k

YOLOv8 - Hard Hat Detection Project

Neste notebook, vamos treinar um modelo YOLOv8 para detectar se uma pessoa está ou não utilizando capacete (EPI), utilizando um dataset do Roboflow.

[ ]

```
!pip install ultralytics
```

```
Collecting ultralytics
  Downloading ultralytics-8.3.161-py3-none-any.whl.metadata (37 kB)
Requirement already satisfied: numpy>=1.23.0 in /usr/local/lib/python3.11/dist-packages (from
ultralytics) (2.0.2)
Requirement already satisfied: matplotlib>=3.3.0 in /usr/local/lib/python3.11/dist-packages (from
ultralytics) (3.10.0)
Requirement already satisfied: opencv-python>=4.6.0 in /usr/local/lib/python3.11/dist-packages
(from ultralytics) (4.11.0.86)
Requirement already satisfied: pillow>=7.1.2 in /usr/local/lib/python3.11/dist-packages (from
ultralytics) (11.2.1)
Requirement already satisfied: pyyaml>=5.3.1 in /usr/local/lib/python3.11/dist-packages (from
ultralytics) (6.0.2)
Requirement already satisfied: requests>=2.23.0 in /usr/local/lib/python3.11/dist-packages (from
ultralytics) (2.32.3)
Requirement already satisfied: scipy>=1.4.1 in /usr/local/lib/python3.11/dist-packages (from
ultralytics) (1.15.3)
Requirement already satisfied: torch>=1.8.0 in /usr/local/lib/python3.11/dist-packages (from
ultralytics) (2.6.0+cu124)
Requirement already satisfied: torchvision>=0.9.0 in /usr/local/lib/python3.11/dist-packages (from
ultralytics) (0.21.0+cu124)
Requirement already satisfied: tqdm>=4.64.0 in /usr/local/lib/python3.11/dist-packages (from
ultralytics) (4.67.1)
Requirement already satisfied: psutil in /usr/local/lib/python3.11/dist-packages (from ultralytics)
(5.9.5)
Requirement already satisfied: py-cpuinfo in /usr/local/lib/python3.11/dist-packages (from ultralytics)
(9.0.0)
Requirement already satisfied: pandas>=1.1.4 in /usr/local/lib/python3.11/dist-packages (from
ultralytics) (2.2.2)
Collecting ultralytics-thop>=2.0.0 (from ultralytics)
  Downloading ultralytics_thop-2.0.14-py3-none-any.whl.metadata (9.4 kB)
Requirement already satisfied: contourpy>=1.0.1 in /usr/local/lib/python3.11/dist-packages (from
matplotlib>=3.3.0->ultralytics) (1.3.2)
Requirement already satisfied: cycler>=0.10 in /usr/local/lib/python3.11/dist-packages (from
matplotlib>=3.3.0->ultralytics) (0.12.1)
```

Requirement already satisfied: fonttools>=4.22.0 in /usr/local/lib/python3.11/dist-packages (from matplotlib>=3.3.0->ultralytics) (4.58.4)
Requirement already satisfied: kiwisolver>=1.3.1 in /usr/local/lib/python3.11/dist-packages (from matplotlib>=3.3.0->ultralytics) (1.4.8)
Requirement already satisfied: packaging>=20.0 in /usr/local/lib/python3.11/dist-packages (from matplotlib>=3.3.0->ultralytics) (24.2)
Requirement already satisfied: pyparsing>=2.3.1 in /usr/local/lib/python3.11/dist-packages (from matplotlib>=3.3.0->ultralytics) (3.2.3)
Requirement already satisfied: python-dateutil>=2.7 in /usr/local/lib/python3.11/dist-packages (from matplotlib>=3.3.0->ultralytics) (2.9.0.post0)
Requirement already satisfied: pytz>=2020.1 in /usr/local/lib/python3.11/dist-packages (from pandas>=1.1.4->ultralytics) (2025.2)
Requirement already satisfied: tzdata>=2022.7 in /usr/local/lib/python3.11/dist-packages (from pandas>=1.1.4->ultralytics) (2025.2)
Requirement already satisfied: charset-normalizer<4,>=2 in /usr/local/lib/python3.11/dist-packages (from requests>=2.23.0->ultralytics) (3.4.2)
Requirement already satisfied: idna<4,>=2.5 in /usr/local/lib/python3.11/dist-packages (from requests>=2.23.0->ultralytics) (3.10)
Requirement already satisfied: urllib3<3,>=1.21.1 in /usr/local/lib/python3.11/dist-packages (from requests>=2.23.0->ultralytics) (2.4.0)
Requirement already satisfied: certifi>=2017.4.17 in /usr/local/lib/python3.11/dist-packages (from requests>=2.23.0->ultralytics) (2025.6.15)
Requirement already satisfied: filelock in /usr/local/lib/python3.11/dist-packages (from torch>=1.8.0->ultralytics) (3.18.0)
Requirement already satisfied: typing-extensions>=4.10.0 in /usr/local/lib/python3.11/dist-packages (from torch>=1.8.0->ultralytics) (4.14.0)
Requirement already satisfied: networkx in /usr/local/lib/python3.11/dist-packages (from torch>=1.8.0->ultralytics) (3.5)
Requirement already satisfied: jinja2 in /usr/local/lib/python3.11/dist-packages (from torch>=1.8.0->ultralytics) (3.1.6)
Requirement already satisfied: fsspec in /usr/local/lib/python3.11/dist-packages (from torch>=1.8.0->ultralytics) (2025.3.2)
Collecting nvidia-cuda-nvrtc-cu12==12.4.127 (from torch>=1.8.0->ultralytics)
  Downloading nvidia_cuda_nvrtc_cu12-12.4.127-py3-none-manylinux2014_x86_64.whl.metadata (1.5 kB)
Collecting nvidia-cuda-runtime-cu12==12.4.127 (from torch>=1.8.0->ultralytics)
  Downloading nvidia_cuda_runtime_cu12-12.4.127-py3-none-manylinux2014_x86_64.whl.metadata (1.5 kB)
Collecting nvidia-cuda-cupti-cu12==12.4.127 (from torch>=1.8.0->ultralytics)
  Downloading nvidia_cuda_cupti_cu12-12.4.127-py3-none-manylinux2014_x86_64.whl.metadata (1.6 kB)
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Collecting nvidia-curand-cu12==10.3.5.147 (from torch>=1.8.0->ultralytics)
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```
Collecting nvidia-cusolver-cu12==11.6.1.9 (from torch>=1.8.0->ultralytics)
  Downloading nvidia_cusolver_cu12-11.6.1.9-py3-none-manylinux2014_x86_64.whl.metadata (1.6 kB)
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kB)
Requirement already satisfied: nvidia-cusparselt-cu12==0.6.2 in
/usr/local/lib/python3.11/dist-packages (from torch>=1.8.0->ultralytics) (0.6.2)
Requirement already satisfied: nvidia-nccl-cu12==2.21.5 in /usr/local/lib/python3.11/dist-packages
(from torch>=1.8.0->ultralytics) (2.21.5)
Requirement already satisfied: nvidia-nvtx-cu12==12.4.127 in /usr/local/lib/python3.11/dist-packages
(from torch>=1.8.0->ultralytics) (12.4.127)
Collecting nvidia-nvjitlink-cu12==12.4.127 (from torch>=1.8.0->ultralytics)
  Downloading nvidia_nvjitlink_cu12-12.4.127-py3-none-manylinux2014_x86_64.whl.metadata (1.5 kB)
Requirement already satisfied: triton==3.2.0 in /usr/local/lib/python3.11/dist-packages (from
torch>=1.8.0->ultralytics) (3.2.0)
Requirement already satisfied: sympy==1.13.1 in /usr/local/lib/python3.11/dist-packages (from
torch>=1.8.0->ultralytics) (1.13.1)
Requirement already satisfied: mpmath<1.4,>=1.1.0 in /usr/local/lib/python3.11/dist-packages (from
sympy==1.13.1->torch>=1.8.0->ultralytics) (1.3.0)
Requirement already satisfied: six>=1.5 in /usr/local/lib/python3.11/dist-packages (from
python-dateutil>=2.7->matplotlib>=3.3.0->ultralytics) (1.17.0)
Requirement already satisfied: MarkupSafe>=2.0 in /usr/local/lib/python3.11/dist-packages (from
jinja2->torch>=1.8.0->ultralytics) (3.0.2)
Downloading ultralytics-8.3.161-py3-none-any.whl (1.0 MB)
   ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 1.0/1.0 MB
29.2 MB/s eta 0:00:00
Downloading nvidia_cublas_cu12-12.4.5.8-py3-none-manylinux2014_x86_64.whl (363.4 MB)
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363.4/363.4 MB 4.4 MB/s eta 0:00:00
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MB 128.0 MB/s eta 0:00:00
Downloading nvidia_cuda_nvrtc_cu12-12.4.127-py3-none-manylinux2014_x86_64.whl (24.6 MB)
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883.7/883.7 kB 54.4 MB/s eta 0:00:00
Downloading nvidia_cudnn_cu12-9.1.0.70-py3-none-manylinux2014_x86_64.whl (664.8 MB)
   ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━
664.8/664.8 MB 2.2 MB/s eta 0:00:00
Downloading nvidia_cufft_cu12-11.2.1.3-py3-none-manylinux2014_x86_64.whl (211.5 MB)
   ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━
211.5/211.5 MB 5.5 MB/s eta 0:00:00
Downloading nvidia_curand_cu12-10.3.5.147-py3-none-manylinux2014_x86_64.whl (56.3 MB)
   ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 56.3/56.3
MB 16.7 MB/s eta 0:00:00
Downloading nvidia_cusolver_cu12-11.6.1.9-py3-none-manylinux2014_x86_64.whl (127.9 MB)
   ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━
127.9/127.9 MB 7.3 MB/s eta 0:00:00
```

```
Downloading nvidia_cusparse_cu12-12.3.1.170-py3-none-manylinux2014_x86_64.whl (207.5 MB)
   ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━
207.5/207.5 MB 5.5 MB/s eta 0:00:00
Downloading nvidia_nvjitlink_cu12-12.4.127-py3-none-manylinux2014_x86_64.whl (21.1 MB)
   ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 21.1/21.1
MB 106.9 MB/s eta 0:00:00
Downloading ultralytics_thop-2.0.14-py3-none-any.whl (26 kB)
Installing collected packages: nvidia-nvjitlink-cu12, nvidia-curand-cu12, nvidia-cufft-cu12,
nvidia-cuda-runtime-cu12, nvidia-cuda-nvrtc-cu12, nvidia-cuda-cupti-cu12, nvidia-cublas-cu12,
nvidia-cusparse-cu12, nvidia-cudnn-cu12, nvidia-cusolver-cu12, ultralytics-thop, ultralytics
  Attempting uninstall: nvidia-nvjitlink-cu12
    Found existing installation: nvidia-nvjitlink-cu12 12.5.82
    Uninstalling nvidia-nvjitlink-cu12-12.5.82:
      Successfully uninstalled nvidia-nvjitlink-cu12-12.5.82
  Attempting uninstall: nvidia-curand-cu12
    Found existing installation: nvidia-curand-cu12 10.3.6.82
    Uninstalling nvidia-curand-cu12-10.3.6.82:
      Successfully uninstalled nvidia-curand-cu12-10.3.6.82
  Attempting uninstall: nvidia-cufft-cu12
    Found existing installation: nvidia-cufft-cu12 11.2.3.61
    Uninstalling nvidia-cufft-cu12-11.2.3.61:
      Successfully uninstalled nvidia-cufft-cu12-11.2.3.61
  Attempting uninstall: nvidia-cuda-runtime-cu12
    Found existing installation: nvidia-cuda-runtime-cu12 12.5.82
    Uninstalling nvidia-cuda-runtime-cu12-12.5.82:
      Successfully uninstalled nvidia-cuda-runtime-cu12-12.5.82
  Attempting uninstall: nvidia-cuda-nvrtc-cu12
    Found existing installation: nvidia-cuda-nvrtc-cu12 12.5.82
    Uninstalling nvidia-cuda-nvrtc-cu12-12.5.82:
      Successfully uninstalled nvidia-cuda-nvrtc-cu12-12.5.82
  Attempting uninstall: nvidia-cuda-cupti-cu12
    Found existing installation: nvidia-cuda-cupti-cu12 12.5.82
    Uninstalling nvidia-cuda-cupti-cu12-12.5.82:
      Successfully uninstalled nvidia-cuda-cupti-cu12-12.5.82
  Attempting uninstall: nvidia-cublas-cu12
    Found existing installation: nvidia-cublas-cu12 12.5.3.2
    Uninstalling nvidia-cublas-cu12-12.5.3.2:
      Successfully uninstalled nvidia-cublas-cu12-12.5.3.2
  Attempting uninstall: nvidia-cusparse-cu12
    Found existing installation: nvidia-cusparse-cu12 12.5.1.3
    Uninstalling nvidia-cusparse-cu12-12.5.1.3:
      Successfully uninstalled nvidia-cusparse-cu12-12.5.1.3
  Attempting uninstall: nvidia-cudnn-cu12
    Found existing installation: nvidia-cudnn-cu12 9.3.0.75
    Uninstalling nvidia-cudnn-cu12-9.3.0.75:
      Successfully uninstalled nvidia-cudnn-cu12-9.3.0.75
  Attempting uninstall: nvidia-cusolver-cu12
    Found existing installation: nvidia-cusolver-cu12 11.6.3.83
    Uninstalling nvidia-cusolver-cu12-11.6.3.83:
      Successfully uninstalled nvidia-cusolver-cu12-11.6.3.83
```

Successfully installed nvidia-cublas-cu12-12.4.5.8 nvidia-cuda-cupti-cu12-12.4.127 nvidia-cuda-nvrtc-cu12-12.4.127 nvidia-cuda-runtime-cu12-12.4.127 nvidia-cudnn-cu12-9.1.0.70 nvidia-cufft-cu12-11.2.1.3 nvidia-curand-cu12-10.3.5.147 nvidia-cusolver-cu12-11.6.1.9 nvidia-cusparse-cu12-12.3.1.170 nvidia-nvjitlink-cu12-12.4.127 ultralytics-8.3.161 ultralytics-thop-2.0.14

[ ]

```
from ultralytics import YOLO

import matplotlib.pyplot as plt

import cv2

import numpy as np

import os
```

Creating new Ultralytics Settings v0.0.6 file ✅
View Ultralytics Settings with 'yolo settings' or at '/root/.config/Ultralytics/settings.json'
Update Settings with 'yolo settings key=value', i.e. 'yolo settings runs_dir=path/to/dir'. For help see https://docs.ultralytics.com/quickstart/#ultralytics-settings.

---

keyboard_arrow_down

Baixando e descompactando o dataset do Roboflow

Substitua a URL abaixo pela que for gerada na sua conta do Roboflow, no formato YOLOv5 PyTorch.

[ ]

```
!curl -L 'https://universe.roboflow.com/ds/A6p6y7Xdlm?key=w20H2JsGQJ' > hardhat_dataset.zip

!unzip -q hardhat_dataset.zip -d hardhat_dataset

!ls hardhat_dataset
```

```
% Total    % Received % Xferd  Average Speed   Time    Time     Time  Current
                                 Dload  Upload   Total   Spent    Left  Speed
```

```
100   910  100   910    0     0   2281      0 --:--:-- --:--:-- --:--:--  2286
100  213M  100  213M    0     0  12.8M      0  0:00:16  0:00:16 --:--:-- 16.7M
data.yaml  README.dataset.txt  README.roboflow.txt  test  train  valid
```

---

keyboard_arrow_down

Explorando a pasta para encontrar o `data.yaml`

[ ]

```
!ls hardhat_dataset/*
```

```
hardhat_dataset/data.yaml            hardhat_dataset/README.roboflow.txt
hardhat_dataset/README.dataset.txt

hardhat_dataset/test:
images labels

hardhat_dataset/train:
images labels

hardhat_dataset/valid:
images labels
```

---

keyboard_arrow_down

Treinando o modelo

Substitua o caminho abaixo se o `data.yaml` estiver em uma subpasta diferente.

[ ]

```
model = YOLO('yolov8n.pt')

model.train(data='hardhat_dataset/data.yaml', epochs=30, imgsz=640)
```

```
Ultralytics 8.3.161 🚀 Python-3.11.13 torch-2.6.0+cu124 CUDA:0 (Tesla T4, 15095MiB)
engine/trainer: agnostic_nms=False, amp=True, augment=False, auto_augment=randaugment,
batch=16, bgr=0.0, box=7.5, cache=False, cfg=None, classes=None, close_mosaic=10, cls=0.5,
conf=None, copy_paste=0.0, copy_paste_mode=flip, cos_lr=False, cutmix=0.0,
```

data=hardhat_dataset/data.yaml, degrees=0.0, deterministic=True, device=None, dfl=1.5, dnn=False, dropout=0.0, dynamic=False, embed=None, epochs=30, erasing=0.4, exist_ok=False, fliplr=0.5, flipud=0.0, format=torchscript, fraction=1.0, freeze=None, half=False, hsv_h=0.015, hsv_s=0.7, hsv_v=0.4, imgsz=640, int8=False, iou=0.7, keras=False, kobj=1.0, line_width=None, lr0=0.01, lrf=0.01, mask_ratio=4, max_det=300, mixup=0.0, mode=train, model=yolov8n.pt, momentum=0.937, mosaic=1.0, multi_scale=False, name=train2, nbs=64, nms=False, opset=None, optimize=False, optimizer=auto, overlap_mask=True, patience=100, perspective=0.0, plots=True, pose=12.0, pretrained=True, profile=False, project=None, rect=False, resume=False, retina_masks=False, save=True, save_conf=False, save_crop=False, save_dir=runs/detect/train2, save_frames=False, save_json=False, save_period=-1, save_txt=False, scale=0.5, seed=0, shear=0.0, show=False, show_boxes=True, show_conf=True, show_labels=True, simplify=True, single_cls=False, source=None, split=val, stream_buffer=False, task=detect, time=None, tracker=botsort.yaml, translate=0.1, val=True, verbose=True, vid_stride=1, visualize=False, warmup_bias_lr=0.1, warmup_epochs=3.0, warmup_momentum=0.8, weight_decay=0.0005, workers=8, workspace=None
Downloading https://ultralytics.com/assets/Arial.ttf to '/root/.config/Ultralytics/Arial.ttf'...
100%|██████████| 755k/755k [00:00<00:00, 118MB/s]Overriding model.yaml nc=80 with nc=2

	from	n	params	module	arguments
0	-1	1	464	ultralytics.nn.modules.conv.Conv	[3, 16, 3, 2]
1	-1	1	4672	ultralytics.nn.modules.conv.Conv	[16, 32, 3, 2]
2	-1	1	7360	ultralytics.nn.modules.block.C2f	[32, 32, 1, True]
3	-1	1	18560	ultralytics.nn.modules.conv.Conv	[32, 64, 3, 2]
4	-1	2	49664	ultralytics.nn.modules.block.C2f	[64, 64, 2, True]
5	-1	1	73984	ultralytics.nn.modules.conv.Conv	[64, 128, 3, 2]
6	-1	2	197632	ultralytics.nn.modules.block.C2f	[128, 128, 2, True]
7	-1	1	295424	ultralytics.nn.modules.conv.Conv	[128, 256, 3, 2]
8	-1	1	460288	ultralytics.nn.modules.block.C2f	[256, 256, 1, True]
9	-1	1	164608	ultralytics.nn.modules.block.SPPF	[256, 256, 5]
10	-1	1	0	torch.nn.modules.upsampling.Upsample	[None, 2, 'nearest']
11	[-1, 6]	1	0	ultralytics.nn.modules.conv.Concat	[1]
12	-1	1	148224	ultralytics.nn.modules.block.C2f	[384, 128, 1]
13	-1	1	0	torch.nn.modules.upsampling.Upsample	[None, 2, 'nearest']
14	[-1, 4]	1	0	ultralytics.nn.modules.conv.Concat	[1]
15	-1	1	37248	ultralytics.nn.modules.block.C2f	[192, 64, 1]
16	-1	1	36992	ultralytics.nn.modules.conv.Conv	[64, 64, 3, 2]
17	[-1, 12]	1	0	ultralytics.nn.modules.conv.Concat	[1]
18	-1	1	123648	ultralytics.nn.modules.block.C2f	[192, 128, 1]
19	-1	1	147712	ultralytics.nn.modules.conv.Conv	[128, 128, 3, 2]
20	[-1, 9]	1	0	ultralytics.nn.modules.conv.Concat	[1]
21	-1	1	493056	ultralytics.nn.modules.block.C2f	[384, 256, 1]
22	[15, 18, 21]	1	751702	ultralytics.nn.modules.head.Detect	[2, [64, 128, 256]]

Model summary: 129 layers, 3,011,238 parameters, 3,011,222 gradients, 8.2 GFLOPs

Transferred 319/355 items from pretrained weights
Freezing layer 'model.22.dfl.conv.weight'
AMP: running Automatic Mixed Precision (AMP) checks...
Downloading https://github.com/ultralytics/assets/releases/download/v8.3.0/yolo11n.pt to 'yolo11n.pt'...
100%|██████████| 5.35M/5.35M [00:00<00:00, 341MB/s]
AMP: checks passed ✅

train: Fast image access ✅ (ping: 0.0±0.0 ms, read: 1086.4±263.7 MB/s, size: 52.2 KB)
train: Scanning /content/hardhat_dataset/train/labels... 4866 images, 42 backgrounds, 0 corrupt: 100%|██████████| 4866/4866 [00:02<00:00, 1852.93it/s]
train: New cache created: /content/hardhat_dataset/train/labels.cache
WARNING ⚠️ Box and segment counts should be equal, but got len(segments) = 3183, len(boxes) = 12719. To resolve this only boxes will be used and all segments will be removed. To avoid this please supply either a detect or segment dataset, not a detect-segment mixed dataset.
albumentations: Blur(p=0.01, blur_limit=(3, 7)), MedianBlur(p=0.01, blur_limit=(3, 7)), ToGray(p=0.01, method='weighted_average', num_output_channels=3), CLAHE(p=0.01, clip_limit=(1.0, 4.0), tile_grid_size=(8, 8))
val: Fast image access ✅ (ping: 0.0±0.0 ms, read: 584.3±497.7 MB/s, size: 41.5 KB)
val: Scanning /content/hardhat_dataset/valid/labels... 39 images, 2 backgrounds, 0 corrupt: 100%|██████████| 39/39 [00:00<00:00, 1272.25it/s]**val:** New cache created: /content/hardhat_dataset/valid/labels.cache
Plotting labels to runs/detect/train2/labels.jpg...
optimizer: 'optimizer=auto' found, ignoring 'lr0=0.01' and 'momentum=0.937' and determining best 'optimizer', 'lr0' and 'momentum' automatically...
optimizer: AdamW(lr=0.001667, 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 2 dataloader workers
Logging results to **runs/detect/train2**
Starting training for 30 epochs...

```
    Epoch   GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
     1/30      2.18G      1.122      1.608      1.261          5       640: 100%|██████████| 305/305 [01:27<00:00,  3.47it/s]
               Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 2/2 [00:01<00:00,  1.49it/s]
                 all         39         69      0.614      0.391      0.459      0.304
    Epoch   GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
     2/30      2.66G      1.003      1.035      1.174          0       640: 100%|██████████| 305/305 [01:21<00:00,  3.73it/s]
               Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 2/2 [00:00<00:00,  3.35it/s]
                 all         39         69      0.623      0.594      0.627      0.416

    Epoch   GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
     3/30      2.68G     0.9772     0.8822      1.154          4       640: 100%|██████████| 305/305 [01:22<00:00,  3.70it/s]
               Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 2/2 [00:00<00:00,  3.61it/s]
                 all         39         69      0.843      0.783      0.827      0.535
    Epoch   GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
     4/30      2.68G     0.9297     0.8038      1.134          1       640: 100%|██████████| 305/305 [01:21<00:00,  3.74it/s]
               Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 2/2 [00:00<00:00,  3.61it/s]
                 all         39         69      0.779      0.409      0.591      0.429
    Epoch   GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
     5/30      2.71G      0.887     0.7456      1.112         12       640: 100%|██████████| 305/305 [01:21<00:00,  3.74it/s]
```

```
      Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████|
2/2 [00:00<00:00,  3.49it/s]
                 all         39         69      0.852      0.667      0.762      0.545

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
       6/30      2.73G     0.8536     0.7089      1.094          3       640: 100%|██████████| 305/305
[01:21<00:00,  3.74it/s]
      Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████|
2/2 [00:00<00:00,  3.13it/s]
                 all         39         69      0.876       0.71      0.796      0.607

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
       7/30      2.75G     0.8197     0.6727      1.076         39       640: 100%|██████████| 305/305
[01:21<00:00,  3.76it/s]
      Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████|
2/2 [00:00<00:00,  3.50it/s]
                 all         39         69      0.901      0.794      0.821      0.571

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
       8/30      2.75G     0.7898      0.638       1.06          3       640: 100%|██████████| 305/305
[01:21<00:00,  3.74it/s]
      Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████|
2/2 [00:00<00:00,  3.24it/s]
                 all         39         69       0.87      0.667      0.771       0.59

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
       9/30      2.78G     0.7719     0.6179      1.056          7       640: 100%|██████████| 305/305
[01:21<00:00,  3.72it/s]
      Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████|
2/2 [00:00<00:00,  3.39it/s]
                 all         39         69      0.862      0.725      0.789      0.601

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      10/30       2.8G     0.7381     0.5932      1.034          4       640: 100%|██████████| 305/305
[01:21<00:00,  3.73it/s]
      Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████|
2/2 [00:00<00:00,  3.99it/s]
                 all         39         69      0.874      0.705      0.749      0.572

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      11/30      2.82G     0.7323     0.5791       1.03          9       640: 100%|██████████| 305/305
[01:21<00:00,  3.76it/s]
      Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████|
2/2 [00:00<00:00,  3.76it/s]
                 all         39         69      0.854      0.754      0.837      0.657

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      12/30      2.82G     0.7233     0.5643      1.031         17       640: 100%|██████████| 305/305
[01:22<00:00,  3.70it/s]
      Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████|
2/2 [00:00<00:00,  3.76it/s]
                 all         39         69      0.925      0.768      0.878      0.648

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      13/30      2.85G     0.6988     0.5431      1.018          3       640: 100%|██████████| 305/305
[01:22<00:00,  3.68it/s]
      Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████|
2/2 [00:00<00:00,  3.59it/s]
                 all         39         69      0.894      0.725      0.859      0.645

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      14/30      2.87G     0.6832     0.5298      1.011          5       640: 100%|██████████| 305/305
[01:23<00:00,  3.65it/s]
      Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████|
2/2 [00:00<00:00,  2.26it/s]
                 all         39         69      0.963      0.765      0.862      0.712

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      15/30      2.88G     0.6784     0.5209      1.003          8       640: 100%|██████████| 305/305
[01:21<00:00,  3.72it/s]
```

Class Images Instances Box(P R mAP50 mAP50-95): 100%|██████████| 2/2 [00:00<00:00, 3.70it/s] all 39 69 0.901 0.79 0.803 0.644

Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size

16/30 2.89G 0.6682 0.5111 0.9959 10 640: 100%|██████████| 305/305 [01:22<00:00, 3.68it/s]

Class Images Instances Box(P R mAP50 mAP50-95): 100%|██████████| 2/2 [00:00<00:00, 2.96it/s] all 39 69 0.906 0.695 0.794 0.642

Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size

17/30 2.92G 0.6409 0.4958 0.9912 3 640: 100%|██████████| 305/305 [01:24<00:00, 3.61it/s]

Class Images Instances Box(P R mAP50 mAP50-95): 100%|██████████| 2/2 [00:00<00:00, 2.98it/s] all 39 69 0.902 0.725 0.834 0.682

Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size

18/30 2.93G 0.6372 0.4807 0.985 3 640: 100%|██████████| 305/305 [01:23<00:00, 3.67it/s]

Class Images Instances Box(P R mAP50 mAP50-95): 100%|██████████| 2/2 [00:00<00:00, 3.19it/s] all 39 69 0.848 0.73 0.808 0.634

Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size

19/30 2.95G 0.6234 0.4775 0.9882 3 640: 100%|██████████| 305/305 [01:24<00:00, 3.62it/s]

Class Images Instances Box(P R mAP50 mAP50-95): 100%|██████████| 2/2 [00:00<00:00, 3.39it/s] all 39 69 0.852 0.837 0.856 0.696

Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size

20/30 2.96G 0.6148 0.4623 0.9801 10 640: 100%|██████████| 305/305 [01:23<00:00, 3.67it/s]

Class Images Instances Box(P R mAP50 mAP50-95): 100%|██████████| 2/2 [00:00<00:00, 2.92it/s] all 39 69 0.901 0.791 0.839 0.682

Closing dataloader mosaic

albumentations: Blur(p=0.01, blur_limit=(3, 7)), MedianBlur(p=0.01, blur_limit=(3, 7)), ToGray(p=0.01, method='weighted_average', num_output_channels=3), CLAHE(p=0.01, clip_limit=(1.0, 4.0), tile_grid_size=(8, 8))

Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size

21/30 2.99G 0.5251 0.3779 0.9167 9 640: 100%|██████████| 305/305 [01:22<00:00, 3.71it/s]

Class Images Instances Box(P R mAP50 mAP50-95): 100%|██████████| 2/2 [00:00<00:00, 3.64it/s] all 39 69 0.903 0.71 0.834 0.701

Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size

22/30 3G 0.5153 0.3667 0.9066 8 640: 100%|██████████| 305/305 [01:18<00:00, 3.89it/s]

Class Images Instances Box(P R mAP50 mAP50-95): 100%|██████████| 2/2 [00:00<00:00, 3.72it/s] all 39 69 0.904 0.821 0.865 0.732

Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size

23/30 3.02G 0.4989 0.3556 0.9014 10 640: 100%|██████████| 305/305 [01:18<00:00, 3.90it/s]

Class Images Instances Box(P R mAP50 mAP50-95): 100%|██████████| 2/2 [00:00<00:00, 4.07it/s] all 39 69 0.883 0.797 0.9 0.717

Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size

24/30 3.03G 0.489 0.3454 0.8929 2 640: 100%|██████████| 305/305 [01:17<00:00, 3.94it/s]

```
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 2/2 [00:00<00:00,  3.66it/s]
                   all         39         69      0.883      0.768      0.839      0.686

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      25/30      3.05G     0.4741      0.335     0.8862          4        640: 100%|██████████| 305/305 [01:17<00:00,  3.93it/s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 2/2 [00:00<00:00,  4.01it/s]
                   all         39         69      0.903      0.809       0.86      0.716
      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      26/30      3.07G     0.4541      0.321      0.883          2        640: 100%|██████████| 305/305 [01:17<00:00,  3.95it/s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 2/2 [00:00<00:00,  3.38it/s]
                   all         39         69      0.899      0.812       0.85      0.707
      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      27/30      3.09G     0.4475     0.3127      0.877          6        640: 100%|██████████| 305/305 [01:17<00:00,  3.95it/s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 2/2 [00:00<00:00,  3.65it/s]
                   all         39         69      0.944      0.733      0.857      0.732

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      28/30      3.09G     0.4383     0.3071      0.871          4        640: 100%|██████████| 305/305 [01:17<00:00,  3.95it/s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 2/2 [00:00<00:00,  3.46it/s]
                   all         39         69      0.856      0.768      0.852      0.731
      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      29/30      3.12G     0.4291     0.3025     0.8683         29        640: 100%|██████████| 305/305 [01:18<00:00,  3.88it/s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 2/2 [00:00<00:00,  4.19it/s]
                   all         39         69      0.907      0.845       0.87      0.751
      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      30/30      3.14G     0.4202     0.2945     0.8689          3        640: 100%|██████████| 305/305 [01:19<00:00,  3.85it/s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 2/2 [00:00<00:00,  3.29it/s]
                   all         39         69      0.904      0.817      0.871      0.748
30 epochs completed in 0.685 hours.
Optimizer stripped from runs/detect/train2/weights/last.pt, 6.2MB
Optimizer stripped from runs/detect/train2/weights/best.pt, 6.2MB

Validating runs/detect/train2/weights/best.pt...
Ultralytics 8.3.161 🚀 Python-3.11.13 torch-2.6.0+cu124 CUDA:0 (Tesla T4, 15095MiB)
Model summary (fused): 72 layers, 3,006,038 parameters, 0 gradients, 8.1 GFLOPs
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 2/2 [00:00<00:00,  4.44it/s]
                   all         39         69      0.907      0.845       0.87       0.75
                     0         37         69      0.907      0.845       0.87       0.75
Speed: 0.4ms preprocess, 2.8ms inference, 0.0ms loss, 1.9ms postprocess per image
Results saved to runs/detect/train2
```

ultralytics.utils.metrics.DetMetrics object with attributes:

ap_class_index: array([0])
box: ultralytics.utils.metrics.Metric object
confusion_matrix: <ultralytics.utils.metrics.ConfusionMatrix object at 0x7e89eaff3a50>
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, 0.028028, 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,
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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,
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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,
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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,
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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,
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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,

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0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0]]), 'Confidence', 'Recall']]
fitness: np.float64(0.7622150544452302)
keys: ['metrics/precision(B)', 'metrics/recall(B)', 'metrics/mAP50(B)', 'metrics/mAP50-95(B)']
maps: array([0.75029, 0.75029])
names: {0: '0', 1: 'object'}
nt_per_class: array([69, 0])
nt_per_image: array([37, 0])
results_dict: {'metrics/precision(B)': np.float64(0.9066502289887122), 'metrics/recall(B)': np.float64(0.8446013347658031), 'metrics/mAP50(B)': np.float64(0.8695035333272602), 'metrics/mAP50-95(B)': np.float64(0.7502941123472268), 'fitness': np.float64(0.7622150544452302)}
save_dir: PosixPath('runs/detect/train2')
speed: {'preprocess': 0.38087456410861564, 'inference': 2.823655769215969, 'loss': 0.0007032564122383543, 'postprocess': 1.8900358205218464}
stats: {'tp': [], 'conf': [], 'pred_cls': [], 'target_cls': [], 'target_img': []}
task: 'detect'

---

keyboard_arrow_down

Visualizando os resultados do treino

[ ]

```
from IPython.display import Image

Image(filename='/content/runs/detect/train2/results.png')
```

---

keyboard_arrow_down

Testando o modelo em uma imagem

[ ]

```
import cv2

import matplotlib.pyplot as plt
```

```
import torch


# Realiza a detecção com confiança mínima baixa
results = model('/content/hardhat_dataset/img/manwithhardhat.jpg', conf=0.05)


# Pega a imagem original
img_path = '/content/hardhat_dataset/img/manwithhardhat.jpg'
img = cv2.imread(img_path)
img = cv2.cvtColor(img, cv2.COLOR_BGR2RGB)


# Pega as caixas, classes e confianças
boxes = results[0].boxes
coords = boxes.xyxy.cpu().numpy()       # Coordenadas das caixas
confs = boxes.conf.cpu().numpy()        # Confiança
clss = boxes.cls.cpu().numpy().astype(int)  # Classes como índices inteiros


# Nome das classes no modelo
names = model.names


# Desenha as caixas
for i in range(len(coords)):
    x1, y1, x2, y2 = coords[i]
    label = names[clss[i]]
```

```
        confidence = confs[i]
        text = f"{label}: {confidence:.2f}"

        # Caixa e texto
        cv2.rectangle(img, (int(x1), int(y1)), (int(x2), int(y2)), (0,255,0), 2)
        cv2.putText(img, text, (int(x1), int(y1)-10),
                    cv2.FONT_HERSHEY_SIMPLEX, 0.6, (0,255,0), 2)

    # Exibe a imagem com Matplotlib
    plt.figure(figsize=(10, 8))
    plt.imshow(img)
    plt.axis('off')
    plt.title("Detecções com Rótulos e Confiança")
    plt.show()
```

[ ]

```
model = YOLO('/content/runs/detect/train2/weights/best.pt')
results = model('/content/hardhat_dataset/img/manwithhardhat1.jpg', conf=0.25)
results[0].show()
```

---

keyboard_arrow_down

Testando o modelo em um vídeo

[ ]YOLOv8 - Hard Hat Detection Project

Neste notebook, vamos treinar um modelo YOLOv8 para detectar se uma pessoa está ou não utilizando capacete (EPI), utilizando um dataset do Roboflow.

[ ]

!pip install ultralytics

Collecting ultralytics

Downloading ultralytics-8.3.161-py3-none-any.whl.metadata (37 kB)

Requirement already satisfied: numpy>=1.23.0 in /usr/local/lib/python3.11/dist-packages (from ultralytics) (2.0.2)

Requirement already satisfied: matplotlib>=3.3.0 in /usr/local/lib/python3.11/dist-packages (from ultralytics) (3.10.0)

Requirement already satisfied: opencv-python>=4.6.0 in /usr/local/lib/python3.11/dist-packages (from ultralytics) (4.11.0.86)

Requirement already satisfied: pillow>=7.1.2 in /usr/local/lib/python3.11/dist-packages (from ultralytics) (11.2.1)

Requirement already satisfied: pyyaml>=5.3.1 in /usr/local/lib/python3.11/dist-packages (from ultralytics) (6.0.2)

Requirement already satisfied: requests>=2.23.0 in /usr/local/lib/python3.11/dist-packages (from ultralytics) (2.32.3)

Requirement already satisfied: scipy>=1.4.1 in /usr/local/lib/python3.11/dist-packages (from ultralytics) (1.15.3)

Requirement already satisfied: torch>=1.8.0 in /usr/local/lib/python3.11/dist-packages (from ultralytics) (2.6.0+cu124)

Requirement already satisfied: torchvision>=0.9.0 in /usr/local/lib/python3.11/dist-packages (from ultralytics) (0.21.0+cu124)

Requirement already satisfied: tqdm>=4.64.0 in /usr/local/lib/python3.11/dist-packages (from ultralytics) (4.67.1)

Requirement already satisfied: psutil in /usr/local/lib/python3.11/dist-packages (from ultralytics) (5.9.5)

Requirement already satisfied: py-cpuinfo in /usr/local/lib/python3.11/dist-packages (from ultralytics) (9.0.0)

Requirement already satisfied: pandas>=1.1.4 in /usr/local/lib/python3.11/dist-packages (from ultralytics) (2.2.2)

Collecting ultralytics-thop>=2.0.0 (from ultralytics)

Downloading ultralytics_thop-2.0.14-py3-none-any.whl.metadata (9.4 kB)

Requirement already satisfied: contourpy>=1.0.1 in /usr/local/lib/python3.11/dist-packages (from matplotlib>=3.3.0->ultralytics) (1.3.2)

Requirement already satisfied: cycler>=0.10 in /usr/local/lib/python3.11/dist-packages (from matplotlib>=3.3.0->ultralytics) (0.12.1)

Requirement already satisfied: fonttools>=4.22.0 in /usr/local/lib/python3.11/dist-packages (from matplotlib>=3.3.0->ultralytics) (4.58.4)

Requirement already satisfied: kiwisolver>=1.3.1 in /usr/local/lib/python3.11/dist-packages (from matplotlib>=3.3.0->ultralytics) (1.4.8)

Requirement already satisfied: packaging>=20.0 in /usr/local/lib/python3.11/dist-packages (from matplotlib>=3.3.0->ultralytics) (24.2)

Requirement already satisfied: pyparsing>=2.3.1 in /usr/local/lib/python3.11/dist-packages (from matplotlib>=3.3.0->ultralytics) (3.2.3)

Requirement already satisfied: python-dateutil>=2.7 in /usr/local/lib/python3.11/dist-packages (from matplotlib>=3.3.0->ultralytics) (2.9.0.post0)

Requirement already satisfied: pytz>=2020.1 in /usr/local/lib/python3.11/dist-packages (from pandas>=1.1.4->ultralytics) (2025.2)

Requirement already satisfied: tzdata>=2022.7 in /usr/local/lib/python3.11/dist-packages (from pandas>=1.1.4->ultralytics) (2025.2)

Requirement already satisfied: charset-normalizer<4,>=2 in /usr/local/lib/python3.11/dist-packages (from requests>=2.23.0->ultralytics) (3.4.2)

Requirement already satisfied: idna<4,>=2.5 in /usr/local/lib/python3.11/dist-packages (from requests>=2.23.0->ultralytics) (3.10)

Requirement already satisfied: urllib3<3,>=1.21.1 in /usr/local/lib/python3.11/dist-packages (from requests>=2.23.0->ultralytics) (2.4.0)

Requirement already satisfied: certifi>=2017.4.17 in /usr/local/lib/python3.11/dist-packages (from requests>=2.23.0->ultralytics) (2025.6.15)

Requirement already satisfied: filelock in /usr/local/lib/python3.11/dist-packages (from torch>=1.8.0->ultralytics) (3.18.0)

Requirement already satisfied: typing-extensions>=4.10.0 in /usr/local/lib/python3.11/dist-packages (from torch>=1.8.0->ultralytics) (4.14.0)

Requirement already satisfied: networkx in /usr/local/lib/python3.11/dist-packages (from torch>=1.8.0->ultralytics) (3.5)

Requirement already satisfied: jinja2 in /usr/local/lib/python3.11/dist-packages (from torch>=1.8.0->ultralytics) (3.1.6)

Requirement already satisfied: fsspec in /usr/local/lib/python3.11/dist-packages (from torch>=1.8.0->ultralytics) (2025.3.2)

Collecting nvidia-cuda-nvrtc-cu12==12.4.127 (from torch>=1.8.0->ultralytics)

Downloading nvidia_cuda_nvrtc_cu12-12.4.127-py3-none-manylinux2014_x86_64.whl.metadata (1.5 kB)

Collecting nvidia-cuda-runtime-cu12==12.4.127 (from torch>=1.8.0->ultralytics)

Downloading nvidia_cuda_runtime_cu12-12.4.127-py3-none-manylinux2014_x86_64.whl.metadata (1.5 kB)

Collecting nvidia-cuda-cupti-cu12==12.4.127 (from torch>=1.8.0->ultralytics)

Downloading nvidia_cuda_cupti_cu12-12.4.127-py3-none-manylinux2014_x86_64.whl.metadata (1.6 kB)

Collecting nvidia-cudnn-cu12==9.1.0.70 (from torch>=1.8.0->ultralytics)

Downloading nvidia_cudnn_cu12-9.1.0.70-py3-none-manylinux2014_x86_64.whl.metadata (1.6 kB)

Collecting nvidia-cublas-cu12==12.4.5.8 (from torch>=1.8.0->ultralytics)

Downloading nvidia_cublas_cu12-12.4.5.8-py3-none-manylinux2014_x86_64.whl.metadata (1.5 kB)

Collecting nvidia-cufft-cu12==11.2.1.3 (from torch>=1.8.0->ultralytics)

Downloading nvidia_cufft_cu12-11.2.1.3-py3-none-manylinux2014_x86_64.whl.metadata (1.5 kB)

Collecting nvidia-curand-cu12==10.3.5.147 (from torch>=1.8.0->ultralytics)

Downloading nvidia_curand_cu12-10.3.5.147-py3-none-manylinux2014_x86_64.whl.metadata (1.5 kB)

Collecting nvidia-cusolver-cu12==11.6.1.9 (from torch>=1.8.0->ultralytics)

Downloading nvidia_cusolver_cu12-11.6.1.9-py3-none-manylinux2014_x86_64.whl.metadata (1.6 kB)

Collecting nvidia-cusparse-cu12==12.3.1.170 (from torch>=1.8.0->ultralytics)

Downloading nvidia_cusparse_cu12-12.3.1.170-py3-none-manylinux2014_x86_64.whl.metadata (1.6 kB)

Requirement already satisfied: nvidia-cusparselt-cu12==0.6.2 in /usr/local/lib/python3.11/dist-packages (from torch>=1.8.0->ultralytics) (0.6.2)

Requirement already satisfied: nvidia-nccl-cu12==2.21.5 in /usr/local/lib/python3.11/dist-packages (from torch>=1.8.0->ultralytics) (2.21.5)

Requirement already satisfied: nvidia-nvtx-cu12==12.4.127 in /usr/local/lib/python3.11/dist-packages (from torch>=1.8.0->ultralytics) (12.4.127)

Collecting nvidia-nvjitlink-cu12==12.4.127 (from torch>=1.8.0->ultralytics)

Downloading nvidia_nvjitlink_cu12-12.4.127-py3-none-manylinux2014_x86_64.whl.metadata (1.5 kB)

Requirement already satisfied: triton==3.2.0 in /usr/local/lib/python3.11/dist-packages (from torch>=1.8.0->ultralytics) (3.2.0)

Requirement already satisfied: sympy==1.13.1 in /usr/local/lib/python3.11/dist-packages (from torch>=1.8.0->ultralytics) (1.13.1)

Requirement already satisfied: mpmath<1.4,>=1.1.0 in /usr/local/lib/python3.11/dist-packages (from sympy==1.13.1->torch>=1.8.0->ultralytics) (1.3.0)

Requirement already satisfied: six>=1.5 in /usr/local/lib/python3.11/dist-packages (from python-dateutil>=2.7->matplotlib>=3.3.0->ultralytics) (1.17.0)

Requirement already satisfied: MarkupSafe>=2.0 in /usr/local/lib/python3.11/dist-packages (from jinja2->torch>=1.8.0->ultralytics) (3.0.2)

Downloading ultralytics-8.3.161-py3-none-any.whl (1.0 MB)

1.0/1.0 MB 29.2 MB/s eta 0:00:00

Downloading nvidia_cublas_cu12-12.4.5.8-py3-none-manylinux2014_x86_64.whl (363.4 MB)

363.4/363.4 MB 4.4 MB/s eta 0:00:00

Downloading nvidia_cuda_cupti_cu12-12.4.127-py3-none-manylinux2014_x86_64.whl (13.8 MB)

13.8/13.8 MB 128.0 MB/s eta 0:00:00

Downloading nvidia_cuda_nvrtc_cu12-12.4.127-py3-none-manylinux2014_x86_64.whl (24.6 MB)

24.6/24.6 MB 82.7 MB/s eta 0:00:00

Downloading nvidia_cuda_runtime_cu12-12.4.127-py3-none-manylinux2014_x86_64.whl (883 kB)

883.7/883.7 kB 54.4 MB/s eta 0:00:00

Downloading nvidia_cudnn_cu12-9.1.0.70-py3-none-manylinux2014_x86_64.whl (664.8 MB)

664.8/664.8 MB 2.2 MB/s eta 0:00:00

Downloading nvidia_cufft_cu12-11.2.1.3-py3-none-manylinux2014_x86_64.whl (211.5 MB)

211.5/211.5 MB 5.5 MB/s eta 0:00:00

Downloading nvidia_curand_cu12-10.3.5.147-py3-none-manylinux2014_x86_64.whl (56.3 MB)

56.3/56.3 MB 16.7 MB/s eta 0:00:00

Downloading nvidia_cusolver_cu12-11.6.1.9-py3-none-manylinux2014_x86_64.whl (127.9 MB)

127.9/127.9 MB 7.3 MB/s eta 0:00:00

Downloading nvidia_cusparse_cu12-12.3.1.170-py3-none-manylinux2014_x86_64.whl (207.5 MB)

207.5/207.5 MB 5.5 MB/s eta 0:00:00

Downloading nvidia_nvjitlink_cu12-12.4.127-py3-none-manylinux2014_x86_64.whl (21.1 MB)

21.1/21.1 MB 106.9 MB/s eta 0:00:00

Downloading ultralytics_thop-2.0.14-py3-none-any.whl (26 kB)

Installing collected packages: nvidia-nvjitlink-cu12, nvidia-curand-cu12, nvidia-cufft-cu12, nvidia-cuda-runtime-cu12, nvidia-cuda-nvrtc-cu12, nvidia-cuda-cupti-cu12, nvidia-cublas-cu12, nvidia-cusparse-cu12, nvidia-cudnn-cu12, nvidia-cusolver-cu12, ultralytics-thop, ultralytics

Attempting uninstall: nvidia-nvjitlink-cu12

Found existing installation: nvidia-nvjitlink-cu12 12.5.82

```
  Uninstalling nvidia-nvjitlink-cu12-12.5.82:
    Successfully uninstalled nvidia-nvjitlink-cu12-12.5.82
Attempting uninstall: nvidia-curand-cu12
  Found existing installation: nvidia-curand-cu12 10.3.6.82
  Uninstalling nvidia-curand-cu12-10.3.6.82:
    Successfully uninstalled nvidia-curand-cu12-10.3.6.82
Attempting uninstall: nvidia-cufft-cu12
  Found existing installation: nvidia-cufft-cu12 11.2.3.61
  Uninstalling nvidia-cufft-cu12-11.2.3.61:
    Successfully uninstalled nvidia-cufft-cu12-11.2.3.61
Attempting uninstall: nvidia-cuda-runtime-cu12
  Found existing installation: nvidia-cuda-runtime-cu12 12.5.82
  Uninstalling nvidia-cuda-runtime-cu12-12.5.82:
    Successfully uninstalled nvidia-cuda-runtime-cu12-12.5.82
Attempting uninstall: nvidia-cuda-nvrtc-cu12
  Found existing installation: nvidia-cuda-nvrtc-cu12 12.5.82
  Uninstalling nvidia-cuda-nvrtc-cu12-12.5.82:
    Successfully uninstalled nvidia-cuda-nvrtc-cu12-12.5.82
Attempting uninstall: nvidia-cuda-cupti-cu12
  Found existing installation: nvidia-cuda-cupti-cu12 12.5.82
  Uninstalling nvidia-cuda-cupti-cu12-12.5.82:
    Successfully uninstalled nvidia-cuda-cupti-cu12-12.5.82
Attempting uninstall: nvidia-cublas-cu12
  Found existing installation: nvidia-cublas-cu12 12.5.3.2
  Uninstalling nvidia-cublas-cu12-12.5.3.2:
    Successfully uninstalled nvidia-cublas-cu12-12.5.3.2
Attempting uninstall: nvidia-cusparse-cu12
  Found existing installation: nvidia-cusparse-cu12 12.5.1.3
  Uninstalling nvidia-cusparse-cu12-12.5.1.3:
    Successfully uninstalled nvidia-cusparse-cu12-12.5.1.3
Attempting uninstall: nvidia-cudnn-cu12
  Found existing installation: nvidia-cudnn-cu12 9.3.0.75
  Uninstalling nvidia-cudnn-cu12-9.3.0.75:
    Successfully uninstalled nvidia-cudnn-cu12-9.3.0.75
Attempting uninstall: nvidia-cusolver-cu12
  Found existing installation: nvidia-cusolver-cu12 11.6.3.83
```

Uninstalling nvidia-cusolver-cu12-11.6.3.83:

Successfully uninstalled nvidia-cusolver-cu12-11.6.3.83

Successfully installed nvidia-cublas-cu12-12.4.5.8 nvidia-cuda-cupti-cu12-12.4.127 nvidia-cuda-nvrtc-cu12-12.4.127 nvidia-cuda-runtime-cu12-12.4.127 nvidia-cudnn-cu12-9.1.0.70 nvidia-cufft-cu12-11.2.1.3 nvidia-curand-cu12-10.3.5.147 nvidia-cusolver-cu12-11.6.1.9 nvidia-cusparse-cu12-12.3.1.170 nvidia-nvjitlink-cu12-12.4.127 ultralytics-8.3.161 ultralytics-thop-2.0.14

[ ]

```
from ultralytics import YOLO
import matplotlib.pyplot as plt
import cv2
import numpy as np
import os
```

Creating new Ultralytics Settings v0.0.6 file ✅

View Ultralytics Settings with 'yolo settings' or at '/root/.config/Ultralytics/settings.json'

Update Settings with 'yolo settings key=value', i.e. 'yolo settings runs_dir=path/to/dir'. For help see https://docs.ultralytics.com/quickstart/#ultralytics-settings.

Baixando e descompactando o dataset do Roboflow

Substitua a URL abaixo pela que for gerada na sua conta do Roboflow, no formato YOLOv5 PyTorch.

[ ]

```
!curl -L 'https://universe.roboflow.com/ds/A6p6y7Xdlm?key=w20H2JsGQJ' > hardhat_dataset.zip
!unzip -q hardhat_dataset.zip -d hardhat_dataset
!ls hardhat_dataset
```

```
  % Total    % Received % Xferd  Average Speed   Time    Time     Time  Current
                                 Dload  Upload   Total   Spent    Left  Speed
100   910  100   910    0     0   2281      0 --:--:-- --:--:-- --:--:--  2286
100  213M  100  213M    0     0  12.8M      0  0:00:16  0:00:16 --:--:-- 16.7M
data.yaml  README.dataset.txt  README.roboflow.txt  test  train  valid
```

Explorando a pasta para encontrar o data.yaml

[ ]

```
!ls hardhat_dataset/*
```

hardhat_dataset/data.yaml hardhat_dataset/README.roboflow.txt

hardhat_dataset/README.dataset.txt

hardhat_dataset/test:

images labels

hardhat_dataset/train:

images labels

hardhat_dataset/valid:

images labels

Treinando o modelo

Substitua o caminho abaixo se o data.yaml estiver em uma subpasta diferente.

[ ]

model = YOLO('yolov8n.pt')

model.train(data='hardhat_dataset/data.yaml', epochs=30, imgsz=640)

Ultralytics 8.3.161 🚀 Python-3.11.13 torch-2.6.0+cu124 CUDA:0 (Tesla T4, 15095MiB)

engine/trainer: agnostic_nms=False, amp=True, augment=False, auto_augment=randaugment, batch=16, bgr=0.0, box=7.5, cache=False, cfg=None, classes=None, close_mosaic=10, cls=0.5, conf=None, copy_paste=0.0, copy_paste_mode=flip, cos_lr=False, cutmix=0.0, data=hardhat_dataset/data.yaml, degrees=0.0, deterministic=True, device=None, dfl=1.5, dnn=False, dropout=0.0, dynamic=False, embed=None, epochs=30, erasing=0.4, exist_ok=False, fliplr=0.5, flipud=0.0, format=torchscript, fraction=1.0, freeze=None, half=False, hsv_h=0.015, hsv_s=0.7, hsv_v=0.4, imgsz=640, int8=False, iou=0.7, keras=False, kobj=1.0, line_width=None, lr0=0.01, lrf=0.01, mask_ratio=4, max_det=300, mixup=0.0, mode=train, model=yolov8n.pt, momentum=0.937, mosaic=1.0, multi_scale=False, name=train2, nbs=64, nms=False, opset=None, optimize=False, optimizer=auto, overlap_mask=True, patience=100, perspective=0.0, plots=True, pose=12.0, pretrained=True, profile=False, project=None, rect=False, resume=False, retina_masks=False, save=True, save_conf=False, save_crop=False, save_dir=runs/detect/train2, save_frames=False, save_json=False, save_period=-1, save_txt=False, scale=0.5, seed=0, shear=0.0, show=False, show_boxes=True, show_conf=True, show_labels=True, simplify=True, single_cls=False, source=None, split=val, stream_buffer=False, task=detect, time=None, tracker=botsort.yaml, translate=0.1, val=True, verbose=True, vid_stride=1, visualize=False, warmup_bias_lr=0.1, warmup_epochs=3.0, warmup_momentum=0.8, weight_decay=0.0005, workers=8, workspace=None

Downloading https://ultralytics.com/assets/Arial.ttf to '/root/.config/Ultralytics/Arial.ttf'...

100%|██████████| 755k/755k [00:00<00:00, 118MB/s]Overriding model.yaml nc=80 with nc=2

	from	n	params	module	arguments
0	-1	1	464	ultralytics.nn.modules.conv.Conv	[3, 16, 3, 2]
1	-1	1	4672	ultralytics.nn.modules.conv.Conv	[16, 32, 3, 2]
2	-1	1	7360	ultralytics.nn.modules.block.C2f	[32, 32, 1, True]
3	-1	1	18560	ultralytics.nn.modules.conv.Conv	[32, 64, 3, 2]
4	-1	2	49664	ultralytics.nn.modules.block.C2f	[64, 64, 2, True]
5	-1	1	73984	ultralytics.nn.modules.conv.Conv	[64, 128, 3, 2]
6	-1	2	197632	ultralytics.nn.modules.block.C2f	[128, 128, 2, True]
7	-1	1	295424	ultralytics.nn.modules.conv.Conv	[128, 256, 3, 2]
8	-1	1	460288	ultralytics.nn.modules.block.C2f	[256, 256, 1, True]
9	-1	1	164608	ultralytics.nn.modules.block.SPPF	[256, 256, 5]
10	-1	1	0	torch.nn.modules.upsampling.Upsample	[None, 2, 'nearest']
11	[-1, 6]	1	0	ultralytics.nn.modules.conv.Concat	[1]
12	-1	1	148224	ultralytics.nn.modules.block.C2f	[384, 128, 1]
13	-1	1	0	torch.nn.modules.upsampling.Upsample	[None, 2, 'nearest']
14	[-1, 4]	1	0	ultralytics.nn.modules.conv.Concat	[1]
15	-1	1	37248	ultralytics.nn.modules.block.C2f	[192, 64, 1]
16	-1	1	36992	ultralytics.nn.modules.conv.Conv	[64, 64, 3, 2]
17	[-1, 12]	1	0	ultralytics.nn.modules.conv.Concat	[1]
18	-1	1	123648	ultralytics.nn.modules.block.C2f	[192, 128, 1]
19	-1	1	147712	ultralytics.nn.modules.conv.Conv	[128, 128, 3, 2]
20	[-1, 9]	1	0	ultralytics.nn.modules.conv.Concat	[1]
21	-1	1	493056	ultralytics.nn.modules.block.C2f	[384, 256, 1]
22	[15, 18, 21]	1	751702	ultralytics.nn.modules.head.Detect	[2, [64, 128, 256]]

Model summary: 129 layers, 3,011,238 parameters, 3,011,222 gradients, 8.2 GFLOPs

Transferred 319/355 items from pretrained weights

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

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

Downloading https://github.com/ultralytics/assets/releases/download/v8.3.0/yolo11n.pt to 'yolo11n.pt'...

100%|[redacted]| 5.35M/5.35M [00:00<00:00, 341MB/s]

AMP: checks passed ✅

train: Fast image access ✅ (ping: 0.0±0.0 ms, read: 1086.4±263.7 MB/s, size: 52.2 KB)

train: Scanning /content/hardhat_dataset/train/labels... 4866 images, 42 backgrounds, 0 corrupt: 100%|| 4866/4866 [00:02<00:00, 1852.93it/s]

train: New cache created: /content/hardhat_dataset/train/labels.cache

WARNING ⚠️ Box and segment counts should be equal, but got len(segments) = 3183, len(boxes) = 12719. To resolve this only boxes will be used and all segments will be removed. To avoid this please supply either a detect or segment dataset, not a detect-segment mixed dataset.

albumentations: Blur(p=0.01, blur_limit=(3, 7)), MedianBlur(p=0.01, blur_limit=(3, 7)), ToGray(p=0.01, method='weighted_average', num_output_channels=3), CLAHE(p=0.01, clip_limit=(1.0, 4.0), tile_grid_size=(8, 8))

val: Fast image access ✅ (ping: 0.0±0.0 ms, read: 584.3±497.7 MB/s, size: 41.5 KB)

val: Scanning /content/hardhat_dataset/valid/labels... 39 images, 2 backgrounds, 0 corrupt: 100%| 39/39 [00:00<00:00, 1272.25it/s]val: New cache created: /content/hardhat_dataset/valid/labels.cache

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

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

optimizer: AdamW(lr=0.001667, 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 2 dataloader workers

Logging results to runs/detect/train2

Starting training for 30 epochs...

Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size

1/30 2.18G 1.122 1.608 1.261 5 640: 100%| 305/305 [01:27<00:00, 3.47it/s]

Class Images Instances Box(P R mAP50 mAP50-95): 100%| 2/2 [00:01<00:00, 1.49it/s]

all 39 69 0.614 0.391 0.459 0.304

Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size

2/30 2.66G 1.003 1.035 1.174 0 640: 100%| 305/305 [01:21<00:00, 3.73it/s]

Class Images Instances Box(P R mAP50 mAP50-95): 100%| 2/2 [00:00<00:00, 3.35it/s]

all 39 69 0.623 0.594 0.627 0.416

Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size

3/30 2.68G 0.9772 0.8822 1.154 4 640: 100%|██████████| 305/305 [01:22<00:00, 3.70it/s]

Class Images Instances Box(P R mAP50 mAP50-95): 100%|██████████| 2/2 [00:00<00:00, 3.61it/s] all 39 69 0.843 0.783 0.827 0.535

Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size

4/30 2.68G 0.9297 0.8038 1.134 1 640: 100%|██████████| 305/305 [01:21<00:00, 3.74it/s]

Class Images Instances Box(P R mAP50 mAP50-95): 100%|██████████| 2/2 [00:00<00:00, 3.61it/s] all 39 69 0.779 0.409 0.591 0.429

Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size

5/30 2.71G 0.887 0.7456 1.112 12 640: 100%|██████████| 305/305 [01:21<00:00, 3.74it/s]

Class Images Instances Box(P R mAP50 mAP50-95): 100%|██████████| 2/2 [00:00<00:00, 3.49it/s] all 39 69 0.852 0.667 0.762 0.545

Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size

6/30 2.73G 0.8536 0.7089 1.094 3 640: 100%|██████████| 305/305 [01:21<00:00, 3.74it/s]

Class Images Instances Box(P R mAP50 mAP50-95): 100%|██████████| 2/2 [00:00<00:00, 3.13it/s] all 39 69 0.876 0.71 0.796 0.607

Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size

7/30 2.75G 0.8197 0.6727 1.076 39 640: 100%|██████████| 305/305 [01:21<00:00, 3.76it/s]

Class Images Instances Box(P R mAP50 mAP50-95): 100%|██████████| 2/2 [00:00<00:00, 3.50it/s] all 39 69 0.901 0.794 0.821 0.571

Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size

8/30 2.75G 0.7898 0.638 1.06 3 640: 100%|██████████| 305/305 [01:21<00:00, 3.74it/s]

Class Images Instances Box(P R mAP50 mAP50-95): 100%|██████████| 2/2 [00:00<00:00, 3.24it/s] all 39 69 0.87 0.667 0.771 0.59

Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size

9/30 2.78G 0.7719 0.6179 1.056 7 640: 100%|██████████| 305/305 [01:21<00:00, 3.72it/s]

Class Images Instances Box(P R mAP50 mAP50-95): 100%|██████████| 2/2 [00:00<00:00, 3.39it/s] all 39 69 0.862 0.725 0.789 0.601

Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size

10/30 2.8G 0.7381 0.5932 1.034 4 640: 100%|██████████| 305/305 [01:21<00:00, 3.73it/s]

Class Images Instances Box(P R mAP50 mAP50-95): 100%|██████████| 2/2 [00:00<00:00, 3.99it/s] all 39 69 0.874 0.705 0.749 0.572

Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size

11/30 2.82G 0.7323 0.5791 1.03 9 640: 100%|██████████| 305/305 [01:21<00:00, 3.76it/s]

Class Images Instances Box(P R mAP50 mAP50-95): 100%|██████████| 2/2 [00:00<00:00, 3.76it/s] all 39 69 0.854 0.754 0.837 0.657

Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size

12/30 2.82G 0.7233 0.5643 1.031 17 640: 100%|██████████| 305/305 [01:22<00:00, 3.70it/s]

Class Images Instances Box(P R mAP50 mAP50-95): 100%|██████████| 2/2 [00:00<00:00, 3.76it/s] all 39 69 0.925 0.768 0.878 0.648

Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size

13/30 2.85G 0.6988 0.5431 1.018 3 640: 100%|██████████| 305/305 [01:22<00:00, 3.68it/s]

Class Images Instances Box(P R mAP50 mAP50-95): 100%|██████████| 2/2 [00:00<00:00, 3.59it/s] all 39 69 0.894 0.725 0.859 0.645

Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size

14/30 2.87G 0.6832 0.5298 1.011 5 640: 100%|██████████| 305/305 [01:23<00:00, 3.65it/s]

Class Images Instances Box(P R mAP50 mAP50-95): 100%|██████████| 2/2 [00:00<00:00, 2.26it/s] all 39 69 0.963 0.765 0.862 0.712

Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size

15/30 2.88G 0.6784 0.5209 1.003 8 640: 100%|██████████| 305/305 [01:21<00:00, 3.72it/s]

Class Images Instances Box(P R mAP50 mAP50-95): 100%|██████████| 2/2 [00:00<00:00, 3.70it/s] all 39 69 0.901 0.79 0.803 0.644

Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size

16/30 2.89G 0.6682 0.5111 0.9959 10 640: 100%|██████████| 305/305 [01:22<00:00, 3.68it/s]

Class Images Instances Box(P R mAP50 mAP50-95): 100%|██████████| 2/2 [00:00<00:00, 2.96it/s] all 39 69 0.906 0.695 0.794 0.642

Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size

17/30 2.92G 0.6409 0.4958 0.9912 3 640: 100%|██████████| 305/305 [01:24<00:00, 3.61it/s]

Class Images Instances Box(P R mAP50 mAP50-95): 100%|██████████| 2/2 [00:00<00:00, 2.98it/s] all 39 69 0.902 0.725 0.834 0.682

Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size

18/30 2.93G 0.6372 0.4807 0.985 3 640: 100%|██████████| 305/305 [01:23<00:00, 3.67it/s]

Class Images Instances Box(P R mAP50 mAP50-95): 100%|██████████| 2/2 [00:00<00:00, 3.19it/s] all 39 69 0.848 0.73 0.808 0.634

Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size

19/30 2.95G 0.6234 0.4775 0.9882 3 640: 100%|██████████| 305/305 [01:24<00:00, 3.62it/s]

Class Images Instances Box(P R mAP50 mAP50-95): 100%|██████████| 2/2 [00:00<00:00, 3.39it/s] all 39 69 0.852 0.837 0.856 0.696

Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size

20/30 2.96G 0.6148 0.4623 0.9801 10 640: 100%|██████████| 305/305 [01:23<00:00, 3.67it/s]

Class Images Instances Box(P R mAP50 mAP50-95): 100%|██████████| 2/2 [00:00<00:00, 2.92it/s] all 39 69 0.901 0.791 0.839 0.682

Closing dataloader mosaic

albumentations: Blur(p=0.01, blur_limit=(3, 7)), MedianBlur(p=0.01, blur_limit=(3, 7)), ToGray(p=0.01, method='weighted_average', num_output_channels=3), CLAHE(p=0.01, clip_limit=(1.0, 4.0), tile_grid_size=(8, 8))

Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size

21/30 2.99G 0.5251 0.3779 0.9167 9 640: 100%|██████████| 305/305 [01:22<00:00, 3.71it/s]

Class Images Instances Box(P R mAP50 mAP50-95): 100%|██████████| 2/2 [00:00<00:00, 3.64it/s] all 39 69 0.903 0.71 0.834 0.701

Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size

22/30 3G 0.5153 0.3667 0.9066 8 640: 100%|██████████| 305/305 [01:18<00:00, 3.89it/s]

Class Images Instances Box(P R mAP50 mAP50-95):
100%|██████████| 2/2 [00:00<00:00, 3.72it/s] all 39 69 0.904 0.821
0.865 0.732

Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size

23/30 3.02G 0.4989 0.3556 0.9014 10 640: 100%|██████████| 305/305
[01:18<00:00, 3.90it/s]

Class Images Instances Box(P R mAP50 mAP50-95):
100%|██████████| 2/2 [00:00<00:00, 4.07it/s] all 39 69 0.883 0.797
0.9 0.717

Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size

24/30 3.03G 0.489 0.3454 0.8929 2 640: 100%|██████████| 305/305
[01:17<00:00, 3.94it/s]

Class Images Instances Box(P R mAP50 mAP50-95):
100%|██████████| 2/2 [00:00<00:00, 3.66it/s]

all 39 69 0.883 0.768 0.839 0.686

Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size

25/30 3.05G 0.4741 0.335 0.8862 4 640: 100%|██████████| 305/305
[01:17<00:00, 3.93it/s]

Class Images Instances Box(P R mAP50 mAP50-95):
100%|██████████| 2/2 [00:00<00:00, 4.01it/s] all 39 69 0.903 0.809
0.86 0.716

Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size

26/30 3.07G 0.4541 0.321 0.883 2 640: 100%|██████████| 305/305
[01:17<00:00, 3.95it/s]

Class Images Instances Box(P R mAP50 mAP50-95):
100%|██████████| 2/2 [00:00<00:00, 3.38it/s] all 39 69 0.899 0.812
0.85 0.707

Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size

27/30 3.09G 0.4475 0.3127 0.877 6 640: 100%|██████████| 305/305
[01:17<00:00, 3.95it/s]

Class Images Instances Box(P R mAP50 mAP50-95):
100%|██████████| 2/2 [00:00<00:00, 3.65it/s]

all 39 69 0.944 0.733 0.857 0.732

Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size

28/30 3.09G 0.4383 0.3071 0.871 4 640: 100%|██████████| 305/305 [01:17<00:00, 3.95it/s]

Class Images Instances Box(P R mAP50 mAP50-95):
100%|██████████| 2/2 [00:00<00:00, 3.46it/s] all 39 69 0.856 0.768 0.852 0.731

Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size

29/30 3.12G 0.4291 0.3025 0.8683 29 640: 100%|██████████| 305/305 [01:18<00:00, 3.88it/s]

Class Images Instances Box(P R mAP50 mAP50-95):
100%|██████████| 2/2 [00:00<00:00, 4.19it/s] all 39 69 0.907 0.845 0.87 0.751

Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size

30/30 3.14G 0.4202 0.2945 0.8689 3 640: 100%|██████████| 305/305 [01:19<00:00, 3.85it/s]

Class Images Instances Box(P R mAP50 mAP50-95):
100%|██████████| 2/2 [00:00<00:00, 3.29it/s] all 39 69 0.904 0.817 0.871 0.748

30 epochs completed in 0.685 hours.

Optimizer stripped from runs/detect/train2/weights/last.pt, 6.2MB

Optimizer stripped from runs/detect/train2/weights/best.pt, 6.2MB

Validating runs/detect/train2/weights/best.pt...

Ultralytics 8.3.161 🚀 Python-3.11.13 torch-2.6.0+cu124 CUDA:0 (Tesla T4, 15095MiB)

Model summary (fused): 72 layers, 3,006,038 parameters, 0 gradients, 8.1 GFLOPs

Class Images Instances Box(P R mAP50 mAP50-95):
100%|██████████| 2/2 [00:00<00:00, 4.44it/s]

all 39 69 0.907 0.845 0.87 0.75

0 37 69 0.907 0.845 0.87 0.75

Speed: 0.4ms preprocess, 2.8ms inference, 0.0ms loss, 1.9ms postprocess per image

Results saved to runs/detect/train2

ultralytics.utils.metrics.DetMetrics object with attributes:

ap_class_index: array([0])

box: ultralytics.utils.metrics.Metric object

confusion_matrix: <ultralytics.utils.metrics.ConfusionMatrix object at 0x7e89eaff3a50>

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, 0.028028, 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,

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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,

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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, 0.5956, 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,

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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,

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0.058769, 0.057631, 0.055884, 0.054136, 0.052388, 0.050641, 0.048893, 0.047145, 0.045397, 0.04365, 0.039012, 0.034061, 0.029109, 0.019329, 0, 0, 0, 0, 0, 0, 0, 0, 0,

0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0]]), 'Confidence', 'Recall']]

fitness: np.float64(0.7622150544452302)

keys: ['metrics/precision(B)', 'metrics/recall(B)', 'metrics/mAP50(B)', 'metrics/mAP50-95(B)']

maps: array([0.75029, 0.75029])

names: {0: '0', 1: 'object'}

nt_per_class: array([69, 0])

nt_per_image: array([37, 0])

results_dict: {'metrics/precision(B)': np.float64(0.9066502289887122), 'metrics/recall(B)': np.float64(0.8446013347658031), 'metrics/mAP50(B)': np.float64(0.8695035333272602), 'metrics/mAP50-95(B)': np.float64(0.7502941123472268), 'fitness': np.float64(0.7622150544452302)}

save_dir: PosixPath('runs/detect/train2')

speed: {'preprocess': 0.38087456410861564, 'inference': 2.823655769215969, 'loss': 0.0007032564122383543, 'postprocess': 1.8900358205218464}

stats: {'tp': [], 'conf': [], 'pred_cls': [], 'target_cls': [], 'target_img': []}

task: 'detect'

Visualizando os resultados do treino

[ ]

```
from IPython.display import Image
Image(filename='/content/runs/detect/train2/results.png')
```

Testando o modelo em uma imagem

[ ]

```
import cv2
import matplotlib.pyplot as plt
import torch

# Realiza a detecção com confiança mínima baixa
results = model('/content/hardhat_dataset/img/manwithhardhat.jpg', conf=0.05)

# Pega a imagem original
img_path = '/content/hardhat_dataset/img/manwithhardhat.jpg'
img = cv2.imread(img_path)
img = cv2.cvtColor(img, cv2.COLOR_BGR2RGB)

# Pega as caixas, classes e confianças
boxes = results[0].boxes
coords = boxes.xyxy.cpu().numpy()       # Coordenadas das caixas
confs = boxes.conf.cpu().numpy()        # Confiança
clss = boxes.cls.cpu().numpy().astype(int)  # Classes como índices inteiros

# Nome das classes no modelo
names = model.names

# Desenha as caixas
```

```
for i in range(len(coords)):
    x1, y1, x2, y2 = coords[i]
    label = names[clss[i]]
    confidence = confs[i]
    text = f"{label}: {confidence:.2f}"

    # Caixa e texto
    cv2.rectangle(img, (int(x1), int(y1)), (int(x2), int(y2)), (0,255,0), 2)
    cv2.putText(img, text, (int(x1), int(y1)-10),
                cv2.FONT_HERSHEY_SIMPLEX, 0.6, (0,255,0), 2)

# Exibe a imagem com Matplotlib
plt.figure(figsize=(10, 8))
plt.imshow(img)
plt.axis('off')
plt.title("Detecções com Rótulos e Confiança")
plt.show()
```

[ ]

```
model = YOLO('/content/runs/detect/train2/weights/best.pt')
results = model('/content/hardhat_dataset/img/manwithhardhat1.jpg', conf=0.25)
results[0].show()
```

Testando o modelo em um vídeo

[ ]

```
results = model('caminho_para_um_video.mp4', save=True)
```

Produtos pagos do Colab - Cancelar contratos

```
 results = model('caminho_para_um_video.mp4', save=True)
```