved to runs\detect\train342
```

[6]: ultralytics.utils.metrics.DetMetrics object with attributes:

```
ap_class_index: array([0, 1, 2])
box: ultralytics.utils.metrics.Metric object
confusion_matrix: <ultralytics.utils.metrics.ConfusionMatrix object at
0x0000018B12684550>
curves: ['Precision-Recall(B)', 'F1-Confidence(B)', 'Precision-Confidence(B)', 'Recall-Confidence(B)']
curves_results: [[array([
    0, 0.001001, 0.002002, 0.003003,
    0.004004, 0.005005, 0.006006, 0.007007, 0.008008, 0.009009,
    0.01001, 0.011011, 0.012012, 0.013013, 0.014014, 0.015015,
```

0.016016,	0.017017,	0.018018,	0.019019,	0.02002,	0.021021,
0.022022,	0.023023,	0.024024,	0.025025,	0.026026,	0.027027,
0.029029,	0.03003,	0.031031,	0.032032,	0.033033,	0.034034,
0.035035,	0.036036,	0.037037,	0.038038,	0.039039,	0.04004,
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	0.28829,	0.28929,	0.29029,	0.29129,	0.29229,
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0.2993,	0.3003,	0.3013,	0.3023,	0.3033,	0.3043,
0.30531,	0.30631,	0.30731,	0.30831,	0.30931,	0.31031,
0.31131,					
	0.31231,	0.31331,	0.31431,	0.31532,	0.31632,
0.31732,	0.31832,	0.31932,	0.32032,	0.32132,	0.32232,
0.32332,	0.32432,	0.32533,	0.32633,	0.32733,	0.32833,
0.32933,	0.33033,	0.33133,	0.33233,	0.33333,	0.33433,
0.33534,					
	0.33634,	0.33734,	0.33834,	0.33934,	0.34034,
0.34134,	0.34234,	0.34334,	0.34434,	0.34535,	0.34635,
0.34735,	0.34835,	0.34935,	0.35035,	0.35135,	0.35235,

0.35335,	0.35435,	0.35536,	0.35636,	0.35736,	0.35836,
0.35936,	0.36036,	0.36136,	0.36236,	0.36336,	0.36436,
0.36537,	0.36637,	0.36737,	0.36837,	0.36937,	0.37037,
0.37137,	0.37237,	0.37337,	0.37437,	0.37538,	0.37638,
0.37738,	0.37838,	0.37938,	0.38038,	0.38138,	0.38238,
0.38338,	0.38438,	0.38539,	0.38639,	0.38739,	0.38839,
0.38939,	0.39039,	0.39139,	0.39239,	0.39339,	0.39439,
0.3954,	0.3964,	0.3974,	0.3984,	0.3994,	0.4004,
0.4014,	0.4024,	0.4034,	0.4044,	0.40541,	0.40641,
0.40741,	0.40841,	0.40941,	0.41041,	0.41141,	0.41241,
0.41341,	0.41441,	0.41542,	0.41642,	0.41742,	0.41842,
0.41942,	0.42042,	0.42142,	0.42242,	0.42342,	0.42442,
0.42543,	0.42643,	0.42743,	0.42843,	0.42943,	0.43043,
0.43143,	0.43243,	0.43343,	0.43443,	0.43544,	0.43644,
0.43744,	0.43844,	0.43944,	0.44044,	0.44144,	0.44244,
0.44344,	0.44444,	0.44545,	0.44645,	0.44745,	0.44845,
0.44945,	0.45045,	0.45145,	0.45245,	0.45345,	0.45445,
0.45546,	0.45646,	0.45746,	0.45846,	0.45946,	0.46046,
0.46146,	0.46246,	0.46346,	0.46446,	0.46547,	0.46647,
0.46747,	0.46847,	0.46947,	0.47047,	0.47147,	0.47247,
0.47347,	0.47447,	0.47548,	0.47648,	0.47748,	0.47848,
0.47948,	0.48048,	0.48148,	0.48248,	0.48348,	0.48448,
0.48549,	0.48649,	0.48749,	0.48849,	0.48949,	0.49049,
0.49149,	0.49249,	0.49349,	0.49449,	0.4955,	0.4965,
0.4975,	0.4985,	0.4995,	0.5005,	0.5015,	0.5025,
0.5035,	0.5045,	0.50551,	0.50651,	0.50751,	0.50851,
0.50951,	0.51051,	0.51151,	0.51251,	0.51351,	0.51451,
0.51552,	0.51652,	0.51752,	0.51852,	0.51952,	0.52052,
0.52152,	0.52252,	0.52352,	0.52452,	0.52553,	0.52653,
0.52753,	0.52853,	0.52953,	0.53053,	0.53153,	0.53253,
0.53353,	0.53453,	0.53554,	0.53654,	0.53754,	0.53854,
0.53954,	0.54054,	0.54154,	0.54254,	0.54354,	0.54454,
0.54555,	0.54655,	0.54755,	0.54855,	0.54955,	0.55055,
0.55155,	0.55255,	0.55355,	0.55455,	0.55556,	0.55656,
0.55756,	0.55856,	0.55956,	0.56056,	0.56156,	0.56256,
0.56356,	0.56456,	0.56557,	0.56657,	0.56757,	0.56857,
0.56957,	0.57057,	0.57157,	0.57257,	0.57357,	0.57457,
0.57558,					

	0.57658,	0.57758,	0.57858,	0.57958,	0.58058,
0.58158,	0.58258,	0.58358,	0.58458,	0.58559,	0.58659,
0.58759,	0.58859,	0.58959,	0.59059,	0.59159,	0.59259,
0.59359,	0.59459,	0.59556,	0.5966,	0.5976,	0.5986,
0.5996,					
	0.6006,	0.6016,	0.6026,	0.6036,	0.6046,
0.60561,	0.60661,	0.60761,	0.60861,	0.60961,	0.61061,
0.61161,	0.61261,	0.61361,	0.61461,	0.61562,	0.61662,
0.61762,	0.61862,	0.61962,	0.62062,	0.62162,	0.62262,
0.62362,					
	0.62462,	0.62563,	0.62663,	0.62763,	0.62863,
0.62963,	0.63063,	0.63163,	0.63263,	0.63363,	0.63463,
0.63564,	0.63664,	0.63764,	0.63864,	0.63964,	0.64064,
0.64164,	0.64264,	0.64364,	0.64464,	0.64565,	0.64665,
0.64765,					
	0.64865,	0.64965,	0.65065,	0.65165,	0.65265,
0.65365,	0.65465,	0.65566,	0.65666,	0.65766,	0.65866,
0.65966,	0.66066,	0.66166,	0.66266,	0.66366,	0.66466,
0.66567,	0.66667,	0.66767,	0.66867,	0.66967,	0.67067,
0.67167,					
	0.67267,	0.67367,	0.67467,	0.67568,	0.67668,
0.67768,	0.67868,	0.67968,	0.68068,	0.68168,	0.68268,
0.68368,	0.68468,	0.68569,	0.68669,	0.68769,	0.68869,
0.68969,	0.69069,	0.69169,	0.69269,	0.69369,	0.69469,
0.6957,					
	0.6967,	0.6977,	0.6987,	0.6997,	0.7007,
0.7017,	0.7027,	0.7037,	0.7047,	0.70571,	0.70671,
0.70771,	0.70871,	0.70971,	0.71071,	0.71171,	0.71271,
0.71371,	0.71471,	0.71572,	0.71672,	0.71772,	0.71872,
0.71972,					
	0.72072,	0.72172,	0.72272,	0.72372,	0.72472,
0.72573,	0.72673,	0.72773,	0.72873,	0.72973,	0.73073,
0.73173,	0.73273,	0.73373,	0.73473,	0.73574,	0.73674,
0.73774,	0.73874,	0.73974,	0.74074,	0.74174,	0.74274,
0.74374,					
	0.74474,	0.74575,	0.74675,	0.74775,	0.74875,
0.74975,	0.75075,	0.75175,	0.75275,	0.75375,	0.75475,
0.75576,	0.75676,	0.75776,	0.75876,	0.75976,	0.76076,
0.76176,	0.76276,	0.76376,	0.76476,	0.76577,	0.76677,
0.76777,					
	0.76877,	0.76977,	0.77077,	0.77177,	0.77277,
0.77377,	0.77477,	0.77578,	0.77678,	0.77778,	0.77878,
0.77978,	0.78078,	0.78178,	0.78278,	0.78378,	0.78478,
0.78579,	0.78679,	0.78779,	0.78879,	0.78979,	0.79079,
0.79179,					
	0.79279,	0.79379,	0.79479,	0.7958,	0.7968,
0.7978,	0.7988,	0.7998,	0.8008,	0.8018,	0.8028,

0.8038,	0.8048,	0.80581,	0.80681,	0.80781,	0.80881,
0.80981,	0.81081,	0.81181,	0.81281,	0.81381,	0.81481,
0.81582,					
	0.81682,	0.81782,	0.81882,	0.81982,	0.82082,
0.82182,	0.82282,	0.82382,	0.82482,	0.82583,	0.82683,
0.82783,	0.82883,	0.82983,	0.83083,	0.83183,	0.83283,
0.83383,	0.83483,	0.83584,	0.83684,	0.83784,	0.83884,
0.83984,					
	0.84084,	0.84184,	0.84284,	0.84384,	0.84484,
0.84585,	0.84685,	0.84785,	0.84885,	0.84985,	0.85085,
0.85185,	0.85285,	0.85385,	0.85485,	0.85586,	0.85686,
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0.86386,					
	0.86486,	0.86587,	0.86687,	0.86787,	0.86887,
0.86987,	0.87087,	0.87187,	0.87287,	0.87387,	0.87487,
0.87588,	0.87688,	0.87788,	0.87888,	0.87988,	0.88088,
0.88188,	0.88288,	0.88388,	0.88488,	0.88589,	0.88689,
0.88789,					
	0.88889,	0.88989,	0.89089,	0.89189,	0.89289,
0.89389,	0.89489,	0.8959,	0.8969,	0.8979,	0.8989,
0.8999,	0.9009,	0.9019,	0.9029,	0.9039,	0.9049,
0.90591,	0.90691,	0.90791,	0.90891,	0.90991,	0.91091,
0.91191,					
	0.91291,	0.91391,	0.91491,	0.91592,	0.91692,
0.91792,	0.91892,	0.91992,	0.92092,	0.92192,	0.92292,
0.92392,	0.92492,	0.92593,	0.92693,	0.92793,	0.92893,
0.92993,	0.93093,	0.93193,	0.93293,	0.93393,	0.93493,
0.93594,					
	0.93694,	0.93794,	0.93894,	0.93994,	0.94094,
0.94194,	0.94294,	0.94394,	0.94494,	0.94595,	0.94695,
0.94795,	0.94895,	0.94995,	0.95095,	0.95195,	0.95295,
0.95395,	0.95495,	0.95596,	0.95696,	0.95796,	0.95896,
0.95996,					
	0.96096,	0.96196,	0.96296,	0.96396,	0.96496,
0.96597,	0.96697,	0.96797,	0.96897,	0.96997,	0.97097,
0.97197,	0.97297,	0.97397,	0.97497,	0.97598,	0.97698,
0.97798,	0.97898,	0.97998,	0.98098,	0.98198,	0.98298,
0.98398,					
	0.98498,	0.98599,	0.98699,	0.98799,	0.98899,
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0.015015,	0.016016,	0.017017,	0.018018,	0.019019,	0.02002,
0.021021,	0.022022,	0.023023,			
	0.024024,	0.025025,	0.026026,	0.027027,	0.028028,
0.029029,	0.03003,	0.031031,	0.032032,	0.033033,	0.034034,
0.035035,	0.036036,	0.037037,	0.038038,	0.039039,	0.04004,
0.041041,	0.042042,	0.043043,	0.044044,	0.045045,	0.046046,
0.047047,					
	0.048048,	0.049049,	0.05005,	0.051051,	0.052052,
0.053053,	0.054054,	0.055055,	0.056056,	0.057057,	0.058058,
0.059059,	0.06006,	0.061061,	0.062062,	0.063063,	0.064064,
0.065065,	0.066066,	0.067067,	0.068068,	0.069069,	0.07007,
0.071071,					
	0.072072,	0.073073,	0.074074,	0.075075,	0.076076,
0.077077,	0.078078,	0.079079,	0.08008,	0.081081,	0.082082,
0.083083,	0.084084,	0.085085,	0.086086,	0.087087,	0.088088,
0.089089,	0.09009,	0.091091,	0.092092,	0.093093,	0.094094,
0.095095,					
	0.096096,	0.097097,	0.098098,	0.099099,	0.1001,
0.1011,	0.1021,	0.1031,	0.1041,	0.10511,	0.10611,
0.10711,	0.10811,	0.10911,	0.11011,	0.11111,	0.11211,
0.11311,	0.11411,	0.11512,	0.11612,	0.11712,	0.11812,
0.11912,					
	0.12012,	0.12112,	0.12212,	0.12312,	0.12412,
0.12513,	0.12613,	0.12713,	0.12813,	0.12913,	0.13013,
0.13113,	0.13213,	0.13313,	0.13413,	0.13514,	0.13614,
0.13714,	0.13814,	0.13914,	0.14014,	0.14114,	0.14214,
0.14314,					
	0.14414,	0.14515,	0.14615,	0.14715,	0.14815,
0.14915,	0.15015,	0.15115,	0.15215,	0.15315,	0.15415,
0.15516,	0.15616,	0.15716,	0.15816,	0.15916,	0.16016,
0.16116,	0.16216,	0.16316,	0.16416,	0.16517,	0.16617,
0.16717,					
	0.16817,	0.16917,	0.17017,	0.17117,	0.17217,
0.17317,	0.17417,	0.17518,	0.17618,	0.17718,	0.17818,
0.17918,	0.18018,	0.18118,	0.18218,	0.18318,	0.18418,
0.18519,	0.18619,	0.18719,	0.18819,	0.18919,	0.19019,
0.19119,					
	0.19219,	0.19319,	0.19419,	0.1952,	0.1962,
0.1972,	0.1982,	0.1992,	0.2002,	0.2012,	0.2022,
0.2032,	0.2042,	0.20521,	0.20621,	0.20721,	0.20821,
0.20921,	0.21021,	0.21121,	0.21221,	0.21321,	0.21421,
0.21522,					
	0.21622,	0.21722,	0.21822,	0.21922,	0.22022,
0.22122,	0.22222,	0.22322,	0.22422,	0.22523,	0.22623,
0.22723,	0.22823,	0.22923,	0.23023,	0.23123,	0.23223,
0.23323,	0.23423,	0.23524,	0.23624,	0.23724,	0.23824,

0.23924,					
	0.24024,	0.24124,	0.24224,	0.24324,	0.24424,
0.24525,	0.24625,	0.24725,	0.24825,	0.24925,	0.25025,
0.25125,	0.25225,	0.25325,	0.25425,	0.25526,	0.25626,
0.25726,	0.25826,	0.25926,	0.26026,	0.26126,	0.26226,
0.26326,					
	0.26426,	0.26527,	0.26627,	0.26727,	0.26827,
0.26927,	0.27027,	0.27127,	0.27227,	0.27327,	0.27427,
0.27528,	0.27628,	0.27728,	0.27828,	0.27928,	0.28028,
0.28128,	0.28228,	0.28328,	0.28428,	0.28529,	0.28629,
0.28729,					
	0.28829,	0.28929,	0.29029,	0.29129,	0.29229,
0.29329,	0.29429,	0.2953,	0.2963,	0.2973,	0.2983,
0.2993,	0.3003,	0.3013,	0.3023,	0.3033,	0.3043,
0.30531,	0.30631,	0.30731,	0.30831,	0.30931,	0.31031,
0.31131,					
	0.31231,	0.31331,	0.31431,	0.31532,	0.31632,
0.31732,	0.31832,	0.31932,	0.32032,	0.32132,	0.32232,
0.32332,	0.32432,	0.32533,	0.32633,	0.32733,	0.32833,
0.32933,	0.33033,	0.33133,	0.33233,	0.33333,	0.33433,
0.33534,					
	0.33634,	0.33734,	0.33834,	0.33934,	0.34034,
0.34134,	0.34234,	0.34334,	0.34434,	0.34535,	0.34635,
0.34735,	0.34835,	0.34935,	0.35035,	0.35135,	0.35235,
0.35335,	0.35435,	0.35536,	0.35636,	0.35736,	0.35836,
0.35936,					
	0.36036,	0.36136,	0.36236,	0.36336,	0.36436,
0.36537,	0.36637,	0.36737,	0.36837,	0.36937,	0.37037,
0.37137,	0.37237,	0.37337,	0.37437,	0.37538,	0.37638,
0.37738,	0.37838,	0.37938,	0.38038,	0.38138,	0.38238,
0.38338,					
	0.38438,	0.38539,	0.38639,	0.38739,	0.38839,
0.38939,	0.39039,	0.39139,	0.39239,	0.39339,	0.39439,
0.3954,	0.3964,	0.3974,	0.3984,	0.3994,	0.4004,
0.4014,	0.4024,	0.4034,	0.4044,	0.40541,	0.40641,
0.40741,					
	0.40841,	0.40941,	0.41041,	0.41141,	0.41241,
0.41341,	0.41441,	0.41542,	0.41642,	0.41742,	0.41842,
0.41942,	0.42042,	0.42142,	0.42242,	0.42342,	0.42442,
0.42543,	0.42643,	0.42743,	0.42843,	0.42943,	0.43043,
0.43143,					
	0.43243,	0.43343,	0.43443,	0.43544,	0.43644,
0.43744,	0.43844,	0.43944,	0.44044,	0.44144,	0.44244,
0.44344,	0.44444,	0.44545,	0.44645,	0.44745,	0.44845,
0.44945,	0.45045,	0.45145,	0.45245,	0.45345,	0.45445,
0.45546,					
	0.45646,	0.45746,	0.45846,	0.45946,	0.46046,

0.46146,	0.46246,	0.46346,	0.46446,	0.46547,	0.46647,
0.46747,	0.46847,	0.46947,	0.47047,	0.47147,	0.47247,
0.47347,	0.47447,	0.47548,	0.47648,	0.47748,	0.47848,
0.47948,					
	0.48048,	0.48148,	0.48248,	0.48348,	0.48448,
0.48549,	0.48649,	0.48749,	0.48849,	0.48949,	0.49049,
0.49149,	0.49249,	0.49349,	0.49449,	0.4955,	0.4965,
0.4975,	0.4985,	0.4995,	0.5005,	0.5015,	0.5025,
0.5035,					
	0.5045,	0.50551,	0.50651,	0.50751,	0.50851,
0.50951,	0.51051,	0.51151,	0.51251,	0.51351,	0.51451,
0.51552,	0.51652,	0.51752,	0.51852,	0.51952,	0.52052,
0.52152,	0.52252,	0.52352,	0.52452,	0.52553,	0.52653,
0.52753,					
	0.52853,	0.52953,	0.53053,	0.53153,	0.53253,
0.53353,	0.53453,	0.53554,	0.53654,	0.53754,	0.53854,
0.53954,	0.54054,	0.54154,	0.54254,	0.54354,	0.54454,
0.54555,	0.54655,	0.54755,	0.54855,	0.54955,	0.55055,
0.55155,					
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0.23924,					
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0.7978,	0.7988,	0.7998,	0.8008,	0.8018,	0.8028,
0.8038,	0.8048,	0.80581,	0.80681,	0.80781,	0.80881,
0.80981,	0.81081,	0.81181,	0.81281,	0.81381,	0.81481,
0.81582,					
	0.81682,	0.81782,	0.81882,	0.81982,	0.82082,
0.82182,	0.82282,	0.82382,	0.82482,	0.82583,	0.82683,
0.82783,	0.82883,	0.82983,	0.83083,	0.83183,	0.83283,
0.83383,	0.83483,	0.83584,	0.83684,	0.83784,	0.83884,
0.83984,					
	0.84084,	0.84184,	0.84284,	0.84384,	0.84484,
0.84585,	0.84685,	0.84785,	0.84885,	0.84985,	0.85085,
0.85185,	0.85285,	0.85385,	0.85485,	0.85586,	0.85686,
0.85786,	0.85886,	0.85986,	0.86086,	0.86186,	0.86286,
0.86386,					
	0.86486,	0.86587,	0.86687,	0.86787,	0.86887,
0.86987,	0.87087,	0.87187,	0.87287,	0.87387,	0.87487,
0.87588,	0.87688,	0.87788,	0.87888,	0.87988,	0.88088,
0.88188,	0.88288,	0.88388,	0.88488,	0.88589,	0.88689,
0.88789,					
	0.88889,	0.88989,	0.89089,	0.89189,	0.89289,
0.89389,	0.89489,	0.8959,	0.8969,	0.8979,	0.8989,
0.8999,	0.9009,	0.9019,	0.9029,	0.9039,	0.9049,
0.90591,	0.90691,	0.90791,	0.90891,	0.90991,	0.91091,
0.91191,					
	0.91291,	0.91391,	0.91491,	0.91592,	0.91692,
0.91792,	0.91892,	0.91992,	0.92092,	0.92192,	0.92292,
0.92392,	0.92492,	0.92593,	0.92693,	0.92793,	0.92893,
0.92993,	0.93093,	0.93193,	0.93293,	0.93393,	0.93493,
0.93594,					
	0.93694,	0.93794,	0.93894,	0.93994,	0.94094,
0.94194,	0.94294,	0.94394,	0.94494,	0.94595,	0.94695,
0.94795,	0.94895,	0.94995,	0.95095,	0.95195,	0.95295,
0.95395,	0.95495,	0.95596,	0.95696,	0.95796,	0.95896,
0.95996,					
	0.96096,	0.96196,	0.96296,	0.96396,	0.96496,
0.96597,	0.96697,	0.96797,	0.96897,	0.96997,	0.97097,
0.97197,	0.97297,	0.97397,	0.97497,	0.97598,	0.97698,
0.97798,	0.97898,	0.97998,	0.98098,	0.98198,	0.98298,
0.98398,					
	0.98498,	0.98599,	0.98699,	0.98799,	0.98899,
0.98999,	0.99099,	0.99199,	0.99299,	0.99399,	0.99499,
0.996,	0.997,	0.998,	0.999,	1]), array([[	
0.97423,	0.97423,	0.97423,	...,	0,	0,
[	0.97313,	0.97313,	0.97015,	...,	0,
0],					
	[ 0.8022,	0.8022,	0.79121,	...,	0,
0]], 'Confidence', 'Recall'])]					

```

fitness: 0.5233388725115536
keys: ['metrics/precision(B)', 'metrics/recall(B)', 'metrics/mAP50(B)', 'metrics/mAP50-95(B)']
maps: array([ 0.57707, 0.62741, 0.29241])
names: {0: 'Bad Weld', 1: 'Good Weld', 2: 'Defect'}
plot: True
results_dict: {'metrics/precision(B)': 0.7244925531567773, 'metrics/recall(B)': 0.7112585931788886, 'metrics/mAP50(B)': 0.7427016155474176, 'metrics/mAP50-95(B)': 0.4989652343964576, 'fitness': 0.5233388725115536}
save_dir: WindowsPath('runs/detect/train342')
speed: {'preprocess': 0.43311641410045826, 'inference': 14.461765862185205, 'loss': 0.0, 'postprocess': 2.3874950071948153}
task: 'detect'

```

[7]: # Save the trained model

```

model_path = "D:\Academics and University\Python\Intelligent Systems\Project\u2\my_yolov8m.pt"
model.save(model_path)

```

[34]:

```

import os
import random
from PIL import Image
from IPython.display import display
from ultralytics import YOLO

# Function to display results
def display_results(model, img_dir, num_images=10):
    images = os.listdir(img_dir)
    sample_images = random.sample(images, num_images)
    save_dir = 'runs/detect/exp'
    os.makedirs(save_dir, exist_ok=True)

    for image_name in sample_images:
        image_path = os.path.join(img_dir, image_name)
        results = model(image_path)
        for result in results:
            result.plot(save=True, filename=os.path.join(save_dir, os.path.basename(image_path)))
            result_image_path = os.path.join(save_dir, os.path.basename(image_path))
            display(Image.open(result_image_path))

```

[35]: # Load the trained model for inference

```

model = YOLO(model_path)

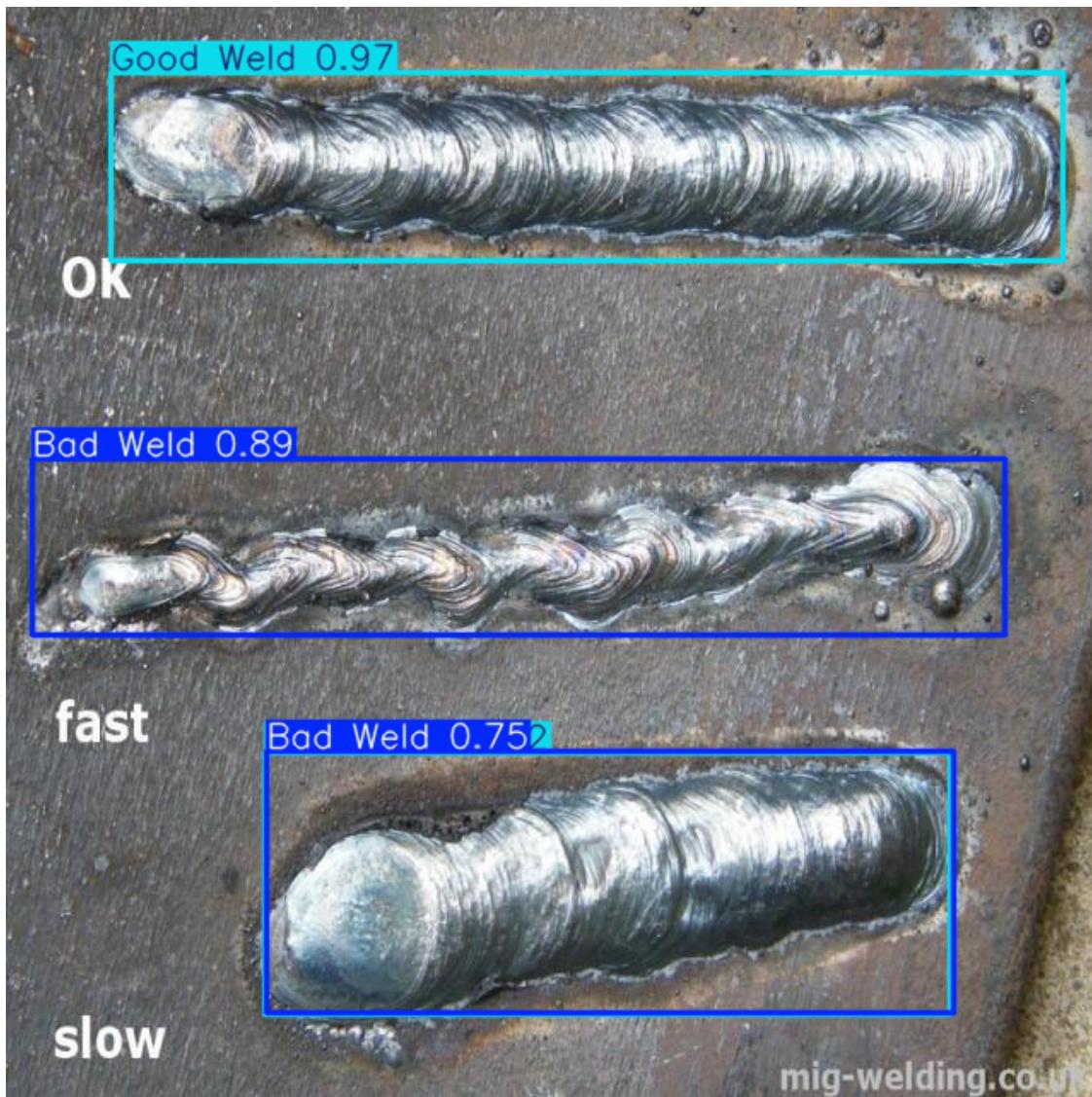
print("Displaying results from model trained on version 1 with augmentation:")

```

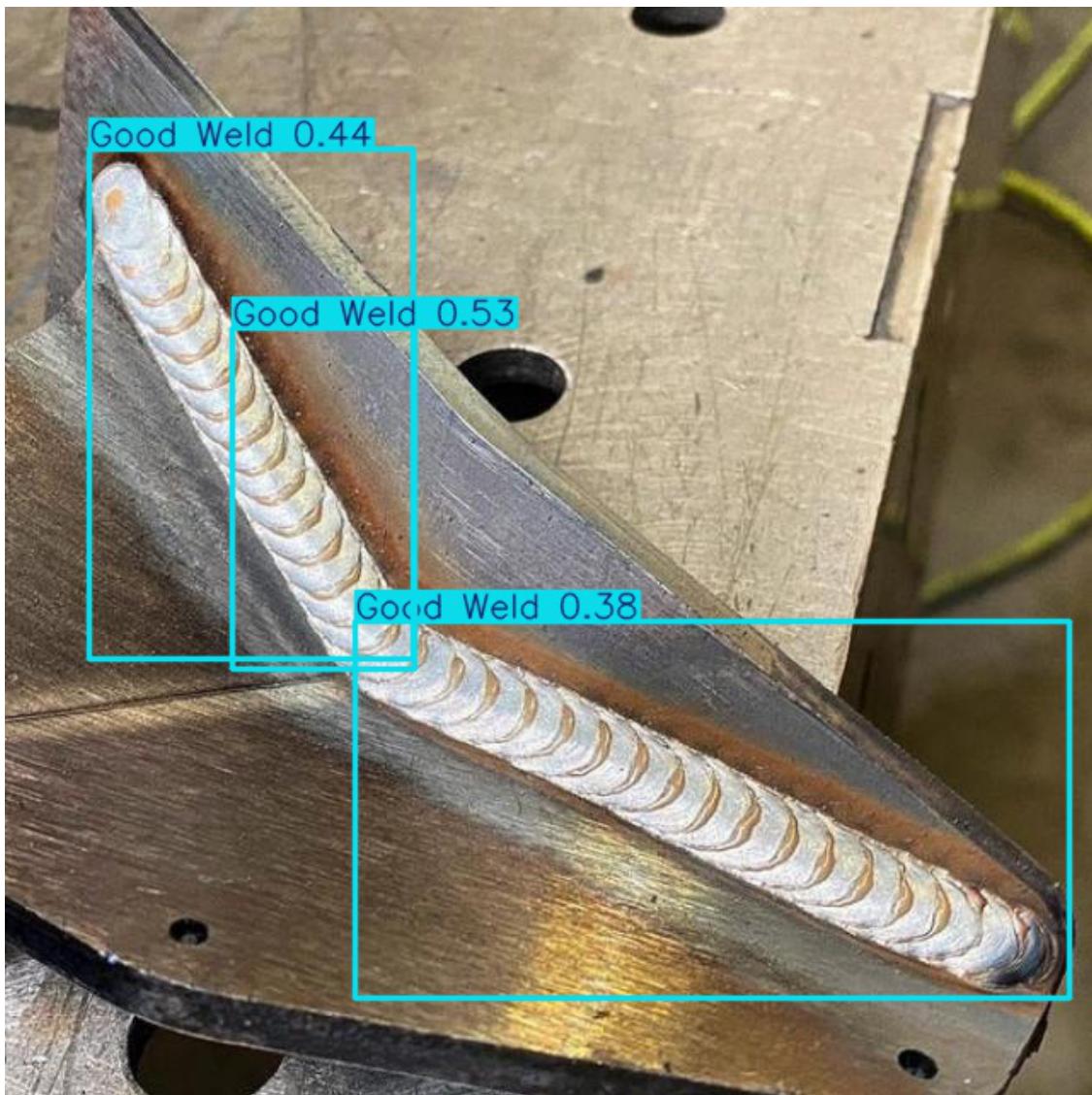
```
img_dir = "D:/Academics and University/Python/Intelligent Systems/Project 2/  
Welding Dataset/test/images"  
display_results(model, img_dir)
```

Displaying results from model trained on version 1 with augmentation:

```
image 1/1 D:\Academics and University\Python\Intelligent Systems\Project  
2\Welding Dataset\test\images\poor-Welding-  
Images_22.jpeg.jpg.rf.3706f7e9a367ae053abfee4902a78288.jpg: 640x640 2 Bad Welds,  
2 Good Welds, 37.7ms  
Speed: 4.9ms preprocess, 37.7ms inference, 5.1ms postprocess per image at shape  
(1, 3, 640, 640)
```



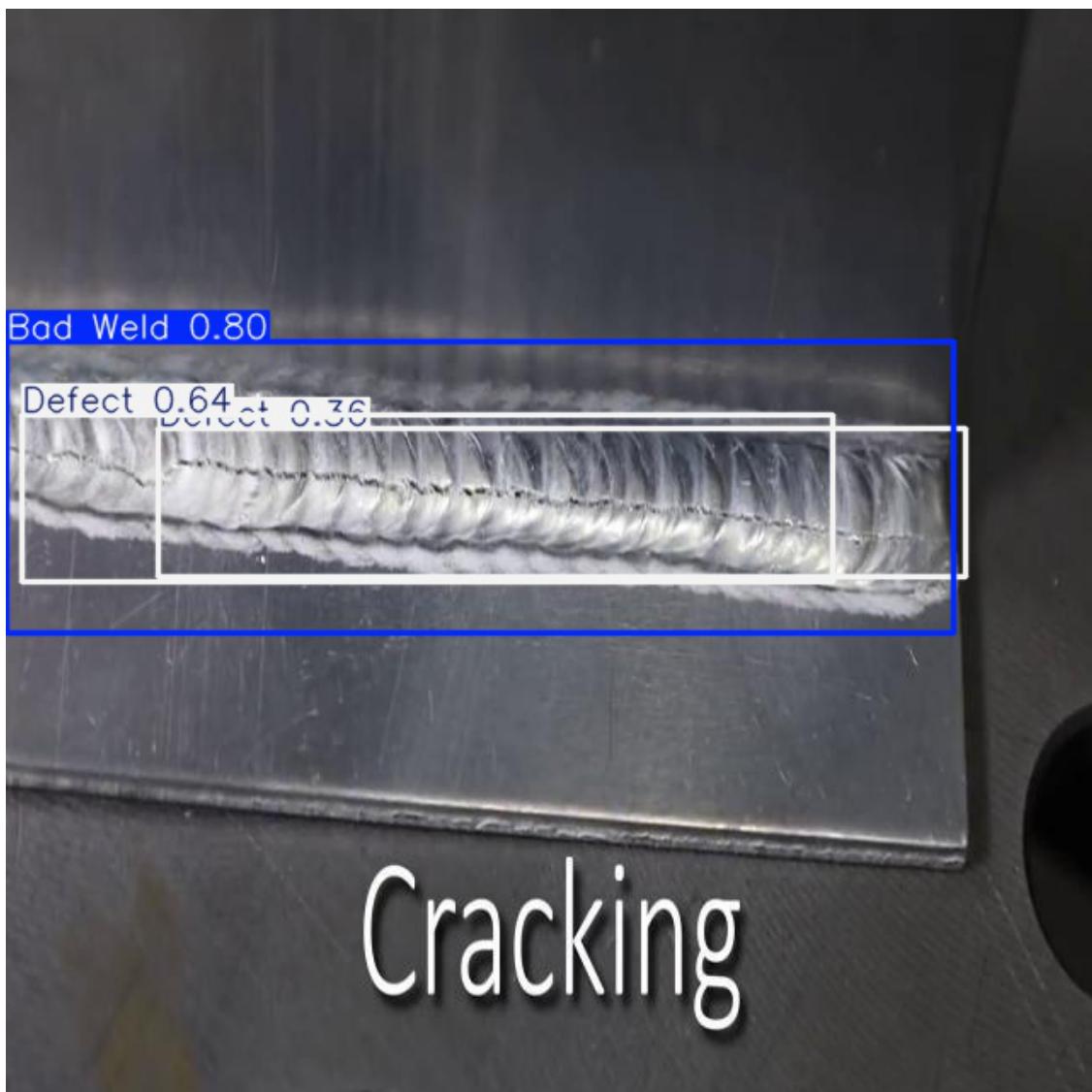
```
image 1/1 D:\Academics and University\Python\Intelligent Systems\Project  
2\Welding Dataset\test\images\mig-good-  
welds_5.jpeg.rf.34d691732b9aaf7d94f3fcdaa144fdb.jpg: 640x640 3 Good Welds,  
28.9ms  
Speed: 4.7ms preprocess, 28.9ms inference, 5.2ms postprocess per image at shape  
(1, 3, 640, 640)
```



```
image 1/1 D:\Academics and University\Python\Intelligent Systems\Project  
2\Welding Dataset\test\images\bad_weld_vid205.jpeg.rf.4732128c8ac74427330c636ff0  
e63949.jpg: 640x640 1 Bad Weld, 36.5ms  
Speed: 3.2ms preprocess, 36.5ms inference, 3.2ms postprocess per image at shape  
(1, 3, 640, 640)
```



image 1/1 D:\Acadamics and University\Python\Intelligent Systems\Project  
2\Welding Dataset\test\images\bad\_weld\_vid374.jpeg.jpg.rf.d1c904ca6a097b2c516652  
38ba9e1147.jpg: 640x640 1 Bad Weld, 2 Defects, 31.0ms  
Speed: 3.5ms preprocess, 31.0ms inference, 4.7ms postprocess per image at shape  
(1, 3, 640, 640)



```
image 1/1 D:\Academics and University\Python\Intelligent Systems\Project  
2\Welding Dataset\test\images\Spatters-welding-  
images_9.jpeg.jpg.rf.a43f10bbaf404937f530d9c278654acb.jpg: 640x640 2 Good Welds,  
77.1ms  
Speed: 3.6ms preprocess, 77.1ms inference, 3.0ms postprocess per image at shape  
(1, 3, 640, 640)
```



image 1/1 D:\Academics and University\Python\Intelligent Systems\Project  
2\Welding Dataset\test\images\Screenshot-2022-12-05-  
230149.jpeg.rf.9a609cc50aed07d1532d574bdfddd081.jpg: 640x640 2 Good Welds,  
26.6ms  
Speed: 3.0ms preprocess, 26.6ms inference, 2.7ms postprocess per image at shape  
(1, 3, 640, 640)



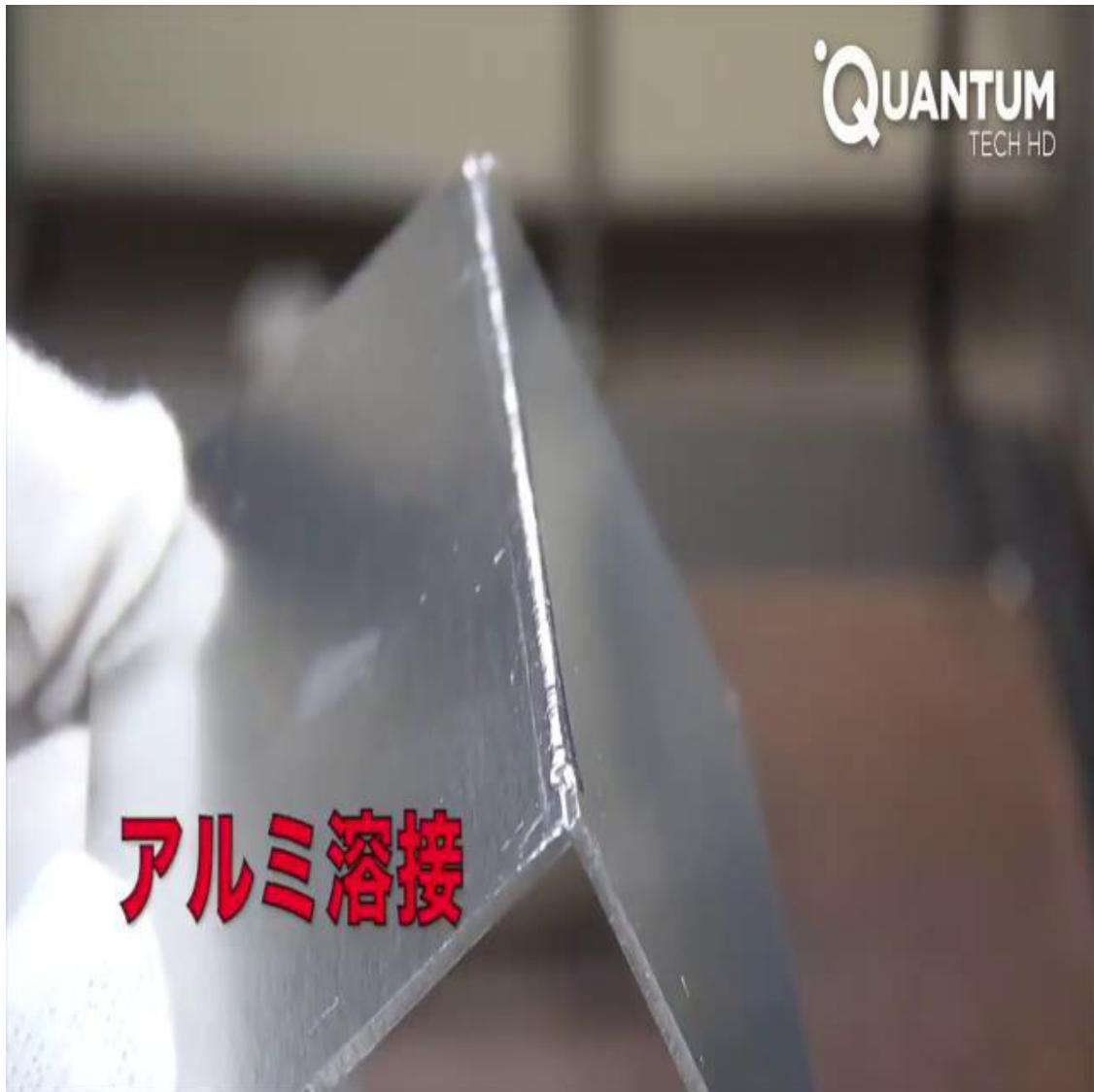
```
image 1/1 D:\Academics and University\Python\Intelligent Systems\Project  
2\Welding Dataset\test\images\good-tig-  
welds_3.jpeg.rf.c6af4c75c9f0f8866e1d58bb2a2ae0d.jpg: 640x640 2 Good Welds,  
22.7ms  
Speed: 4.9ms preprocess, 22.7ms inference, 3.1ms postprocess per image at shape  
(1, 3, 640, 640)
```



```
image 1/1 D:\Academics and University\Python\Intelligent Systems\Project  
2\Welding Dataset\test\images\good_weld_vid1098.jpeg.rf.fa02bd1ec37898d82bf99052  
5548da93.jpg: 640x640 (no detections), 24.7ms  
Speed: 4.3ms preprocess, 24.7ms inference, 1.5ms postprocess per image at shape  
(1, 3, 640, 640)
```



```
image 1/1 D:\Academics and University\Python\Intelligent Systems\Project  
2\Welding Dataset\test\images\good_weld_vid1134.jpeg.jpg.rf.5531f5eb2fc03e6b2b99  
2469c012caa4.jpg: 640x640 (no detections), 22.2ms  
Speed: 4.0ms preprocess, 22.2ms inference, 1.0ms postprocess per image at shape  
(1, 3, 640, 640)
```



```
image 1/1 D:\Academics and University\Python\Intelligent Systems\Project  
2\Welding Dataset\test\images\good_weld_vid189.jpeg.jpg.rf.33380af68fa3c4f459a81  
f26d1bdbcb9.jpg: 640x640 1 Good Weld, 38.0ms  
Speed: 5.7ms preprocess, 38.0ms inference, 4.0ms postprocess per image at shape  
(1, 3, 640, 640)
```

