In [ ]:
```
from ultralytics import YOLO
from PIL import Image
```

```
Copying files: 3008 files [03:41, 13.55 files/s]
```

In [ ]:
```
# Load a pretrained YOLO model (recommended for training)
model = YOLO('yolov8n.pt')
```

In [ ]:
```
# Train the model using the 'coco128.yaml' dataset for 3 epochs
results = model.train(data='coco128.yaml', epochs=3)
```

```
Ultralytics YOLOv8.1.47  Python-3.10.11 torch-2.2.2+cpu CPU (AMD Ryzen 5 3600 6-Core
Processor)
engine\trainer: task=detect, mode=train, model=yolov8n.pt, data=coco128.yaml, epochs
=3, time=None, patience=100, batch=16, imgsz=640, save=True, save_period=-1, cache=F
alse, device=None, workers=8, project=None, name=train, exist_ok=False, pretrained=T
rue, optimizer=auto, verbose=True, seed=0, deterministic=True, single_cls=False, rec
t=False, cos_lr=False, close_mosaic=10, resume=False, amp=True, fraction=1.0, profil
e=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_mas
ks=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=Non
e, format=torchscript, keras=False, optimize=False, int8=False, dynamic=False, simpl
ify=False, opset=None, workspace=4, nms=False, lr0=0.01, lrf=0.01, momentum=0.937, w
eight_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, 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, perspectiv
e=0.0, flipud=0.0, fliplr=0.5, bgr=0.0, mosaic=1.0, mixup=0.0, copy_paste=0.0, auto_
augment=randaugment, erasing=0.4, crop_fraction=1.0, cfg=None, tracker=botsort.yaml,
save_dir=runs\detect\train

Dataset 'coco128.yaml' images not found , missing path 'C:\Users\Shawn\Documents\mas
ters_spring_2024\deeplearning\datasets\coco128\images\train2017'
Downloading https://ultralytics.com/assets/coco128.zip to 'C:\Users\Shawn\Documents
\masters_spring_2024\deeplearning\datasets\coco128.zip'...
100%|██████████| 6.66M/6.66M [00:00<00:00, 23.0MB/s]
Unzipping C:\Users\Shawn\Documents\masters_spring_2024\deeplearning\datasets\coco12
8.zip to C:\Users\Shawn\Documents\masters_spring_2024\deeplearning\datasets\coco12
8...: 100%|██████████| 263/263 [00:00<00:00, 1764.72file/s]
Dataset download success  (1.9s), saved to C:\Users\Shawn\Documents\masters_spring_2
024\deeplearning\datasets

Downloading https://ultralytics.com/assets/Arial.ttf to 'C:\Users\Shawn\AppData\Roam
ing\Ultralytics\Arial.ttf'...
100%|██████████| 755k/755k [00:00<00:00, 8.67MB/s]
                   from  n    params  module                                       a
rguments
  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    897664  ultralytics.nn.modules.head.Detect
[80, [64, 128, 256]]
Model summary: 225 layers, 3157200 parameters, 3157184 gradients, 8.9 GFLOPs

Transferred 355/355 items from pretrained weights
Freezing layer 'model.22.dfl.conv.weight'
train: Scanning C:\Users\Shawn\Documents\masters_spring_2024\deeplearning\datasets\c
oco128\labels\train2017... 126 images, 2 backgrounds, 0 corrupt: 100%|████████| 12
8/128 [00:00<00:00, 503.82it/s]
train: New cache created: C:\Users\Shawn\Documents\masters_spring_2024\deeplearning
\datasets\coco128\labels\train2017.cache
val: Scanning C:\Users\Shawn\Documents\masters_spring_2024\deeplearning\datasets\coc
o128\labels\train2017.cache... 126 images, 2 backgrounds, 0 corrupt: 100%|
████████| 128/128 [00:00<?, ?it/s]
```

```
Plotting labels to runs\detect\train\labels.jpg...
optimizer: 'optimizer=auto' found, ignoring 'lr0=0.01' and 'momentum=0.937' and dete
rmining best 'optimizer', 'lr0' and 'momentum' automatically...
optimizer: AdamW(lr=0.000119, momentum=0.9) with parameter groups 57 weight(decay=0.
0), 64 weight(decay=0.0005), 63 bias(decay=0.0)
Image sizes 640 train, 640 val
Using 0 dataloader workers
Logging results to runs\detect\train
Starting training for 3 epochs...

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
        1/3         0G      1.135      1.433      1.236        278        640: 100%|
████████| 8/8 [00:40<00:00,  5.11s/it]
                 Class     Images  Instances      Box(P          R      mAP50  mAP5
0-95): 100%|████████| 4/4 [00:16<00:00,  4.17s/it]
                   all        128        929      0.657      0.534      0.615
0.457
      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
        2/3         0G      1.111      1.346      1.238        167        640: 100%|
████████| 8/8 [00:39<00:00,  4.95s/it]
                 Class     Images  Instances      Box(P          R      mAP50  mAP5
0-95): 100%|████████| 4/4 [00:15<00:00,  3.81s/it]
                   all        128        929      0.681      0.541      0.625
0.465
      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
        3/3         0G      1.199      1.409      1.239        239        640: 100%|
████████| 8/8 [00:39<00:00,  4.89s/it]
                 Class     Images  Instances      Box(P          R      mAP50  mAP5
0-95): 100%|████████| 4/4 [00:15<00:00,  3.82s/it]
                   all        128        929      0.656      0.554      0.631
0.471
3 epochs completed in 0.047 hours.
Optimizer stripped from runs\detect\train\weights\last.pt, 6.5MB
Optimizer stripped from runs\detect\train\weights\best.pt, 6.5MB

Validating runs\detect\train\weights\best.pt...
Ultralytics YOLOv8.1.47  Python-3.10.11 torch-2.2.2+cpu CPU (AMD Ryzen 5 3600 6-Core
Processor)
Model summary (fused): 168 layers, 3151904 parameters, 0 gradients, 8.7 GFLOPs
                 Class     Images  Instances      Box(P          R      mAP50  mAP5
0-95): 100%|████████| 4/4 [00:10<00:00,  2.75s/it]
```

all	128	929	0.657	0.554	0.631	0.471
person	128	254	0.805	0.684	0.768	0.545
bicycle	128	6	0.515	0.333	0.327	0.282
car	128	46	0.803	0.217	0.282	0.174
motorcycle	128	5	0.683	0.869	0.898	0.675
airplane	128	6	0.83	0.818	0.927	0.708
bus	128	7	0.718	0.714	0.73	0.641
train	128	3	0.564	0.667	0.775	0.687
truck	128	12	1	0.456	0.522	0.329
boat	128	6	0.279	0.167	0.433	0.264
traffic light	128	14	0.659	0.214	0.204	0.139
stop sign	128	2	0.98	1	0.995	0.711
bench	128	9	0.841	0.591	0.633	0.381
bird	128	16	0.924	0.762	0.891	0.538
cat	128	4	0.868	1	0.995	0.835
dog	128	9	0.648	0.889	0.852	0.599
horse	128	2	0.595	1	0.995	0.464
elephant	128	17	0.839	0.765	0.908	0.676
bear	128	1	0.617	1	0.995	0.995
zebra	128	4	0.853	1	0.995	0.965
giraffe	128	9	0.834	1	0.962	0.723
backpack	128	6	0.605	0.333	0.382	0.235
umbrella	128	18	0.748	0.494	0.633	0.425
handbag	128	19	0.569	0.0744	0.185	0.0976
tie	128	7	0.799	0.714	0.677	0.455
suitcase	128	4	0.639	1	0.828	0.622
frisbee	128	5	0.609	0.8	0.76	0.688
skis	128	1	0.625	1	0.995	0.497

snowboard	128	7	0.703	0.714	0.764	0.506
sports ball	128	6	0.588	0.333	0.477	0.269
kite	128	10	0.816	0.5	0.588	0.215
baseball bat	128	4	0.408	0.362	0.373	0.187
baseball glove	128	7	0.656	0.429	0.43	0.295
skateboard	128	5	0.759	0.6	0.599	0.446
tennis racket	128	7	0.741	0.414	0.502	0.342
bottle	128	18	0.501	0.389	0.355	0.21
wine glass	128	16	0.575	0.562	0.558	0.329
cup	128	36	0.615	0.267	0.399	0.283
fork	128	6	0.582	0.167	0.296	0.206
knife	128	16	0.635	0.544	0.603	0.364
spoon	128	22	0.613	0.227	0.34	0.186
bowl	128	28	0.652	0.679	0.642	0.535
banana	128	1	0	0	0.142	0.042
sandwich	128	2	0.383	0.5	0.662	0.662
orange	128	4	1	0.357	0.995	0.666
broccoli	128	11	0.418	0.198	0.271	0.222
carrot	128	24	0.685	0.543	0.692	0.448
hot dog	128	2	0.652	0.956	0.828	0.796
pizza	128	5	0.792	1	0.995	0.844
donut	128	14	0.645	1	0.917	0.83
cake	128	4	0.735	1	0.995	0.88
chair	128	35	0.479	0.486	0.466	0.266
couch	128	6	0.404	0.333	0.641	0.49
potted plant	128	14	0.69	0.643	0.729	0.5
bed	128	3	0.76	0.667	0.83	0.689
dining table	128	13	0.46	0.615	0.496	0.395

```
                toilet        128          2      0.623        0.5      0.828
0.796
                    tv        128          2      0.408        0.5      0.695
0.656
                laptop        128          3          1      0.341      0.764
0.602
                 mouse        128          2          1          0     0.0483    0.0
0483
                remote        128          8      0.838        0.5      0.581
0.505
            cell phone        128          8          0          0     0.0578     0.
0361
             microwave        128          3      0.486      0.667       0.83
0.733
                  oven        128          5      0.462        0.4      0.343
0.273
                  sink        128          6      0.359      0.167      0.231
0.147
          refrigerator        128          5      0.691        0.4      0.648
0.525
                  book        128         29      0.642      0.125      0.376
0.189
                 clock        128          9      0.811      0.778      0.895
0.74
                  vase        128          2      0.365          1      0.828
0.795
              scissors        128          1          1          0      0.249     0.
0802
            teddy bear        128         21      0.887      0.375      0.624
0.43
            toothbrush        128          5       0.71      0.503      0.702
0.442
Speed: 1.8ms preprocess, 73.2ms inference, 0.0ms loss, 2.2ms postprocess per image
Results saved to runs\detect\train
```

In [ ]:
```
# Evaluate the model's performance on the validation set
results = model.val()
```

```
Ultralytics YOLOv8.1.47  Python-3.10.11 torch-2.2.2+cpu CPU (AMD Ryzen 5 3600 6-Core
Processor)
Model summary (fused): 168 layers, 3151904 parameters, 0 gradients, 8.7 GFLOPs
val: Scanning C:\Users\Shawn\Documents\masters_spring_2024\deeplearning\datasets\coc
o128\labels\train2017.cache... 126 images, 2 backgrounds, 0 corrupt: 100%|
████████| 128/128 [00:00<?, ?it/s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP5
0-95): 100%|████████| 8/8 [00:09<00:00,  1.22s/it]
```

all	128	929	0.656	0.561	0.629	0.467
person	128	254	0.805	0.682	0.769	0.545
bicycle	128	6	0.509	0.333	0.323	0.28
car	128	46	0.799	0.217	0.282	0.174
motorcycle	128	5	0.684	0.872	0.898	0.675
airplane	128	6	0.83	0.819	0.927	0.708
bus	128	7	0.634	0.714	0.729	0.64
train	128	3	0.564	0.667	0.789	0.698
truck	128	12	0.92	0.417	0.503	0.288
boat	128	6	0.315	0.239	0.394	0.234
traffic light	128	14	0.688	0.214	0.205	0.14
stop sign	128	2	0.975	1	0.995	0.713
bench	128	9	0.843	0.6	0.633	0.381
bird	128	16	0.924	0.763	0.89	0.536
cat	128	4	0.864	1	0.995	0.835
dog	128	9	0.647	0.889	0.852	0.6
horse	128	2	0.592	1	0.995	0.464
elephant	128	17	0.836	0.765	0.908	0.676
bear	128	1	0.616	1	0.995	0.995
zebra	128	4	0.853	1	0.995	0.965
giraffe	128	9	0.739	1	0.975	0.759
backpack	128	6	0.615	0.333	0.381	0.232
umbrella	128	18	0.748	0.496	0.629	0.423
handbag	128	19	0.575	0.0765	0.183	0.0968
tie	128	7	0.798	0.714	0.677	0.454
suitcase	128	4	0.635	1	0.828	0.622
frisbee	128	5	0.607	0.8	0.759	0.688
skis	128	1	0.618	1	0.995	0.497

```
            snowboard        128          7      0.701      0.714      0.757
0.506
          sports ball        128          6      0.587      0.333      0.464
0.263
                 kite        128         10      0.812        0.5      0.589
0.216
         baseball bat        128          4      0.407       0.25      0.348
0.199
       baseball glove        128          7      0.642      0.429       0.43
0.316
           skateboard        128          5      0.823        0.6      0.599
0.426
        tennis racket        128          7      0.742      0.415      0.502
0.327
               bottle        128         18       0.47      0.389      0.379
0.225
           wine glass        128         16      0.587      0.562      0.531
0.32
                  cup        128         36      0.606        0.3      0.419
0.292
                 fork        128          6       0.57      0.167      0.238
0.184
                knife        128         16      0.557      0.551      0.588
0.358
                spoon        128         22      0.585      0.182      0.341
0.193
                 bowl        128         28      0.662      0.679      0.663
0.507
               banana        128          1          0          0     0.0995     0.
0379
             sandwich        128          2       0.31        0.5      0.414
0.414
               orange        128          4          1       0.36      0.995
0.666
             broccoli        128         11      0.351      0.182      0.262
0.21
               carrot        128         24      0.703      0.625      0.686
0.441
              hot dog        128          2      0.642      0.925      0.828
0.796
                pizza        128          5      0.875          1      0.995
0.843
                donut        128         14      0.645          1      0.913
0.831
                 cake        128          4      0.634          1      0.995
0.88
                chair        128         35      0.475      0.486      0.463
0.257
                couch        128          6       0.51        0.5      0.738
0.579
        potted plant        128         14      0.677      0.643      0.729
0.501
                  bed        128          3          1      0.924      0.995
0.707
        dining table        128         13      0.522      0.615      0.488
0.389
```

```
                toilet        128          2      0.621        0.5      0.828
0.796
                    tv        128          2      0.407        0.5      0.695
0.656
                laptop        128          3          1      0.344      0.708
0.566
                 mouse        128          2          1          0     0.0694    0.0
0694
                remote        128          8      0.837        0.5      0.608
0.522
            cell phone        128          8          0          0     0.0578     0.
0361
             microwave        128          3      0.484      0.667       0.83
0.733
                  oven        128          5      0.432        0.4      0.343
0.273
                  sink        128          6      0.371      0.167      0.183
0.129
          refrigerator        128          5       0.69        0.4      0.648
0.515
                  book        128         29      0.657      0.133      0.378
0.196
                 clock        128          9      0.808      0.778      0.895
0.74
                  vase        128          2      0.363          1      0.828
0.795
              scissors        128          1          1          0      0.249     0.
0799
            teddy bear        128         21      0.887      0.376      0.622
0.428
            toothbrush        128          5      0.665        0.6      0.743
0.469
Speed: 1.2ms preprocess, 64.3ms inference, 0.0ms loss, 2.2ms postprocess per image
Results saved to runs\detect\train2
```

In [ ]:
```
im1 = Image.open('datasets\caltech256\258.screws\manipulated_front000.png')
results = model.predict(source=im1, save=True)  # save plotted images
```

```
0: 640x640 1 airplane, 90.0ms
Speed: 3.0ms preprocess, 90.0ms inference, 1.0ms postprocess per image at shape (1,
3, 640, 640)
Results saved to runs\detect\train3
```

In [ ]:
```
import splitfolders

# Path to the Caltech 256 dataset
caltech256_dataset_path = "datasets/caltech256"

# Output paths for training and testing datasets
output_path = "datasets/caltech256"

# Split the dataset into training and testing sets (80% train, 20% test)
splitfolders.ratio(caltech256_dataset_path, output=output_path, seed=42, ratio=(0.8
```

```
Copying files: 0 files [00:00, ? files/s]
Copying files: 31463 files [00:30, 1023.76 files/s]
```

In [ ]:
```
# Load a model
model_2 = YOLO('yolov8n-cls.pt')  # load a pretrained model_2 (recommended for trai

# Train the model_2
results = model_2.train(data='caltech256', epochs=3, imgsz=416)
```

```
Ultralytics YOLOv8.1.47  Python-3.10.11 torch-2.2.2+cpu CPU (AMD Ryzen 5 3600 6-Core
Processor)
engine\trainer: task=classify, mode=train, model=yolov8n-cls.pt, data=caltech256, ep
ochs=3, time=None, patience=100, batch=16, imgsz=416, save=True, save_period=-1, cac
he=False, device=None, workers=8, project=None, name=train7, exist_ok=False, pretrai
ned=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, p
rofile=False, freeze=None, multi_scale=False, overlap_mask=True, mask_ratio=4, dropo
ut=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_bu
ffer=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=F
alse, 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, s
implify=False, opset=None, workspace=4, nms=False, lr0=0.01, lrf=0.01, momentum=0.93
7, 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, 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, perspe
ctive=0.0, flipud=0.0, fliplr=0.5, bgr=0.0, mosaic=1.0, mixup=0.0, copy_paste=0.0, a
uto_augment=randaugment, erasing=0.4, crop_fraction=1.0, cfg=None, tracker=botsort.y
aml, save_dir=runs\classify\train7
train: C:\Users\Shawn\Documents\masters_spring_2024\deeplearning\datasets\caltech256
\train... found 25069 images in 259 classes
val: C:\Users\Shawn\Documents\masters_spring_2024\deeplearning\datasets\caltech256\v
al... found 6393 images in 259 classes
test: None...
Overriding model.yaml nc=1000 with nc=259

                   from  n    params  module                                       a
rguments
  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    662019  ultralytics.nn.modules.head.Classify
[256, 259]
YOLOv8n-cls summary: 99 layers, 1770067 parameters, 1770067 gradients, 3.6 GFLOPs
Transferred 156/158 items from pretrained weights

train: Scanning C:\Users\Shawn\Documents\masters_spring_2024\deeplearning\datasets\c
altech256\train... 25069 images, 0 corrupt: 100%|████████| 25069/25069 [00:55<00:0
0, 451.75it/s]
```

```
train: WARNING  C:\Users\Shawn\Documents\masters_spring_2024\deeplearning\datasets\caltech256\train\259.solar_panels\Clean (13).jpg: corrupt JPEG restored and saved
train: WARNING  C:\Users\Shawn\Documents\masters_spring_2024\deeplearning\datasets\caltech256\train\259.solar_panels\Dust (17).jpg: corrupt JPEG restored and saved
train: WARNING  C:\Users\Shawn\Documents\masters_spring_2024\deeplearning\datasets\caltech256\train\259.solar_panels\Electrical (41).jpg: corrupt JPEG restored and saved
train: WARNING  C:\Users\Shawn\Documents\masters_spring_2024\deeplearning\datasets\caltech256\train\259.solar_panels\Electrical (61).jpg: corrupt JPEG restored and saved

train: New cache created: C:\Users\Shawn\Documents\masters_spring_2024\deeplearning\datasets\caltech256\train.cache

val: Scanning C:\Users\Shawn\Documents\masters_spring_2024\deeplearning\datasets\caltech256\val... 6393 images, 0 corrupt: 100%|██████████| 6393/6393 [00:10<00:00, 619.25it/s]
val: New cache created: C:\Users\Shawn\Documents\masters_spring_2024\deeplearning\datasets\caltech256\val.cache
optimizer: 'optimizer=auto' found, ignoring 'lr0=0.01' and 'momentum=0.937' and determining best 'optimizer', 'lr0' and 'momentum' automatically...
optimizer: AdamW(lr=0.000714, momentum=0.9) with parameter groups 26 weight(decay=0.0), 27 weight(decay=0.0005), 27 bias(decay=0.0)
Image sizes 416 train, 416 val
Using 0 dataloader workers
Logging results to runs\classify\train7
Starting training for 3 epochs...

      Epoch    GPU_mem       loss  Instances       Size
        1/3         0G      4.157         13        416: 100%|██████████| 1567/1567 [31:51<00:00,  1.22s/it]
               classes   top1_acc   top5_acc: 100%|██████████| 200/200 [02:34<00:00, 1.30it/s]
                   all      0.508      0.752

      Epoch    GPU_mem       loss  Instances       Size
        2/3         0G      2.113         13        416: 100%|██████████| 1567/1567 [26:54<00:00,  1.03s/it]
               classes   top1_acc   top5_acc: 100%|██████████| 200/200 [02:27<00:00, 1.36it/s]
                   all      0.653      0.863

      Epoch    GPU_mem       loss  Instances       Size
        3/3         0G      1.581         13        416: 100%|██████████| 1567/1567 [48:11<00:00,  1.84s/it]
               classes   top1_acc   top5_acc: 100%|██████████| 200/200 [02:29<00:00, 1.33it/s]
                   all      0.711      0.888

3 epochs completed in 1.908 hours.
Optimizer stripped from runs\classify\train7\weights\last.pt, 3.6MB
```

```
Optimizer stripped from runs\classify\train7\weights\best.pt, 3.6MB

Validating runs\classify\train7\weights\best.pt...
Ultralytics YOLOv8.1.47  Python-3.10.11 torch-2.2.2+cpu CPU (AMD Ryzen 5 3600 6-Core
Processor)
YOLOv8n-cls summary (fused): 73 layers, 1766659 parameters, 0 gradients, 3.6 GFLOPs
train: C:\Users\Shawn\Documents\masters_spring_2024\deeplearning\datasets\caltech256
\train... found 25069 images in 259 classes
val: C:\Users\Shawn\Documents\masters_spring_2024\deeplearning\datasets\caltech256\v
al... found 6393 images in 259 classes
test: None...
               classes   top1_acc   top5_acc: 100%|██████████| 200/200 [02:10<00:00,
1.53it/s]
                 all      0.711      0.888
Speed: 0.0ms preprocess, 14.0ms inference, 0.0ms loss, 0.0ms postprocess per image
Results saved to runs\classify\train7
Speed: 0.0ms preprocess, 14.0ms inference, 0.0ms loss, 0.0ms postprocess per image
Results saved to runs\classify\train7
Results saved to runs\classify\train7
```

In [ ]:
```
im1 = Image.open('datasets/caltech256/001.ak47/001_0001.jpg')
results = model_2.predict(source=im1, save=True)  # save plotted images
```

```
0: 416x416 001.ak47 0.92, 173.rifle 0.06, 172.revolver-101 0.02, 209.sword 0.00, 180
.screwdriver 0.00, 24.0ms
Speed: 7.0ms preprocess, 24.0ms inference, 0.0ms postprocess per image at shape (1,
3, 416, 416)
Results saved to runs\classify\train72
```

In [ ]:
```
im1 = Image.open('datasets/caltech256/val/258.screws/ok001.png')
results = model_2.predict(source=im1, save=True)  # save plotted images
```

```
0: 416x416 258.screws 1.00, 180.screwdriver 0.00, 210.syringe 0.00, 209.sword 0.00,
074.flashlight 0.00, 22.0ms
Speed: 11.0ms preprocess, 22.0ms inference, 0.0ms postprocess per image at shape (1,
3, 416, 416)
Results saved to runs\classify\train75
```

In [ ]:
```
im1 = Image.open('datasets/caltech256/val/259.solar_panels/Clean (3).jpg')
results = model_2.predict(source=im1, save=True)  # save plotted images
```

```
0: 416x416 259.solar_panels 0.96, 187.skyscraper 0.00, 198.spider 0.00, 217.tennis-c
ourt 0.00, 136.mandolin 0.00, 23.0ms
Speed: 7.0ms preprocess, 23.0ms inference, 0.0ms postprocess per image at shape (1,
3, 416, 416)
Results saved to runs\classify\train76
```

In [ ]:
```
# Export the model
model_2.export(format='onnx')
```

```
Ultralytics YOLOv8.1.47  Python-3.10.11 torch-2.2.2+cpu CPU (AMD Ryzen 5 3600 6-Core
Processor)

PyTorch: starting from 'runs\classify\train7\weights\best.pt' with input shape (1, 3
, 416, 416) BCHW and output shape(s) (1, 259) (3.5 MB)
requirements: Ultralytics requirement ['onnx>=1.12.0'] not found, attempting AutoUpd
ate...
Collecting onnx>=1.12.0
  Downloading onnx-1.16.0-cp310-cp310-win_amd64.whl.metadata (16 kB)
Requirement already satisfied: numpy>=1.20 in c:\users\shawn\appdata\local\packages
\pythonsoftwarefoundation.python.3.10_qbz5n2kfra8p0\localcache\local-packages\python
310\site-packages (from onnx>=1.12.0) (1.26.0)
Collecting protobuf>=3.20.2 (from onnx>=1.12.0)
  Downloading protobuf-5.26.1-cp310-abi3-win_amd64.whl.metadata (592 bytes)
Downloading onnx-1.16.0-cp310-cp310-win_amd64.whl (14.4 MB)
   ---------------------------------------- 14.4/14.4 MB 22.6 MB/s eta 0:00:00
Downloading protobuf-5.26.1-cp310-abi3-win_amd64.whl (420 kB)
   ---------------------------------------- 420.9/420.9 kB 25.7 MB/s eta 0:00:00
Installing collected packages: protobuf, onnx
  Attempting uninstall: protobuf
    Found existing installation: protobuf 3.19.6
    Uninstalling protobuf-3.19.6:
      Successfully uninstalled protobuf-3.19.6
Successfully installed onnx-1.16.0 protobuf-5.26.1

requirements: AutoUpdate success  18.0s, installed 1 package: ['onnx>=1.12.0']
requirements:  Restart runtime or rerun command for updates to take effect


ONNX: starting export with onnx 1.16.0 opset 17...
ONNX: export success  18.7s, saved as 'runs\classify\train7\weights\best.onnx' (6.8
MB)

Export complete (20.3s)
Results saved to C:\Users\Shawn\Documents\masters_spring_2024\deeplearning\runs\clas
sify\train7\weights
Predict:         yolo predict task=classify model=runs\classify\train7\weights\bes
t.onnx imgsz=416
Validate:        yolo val task=classify model=runs\classify\train7\weights\best.onnx
imgsz=416 data=caltech256
Visualize:       https://netron.app
```

Out[ ]: 'runs\\classify\\train7\\weights\\best.onnx'

citation

Fei-Fei, Li, Rob Fergus, and Pietro Perona. "Learning generative visual models from few training examples: An incremental Bayesian approach tested on 101 object categories." Computer vision and Image understanding 106.1 (2007): 59-70. Elsevier.