```
# First, install necessary libraries
import time
import boto3
from botocore import UNSIGNED
from botocore.config import Config
import numpy as np
import botocore
import logging
from multiprocessing import Pool, Manager
import pandas as pd
import os
import sys
import functools
from urllib import request



s3 = boto3.client('s3', config=Config(signature_version=UNSIGNED))

def download(bucket, root, retry, counter, lock, path):
    i = 0
    src = path
    dest = f"{root}/{path}"
    while i < retry:
        try:
            if not os.path.exists(dest):
                s3.download_file(bucket, src, dest)
            else:
                logging.info(f"{dest} already exists.")
            with lock:
                counter.value += 1
                if counter.value % 100 == 0:
                    logging.warning(f"Downloaded {counter.value} images.")
            return
        except botocore.exceptions.ClientError as e:
            if e.response['Error']['Code'] == "404":
                logging.warning(f"The file s3://{bucket}/{src} does not exist.")
                return
            i += 1
            logging.warning(f"Sleep {i} and try again.")
            time.sleep(i)
    logging.warning(f"Failed to download the file s3://{bucket}/{src}. Exception: {e}")

def batch_download(bucket, file_paths, root, num_workers=10, retry=10):
    with Pool(num_workers) as p:
        m = Manager()
        counter = m.Value('i', 0)
        lock = m.Lock()
        download_ = functools.partial(download, bucket, root, retry, counter, lock)
        p.map(download_, file_paths)

def http_download(url, path):
    with request.urlopen(url) as f:
        with open(path, "wb") as fout:
            buf = f.read(1024)
            while buf:
                fout.write(buf)
                buf = f.read(1024)

def log_counts(values):
    for k, count in values.value_counts().items():  # Changed iteritems() to items()
        logging.warning(f"{k}: {count}/{len(values)} = {count/len(values):.2f}.")


# Argument Simulation for Colab
class Args:
    root = './open_images_data'
    include_depiction = False
    class_names = "Aircraft,Aeroplane"
    num_workers = 2
    retry = 10
    filter_file = ""
    remove_overlapped = False

args = Args()

# Create root directory if it doesn't exist
```

```
    # Create root directory if it doesn't exist
    os.makedirs(args.root, exist_ok=True)

    # Start processing based on arguments
    bucket = "open-images-dataset"
    names = [e.strip() for e in args.class_names.split(",")]
    class_names = []
    group_filters = []
    percentages = []
    for name in names:
        t = name.split(":")
        class_names.append(t[0].strip())
        if len(t) >= 2 and t[1].strip():
            group_filters.append(t[1].strip())
        else:
            group_filters.append("")
        if len(t) >= 3 and t[2].strip():
            percentages.append(float(t[2].strip()))
        else:
            percentages.append(1.0)

    # Exclude images if a filter file is provided
    excluded_images = set()
    if args.filter_file:
        for line in open(args.filter_file):
            img_id = line.strip()
            if not img_id:
                continue
            excluded_images.add(img_id)

    # Download class description file
    class_description_file = os.path.join(args.root, "class-descriptions-boxable.csv")
    if not os.path.exists(class_description_file):
        url = "https://storage.googleapis.com/openimages/2018_04/class-descriptions-boxable.csv"
        logging.warning(f"Download {url}.")
        http_download(url, class_description_file)

    # Load the class descriptions to filter by selected classes
    class_descriptions = pd.read_csv(class_description_file, names=["id", "ClassName"])
    class_descriptions = class_descriptions[class_descriptions['ClassName'].isin(class_names)]

    # Download images by dataset type (train, validation, test)
    image_files = []
    for dataset_type in ["train", "validation", "test"]:
        image_dir = os.path.join(args.root, dataset_type)
        os.makedirs(image_dir, exist_ok=True)

        annotation_file = f"{args.root}/{dataset_type}-annotations-bbox.csv"
        if not os.path.exists(annotation_file):
            url = f"https://storage.googleapis.com/openimages/2018_04/{dataset_type}/{dataset_type}-annotations-bbox.csv"
            logging.warning(f"Download {url}.")
            http_download(url, annotation_file)
        logging.warning(f"Read annotation file {annotation_file}")
        annotations = pd.read_csv(annotation_file)
        annotations = pd.merge(annotations, class_descriptions, left_on="LabelName", right_on="id", how="inner")
        if not args.include_depiction:
            annotations = annotations.loc[annotations['IsDepiction'] != 1, :]

        # Apply filtering and exclusions
        filtered = []
        for class_name, group_filter, percentage in zip(class_names, group_filters, percentages):
            sub = annotations.loc[annotations['ClassName'] == class_name, :]
            excluded_images |= set(sub['ImageID'].sample(frac=1 - percentage))

            if group_filter == '~group':
                excluded_images |= set(sub.loc[sub['IsGroupOf'] == 1, 'ImageID'])
            elif group_filter == 'group':
                excluded_images |= set(sub.loc[sub['IsGroupOf'] == 0, 'ImageID'])
            filtered.append(sub)

        annotations = pd.concat(filtered)
        annotations = annotations.loc[~annotations['ImageID'].isin(excluded_images), :]

        if args.remove_overlapped:
            images_with_group = annotations.loc[annotations['IsGroupOf'] == 1, 'ImageID']
            annotations = annotations.loc[~(annotations['ImageID'].isin(set(images_with_group)) & (annotations['IsGroupOf'] == 0)), :
        annotations = annotations.sample(frac=1.0)
        logging.warning(f"{dataset_type} bounding boxes size: {annotations.shape[0]}")
        logging.warning("Approximate Image Stats: ")
        log_counts(annotations.drop_duplicates(["ImageID", "ClassName"])["ClassName"])
        logging.warning("Label distribution: ")
        log_counts(annotations['ClassName'])

        sub_annotation_file = f"{args.root}/sub-{dataset_type}-annotations-bbox.csv"
        logging.warning(f"Save {dataset_type} data to {sub_annotation_file}.")
        annotations.to_csv(sub_annotation_file, index=False)
        image_files.extend(f"{dataset_type}/{id}.jpg" for id in set(annotations['ImageID']))

    logging.warning(f"Start downloading {len(image_files)} images.")
    batch_download(bucket, image_files, args.root, args.num_workers, args.retry)
    logging.warning("Task Done.")
```

```
WARNING:root:Read annotation file ./open_images_data/train-annotations-bbox.csv
WARNING:root:train bounding boxes size: 1722
WARNING:root:Approximate Image Stats: 
WARNING:root:Aircraft: 1030/1030 = 1.00.
WARNING:root:Label distribution: 
WARNING:root:Aircraft: 1722/1722 = 1.00.
WARNING:root:Save train data to ./open_images_data/sub-train-annotations-bbox.csv.
WARNING:root:Read annotation file ./open_images_data/validation-annotations-bbox.csv
WARNING:root:validation bounding boxes size: 182
WARNING:root:Approximate Image Stats: 
WARNING:root:Aircraft: 148/148 = 1.00.
WARNING:root:Label distribution: 
WARNING:root:Aircraft: 182/182 = 1.00.
WARNING:root:Save validation data to ./open_images_data/sub-validation-annotations-bbox.csv.
WARNING:root:Read annotation file ./open_images_data/test-annotations-bbox.csv
WARNING:root:test bounding boxes size: 542
WARNING:root:Approximate Image Stats: 
WARNING:root:Aircraft: 430/430 = 1.00.
WARNING:root:Label distribution: 
WARNING:root:Aircraft: 542/542 = 1.00.
WARNING:root:Save test data to ./open_images_data/sub-test-annotations-bbox.csv.
WARNING:root:Start downloading 1608 images.
WARNING:root:Downloaded 100 images.
WARNING:root:Downloaded 200 images.
WARNING:root:Downloaded 300 images.
WARNING:root:Downloaded 400 images.
WARNING:root:Downloaded 500 images.
WARNING:root:Downloaded 600 images.
WARNING:root:Downloaded 700 images.
WARNING:root:Downloaded 800 images.
WARNING:root:Downloaded 900 images.
WARNING:root:Downloaded 1000 images.
WARNING:root:Downloaded 1100 images.
WARNING:root:Downloaded 1200 images.
WARNING:root:Downloaded 1300 images.
WARNING:root:Downloaded 1400 images.
WARNING:root:Downloaded 1500 images.
WARNING:root:Downloaded 1600 images.
WARNING:root:Task Done.
```

```
from google.colab import drive
drive.mount('/content/drive')
```

```
!git clone https://github.com/qfgaohao/pytorch-ssd.git
```

```
fatal: destination path 'pytorch-ssd' already exists and is not an empty directory.
```

```
!pwd
```

```
/content
```

```
import sys
sys.path.append("/content/pytorch-ssd")
```

```
!python /content/pytorch-ssd/train_ssd.py \
    --dataset_type open_images \
    --datasets /content/open_images_data \
    --net mb1-ssd \
    --pretrained_ssd /content/pytorch-ssd/models/mobilenet-v1-ssd-mp-0_675.pth \
    --scheduler cosine \
    --lr 0.01 \
    --t_max 100 \
    --validation_epochs 5 \
    --num_epochs 20 \
    --base_net_lr 0.001 \
    --batch_size 5 \
    --checkpoint_folder /content/pytorch-ssd/models/ \
    --freeze_base_net
```

```
2024-11-11 09:25:33,646 - root - INFO - Epoch: 14, Step: 100, Average Loss: 4.9310, Average Regression Loss 2.0538, Avera
2024-11-11 09:26:11,708 - root - INFO - Epoch: 14, Step: 200, Average Loss: 4.6520, Average Regression Loss 1.9715, Avera
/content/pytorch-ssd/vision/transforms/transforms.py:247: VisibleDeprecationWarning: Creating an ndarray from ragged nes
  mode = random.choice(self.sample_options)
/content/pytorch-ssd/vision/transforms/transforms.py:247: VisibleDeprecationWarning: Creating an ndarray from ragged nes
  mode = random.choice(self.sample_options)
/content/pytorch-ssd/vision/transforms/transforms.py:247: VisibleDeprecationWarning: Creating an ndarray from ragged nes
  mode = random.choice(self.sample_options)
/content/pytorch-ssd/vision/transforms/transforms.py:247: VisibleDeprecationWarning: Creating an ndarray from ragged nes
  mode = random.choice(self.sample_options)
2024-11-11 09:26:49,186 - root - INFO - Epoch: 15, Step: 100, Average Loss: 4.7401, Average Regression Loss 2.0518, Avera
2024-11-11 09:27:22,249 - root - INFO - Epoch: 15, Step: 200, Average Loss: 4.6553, Average Regression Loss 2.0378, Avera
2024-11-11 09:27:31,192 - root - INFO - Epoch: 15, Validation Loss: 6.2867, Validation Regression Loss 2.3003, Validatio
2024-11-11 09:27:31,274 - root - INFO - Saved model /content/pytorch-ssd/models/mb1-ssd-Epoch-15-Loss-6.286716782769491.
/content/pytorch-ssd/vision/transforms/transforms.py:247: VisibleDeprecationWarning: Creating an ndarray from ragged nes
  mode = random.choice(self.sample_options)
/content/pytorch-ssd/vision/transforms/transforms.py:247: VisibleDeprecationWarning: Creating an ndarray from ragged nes
  mode = random.choice(self.sample_options)
/content/pytorch-ssd/vision/transforms/transforms.py:247: VisibleDeprecationWarning: Creating an ndarray from ragged nes
  mode = random.choice(self.sample_options)
/content/pytorch-ssd/vision/transforms/transforms.py:247: VisibleDeprecationWarning: Creating an ndarray from ragged nes
  mode = random.choice(self.sample_options)
2024-11-11 09:28:07,377 - root - INFO - Epoch: 16, Step: 100, Average Loss: 4.9693, Average Regression Loss 2.0573, Avera
2024-11-11 09:28:43,875 - root - INFO - Epoch: 16, Step: 200, Average Loss: 4.6797, Average Regression Loss 2.1022, Avera
/content/pytorch-ssd/vision/transforms/transforms.py:247: VisibleDeprecationWarning: Creating an ndarray from ragged nes
  mode = random.choice(self.sample_options)
/content/pytorch-ssd/vision/transforms/transforms.py:247: VisibleDeprecationWarning: Creating an ndarray from ragged nes
  mode = random.choice(self.sample_options)
/content/pytorch-ssd/vision/transforms/transforms.py:247: VisibleDeprecationWarning: Creating an ndarray from ragged nes
  mode = random.choice(self.sample_options)
/content/pytorch-ssd/vision/transforms/transforms.py:247: VisibleDeprecationWarning: Creating an ndarray from ragged nes
  mode = random.choice(self.sample_options)
2024-11-11 09:29:23,928 - root - INFO - Epoch: 17, Step: 100, Average Loss: 4.8111, Average Regression Loss 2.1033, Avera
2024-11-11 09:30:00,042 - root - INFO - Epoch: 17, Step: 200, Average Loss: 4.6194, Average Regression Loss 1.9990, Avera
/content/pytorch-ssd/vision/transforms/transforms.py:247: VisibleDeprecationWarning: Creating an ndarray from ragged nes
  mode = random.choice(self.sample_options)
/content/pytorch-ssd/vision/transforms/transforms.py:247: VisibleDeprecationWarning: Creating an ndarray from ragged nes
  mode = random.choice(self.sample_options)
/content/pytorch-ssd/vision/transforms/transforms.py:247: VisibleDeprecationWarning: Creating an ndarray from ragged nes
  mode = random.choice(self.sample_options)
/content/pytorch-ssd/vision/transforms/transforms.py:247: VisibleDeprecationWarning: Creating an ndarray from ragged nes
  mode = random.choice(self.sample_options)
2024-11-11 09:30:39,763 - root - INFO - Epoch: 18, Step: 100, Average Loss: 4.6122, Average Regression Loss 1.9634, Avera
2024-11-11 09:31:16,991 - root - INFO - Epoch: 18, Step: 200, Average Loss: 4.4793, Average Regression Loss 1.9149, Avera
/content/pytorch-ssd/vision/transforms/transforms.py:247: VisibleDeprecationWarning: Creating an ndarray from ragged nes
  mode = random.choice(self.sample_options)
/content/pytorch-ssd/vision/transforms/transforms.py:247: VisibleDeprecationWarning: Creating an ndarray from ragged nes
  mode = random.choice(self.sample_options)
/content/pytorch-ssd/vision/transforms/transforms.py:247: VisibleDeprecationWarning: Creating an ndarray from ragged nes
  mode = random.choice(self.sample_options)
/content/pytorch-ssd/vision/transforms/transforms.py:247: VisibleDeprecationWarning: Creating an ndarray from ragged nes
  mode = random.choice(self.sample_options)
2024-11-11 09:31:55,987 - root - INFO - Epoch: 19, Step: 100, Average Loss: 4.4048, Average Regression Loss 1.9591, Avera
2024-11-11 09:32:33,814 - root - INFO - Epoch: 19, Step: 200, Average Loss: 4.4256, Average Regression Loss 1.9658, Avera
2024-11-11 09:32:39,665 - root - INFO - Epoch: 19, Validation Loss: 7.5115, Validation Regression Loss 2.4906, Validatio
2024-11-11 09:32:39,718 - root - INFO - Saved model /content/pytorch-ssd/models/mb1-ssd-Epoch-19-Loss-7.511481892230899.
```

```
!python pytorch-ssd/eval_ssd.py \
    --net mb1-ssd \
    --trained_model /content/pytorch-ssd/models/mb1-ssd-Epoch-19-Loss-4.53431602134261.pth \
    --dataset_type open_images \
    --dataset /content/open_images_data/test \
    --label_file /content/open_images_data/open-images-model-labels.txt \
    --use_cuda True \
    --iou_threshold 0.5 \
    --eval_dir /content/pytorch-ssd/eval_results
# !python /content/pytorch-ssd/eval_ssd.py \
#     --net mb1-ssd \
#     --dataset_type open_images \
#     --dataset /content/open_images_data/test \
#     --trained_model /content/pytorch-ssd/models/mobilenet-v1-ssd-mp-0_675.pth \
#     --label_file /content/open_images_data/open-images-model-labels.txt
```

```
Inference time:  0.018057584762573242
Prediction: 0.057309 seconds.
process image 418
Load Image: 0.017818 seconds.
Inference time:  0.012708425521850586
Prediction: 0.045740 seconds.
process image 419
Load Image: 0.020561 seconds.
Inference time:  0.014165401458740234
Prediction: 0.034618 seconds.
process image 420
Load Image: 0.012233 seconds.
Inference time:  0.009025812149047852
Prediction: 0.025787 seconds.
process image 421
Load Image: 0.004490 seconds.
Inference time:  0.008715391159057617
Prediction: 0.027351 seconds.
process image 422
Load Image: 0.015175 seconds.
Inference time:  0.01001739501953125
Prediction: 0.027545 seconds.
process image 423
Load Image: 0.006459 seconds.
Inference time:  0.00841832160949707
Prediction: 0.032301 seconds.
process image 424
Load Image: 0.026086 seconds.
Inference time:  0.008852720260620117
Prediction: 0.040813 seconds.
process image 425
Load Image: 0.008955 seconds.
Inference time:  0.009454488754272461
Prediction: 0.031151 seconds.
process image 426
Load Image: 0.009100 seconds.
Inference time:  0.008929252624511719
Prediction: 0.035388 seconds.
process image 427
Load Image: 0.015287 seconds.
Inference time:  0.00850820541381836
Prediction: 0.025509 seconds.
process image 428
Load Image: 0.010071 seconds.
Inference time:  0.008764505386352539
Prediction: 0.022185 seconds.
process image 429
Load Image: 0.006225 seconds.
Inference time:  0.009817361831665039
Prediction: 0.024452 seconds.


Average Precision Per-class:
Aircraft: 0.2761467181108383

Average Precision Across All Classes:0.2761467181108383
```

```
### results for original model ###
!python pytorch-ssd/eval_ssd.py \
    --net mb1-ssd \
    --trained_model /content/pytorch-ssd/models/mobilenet-v1-ssd-mp-0_675_pretrain.pth \
    --dataset_type open_images \
    --dataset /content/open_images_data/test \
    --label_file /content/open_images_data/open-images-model-labels.txt \
    --use_cuda True \
    --iou_threshold 0.5 \
    --eval_dir /content/pytorch-ssd/eval_results
```

```
Load Image: 0.008769 seconds.
Inference time:  0.005347728729248047
Prediction: 0.019913 seconds.
process image 420
Load Image: 0.009129 seconds.
Inference time:  0.005290508270263672
Prediction: 0.016429 seconds.
process image 421
Load Image: 0.002997 seconds.
Inference time:  0.005322456359863281
Prediction: 0.020110 seconds.
process image 422
Load Image: 0.010688 seconds.
Inference time:  0.0049822330474853516
Prediction: 0.019521 seconds.
process image 423
Load Image: 0.004372 seconds.
Inference time:  0.005241870880126953
Prediction: 0.020296 seconds.
process image 424
Load Image: 0.018110 seconds.
Inference time:  0.00492405891418457
Prediction: 0.022768 seconds.
process image 425
Load Image: 0.005823 seconds.
Inference time:  0.005351066589355469
Prediction: 0.021889 seconds.
process image 426
Load Image: 0.006161 seconds.
Inference time:  0.0048389434814453125
Prediction: 0.018375 seconds.
process image 427
Load Image: 0.010590 seconds.
Inference time:  0.004818916320800781
Prediction: 0.020329 seconds.
process image 428
Load Image: 0.006949 seconds.
Inference time:  0.004815578460693359
Prediction: 0.019782 seconds.
process image 429
Load Image: 0.005605 seconds.
Inference time:  0.005781888961791992
Prediction: 0.020302 seconds.


Average Precision Per-class:
Aircraft: 0.20173707211643327

Average Precision Across All Classes:0.20173707211643327
```

After fine-tuning the model for 20 epochs, the avg precision for the aircraft class improved from 0.2017 to 0.2761, which is a decent gain. This suggests the model has begun adapting to features of the new dataset but still needs additional fine-tuning or hyperparameter adjustments. To further enhance AP, consider a lower learning rate, increasing the number of epochs.

```
!python /content/pytorch-ssd/convert_to_caffe2_models.py mb1-ssd \
    /content/pytorch-ssd/models/mb1-ssd-Epoch-19-Loss-4.53431602134261.pth \
    /content/open_images_data/open-images-model-labels.txt
```

```
Traceback (most recent call last):
  File "/content/pytorch-ssd/convert_to_caffe2_models.py", line 9, in <module>
    from caffe2.python.onnx.backend import Caffe2Backend as c2
ModuleNotFoundError: No module named 'caffe2'
```

```
!python /content/pytorch-ssd/convert_to_onnx_models.py mb1-ssd \
    /content/pytorch-ssd/models/mb1-ssd-Epoch-19-Loss-4.53431602134261.pth \
    /content/open_images_data/open-images-model-labels.txt
```

```
/content/pytorch-ssd/vision/ssd/ssd.py:135: FutureWarning: You are using `torch.load` with `weights_only=False` (the current
  self.load_state_dict(torch.load(model, map_location=lambda storage, loc: storage))
ONNX model has been saved to /content/pytorch-ssd/models/mb1-ssd.onnx
```

```
!pip install onnx
```

```
Collecting onnx
  Downloading onnx-1.17.0-cp310-cp310-manylinux_2_17_x86_64.manylinux2014_x86_64.whl.metadata (16 kB)
Requirement already satisfied: numpy>=1.20 in /usr/local/lib/python3.10/dist-packages (from onnx) (1.22.0)
Requirement already satisfied: protobuf>=3.20.2 in /usr/local/lib/python3.10/dist-packages (from onnx) (3.20.3)
Downloading onnx-1.17.0-cp310-cp310-manylinux_2_17_x86_64.manylinux2014_x86_64.whl (16.0 MB)
   ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 16.0/16.0 MB 105.4 MB/s eta 0:00:00
Installing collected packages: onnx
Successfully installed onnx-1.17.0
```

```
import onnx

# Load the saved ONNX model
onnx_model_path = "/content/pytorch-ssd/models/mb1-ssd.onnx"
model = onnx.load(onnx_model_path)

# Verify the model’s structure
try:
    onnx.checker.check_model(model)
    print("The ONNX model structure is valid.")
except onnx.checker.ValidationError as e:
    print("The ONNX model structure is invalid:", e)
```

```
The ONNX model structure is valid.
```

```
!pip install onnxruntime
```

```
Collecting onnxruntime
  Downloading onnxruntime-1.20.0-cp310-cp310-manylinux_2_27_x86_64.manylinux_2_28_x86_64.whl.metadata (4.4 kB)
Collecting coloredlogs (from onnxruntime)
  Downloading coloredlogs-15.0.1-py2.py3-none-any.whl.metadata (12 kB)
Requirement already satisfied: flatbuffers in /usr/local/lib/python3.10/dist-packages (from onnxruntime) (24.3.25)
Requirement already satisfied: numpy>=1.21.6 in /usr/local/lib/python3.10/dist-packages (from onnxruntime) (1.22.0)
Requirement already satisfied: packaging in /usr/local/lib/python3.10/dist-packages (from onnxruntime) (24.1)
Requirement already satisfied: protobuf in /usr/local/lib/python3.10/dist-packages (from onnxruntime) (3.20.3)
Requirement already satisfied: sympy in /usr/local/lib/python3.10/dist-packages (from onnxruntime) (1.13.1)
Collecting humanfriendly>=9.1 (from coloredlogs->onnxruntime)
  Downloading humanfriendly-10.0-py2.py3-none-any.whl.metadata (9.2 kB)
Requirement already satisfied: mpmath<1.4,>=1.1.0 in /usr/local/lib/python3.10/dist-packages (from sympy->onnxruntime) (1.3.
Downloading onnxruntime-1.20.0-cp310-cp310-manylinux_2_27_x86_64.manylinux_2_28_x86_64.whl (13.3 MB)
   ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 13.3/13.3 MB 104.5 MB/s eta 0:00:00
Downloading coloredlogs-15.0.1-py2.py3-none-any.whl (46 kB)
   ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 46.0/46.0 kB 3.6 MB/s eta 0:00:00
Downloading humanfriendly-10.0-py2.py3-none-any.whl (86 kB)
   ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 86.8/86.8 kB 8.0 MB/s eta 0:00:00
Installing collected packages: humanfriendly, coloredlogs, onnxruntime
Successfully installed coloredlogs-15.0.1 humanfriendly-10.0 onnxruntime-1.20.0
```

```
import onnxruntime as ort
import numpy as np

# Define the model path and create an ONNX Runtime inference session
onnx_model_path = "/content/pytorch-ssd/models/mb1-ssd.onnx"
session = ort.InferenceSession(onnx_model_path)

# Display the model's input and output names for reference
input_name = session.get_inputs()[0].name
output_names = [output.name for output in session.get_outputs()]
print("Input Name:", input_name)
print("Output Names:", output_names)

# Create a dummy input tensor with the shape expected by the model (e.g., batch size 1, 3 channels, 300x300 image)
dummy_input = np.random.randn(1, 3, 300, 300).astype(np.float32)

# Run the model and get the output
outputs = session.run(output_names, {input_name: dummy_input})

# Show the output for inspection
print("Model output scores:", outputs[0])  # Output scores
print("Model output boxes:", outputs[1])    # Output bounding boxes
```

```
Input Name: input.1
Output Names: ['scores', 'boxes']
Model output scores: [[[0.9812401  0.01875984]
```

```
   [0.9896458  0.01035417]
   [0.95239407 0.04760591]
   ...
   [0.8913681  0.10863195]
   [0.92840225 0.07159783]
   [0.90786034 0.09213968]]]
 Model output boxes: [[[ 2.0111270e-02  2.3486909e-02  9.2707910e-02  9.7269580e-02]
   [-7.3224351e-02 -9.2235573e-02  1.3922818e-01  1.4815557e-01]
   [ 1.2119297e-02  3.6112197e-02  7.8048974e-02  7.4776717e-02]
   ...
   [ 2.3496449e-03  5.3672940e-02  9.5140386e-01  9.9243689e-01]
   [ 1.5386701e-02  3.9926052e-02  9.5258874e-01  9.8600960e-01]
   [ 3.3587217e-04  3.8519919e-02  9.4960421e-01  9.9136883e-01]]]
```

Start coding or generate with AI.

Step 5

```
import numpy as np
import torch
import onnxruntime as ort
from PIL import Image
import torchvision.transforms as transforms
import cv2
import matplotlib.pyplot as plt

pytorch_model_path = "/content/pytorch-ssd/models/mb1-ssd-Epoch-19-Loss-4.53431602134261.pth"
onnx_model_path = "/content/pytorch-ssd/models/mb1-ssd.onnx"

image_paths = ["/content/open_images_data/test/test/00835f0fbe950715.jpg", "/content/open_images_data/test/test/01d4c269fd96589d.



# Preprocess images
def preprocess_image(image_path):
    image = Image.open(image_path).convert("RGB")
    transform = transforms.Compose([
        transforms.Resize((300, 300)),
        transforms.ToTensor(),
    ])
    image = transform(image)
    return image.unsqueeze(0)  # Add batch dimension


images = [preprocess_image(path) for path in image_paths]




from vision.ssd.mobilenetv1_ssd import create_mobilenetv1_ssd


num_classes = 2  # Adjust this based on your dataset
model = create_mobilenetv1_ssd(num_classes=num_classes, is_test=True)
model.load_state_dict(torch.load(pytorch_model_path))
model = model.to("cuda")


def run_pytorch_inference(model, image_tensor):
    model.eval()
    with torch.no_grad():
        scores, boxes = model(image_tensor.to("cuda"))
    return scores.cpu().numpy(), boxes.cpu().numpy()

pytorch_scores, pytorch_boxes = run_pytorch_inference(model, images[0].to("cuda"))
```

```
<ipython-input-51-332911b6a0e1>:7: FutureWarning: You are using `torch.load` with `weights_only=False` (the current default
  model.load_state_dict(torch.load(pytorch_model_path))
```

```
#ONNX runtime
ort_session = ort.InferenceSession(onnx_model_path)
```

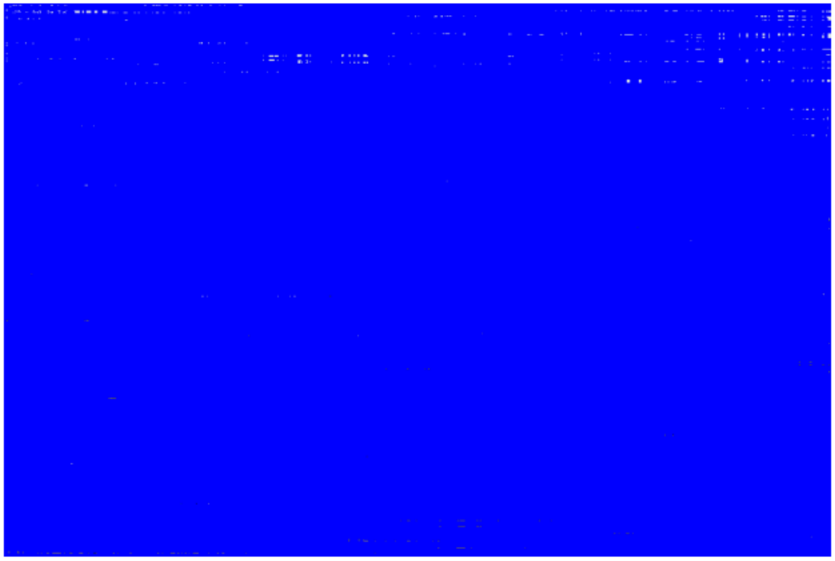
```
def run_onnx_inference(session, image_tensor):
    ort_inputs = {session.get_inputs()[0].name: image_tensor.numpy()}
    ort_outs = session.run(None, ort_inputs)
    return ort_outs[0], ort_outs[1]

onnx_scores, onnx_boxes = run_onnx_inference(ort_session, images[0])



# Compar
def compare_outputs(pytorch_output, onnx_output, tolerance=1e-5):
    return np.allclose(pytorch_output, onnx_output, atol=tolerance)

scores_match = compare_outputs(pytorch_scores, onnx_scores)
boxes_match = compare_outputs(pytorch_boxes, onnx_boxes)
print(f"Do PyTorch and ONNX outputs match? Scores: {scores_match}, Boxes: {boxes_match}")
```

```
Do PyTorch and ONNX outputs match? Scores: True, Boxes: True
```

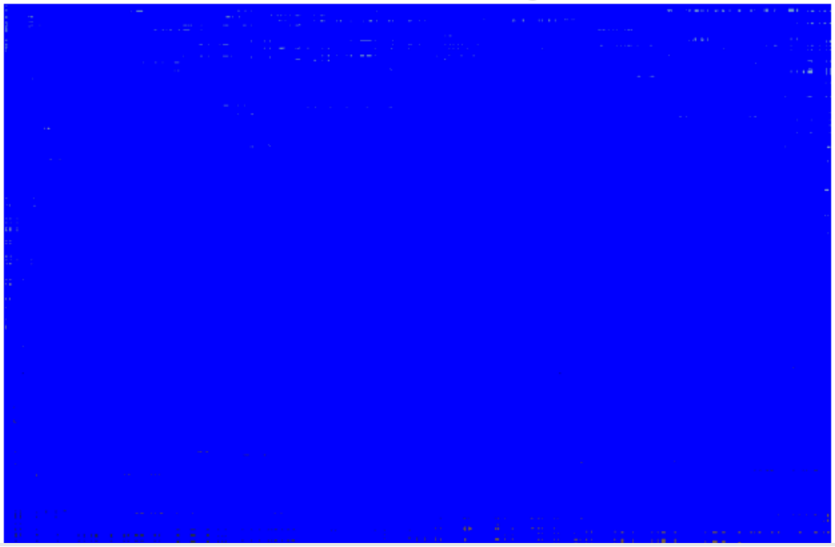
```
# Run inference with ONNX
ort_outputs = [run_onnx_inference(ort_session, img) for img in images]

for i, (scores, boxes) in enumerate(ort_outputs):
    print(f"Image {i+1} Output Scores:\n{scores}")
    print(f"Image {i+1} Output Boxes:\n{boxes}")
```

```
Image 1 Output Scores:
[[[0.98609936 0.01390067]
  [0.9922368  0.00776316]
  [0.9765129  0.02348709]
  ...
  [0.9138311  0.08616882]
  [0.88797045 0.11202951]
  [0.9385606  0.06143935]]]
Image 1 Output Boxes:
[[[ 8.45224783e-03  2.31708027e-02  9.94724482e-02  1.12552494e-01]
  [-8.86582881e-02 -7.63940066e-02  1.41702831e-01  1.68326065e-01]
  [-1.40358098e-02  3.18231136e-02  7.93265849e-02  8.37286040e-02]
  ...
  [ 1.00037754e-02  1.18435740e-01  9.29769278e-01  9.42582250e-01]
  [-5.73217869e-04  2.08032310e-01  9.53017712e-01  8.61026227e-01]
  [ 3.70020866e-02  8.51177275e-02  9.04490709e-01  9.65587258e-01]]]
Image 2 Output Scores:
[[[0.99659616 0.00340383]
  [0.99416274 0.00583728]
  [0.9891417  0.01085833]
  ...
  [0.87978977 0.12021025]
  [0.75105    0.24894999]
  [0.907893   0.09210702]]]
Image 2 Output Boxes:
[[[ 0.01511099  0.01073169  0.09782965  0.09936808]
  [-0.09298997 -0.12491205  0.14805041  0.19104698]
  [-0.01706864  0.02830485  0.04191089  0.07009736]
  ...
  [ 0.09663793  0.16920671  0.9310106   0.9239807 ]
  [ 0.09857202  0.24746355  0.9572005   0.83869374]
  [ 0.12153351  0.13733792  0.9105358   0.9365696 ]]]
```

```
def annotate_image(image_path, boxes, scores, threshold=0.5):
    image = cv2.imread(image_path)
    h, w, _ = image.shape
    for i in range(len(scores)):
        if scores[i][0] > threshold:  # Adjust threshold as needed
            box = boxes[i]
            box = [int(b) for b in [box[0] * w, box[1] * h, box[2] * w, box[3] * h]]
            cv2.rectangle(image, (box[0], box[1]), (box[2], box[3]), (255, 0, 0), 2)
            cv2.putText(image, f"{scores[i][0]:.2f}", (box[0], box[1]-10), cv2.FONT_HERSHEY_SIMPLEX, 0.5, (255, 0, 0), 1)
    return image



# Annotate
for i, img_path in enumerate(image_paths):
    annotated_image = annotate_image(img_path, ort_outputs[i][1][0], ort_outputs[i][0][0])  # using ONNX output
    plt.figure(figsize=(8, 8))
    plt.imshow(cv2.cvtColor(annotated_image, cv2.COLOR_BGR2RGB))
    plt.title(f"Inference Result for Image {i+1}")
    plt.axis("off")
    plt.show()
```



Inference Result for Image 1



Inference Result for Image 2

Start coding or generate with AI.