```
!pip install pyyaml==5.1

import torch
TORCH_VERSION = ".".join(torch.__version__.split(".")[:2])
CUDA_VERSION = torch.__version__.split("+")[-1]
print("torch: ", TORCH_VERSION, "; cuda: ", CUDA_VERSION)
# Install detectron2 that matches the above pytorch version
# See https://detectron2.readthedocs.io/tutorials/install.html for instructions
!pip install detectron2 -f https://dl.fbaipublicfiles.com/detectron2/wheels/$CUDA_VERSION/tor
# If there is not yet a detectron2 release that matches the given torch + CUDA version, you r
```

```
     |████████████████████████████████| 749 kB 32.2 MB/s
Requirement already satisfied: numpy in /usr/local/lib/python3.7/dist-packages (from fv
Requirement already satisfied: pyyaml>=5.1 in /usr/local/lib/python3.7/dist-packages (f
Collecting antlr4-python3-runtime==4.8
  Downloading antlr4-python3-runtime-4.8.tar.gz (112 kB)
     |████████████████████████████████| 112 kB 58.1 MB/s
Requirement already satisfied: importlib-resources in /usr/local/lib/python3.7/dist-pac
Collecting portalocker
  Downloading portalocker-2.3.2-py2.py3-none-any.whl (15 kB)
Requirement already satisfied: cython>=0.27.3 in /usr/local/lib/python3.7/dist-packages
Requirement already satisfied: setuptools>=18.0 in /usr/local/lib/python3.7/dist-packag
Requirement already satisfied: cycler>=0.10 in /usr/local/lib/python3.7/dist-packages (
Requirement already satisfied: kiwisolver>=1.0.1 in /usr/local/lib/python3.7/dist-packa
Requirement already satisfied: pyparsing!=2.0.4,!=2.1.2,!=2.1.6,>=2.0.1 in /usr/local/l
Requirement already satisfied: python-dateutil>=2.1 in /usr/local/lib/python3.7/dist-pa
Requirement already satisfied: six>=1.5 in /usr/local/lib/python3.7/dist-packages (from
Requirement already satisfied: zipp>=3.1.0 in /usr/local/lib/python3.7/dist-packages (f
Requirement already satisfied: absl-py>=0.4 in /usr/local/lib/python3.7/dist-packages (
Requirement already satisfied: google-auth-oauthlib<0.5,>=0.4.1 in /usr/local/lib/pytho
Requirement already satisfied: protobuf>=3.6.0 in /usr/local/lib/python3.7/dist-package
Requirement already satisfied: google-auth<3,>=1.6.3 in /usr/local/lib/python3.7/dist-p
Requirement already satisfied: werkzeug>=0.11.15 in /usr/local/lib/python3.7/dist-packa
Requirement already satisfied: wheel>=0.26 in /usr/local/lib/python3.7/dist-packages (f
Requirement already satisfied: requests<3,>=2.21.0 in /usr/local/lib/python3.7/dist-pac
Requirement already satisfied: tensorboard-data-server<0.7.0,>=0.6.0 in /usr/local/lib/
Requirement already satisfied: markdown>=2.6.8 in /usr/local/lib/python3.7/dist-package
Requirement already satisfied: tensorboard-plugin-wit>=1.6.0 in /usr/local/lib/python3.
Requirement already satisfied: grpcio>=1.24.3 in /usr/local/lib/python3.7/dist-packages
Requirement already satisfied: rsa<5,>=3.1.4 in /usr/local/lib/python3.7/dist-packages
Requirement already satisfied: cachetools<5.0,>=2.0.0 in /usr/local/lib/python3.7/dist-
Requirement already satisfied: pyasn1-modules>=0.2.1 in /usr/local/lib/python3.7/dist-p
Requirement already satisfied: requests-oauthlib>=0.7.0 in /usr/local/lib/python3.7/dis
Requirement already satisfied: importlib-metadata in /usr/local/lib/python3.7/dist-pack
Requirement already satisfied: pyasn1<0.5.0,>=0.4.6 in /usr/local/lib/python3.7/dist-pa
Requirement already satisfied: urllib3!=1.25.0,!=1.25.1,<1.26,>=1.21.1 in /usr/local/li
Requirement already satisfied: certifi>=2017.4.17 in /usr/local/lib/python3.7/dist-pack
Requirement already satisfied: chardet<4,>=3.0.2 in /usr/local/lib/python3.7/dist-packa
Requirement already satisfied: idna<3,>=2.5 in /usr/local/lib/python3.7/dist-packages (
Requirement already satisfied: oauthlib>=3.0.0 in /usr/local/lib/python3.7/dist-package
Building wheels for collected packages: fvcore, antlr4-python3-runtime
  Building wheel for fvcore (setup.py) ... done
  Created wheel for fvcore: filename=fvcore-0.1.5.post20211023-py3-none-any.whl size=60
  Stored in directory: /root/.cache/pip/wheels/16/98/fc/252d62cab6263c719120e06b28f3378
  Building wheel for antlr4-python3-runtime (setup.py) ... done
  Created wheel for antlr4-python3-runtime: filename=antlr4_python3_runtime-4.8-py3-non
  Stored in directory: /root/.cache/pip/wheels/ca/33/b7/336836125fc9bb4ceaa4376d8abca10
Successfully built fvcore antlr4-python3-runtime
Installing collected packages: portalocker, antlr4-python3-runtime, yacs, typed-ast, re
  Attempting uninstall: regex
    Found existing installation: regex 2019.12.20
    Uninstalling regex-2019.12.20:
      Successfully uninstalled regex-2019.12.20
Successfully installed antlr4-python3-runtime-4.8 black-21.4b2 detectron2-0.6+cu111 fvc
WARNING: The following packages were previously imported in this runtime:
  [pydevd_plugins]
You must restart the runtime in order to use newly installed versions.
```

RESTART RUNTIME

RESTART RUNTIME

```
import detectron2
from detectron2.utils.logger import setup_logger
setup_logger()

# import some common libraries
import numpy as np
import os, json, cv2, random
from google.colab.patches import cv2_imshow

# import some common detectron2 utilities
from detectron2 import model_zoo
from detectron2.engine import DefaultPredictor
from detectron2.config import get_cfg
from detectron2.utils.visualizer import Visualizer
from detectron2.data import MetadataCatalog, DatasetCatalog
from detectron2.evaluation import PascalVOCDetectionEvaluator


!wget http://host.robots.ox.ac.uk/pascal/VOC/voc2007/VOCtrainval_06-Nov-2007.tar
!tar -xvf VOCtrainval_06-Nov-2007.tar
```

```
VOCdevkit/VOC2007/SegmentationObject/008722.png
VOCdevkit/VOC2007/SegmentationObject/008747.png
VOCdevkit/VOC2007/SegmentationObject/008764.png
VOCdevkit/VOC2007/SegmentationObject/008801.png
VOCdevkit/VOC2007/SegmentationObject/008815.png
VOCdevkit/VOC2007/SegmentationObject/008927.png
VOCdevkit/VOC2007/SegmentationObject/008932.png
VOCdevkit/VOC2007/SegmentationObject/008944.png
VOCdevkit/VOC2007/SegmentationObject/008948.png
VOCdevkit/VOC2007/SegmentationObject/008973.png
VOCdevkit/VOC2007/SegmentationObject/008980.png
VOCdevkit/VOC2007/SegmentationObject/009015.png
VOCdevkit/VOC2007/SegmentationObject/009068.png
VOCdevkit/VOC2007/SegmentationObject/009209.png
VOCdevkit/VOC2007/SegmentationObject/009221.png
```

```
VOCdevkit/VOC2007/SegmentationObject/009221.png
VOCdevkit/VOC2007/SegmentationObject/009245.png
VOCdevkit/VOC2007/SegmentationObject/009251.png
VOCdevkit/VOC2007/SegmentationObject/009252.png
VOCdevkit/VOC2007/SegmentationObject/009295.png
VOCdevkit/VOC2007/SegmentationObject/009323.png
VOCdevkit/VOC2007/SegmentationObject/009327.png
VOCdevkit/VOC2007/SegmentationObject/009331.png
VOCdevkit/VOC2007/SegmentationObject/009348.png
VOCdevkit/VOC2007/SegmentationObject/009392.png
VOCdevkit/VOC2007/SegmentationObject/009413.png
VOCdevkit/VOC2007/SegmentationObject/009419.png
VOCdevkit/VOC2007/SegmentationObject/009422.png
VOCdevkit/VOC2007/SegmentationObject/009446.png
VOCdevkit/VOC2007/SegmentationObject/009458.png
VOCdevkit/VOC2007/SegmentationObject/009464.png

VOCdevkit/VOC2007/SegmentationObject/009527.png
VOCdevkit/VOC2007/SegmentationObject/009533.png
VOCdevkit/VOC2007/SegmentationObject/009550.png
VOCdevkit/VOC2007/SegmentationObject/009562.png
VOCdevkit/VOC2007/SegmentationObject/009580.png
VOCdevkit/VOC2007/SegmentationObject/009597.png
VOCdevkit/VOC2007/SegmentationObject/009605.png
VOCdevkit/VOC2007/SegmentationObject/009618.png
VOCdevkit/VOC2007/SegmentationObject/009649.png
VOCdevkit/VOC2007/SegmentationObject/009654.png
VOCdevkit/VOC2007/SegmentationObject/009655.png
VOCdevkit/VOC2007/SegmentationObject/009684.png
VOCdevkit/VOC2007/SegmentationObject/009687.png
VOCdevkit/VOC2007/SegmentationObject/009691.png
VOCdevkit/VOC2007/SegmentationObject/009706.png
VOCdevkit/VOC2007/SegmentationObject/009709.png
VOCdevkit/VOC2007/SegmentationObject/009724.png
VOCdevkit/VOC2007/SegmentationObject/009756.png
VOCdevkit/VOC2007/SegmentationObject/009764.png
VOCdevkit/VOC2007/SegmentationObject/009794.png
VOCdevkit/VOC2007/SegmentationObject/009807.png
VOCdevkit/VOC2007/SegmentationObject/009832.png
VOCdevkit/VOC2007/SegmentationObject/009841.png
VOCdevkit/VOC2007/SegmentationObject/009897.png
VOCdevkit/VOC2007/SegmentationObject/009911.png
VOCdevkit/VOC2007/SegmentationObject/009923.png
VOCdevkit/VOC2007/SegmentationObject/009938.png
VOCdevkit/VOC2007/SegmentationObject/009947.png
VOCdevkit/VOC2007/SegmentationObject/009950.png
```

```
!mv VOCdevkit datasets


from detectron2.engine import DefaultTrainer

cfg = get_cfg()
cfg.merge_from_file(model_zoo.get_config_file("COCO-Detection/faster_rcnn_R_50_FPN_3x.yaml"))
cfg.OUTPUT_DIR = 'MyVOCTraining'
cfg.DATASETS.TRAIN = ("voc_2007_train",)
```

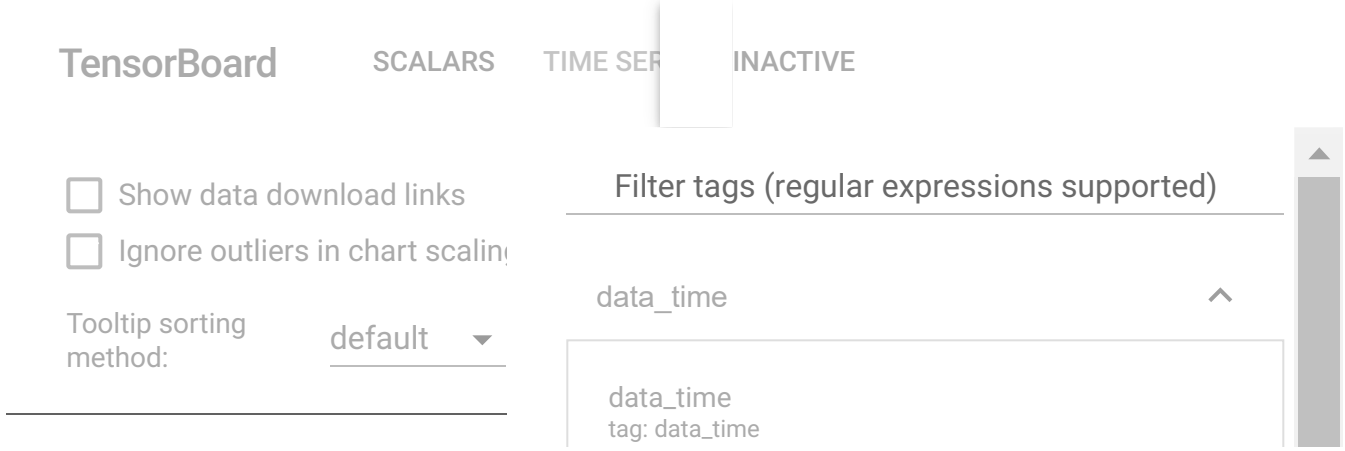
```
cfg.DATASETS.TEST = ()
cfg.DATALOADER.NUM_WORKERS = 1
cfg.MODEL.WEIGHTS = model_zoo.get_checkpoint_url("COCO-Detection/faster_rcnn_R_50_FPN_3x.yaml
cfg.SOLVER.IMS_PER_BATCH = 1
cfg.SOLVER.BASE_LR = 0.00025 # pick a good LR
cfg.SOLVER.MAX_ITER = 3000
cfg.MODEL.ROI_HEADS.BATCH_SIZE_PER_IMAGE = 128
cfg.MODEL.ROI_HEADS.NUM_CLASSES = 20

os.makedirs(cfg.OUTPUT_DIR, exist_ok=True)
trainer = DefaultTrainer(cfg)
trainer.resume_or_load(resume=False)
trainer.train()
```

```
[11/18 06:18:34 d2.engine.defaults]: Model:
GeneralizedRCNN(
  (backbone): FPN(
    (fpn_lateral2): Conv2d(256, 256, kernel_size=(1, 1), stride=(1, 1))
    (fpn_output2): Conv2d(256, 256, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1
    (fpn_lateral3): Conv2d(512, 256, kernel_size=(1, 1), stride=(1, 1))
    (fpn_output3): Conv2d(256, 256, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1
    (fpn_lateral4): Conv2d(1024, 256, kernel_size=(1, 1), stride=(1, 1))
    (fpn_output4): Conv2d(256, 256, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1
    (fpn_lateral5): Conv2d(2048, 256, kernel_size=(1, 1), stride=(1, 1))
    (fpn_output5): Conv2d(256, 256, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1
    (top_block): LastLevelMaxPool()
    (bottom_up): ResNet(
      (stem): BasicStem(
        (conv1): Conv2d(
          3, 64, kernel_size=(7, 7), stride=(2, 2), padding=(3, 3), bias=False
          (norm): FrozenBatchNorm2d(num_features=64, eps=1e-05)
        )
      )
      (res2): Sequential(
        (0): BottleneckBlock(
          (shortcut): Conv2d(
            64, 256, kernel_size=(1, 1), stride=(1, 1), bias=False
            (norm): FrozenBatchNorm2d(num_features=256, eps=1e-05)
          )
          (conv1): Conv2d(
            64, 64, kernel_size=(1, 1), stride=(1, 1), bias=False
            (norm): FrozenBatchNorm2d(num_features=64, eps=1e-05)
          )
          (conv2): Conv2d(
            64, 64, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1), bias=False
            (norm): FrozenBatchNorm2d(num_features=64, eps=1e-05)
          )
          (conv3): Conv2d(
            64, 256, kernel_size=(1, 1), stride=(1, 1), bias=False
            (norm): FrozenBatchNorm2d(num_features=256, eps=1e-05)
          )
        )
        (1): BottleneckBlock(
          (conv1): Conv2d(
            256, 64, kernel_size=(1, 1), stride=(1, 1), bias=False
            (norm): FrozenBatchNorm2d(num_features=64, eps=1e-05)
```

```
    )
    (conv2): Conv2d(
      64, 64, kernel_size=(3, 3), stride=(1, 1), padding=(1, 1), bias=False
      (norm): FrozenBatchNorm2d(num_features=64, eps=1e-05)
    )
    (conv3): Conv2d(
      64, 256, kernel_size=(1, 1), stride=(1, 1), bias=False
      (norm): FrozenBatchNorm2d(num_features=256, eps=1e-05)
    )
  )
  (2): BottleneckBlock(
    (conv1): Conv2d(
      256, 64, kernel_size=(1, 1), stride=(1, 1), bias=False
      (norm): FrozenBatchNorm2d(num_features=64, eps=1e-05)
    )
    (conv2): Conv2d(
```

```
# Look at training curves in tensorboard:
%reload_ext tensorboard
%tensorboard --logdir MyVOCTraining/
```

```
The tensorboard extension is already loaded. To reload it, use:
  %reload_ext tensorboard
```




```
# Inference should use the config with parameters that are used in training
# cfg now already contains everything we've set previously. We changed it a little bit for ir
cfg.MODEL.WEIGHTS = os.path.join(cfg.OUTPUT_DIR, "model_final.pth")  # path to the model we j
cfg.MODEL.ROI_HEADS.SCORE_THRESH_TEST = 0.7   # set a custom testing threshold
predictor = DefaultPredictor(cfg)
```

```
from detectron2.evaluation import PascalVOCDetectionEvaluator, inference_on_dataset
from detectron2.data import build_detection_test_loader
evaluator = PascalVOCDetectionEvaluator("voc_2007_val")
val_loader = build_detection_test_loader(cfg, "voc_2007_val")
print(inference_on_dataset(predictor.model, val_loader, evaluator))
```

```
[11/18 07:20:19 d2.data.dataset_mapper]: [DatasetMapper] Augmentations used in infer
[11/18 07:20:19 d2.data.common]: Serializing 2510 elements to byte tensors and conca
[11/18 07:20:19 d2.data.common]: Serialized dataset takes 1.14 MiB
[11/18 07:20:19 d2.evaluation.evaluator]: Start inference on 2510 batches
/usr/local/lib/python3.7/dist-packages/detectron2/structures/image_list.py:88: UserW
  max_size = (max_size + (stride - 1)) // stride * stride
[11/18 07:20:23 d2.evaluation.evaluator]: Inference done 11/2510. Dataloading: 0.001
[11/18 07:20:28 d2.evaluation.evaluator]: Inference done 26/2510. Dataloading: 0.002
[11/18 07:20:33 d2.evaluation.evaluator]: Inference done 42/2510. Dataloading: 0.002
[11/18 07:20:39 d2.evaluation.evaluator]: Inference done 58/2510. Dataloading: 0.002
[11/18 07:20:44 d2.evaluation.evaluator]: Inference done 74/2510. Dataloading: 0.002
[11/18 07:20:49 d2.evaluation.evaluator]: Inference done 89/2510. Dataloading: 0.002
[11/18 07:20:54 d2.evaluation.evaluator]: Inference done 105/2510. Dataloading: 0.00
[11/18 07:20:59 d2.evaluation.evaluator]: Inference done 121/2510. Dataloading: 0.00
[11/18 07:21:04 d2.evaluation.evaluator]: Inference done 136/2510. Dataloading: 0.00
[11/18 07:21:10 d2.evaluation.evaluator]: Inference done 151/2510. Dataloading: 0.00
[11/18 07:21:15 d2.evaluation.evaluator]: Inference done 167/2510. Dataloading: 0.00
[11/18 07:21:20 d2.evaluation.evaluator]: Inference done 183/2510. Dataloading: 0.00
[11/18 07:21:25 d2.evaluation.evaluator]: Inference done 198/2510. Dataloading: 0.00
[11/18 07:21:30 d2.evaluation.evaluator]: Inference done 213/2510. Dataloading: 0.00
[11/18 07:21:36 d2.evaluation.evaluator]: Inference done 229/2510. Dataloading: 0.00
[11/18 07:21:41 d2.evaluation.evaluator]: Inference done 245/2510. Dataloading: 0.00
[11/18 07:21:46 d2.evaluation.evaluator]: Inference done 261/2510. Dataloading: 0.00
[11/18 07:21:51 d2.evaluation.evaluator]: Inference done 276/2510. Dataloading: 0.00
[11/18 07:21:56 d2.evaluation.evaluator]: Inference done 291/2510. Dataloading: 0.00
[11/18 07:22:02 d2.evaluation.evaluator]: Inference done 307/2510. Dataloading: 0.00
```

```
[11/18 07:22:07 d2.evaluation.evaluator]: Inference done 322/2510. Dataloading: 0.00
[11/18 07:22:12 d2.evaluation.evaluator]: Inference done 337/2510. Dataloading: 0.00
[11/18 07:22:17 d2.evaluation.evaluator]: Inference done 352/2510. Dataloading: 0.00
[11/18 07:22:22 d2.evaluation.evaluator]: Inference done 367/2510. Dataloading: 0.00
[11/18 07:22:27 d2.evaluation.evaluator]: Inference done 383/2510. Dataloading: 0.00
[11/18 07:22:32 d2.evaluation.evaluator]: Inference done 398/2510. Dataloading: 0.00
[11/18 07:22:37 d2.evaluation.evaluator]: Inference done 413/2510. Dataloading: 0.00
[11/18 07:22:42 d2.evaluation.evaluator]: Inference done 428/2510. Dataloading: 0.00
[11/18 07:22:47 d2.evaluation.evaluator]: Inference done 443/2510. Dataloading: 0.00
[11/18 07:22:52 d2.evaluation.evaluator]: Inference done 458/2510. Dataloading: 0.00
[11/18 07:22:58 d2.evaluation.evaluator]: Inference done 474/2510. Dataloading: 0.00
[11/18 07:23:03 d2.evaluation.evaluator]: Inference done 489/2510. Dataloading: 0.00
[11/18 07:23:08 d2.evaluation.evaluator]: Inference done 504/2510. Dataloading: 0.00
[11/18 07:23:13 d2.evaluation.evaluator]: Inference done 519/2510. Dataloading: 0.00
[11/18 07:23:18 d2.evaluation.evaluator]: Inference done 534/2510. Dataloading: 0.00
[11/18 07:23:23 d2.evaluation.evaluator]: Inference done 550/2510. Dataloading: 0.00
[11/18 07:23:28 d2.evaluation.evaluator]: Inference done 565/2510. Dataloading: 0.00
[11/18 07:23:34 d2.evaluation.evaluator]: Inference done 581/2510. Dataloading: 0.00
[11/18 07:23:39 d2.evaluation.evaluator]: Inference done 597/2510. Dataloading: 0.00
[11/18 07:23:44 d2.evaluation.evaluator]: Inference done 612/2510. Dataloading: 0.00
[11/18 07:23:49 d2.evaluation.evaluator]: Inference done 628/2510. Dataloading: 0.00
[11/18 07:23:54 d2.evaluation.evaluator]: Inference done 644/2510. Dataloading: 0.00
[11/18 07:24:00 d2.evaluation.evaluator]: Inference done 660/2510. Dataloading: 0.00
[11/18 07:24:05 d2.evaluation.evaluator]: Inference done 676/2510. Dataloading: 0.00
[11/18 07:24:10 d2.evaluation.evaluator]: Inference done 691/2510. Dataloading: 0.00
[11/18 07:24:15 d2.evaluation.evaluator]: Inference done 707/2510. Dataloading: 0.00
[11/18 07:24:21 d2.evaluation.evaluator]: Inference done 722/2510. Dataloading: 0.00
[11/18 07:24:26 d2.evaluation.evaluator]: Inference done 738/2510. Dataloading: 0.00
[11/18 07:24:31 d2.evaluation.evaluator]: Inference done 753/2510. Dataloading: 0.00
[11/18 07:24:36 d2.evaluation.evaluator]: Inference done 769/2510. Dataloading: 0.00
[11/18 07:24:42 d2.evaluation.evaluator]: Inference done 785/2510. Dataloading: 0.00
[11/18 07:24:47 d2.evaluation.evaluator]: Inference done 800/2510. Dataloading: 0.00
```

```
dataset_dicts = detectron2.data.get_detection_dataset_dicts('voc_2007_val')
for d in random.sample(dataset_dicts, 3):
    im = cv2.imread(d["file_name"])
    outputs = predictor(im)  # format is documented at https://detectron2.readthedocs.io/tutc
    v = Visualizer(im[:, :, ::-1],
                   detectron2.data.MetadataCatalog.get('voc_2007_val'),
                   scale=0.5,
                   )
    out = v.draw_instance_predictions(outputs["instances"].to("cpu"))
    cv2_imshow(out.get_image()[:, :, ::-1])
```