

Model Training_Conversion

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1. Model Training

2. Model Conversion

References

After completing the dataset annotation tutorial content, we can start training the model using the board.

This tutorial only introduces CLI model training and conversion. You can refer to the official website for Python case modifications.

1. Model Training

Use CLI command to directly train the model: Copy the yolo11n.pt file to the directory where the configuration file is located, then open a terminal in the configuration file directory:

```
cd /home/jetson/ultralytics/ultralytics/data/yahboom_data/orange_data
```

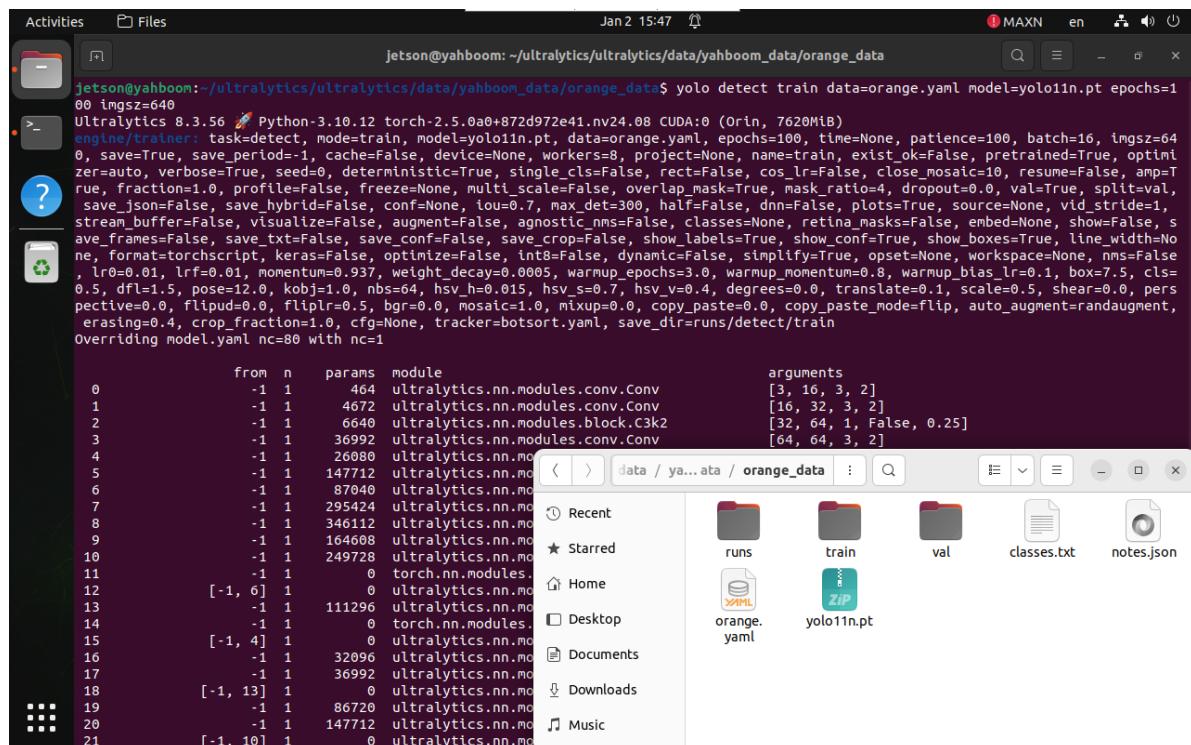
```
yolo detect train data=orange.yaml model=yolo11n.pt epochs=100 imgs=640
```

`data`: Dataset configuration file

`model`: Pre-trained model file

`epochs`: Number of training epochs

`imgsz`: Input specified image size



```
jetson@yahboom:~/ultralytics/ultralytics/data/yahboom_data/orange_data$ yolo detect train data=orange.yaml model=yolo11n.pt epochs=100 imgs=640
Ultralytics 8.3.56 Python-3.10.12 torch-2.5.0a0+872d972e41.nv24.08 CUDA:0 (Orin, 7620MiB)
engine/trainer: task=detect, mode=train, model=yolo11n.pt, data=orange.yaml, epochs=100, time=None, patience=100, batch=16, imgsz=64
0, save=True, save_period=1, cache=False, device=None, workers=8, project=None, name=train, 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, 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, filplr=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/train
Overriding model.yaml nc=80 with nc=1

      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       6640 ultralytics.nn.modules.block.C3k2     [32, 64, 1, False, 0.25]
3       -1    1       36992 ultralytics.nn.modules.conv.Conv     [64, 64, 3, 2]
4       -1    1       26080 ultralytics.nn.modules.conv.Conv
5       -1    1      147712 ultralytics.nn.modules.conv.Conv
6       -1    1       87040 ultralytics.nn.modules.conv.Conv
7       -1    1      295424 ultralytics.nn.modules.conv.Conv
8       -1    1      346112 ultralytics.nn.modules.conv.Conv
9       -1    1      164668 ultralytics.nn.modules.conv.Conv
10      -1    1      249728 ultralytics.nn.modules.conv.Conv
11      -1    1        0 torch.nn.modules.conv.Conv
12      [-1, 6]  1        0 ultralytics.nn.modules.conv.Conv
13      -1    1      111296 ultralytics.nn.modules.conv.Conv
14      -1    1        0 torch.nn.modules.conv.Conv
15      [-1, 4]  1        0 ultralytics.nn.modules.conv.Conv
16      -1    1      32096 ultralytics.nn.modules.conv.Conv
17      -1    1      36992 ultralytics.nn.modules.conv.Conv
18      [-1, 13] 1        0 ultralytics.nn.modules.conv.Conv
19      -1    1      86720 ultralytics.nn.modules.conv.Conv
20      -1    1      147712 ultralytics.nn.modules.conv.Conv
21      [-1, 10] 1        0 ultralytics.nn.modules.conv.Conv
```

```

Activities Terminal Jan 2 15:47 ⓘ MAXN en 🔍 ⌂
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ System throttled due to Over-current.
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ YOLOv1n summary: 319 layers, 2,590,035 parameters, 2,590,019 gradients, 6.4 GFLOPs
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ Transferred 448/499 items from pretrained weights
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ Freezing layer 'model.23.dfl.conv.weight'
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ AMP: running Automatic Mixed Precision (AMP) checks...
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ AMP: checks passed ✓
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ train: Scanning /home/jetson/ultralytics/ultralytics/data/yahboom_data/orange_data/train/labels... 153 images, 0 backgrounds, 0 corrupt
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ train: New cache created: /home/jetson/ultralytics/ultralytics/data/yahboom_data/orange_data/train/labels.cache
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ val: Scanning /home/jetson/ultralytics/ultralytics/data/yahboom_data/orange_data/val/labels... 20 images, 0 backgrounds, 0 corrupt
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ val: New cache created: /home/jetson/ultralytics/ultralytics/data/yahboom_data/orange_data/val/labels.cache
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ Plotting labels to runs/detect/train/labels.jpg...
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ optimizer: 'optimizer=auto' found, ignoring 'lr0=0.01' and 'momentum=0.937' and determining best 'optimizer', 'lr0' and 'momentum' automatically...
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ optimizer: AdamW(lr=0.002, momentum=0.9) with parameter groups 81 weight(decay=0.0), 88 weight(decay=0.0005), 87 bias(decay=0.0)
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ Image sizes 640 train, 640 val
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ Using 6 dataloader workers
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ Logging results to runs/detect/train
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ Starting training for 100 epochs...
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ 1/100 2.35G 0.5434 2.647 0.9827 19 640: 100% [██████] 10/10 [00:08<00:00, 1.14it/s]
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ Class Images Instances Box(P R mAP50 mAP50-95): 100% [██████] 1/1 [00:00<00:00, 2.03it
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ all 20 20 0.00333 1 0.995 0.888
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ 2/100 2.36G 0.5282 1.707 0.9395 21 640: 100% [██████] 10/10 [00:05<00:00, 1.74it/s]
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ Class Images Instances Box(P R mAP50 mAP50-95): 100% [██████] 1/1 [00:00<00:00, 3.21it
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ all 20 20 0.00333 1 0.995 0.879
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ 3/100 2.38G 0.5424 1.267 0.972 16 640: 100% [██████] 10/10 [00:05<00:00, 1.71it/s]
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ Class Images Instances Box(P R mAP50 mAP50-95): 100% [██████] 1/1 [00:00<00:00, 3.27it
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ all 20 20 0.00838 1 0.995 0.912

```

```

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jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ Jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ all 20 20 0.997 1 0.995 0.943
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ 96/100 2.38G 0.2912 0.2331 0.8209 9 640: 100% [██████] 10/10 [00:05<00:00, 1.96it/s]
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ Class Images Instances Box(P R mAP50 mAP50-95): 100% [██████] 1/1 [00:00<00:00, 3.06it
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ all 20 20 0.997 1 0.995 0.954
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ 97/100 2.37G 0.2719 0.2317 0.8218 9 640: 100% [██████] 10/10 [00:05<00:00, 1.98it/s]
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ Class Images Instances Box(P R mAP50 mAP50-95): 100% [██████] 1/1 [00:00<00:00, 3.41it
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ all 20 20 0.997 1 0.995 0.946
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ 98/100 2.38G 0.2796 0.2191 0.8276 9 640: 100% [██████] 10/10 [00:05<00:00, 1.96it/s]
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ Class Images Instances Box(P R mAP50 mAP50-95): 100% [██████] 1/1 [00:00<00:00, 3.34it
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ all 20 20 0.997 1 0.995 0.962
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ 99/100 2.37G 0.2753 0.2198 0.8061 9 640: 100% [██████] 10/10 [00:05<00:00, 1.99it/s]
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ Class Images Instances Box(P R mAP50 mAP50-95): 100% [██████] 1/1 [00:00<00:00, 3.20it
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ all 20 20 0.997 1 0.995 0.948
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ 100/100 2.38G 0.2593 0.2153 0.8236 9 640: 100% [██████] 10/10 [00:05<00:00, 1.96it/s]
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ Class Images Instances Box(P R mAP50 mAP50-95): 100% [██████] 1/1 [00:00<00:00, 3.45it
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ all 20 20 0.997 1 0.995 0.955
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ 100 epochs completed in 0.182 hours.
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ Optimizer stripped from runs/detect/train/weights/last.pt, 5.5MB
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ Optimizer stripped from runs/detect/train/weights/best.pt, 5.5MB
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ Validating runs/detect/train/weights/best.pt...
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ Ultralytics 8.3.56 🚀 Python-3.10.12 torch-2.5.0a0+872d972e41.nv24.08 CUDA:0 (Orin, 7620MiB)
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ YOLOv1n summary (fused): 238 layers, 2,582,347 parameters, 0 gradients, 6.3 GFLOPs
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ Class Images Instances Box(P R mAP50 mAP50-95): 100% [██████] 1/1 [00:00<00:00, 2.46it
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ all 20 20 0.997 1 0.995 0.962
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ Speed: 0.8ms preprocess, 9.8ms inference, 0.0ms loss, 1.8ms postprocess per image
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ Results saved to runs/detect/train
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ Learn more at https://docs.ultralytics.com/modes/train
jetson@yahboom: ~/ultralytics/ultralytics/data/yahboom_data/orange_data$ 

```

2. Model Conversion

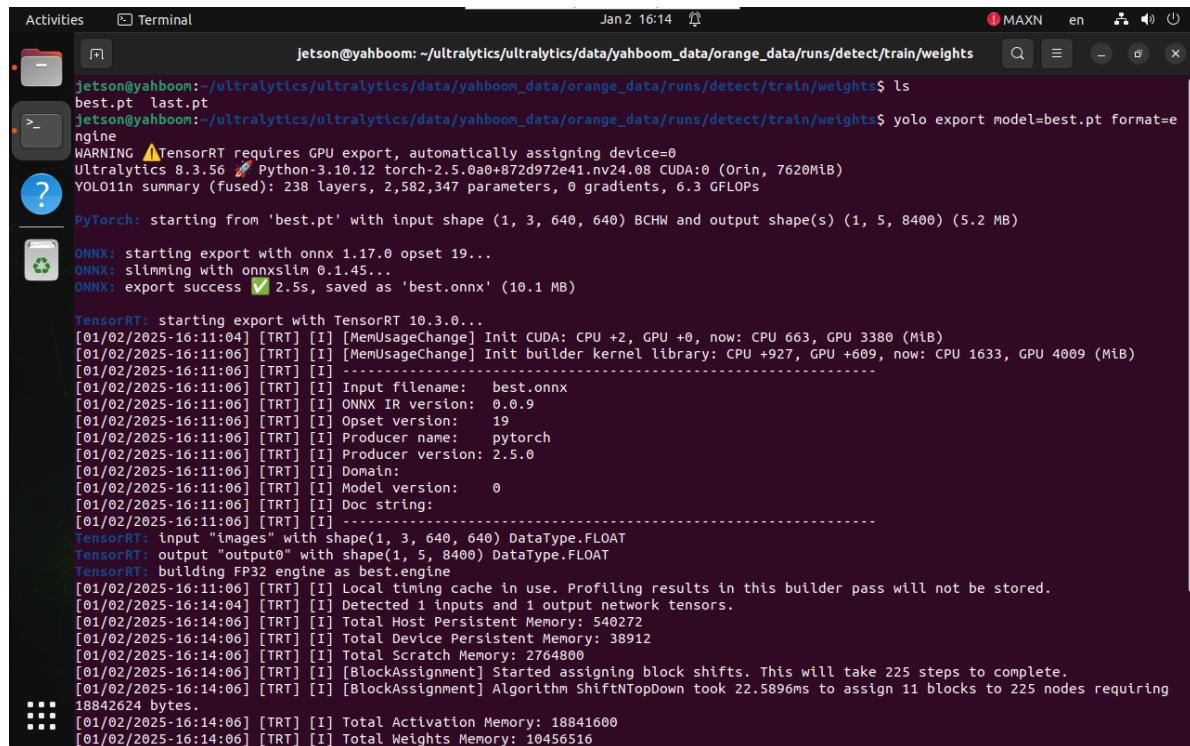
The final model will be generated in the runs folder: Generally select the best.pt file for use

```
/home/jetson/ultralytics/ultralytics/data/yahboom_data/orange_data/runs/detect/train/weights
```

Convert PyTorch format model to TensorRT:

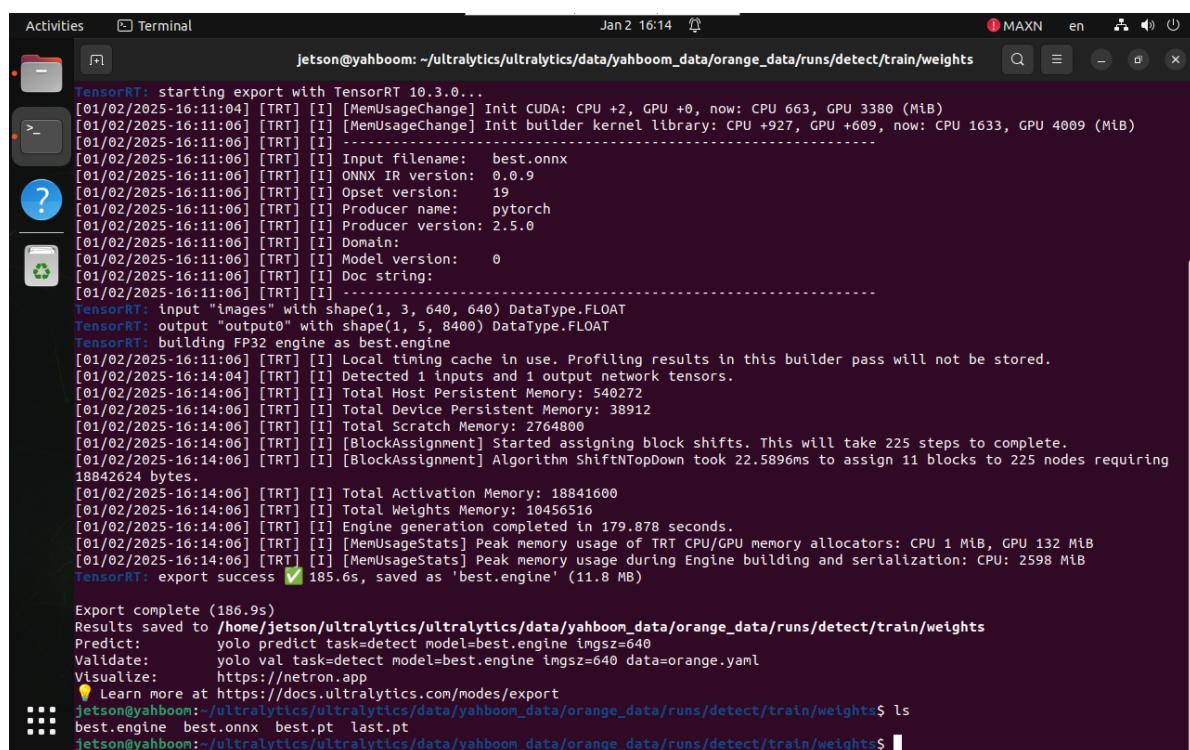
```
cd
/home/jetson/ultralytics/ultralytics/data/yahboom_data/orange_data/runs/detect/train/weights
```

```
yolo export model=best.pt format=engine
```



```
jetson@yahboom:~/ultralytics/ultralytics/data/yahboom_data/orange_data/runs/detect/train/weights$ ls best.pt last.pt
jetson@yahboom:~/ultralytics/ultralytics/data/yahboom_data/orange_data/runs/detect/train/weights$ yolo export model=best.pt format=engine
WARNING TensorRT requires GPU export, automatically assigning device=0
Ultralytics 8.3.56 Python-3.10.6 torch-2.5.0a0+872d972e41.nv24.08 CUDA:0 (Orin, 7620MiB)
YOLOin summary (fused): 238 layers, 2,582,347 parameters, 0 gradients, 6.3 GFLOPs
PyTorch: starting from 'best.pt' with input shape (1, 3, 640, 640) BCHW and output shape(s) (1, 5, 8400) (5.2 MB)
ONNX: starting export with onnx 1.17.0 opset 19...
ONNX: slimming with onnxslim 0.1.45...
ONNX: export success ✓ 2.5s, saved as 'best.onnx' (10.1 MB)

TensorRT: starting export with TensorRT 10.3.0...
[01/02/2025-16:11:04] [TRT] [I] [MemUsageChange] Init CUDA: CPU +2, GPU +0, now: CPU 663, GPU 3380 (MiB)
[01/02/2025-16:11:06] [TRT] [I] [MemUsageChange] Init builder kernel library: CPU +927, GPU +609, now: CPU 1633, GPU 4009 (MiB)
[01/02/2025-16:11:06] [TRT] [I] -----
[01/02/2025-16:11:06] [TRT] [I] Input filename: best.onnx
[01/02/2025-16:11:06] [TRT] [I] ONNX IR version: 0.0.9
[01/02/2025-16:11:06] [TRT] [I] Opset version: 19
[01/02/2025-16:11:06] [TRT] [I] Producer name: pytorch
[01/02/2025-16:11:06] [TRT] [I] Producer version: 2.5.0
[01/02/2025-16:11:06] [TRT] [I] Domain:
[01/02/2025-16:11:06] [TRT] [I] Model version: 0
[01/02/2025-16:11:06] [TRT] [I] Doc string:
[01/02/2025-16:11:06] [TRT] [I] -----
TensorRT input "images" with shape(1, 3, 640, 640) DataType.FLOAT
TensorRT output "output0" with shape(1, 5, 8400) DataType.FLOAT
TensorRT: building FP32 engine as best.engine
[01/02/2025-16:11:06] [TRT] [I] Local timing cache in use. Profiling results in this builder pass will not be stored.
[01/02/2025-16:14:04] [TRT] [I] Detected 1 inputs and 1 output network tensors.
[01/02/2025-16:14:06] [TRT] [I] Total Host Persistent Memory: 540272
[01/02/2025-16:14:06] [TRT] [I] Total Device Persistent Memory: 38912
[01/02/2025-16:14:06] [TRT] [I] Total Scratch Memory: 2764800
[01/02/2025-16:14:06] [TRT] [I] [BlockAssignment] Started assigning block shifts. This will take 225 steps to complete.
[01/02/2025-16:14:06] [TRT] [I] [BlockAssignment] Algorithm ShiftNTopDown took 22.5896ms to assign 11 blocks to 225 nodes requiring 18842624 bytes.
[01/02/2025-16:14:06] [TRT] [I] Total Activation Memory: 18841600
[01/02/2025-16:14:06] [TRT] [I] Total Weights Memory: 10456516
```



```
jetson@yahboom:~/ultralytics/ultralytics/data/yahboom_data/orange_data/runs/detect/train/weights$ ls best.onnx best.engine best.pt last.pt
jetson@yahboom:~/ultralytics/ultralytics/data/yahboom_data/orange_data/runs/detect/train/weights$ yolo export model=best.pt format=engine
TensorRT: starting export with TensorRT 10.3.0...
[01/02/2025-16:11:04] [TRT] [I] [MemUsageChange] Init CUDA: CPU +2, GPU +0, now: CPU 663, GPU 3380 (MiB)
[01/02/2025-16:11:06] [TRT] [I] [MemUsageChange] Init builder kernel library: CPU +927, GPU +609, now: CPU 1633, GPU 4009 (MiB)
[01/02/2025-16:11:06] [TRT] [I] -----
[01/02/2025-16:11:06] [TRT] [I] Input filename: best.onnx
[01/02/2025-16:11:06] [TRT] [I] ONNX IR version: 0.0.9
[01/02/2025-16:11:06] [TRT] [I] Opset version: 19
[01/02/2025-16:11:06] [TRT] [I] Producer name: pytorch
[01/02/2025-16:11:06] [TRT] [I] Producer version: 2.5.0
[01/02/2025-16:11:06] [TRT] [I] Domain:
[01/02/2025-16:11:06] [TRT] [I] Model version: 0
[01/02/2025-16:11:06] [TRT] [I] Doc string:
[01/02/2025-16:11:06] [TRT] [I] -----
TensorRT input "images" with shape(1, 3, 640, 640) DataType.FLOAT
TensorRT output "output0" with shape(1, 5, 8400) DataType.FLOAT
TensorRT: building FP32 engine as best.engine
[01/02/2025-16:11:06] [TRT] [I] Local timing cache in use. Profiling results in this builder pass will not be stored.
[01/02/2025-16:14:04] [TRT] [I] Detected 1 inputs and 1 output network tensors.
[01/02/2025-16:14:06] [TRT] [I] Total Host Persistent Memory: 540272
[01/02/2025-16:14:06] [TRT] [I] Total Device Persistent Memory: 38912
[01/02/2025-16:14:06] [TRT] [I] Total Scratch Memory: 2764800
[01/02/2025-16:14:06] [TRT] [I] [BlockAssignment] Started assigning block shifts. This will take 225 steps to complete.
[01/02/2025-16:14:06] [TRT] [I] [BlockAssignment] Algorithm ShiftNTopDown took 22.5896ms to assign 11 blocks to 225 nodes requiring 18842624 bytes.
[01/02/2025-16:14:06] [TRT] [I] Total Activation Memory: 18841600
[01/02/2025-16:14:06] [TRT] [I] Total Weights Memory: 10456516
[01/02/2025-16:14:06] [TRT] [I] Engine generation completed in 179.878 seconds.
[01/02/2025-16:14:06] [TRT] [I] [MemUsageStats] Peak memory usage of TRT CPU/GPU memory allocators: CPU 1 MiB, GPU 132 MiB
[01/02/2025-16:14:06] [TRT] [I] [MemUsageStats] Peak memory usage during Engine building and serialization: CPU: 2598 MiB
TensorRT: export success ✓ 185.6s, saved as 'best.engine' (11.8 MB)

Export complete (186.9s)
Results saved to /home/jetson/ultralytics/ultralytics/data/yahboom_data/orange_data/runs/detect/train/weights
Predict: yolo predict task=detect model=best.engine imgs=640
Validate: yolo val task=detect model=best.engine imgs=640 data=orange.yaml
Visualize: https://netron.app
💡 Learn more at https://docs.ultralytics.com/modes/export
jetson@yahboom:~/ultralytics/ultralytics/data/yahboom_data/orange_data/runs/detect/train/weights$ ls best.engine best.onnx best.pt last.pt
jetson@yahboom:~/ultralytics/ultralytics/data/yahboom_data/orange_data/runs/detect/train/weights$
```

References

<https://docs.ultralytics.com/modes/train/>