In [ ]:
```
!pip install ultralytics
```

```
Collecting ultralytics
  Downloading ultralytics-8.3.170-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) (4.12.0.88)
Requirement already satisfied: pillow>=7.1.2 in /usr/local/lib/python3.11/dist-packages (from ultralytics) (11.3.0)
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) (1.16.0)
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->ultralytic
s) (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->ultralytic
s) (4.59.0)
Requirement already satisfied: kiwisolver>=1.3.1 in /usr/local/lib/python3.11/dist-packages (from matplotlib>=3.3.0->ultralytic
s) (1.4.8)
Requirement already satisfied: packaging>=20.0 in /usr/local/lib/python3.11/dist-packages (from matplotlib>=3.3.0->ultralytics)
(25.0)
Requirement already satisfied: pyparsing>=2.3.1 in /usr/local/lib/python3.11/dist-packages (from matplotlib>=3.3.0->ultralytic
s) (3.2.3)
Requirement already satisfied: python-dateutil>=2.7 in /usr/local/lib/python3.11/dist-packages (from matplotlib>=3.3.0->ultraly
tics) (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) (202
5.2)
Requirement already satisfied: charset-normalizer<4,>=2 in /usr/local/lib/python3.11/dist-packages (from requests>=2.23.0->ultr
alytics) (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->ultralytic
s) (2.5.0)
```

```
Requirement already satisfied: certifi>=2017.4.17 in /usr/local/lib/python3.11/dist-packages (from requests>=2.23.0->ultralytic
s) (2025.7.14)
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->ultraly
tics) (4.14.1)
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) (2025.3.0)
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->ult
ralytics) (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->ultralyt
ics) (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->ultral
ytics) (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->ultralyti
cs) (3.0.2)
Downloading ultralytics-8.3.170-py3-none-any.whl (1.0 MB)
   ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 1.0/1.0 MB 20.0 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 3.0 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 104.9 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 86.9 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 58.1 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 1.7 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 11.6 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 41.1 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 18.6 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 4.7 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 112.7 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-c
uda-nvrtc-cu12, nvidia-cuda-cupti-cu12, nvidia-cublas-cu12, nvidia-cusparse-cu12, nvidia-cudnn-cu12, nvidia-cusolver-cu12, ultr
alytics-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-8.3.170 ultralytics-thop-2.0.14
```

In [ ]:
```
from ultralytics import YOLO
import torch
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.ultralytic
s.com/quickstart/#ultralytics-settings.
```

In [ ]:
```
print("Train images:", len(os.listdir('/content/datasets/brain-tumor/train')))
print("Valid images:", len(os.listdir('/content/datasets/brain-tumor/valid')))
with open('datasets/brain-tumor.yaml', 'r', encoding='utf-8') as f:
    print(f.read())
```

```
Train images: 4
Valid images: 3
# Ultralytics YOLO 🚀, AGPL-3.0 license
# Brain-tumor dataset by Ultralytics
# Documentation: https://docs.ultralytics.com/datasets/detect/brain-tumor/
# Example usage: yolo train data=brain-tumor.yaml
# parent
# ├── ultralytics
# └── datasets
#     └── brain-tumor  ← downloads here (4.05 MB)

# Train/val/test sets as 1) dir: path/to/imgs, 2) file: path/to/imgs.txt, or 3) list: [path/to/imgs1, path/to/imgs2, ..]
path: ../datasets/brain-tumor # dataset root dir
train: train/images # train images (relative to 'path') 893 images
val: valid/images # val images (relative to 'path') 223 images
test: # test images (relative to 'path')

# Classes
names:
  0: negative
  1: positive

# Download script/URL (optional)
download: https://github.com/ultralytics/assets/releases/download/v0.0.0/brain-tumor.zip
```

In [ ]:
```
# Cargar un modelo YOLOv8 pequeño (rápido para dataset pequeño)
model = YOLO('yolov8n.pt')  # también puedes usar yolov8s.pt si tienes buena GPU
```

In [ ]:
```
model.train(
    data='datasets/brain-tumor.yaml',  # Ruta a tu YAML
    epochs=50,                     # número de épocas
    imgsz=640,                     # tamaño de imagen
    batch=8,                       # reduce si tu GPU tiene poca memoria
    device=0                       # 0 = usa la primera GPU disponible, 'cpu' si no tienes GPU
)
```

```
Ultralytics 8.3.170 🚀 Python-3.11.13 torch-2.6.0+cu124 CUDA:0 (NVIDIA A100-SXM4-40GB, 40507MiB)
engine/trainer: agnostic_nms=False, amp=True, augment=False, auto_augment=randaugment, batch=8, 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, da
ta=datasets/brain-tumor.yaml, degrees=0.0, deterministic=True, device=0, dfl=1.5, dnn=False, dropout=0.0, dynamic=False, embed=
None, epochs=50, erasing=0.4, exist_ok=False, fliplr=0.5, flipud=0.0, format=torchscript, fraction=1.0, freeze=None, half=Fals
e, 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=0.0
1, mask_ratio=4, max_det=300, mixup=0.0, mode=train, model=yolov8n.pt, momentum=0.937, mosaic=1.0, multi_scale=False, name=trai
n3, nbs=64, nms=False, opset=None, optimize=False, optimizer=auto, overlap_mask=True, patience=100, perspective=0.0, plots=Tru
e, 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/train3, 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, workspac
e=None
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...
AMP: checks passed ✅
train: Fast image access ✅ (ping: 0.0±0.0 ms, read: 160.0±80.8 MB/s, size: 3.7 KB)
train: Scanning /content/datasets/brain-tumor/train/labels.cache... 878 images, 15 backgrounds, 0 corrupt: 100%|██████████| 893/893 [00:00<?, ?it/s]
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: 116.9±76.9 MB/s, size: 3.4 KB)
val: Scanning /content/datasets/brain-tumor/valid/labels... 223 images, 0 backgrounds, 0 corrupt: 100%|██████████| 223/223 [00:00<00:00, 1336.40it/s]
val: New cache created: /content/datasets/brain-tumor/valid/labels.cache
Plotting labels to runs/detect/train3/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 8 dataloader workers
Logging results to runs/detect/train3
Starting training for 50 epochs...

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
       1/50      1.14G      1.358       3.27      1.212         13        640: 100%|██████████| 112/112 [00:10<00:00, 11.15it/s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 14/14 [00:02<00:00, 6.74it/s]
                   all        223        241      0.478      0.495      0.416       0.26

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
       2/50      1.43G      1.246      2.353       1.16          6        640: 100%|██████████| 112/112 [00:08<00:00, 13.93it/s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 14/14 [00:01<00:00, 12.59it/s]
                   all        223        241      0.406      0.725       0.44      0.291

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
```

```
       3/50      1.45G      1.242      2.004      1.162          6        640: 100%|██████████| 112/112 [00:08<00:00, 13.78it/
s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 14/14 [00:01<00:00,
13.90it/s]
                   all        223        241      0.396      0.643      0.387      0.254

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
       4/50      1.46G      1.234      1.774      1.154          7        640: 100%|██████████| 112/112 [00:07<00:00, 14.14it/
s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 14/14 [00:01<00:00,
13.88it/s]
                   all        223        241      0.451      0.804      0.494      0.339

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
       5/50      1.48G      1.192      1.591      1.146          5        640: 100%|██████████| 112/112 [00:08<00:00, 13.92it/
s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 14/14 [00:00<00:00,
14.48it/s]
                   all        223        241      0.447      0.767      0.455      0.305

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
       6/50       1.5G      1.213      1.525      1.142         12        640: 100%|██████████| 112/112 [00:08<00:00, 13.90it/
s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 14/14 [00:00<00:00,
15.02it/s]
                   all        223        241      0.436      0.669      0.447      0.303

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
       7/50      1.51G      1.164      1.409      1.118         10        640: 100%|██████████| 112/112 [00:08<00:00, 13.97it/
s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 14/14 [00:00<00:00,
14.62it/s]
                   all        223        241      0.464      0.721      0.503      0.351

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
       8/50      1.53G      1.147      1.362      1.115          9        640: 100%|██████████| 112/112 [00:07<00:00, 14.17it/
s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 14/14 [00:00<00:00,
14.13it/s]
                   all        223        241      0.467      0.787      0.494      0.351

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
```

```
       9/50      1.55G      1.136       1.33      1.111          7        640: 100%|██████████| 112/112 [00:08<00:00, 13.77it/
s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 14/14 [00:00<00:00,
14.37it/s]
                   all        223        241      0.471      0.828      0.476       0.33

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      10/50      1.56G      1.101      1.306      1.095          6        640: 100%|██████████| 112/112 [00:08<00:00, 13.68it/
s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 14/14 [00:00<00:00,
14.37it/s]
                   all        223        241      0.458      0.815      0.496      0.362

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      11/50      1.58G      1.076      1.249      1.087         11        640: 100%|██████████| 112/112 [00:07<00:00, 14.05it/
s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 14/14 [00:00<00:00,
14.10it/s]
                   all        223        241      0.462      0.825      0.488      0.345

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      12/50       1.6G      1.077       1.21      1.075          9        640: 100%|██████████| 112/112 [00:07<00:00, 14.21it/
s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 14/14 [00:00<00:00,
14.45it/s]
                   all        223        241      0.445      0.873      0.475      0.341

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      13/50      1.62G      1.066      1.221      1.075          9        640: 100%|██████████| 112/112 [00:08<00:00, 13.99it/
s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 14/14 [00:00<00:00,
14.20it/s]
                   all        223        241      0.429      0.825      0.457      0.316

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      14/50      1.63G      1.083      1.207      1.087          7        640: 100%|██████████| 112/112 [00:08<00:00, 13.73it/
s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 14/14 [00:00<00:00,
14.76it/s]
                   all        223        241      0.449      0.833      0.494      0.355

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
```

```
      15/50      1.65G      1.036      1.169      1.072          5        640: 100%|██████████| 112/112 [00:08<00:00, 13.82it/
s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 14/14 [00:01<00:00,
13.93it/s]
                   all        223        241      0.437      0.848      0.479       0.34

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      16/50      1.67G      1.023       1.17      1.063          6        640: 100%|██████████| 112/112 [00:07<00:00, 14.33it/
s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 14/14 [00:00<00:00,
14.72it/s]
                   all        223        241      0.448      0.826      0.473      0.349

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      17/50      1.69G       1.04      1.145      1.074          8        640: 100%|██████████| 112/112 [00:08<00:00, 13.89it/
s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 14/14 [00:00<00:00,
14.65it/s]
                   all        223        241      0.447      0.852      0.451      0.319

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      18/50       1.7G      1.016      1.149      1.063         11        640: 100%|██████████| 112/112 [00:08<00:00, 13.66it/
s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 14/14 [00:00<00:00,
14.39it/s]
                   all        223        241      0.449      0.825      0.476      0.344

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      19/50      1.72G      1.009      1.118      1.049         12        640: 100%|██████████| 112/112 [00:08<00:00, 13.92it/
s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 14/14 [00:00<00:00,
14.18it/s]
                   all        223        241      0.441      0.862      0.466      0.339

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      20/50      1.74G     0.9867      1.095      1.037          7        640: 100%|██████████| 112/112 [00:07<00:00, 14.01it/
s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 14/14 [00:01<00:00,
13.74it/s]
                   all        223        241      0.437       0.87      0.458      0.321

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
```

```
      21/50      1.75G     0.9807      1.111      1.028          8        640: 100%|██████████| 112/112 [00:08<00:00, 13.91it/
s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 14/14 [00:00<00:00,
14.95it/s]
                   all        223        241      0.472      0.826      0.485      0.344

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      22/50      1.77G     0.9732      1.088      1.044         11        640: 100%|██████████| 112/112 [00:08<00:00, 13.65it/
s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 14/14 [00:00<00:00,
15.07it/s]
                   all        223        241      0.451      0.842      0.484      0.354

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      23/50      1.79G      1.002      1.098      1.035         11        640: 100%|██████████| 112/112 [00:08<00:00, 13.75it/
s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 14/14 [00:00<00:00,
14.59it/s]
                   all        223        241      0.428      0.906      0.453      0.323

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      24/50       1.8G     0.9884      1.059      1.034          9        640: 100%|██████████| 112/112 [00:08<00:00, 13.85it/
s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 14/14 [00:00<00:00,
14.40it/s]
                   all        223        241      0.455      0.879      0.468      0.342

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      25/50      1.82G     0.9728      1.064      1.036          8        640: 100%|██████████| 112/112 [00:08<00:00, 13.90it/
s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 14/14 [00:00<00:00,
14.94it/s]
                   all        223        241      0.425      0.854      0.444      0.318

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      26/50      1.84G     0.9582      1.028      1.037          6        640: 100%|██████████| 112/112 [00:08<00:00, 13.92it/
s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 14/14 [00:00<00:00,
14.53it/s]
                   all        223        241      0.412      0.821      0.428      0.307

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
```

```
      27/50      1.86G     0.9414       1.01      1.006          6        640: 100%|██████████| 112/112 [00:08<00:00, 13.77it/
s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 14/14 [00:00<00:00,
14.41it/s]
                   all        223        241      0.447      0.872      0.479      0.346

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      28/50      1.87G     0.9205      1.012      1.008          7        640: 100%|██████████| 112/112 [00:08<00:00, 13.77it/
s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 14/14 [00:00<00:00,
14.47it/s]
                   all        223        241      0.407      0.818      0.417      0.301

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      29/50      1.89G     0.9018     0.9896      1.007          8        640: 100%|██████████| 112/112 [00:08<00:00, 13.66it/
s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 14/14 [00:00<00:00,
14.37it/s]
                   all        223        241      0.443      0.886      0.487      0.353

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      30/50      1.91G     0.9058     0.9746     0.9978         10        640: 100%|██████████| 112/112 [00:08<00:00, 13.94it/
s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 14/14 [00:00<00:00,
14.97it/s]
                   all        223        241      0.431      0.875      0.454      0.324

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      31/50      1.92G     0.9254     0.9695      1.005         12        640: 100%|██████████| 112/112 [00:08<00:00, 13.72it/
s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 14/14 [00:00<00:00,
14.52it/s]
                   all        223        241      0.411      0.873      0.419        0.3

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      32/50      1.94G     0.9117     0.9401      1.012         12        640: 100%|██████████| 112/112 [00:08<00:00, 13.80it/
s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 14/14 [00:00<00:00,
14.85it/s]
                   all        223        241      0.429      0.856      0.447      0.329

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
```

```
      33/50      1.96G      0.919     0.9647      1.004         12        640: 100%|██████████| 112/112 [00:08<00:00, 13.60it/
s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 14/14 [00:00<00:00,
15.51it/s]
                   all        223        241      0.431      0.864      0.437      0.308

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      34/50      1.98G     0.8899     0.9355      1.004         12        640: 100%|██████████| 112/112 [00:08<00:00, 13.84it/
s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 14/14 [00:00<00:00,
14.74it/s]
                   all        223        241      0.444      0.819      0.484      0.358

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      35/50      1.99G     0.8797     0.9181     0.9893          3        640: 100%|██████████| 112/112 [00:08<00:00, 13.85it/
s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 14/14 [00:00<00:00,
14.47it/s]
                   all        223        241      0.417      0.867      0.439      0.321

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      36/50      2.01G     0.8788     0.9119      0.995         10        640: 100%|██████████| 112/112 [00:08<00:00, 13.75it/
s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 14/14 [00:00<00:00,
14.69it/s]
                   all        223        241      0.417      0.876      0.466      0.348

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      37/50      2.03G     0.8827     0.8934     0.9974          8        640: 100%|██████████| 112/112 [00:07<00:00, 14.04it/
s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 14/14 [00:00<00:00,
14.97it/s]
                   all        223        241      0.432      0.888       0.43      0.308

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      38/50      2.04G     0.8463     0.8355      0.969          6        640: 100%|██████████| 112/112 [00:08<00:00, 13.97it/
s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 14/14 [00:00<00:00,
14.27it/s]
                   all        223        241      0.434      0.847      0.458      0.341

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
```

```
      39/50      2.06G     0.8752     0.8666     0.9928         10        640: 100%|██████████| 112/112 [00:08<00:00, 13.84it/
s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 14/14 [00:00<00:00,
15.08it/s]
                   all        223        241      0.436      0.863      0.449      0.326

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      40/50      2.08G     0.8476     0.8286     0.9713         10        640: 100%|██████████| 112/112 [00:08<00:00, 13.95it/
s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 14/14 [00:00<00:00,
14.52it/s]
                   all        223        241      0.423      0.849      0.453      0.329

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_averag
e', 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
      41/50      2.09G     0.7911     0.8011     0.9576          6        640: 100%|██████████| 112/112 [00:08<00:00, 13.34it/
s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 14/14 [00:00<00:00,
14.83it/s]
                   all        223        241      0.413      0.854      0.443      0.323

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      42/50      2.11G     0.8085     0.7583      0.966          4        640: 100%|██████████| 112/112 [00:08<00:00, 13.71it/
s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 14/14 [00:00<00:00,
14.49it/s]
                   all        223        241      0.418      0.831       0.47      0.347

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      43/50      2.13G     0.7755     0.7419     0.9491          5        640: 100%|██████████| 112/112 [00:08<00:00, 13.97it/
s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 14/14 [00:00<00:00,
14.70it/s]
                   all        223        241      0.423      0.847      0.462      0.341

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
```

```
      44/50      2.14G     0.7623     0.7144     0.9374          5        640: 100%|██████████| 112/112 [00:07<00:00, 14.11it/
s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 14/14 [00:00<00:00,
15.19it/s]
                   all        223        241      0.425       0.81      0.498      0.367

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      45/50      2.16G     0.7676     0.7012     0.9374          5        640: 100%|██████████| 112/112 [00:08<00:00, 13.96it/
s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 14/14 [00:00<00:00,
14.76it/s]
                   all        223        241      0.421       0.83      0.453      0.328

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      46/50      2.18G     0.7764     0.6774     0.9387          5        640: 100%|██████████| 112/112 [00:08<00:00, 13.83it/
s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 14/14 [00:00<00:00,
15.15it/s]
                   all        223        241      0.417       0.844      0.471      0.345

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      47/50       2.2G      0.733     0.6544     0.9248          5        640: 100%|██████████| 112/112 [00:08<00:00, 13.79it/
s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 14/14 [00:00<00:00,
14.93it/s]
                   all        223        241      0.421       0.819      0.498      0.368

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      48/50      2.21G     0.7352     0.6431     0.9247          5        640: 100%|██████████| 112/112 [00:08<00:00, 13.85it/
s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 14/14 [00:00<00:00,
14.34it/s]
                   all        223        241      0.431       0.836      0.487      0.355

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
      49/50      2.23G     0.7319     0.6326     0.9227          5        640: 100%|██████████| 112/112 [00:07<00:00, 14.07it/
s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 14/14 [00:00<00:00,
15.16it/s]
                   all        223        241       0.43       0.828      0.476       0.35

      Epoch    GPU_mem   box_loss   cls_loss   dfl_loss  Instances       Size
```

```
      50/50      2.25G     0.7205     0.6098     0.9171          6        640: 100%|██████████| 112/112 [00:08<00:00, 13.99it/
s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 14/14 [00:00<00:00,
14.69it/s]
                   all        223        241      0.425      0.817       0.47      0.347

50 epochs completed in 0.130 hours.
Optimizer stripped from runs/detect/train3/weights/last.pt, 6.2MB
Optimizer stripped from runs/detect/train3/weights/best.pt, 6.2MB

Validating runs/detect/train3/weights/best.pt...
Ultralytics 8.3.170 🚀 Python-3.11.13 torch-2.6.0+cu124 CUDA:0 (NVIDIA A100-SXM4-40GB, 40507MiB)
Model summary (fused): 72 layers, 3,006,038 parameters, 0 gradients, 8.1 GFLOPs
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 14/14 [00:01<00:00,
10.63it/s]
                   all        223        241       0.42       0.82      0.499      0.367
              negative        142        154      0.545      0.708      0.591      0.437
              positive         81         87      0.296      0.931      0.407      0.298
Speed: 0.1ms preprocess, 0.9ms inference, 0.0ms loss, 1.7ms postprocess per image
Results saved to runs/detect/train3
```

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

```
ap_class_index: array([0, 1])
box: ultralytics.utils.metrics.Metric object
confusion_matrix: <ultralytics.utils.metrics.ConfusionMatrix object at 0x7b26fafc61d0>
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,    0.0070
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0.017017,    0.018018,    0.019019,     0.02002,    0.021021,    0.022022,    0.023023,
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0.99399,     0.99499,       0.996,       0.997,       0.998,       0.999,           1]), array([[    0.97403,     0.97403,
0.96753, ...,           0,           0,           0],
       [    0.98851,     0.98851,     0.97701, ...,           0,           0,           0]]), 'Confidence', 'Recall']]
fitness: np.float64(0.38034850863816727)
keys: ['metrics/precision(B)', 'metrics/recall(B)', 'metrics/mAP50(B)', 'metrics/mAP50-95(B)']
maps: array([    0.43658,     0.29777])
names: {0: 'negative', 1: 'positive'}
nt_per_class: array([154,  87])
nt_per_image: array([142,  81])
results_dict: {'metrics/precision(B)': np.float64(0.42049937790243863), 'metrics/recall(B)': np.float64(0.8195621356540896),
'metrics/mAP50(B)': np.float64(0.4988821680458858), 'metrics/mAP50-95(B)': np.float64(0.3671781020373096), 'fitness': np.floa
t64(0.38034850863816727)}
save_dir: PosixPath('runs/detect/train3')
speed: {'preprocess': 0.14256646636873777, 'inference': 0.942560771301591, 'loss': 0.000536044844227643, 'postprocess': 1.686
6067219723135}
stats: {'tp': [], 'conf': [], 'pred_cls': [], 'target_cls': [], 'target_img': []}
task: 'detect'
```

In [ ]:

```
metrics = model.val()
print(metrics)
```

```
Ultralytics 8.3.170 🚀 Python-3.11.13 torch-2.6.0+cu124 CUDA:0 (NVIDIA A100-SXM4-40GB, 40507MiB)
Model summary (fused): 72 layers, 3,006,038 parameters, 0 gradients, 8.1 GFLOPs
val: Fast image access ✅ (ping: 0.0±0.0 ms, read: 178.4±90.8 MB/s, size: 3.4 KB)
val: Scanning /content/datasets/brain-tumor/valid/labels.cache... 223 images, 0 backgrounds, 0 corrupt: 100%|██████████| 223/223 [00:00<?, ?it/s]
                 Class     Images  Instances      Box(P          R      mAP50  mAP50-95): 100%|██████████| 28/28 [00:01<00:00, 17.38it/s]
```

```
                   all        223        241       0.42      0.819      0.499      0.367
              negative        142        154      0.545      0.708      0.591      0.436
              positive         81         87      0.296      0.931      0.408      0.297
Speed: 0.6ms preprocess, 2.3ms inference, 0.0ms loss, 1.0ms postprocess per image
Results saved to runs/detect/train32
ultralytics.utils.metrics.DetMetrics object with attributes:

ap_class_index: array([0, 1])
box: ultralytics.utils.metrics.Metric object
confusion_matrix: <ultralytics.utils.metrics.ConfusionMatrix object at 0x7b26dda6ce10>
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,    0.00700
7,    0.008008,    0.009009,     0.01001,    0.011011,    0.012012,    0.013013,    0.014014,    0.015015,    0.016016,    0.01
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```

```
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0.96997,     0.97097,     0.97197,     0.97297,     0.97397,     0.97497,     0.97598,     0.97698,     0.97798,     0.97898,
0.97998,     0.98098,     0.98198,     0.98298,     0.98398,
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0.99399,     0.99499,        0.996,        0.997,        0.998,        0.999,            1]), array([[    0.97403,     0.97403,
0.96753, ...,           0,           0,           0],
       [    0.98851,     0.98851,     0.97701, ...,           0,           0,           0]]), 'Confidence', 'Recall']]
fitness: np.float64(0.37978771874022627)
keys: ['metrics/precision(B)', 'metrics/recall(B)', 'metrics/mAP50(B)', 'metrics/mAP50-95(B)']
maps: array([    0.43559,     0.29742])
names: {0: 'negative', 1: 'positive'}
nt_per_class: array([154,  87])
nt_per_image: array([142,  81])
results_dict: {'metrics/precision(B)': np.float64(0.4204970296949163), 'metrics/recall(B)': np.float64(0.8194133452754142), 'me
trics/mAP50(B)': np.float64(0.4993339060856102), 'metrics/mAP50-95(B)': np.float64(0.3665048090351836), 'fitness': np.float64
(0.37978771874022627)}
save_dir: PosixPath('runs/detect/train32')
speed: {'preprocess': 0.5868581704046362, 'inference': 2.3020288565027593, 'loss': 0.0011525201774228388, 'postprocess': 0.9737
175291459123}
stats: {'tp': [], 'conf': [], 'pred_cls': [], 'target_cls': [], 'target_img': []}
task: 'detect'
```

In [ ]:
```
results = model.predict('datasets/brain-tumor/valid/test/metastasis-6.jpg', conf=0.25, save=True)
```

```
image 1/1 /content/datasets/brain-tumor/valid/test/metastasis-6.jpg: 640x480 1 positive, 10.0ms
Speed: 3.2ms preprocess, 10.0ms inference, 2.0ms postprocess per image at shape (1, 3, 640, 480)
Results saved to runs/detect/train317
```

In [ ]:
```
import matplotlib.pyplot as plt

# Convertir la imagen con los resultados a numpy y mostrar
plt.imshow(results[0].plot())  # .plot() dibuja las cajas en la imagen
plt.axis('off')
plt.show()
```