MobilenetSSD : A Machine Learning Model for Fast Object Detection

David Cochard · Follow

Published in axinc-ai · 5 min read · May 24, 2021

This is an introduction to「MobilenetSSD」, a machine learning model that can be used with ailia SDK. You can easily use this model to create AI applications using ailia SDK as well as many other ready-to-use ailia MODELS.

Overview

MobilenetSSD is an object detection model that computes the bounding box and category of an object from an input image. This *Single Shot Detector* (SSD) object detection model uses *Mobilenet* as backbone and can achieve fast object detection optimized for mobile devices.

SSD: Single Shot MultiBox Detector

We present a method for detecting objects in images using a single deep neural network. Our approach, named SSD...

arxiv.org

MobileNets: Efficient Convolutional Neural Networks for Mobile Vision Applications

We present a class of efficient models called MobileNets for mobile and embedded vision applications. MobileNets are...

arxiv.org

Architecture

*MobilenetSSD*takes a (3,300,300) image as input and outputs (1,3000,4) *boxes* and (1,3000,21) *scores*. *Boxes* contains offset values (cx,cy,w,h) from the default box. *Scores* contains confidence values for the presence of each of the 20 object categories, the value 0 being reserved for the background.

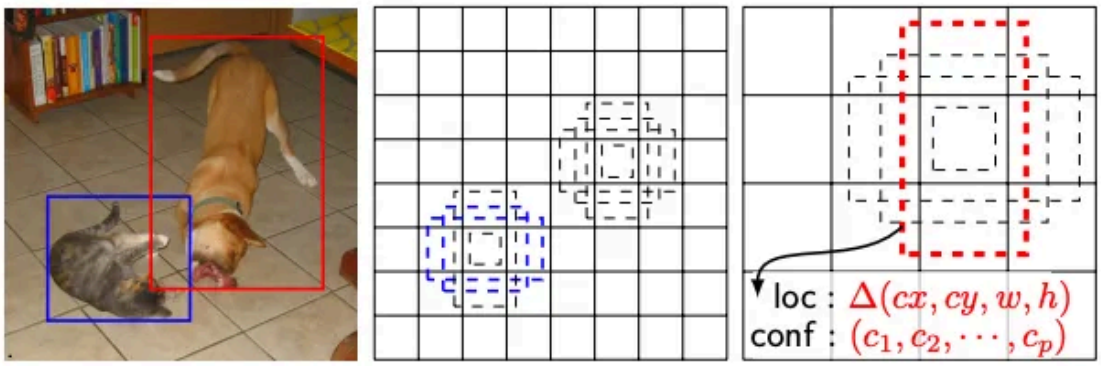


Fig. 1: **SSD framework.** (a) SSD only needs an input image and ground truth boxes for each object during training. In a convolutional fashion, we evaluate a small set (e.g. 4) of default boxes of different aspect ratios at each location in several feature maps with different scales (e.g. 8×8 and 4×4 in (b) and (c)). For each default box, we predict both the shape offsets and the confidences for all object categories ($(c_1, c_2, \cdots, c_p)$). At training time, we first match these default boxes to the ground truth boxes. For example, we have matched two default boxes with the cat and one with the dog, which are treated as positives and the rest as negatives. The model loss is a weighted sum between localization loss (e.g. Smooth L1 [6]) and confidence loss (e.g. Softmax).

Source: https://arxiv.org/pdf/1512.02325.pdf

In SSD, after extracting the features using an arbitrary backbone, the bounding boxes are calculated at each resolution while reducing the resolution with *Extra Feature Layers*. *MobilenetSSD* will concatenate the output of the six levels of resolution and calculate a total of 3000 bounding boxes, and finally, filter out bounding boxes using non-maximum suppression (nms).

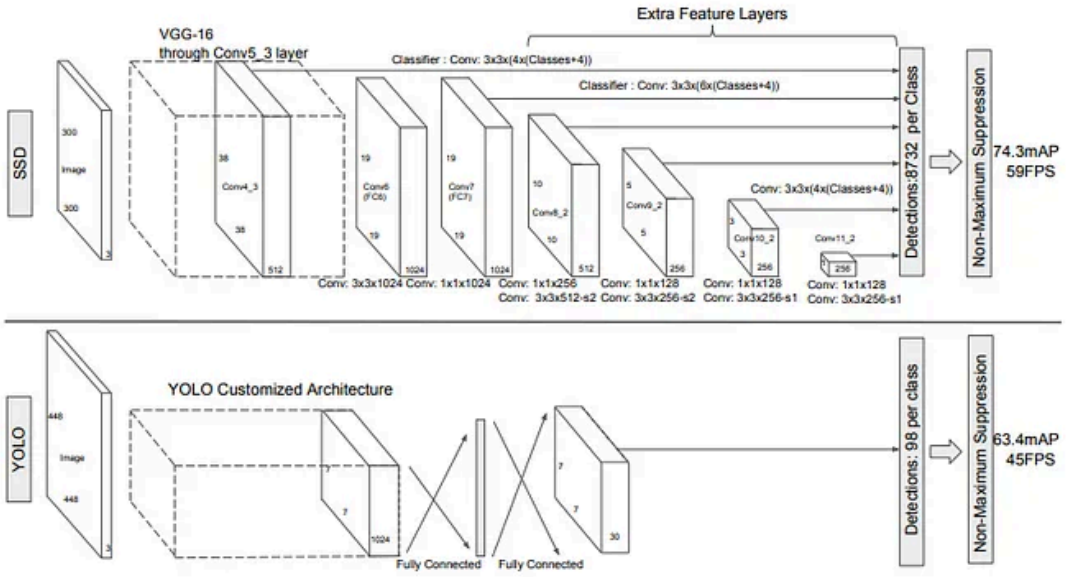


Fig. 2: A comparison between two single shot detection models: SSD and YOLO [5]. Our SSD model adds several feature layers to the end of a base network, which predict the offsets to default boxes of different scales and aspect ratios and their associated confidences. SSD with a 300 × 300 input size significantly outperforms its 448 × 448 YOLO counterpart in accuracy on VOC2007 `test` while also improving the speed.

Source: https://arxiv.org/pdf/1512.02325.pdf

The configuration of *MobilenetSSD* is shown below. A default box size is defined in *SSDSpec* for each resolution.

```
image_size = 300
image_mean = np.array([127, 127, 127]) # RGB layout
image_std = 128.0
```

> *iou_threshold = 0.45*
> *center_variance = 0.1*
> *size_variance = 0.2*
>
> *specs = [*
> *SSDSpec(19, 16, SSDBoxSizes(60, 105), [2, 3]),*
> *SSDSpec(10, 32, SSDBoxSizes(105, 150), [2, 3]),*
> *SSDSpec(5, 64, SSDBoxSizes(150, 195), [2, 3]),*
> *SSDSpec(3, 100, SSDBoxSizes(195, 240), [2, 3]),*
> *SSDSpec(2, 150, SSDBoxSizes(240, 285), [2, 3]),*
> *SSDSpec(1, 300, SSDBoxSizes(285, 330), [2, 3])*
> *]*

qfgaohao/pytorch-ssd

MobileNetV1, MobileNetV2, VGG based SSD/SSD-lite implementation in Pytorch 1.0 / Pytorch 0.4. Out-of-box support...

github.com

SSDSpec is defined as follows.

> *SSDSpec = collections.namedtuple('SSDSpec', ['feature_map_size', 'shrinkage', 'box_sizes', 'aspect_ratios'])*

In the case of `SSDSpec(19, 16, SSDBoxSizes(60, 105), [2, 3])`, a total of six boxes are defined with sizes 60x60, 105x105, as well as sizes 120x60, 60x120, 210x105 and 105x210 for the aspect ratio of 2.

qfgaohao/pytorch-ssd

You can’t perform that action at this time. You signed in with another tab or window. You signed out in another tab or...

github.com

Six levels of recognition results are concatenated, producing a total of 3000 bounding boxes.

Usage

The sample below demonstrates how to use *MobilenetSSD* with ailia SDK.

axinc-ai/ailia-models

Ailia input shape(1, 3, 300, 300) Range:[0, 1] Automatically downloads the onnx and prototxt files on the first run. It...

github.com

The following command runs the model on the web camera video stream.

```
$ python3 mobilenet_ssd.py -v 0
```

Input image (Source: https://pixabay.com/ja/photos/%E3%83%AD%E3%83%B3%E3%83%89%E3%83%B3%E5%B8%82-%E9%8A%80%E8%A1%8C-%E3%83%AD%E3%83%B3%E3%83%89%E3%83%B3-4481399/)

Inference result

Train MobilenetSSD on your own data

`pytorch-ssd` can be used to train *MobilenetSSD* on your own data.

qfgaohao/pytorch-ssd

This repo implements SSD (Single Shot MultiBox Detector). The implementation is heavily influenced by the projects...

github.com

Since `pytorch-ssd` uses lambda objects in *DataLoader*, it cannot be used on Windows, only Mac or Linux are supported.

Can't pickle local object 'DataLoader.__init__. . '

Hi all, I hope everybody reading this is having a great day. So I have a problem with torchvision.transforms.Lambda()...

discuss.pytorch.org

The data format for training follows the open-image-dataset format. The following four files are required for training.

> */dataset/open_images_mixed/sub-test-annotations-bbox.csv*
> */dataset/open_images_mixed/sub-train-annotations-bbox.csv*
> */dataset/open_images_mixed/train/images.jpg*
> */dataset/open_images_mixed/test/images.jpg*

The format of the csv is as follows.

> *ImageID,Source,LabelName,Confidence,XMin,XMax,YMin,YMax,IsOccluded,IsTruncated,IsGroupOf,IsDepiction,IsInside,id,ClassName*

ImageId is the file name of the image (without extension), *Xmin* to *YMax* is the bounding box from 0 to 1, and *ClassName* is the category. Here is an example.

> *img_591,xclick,/m/0gxl3,1,0.40920866666666667,0.08862621809744783,0.7894286666666666,0.6620986078886312,0,0,0,0,0,/m/0gxl3,Handgun*

Place the training image in the `train` folder, where it will be referenced as `ImageId.jpg`

Training is done by transfer learning, so first download the trained model.

> *wget -P models https://storage.googleapis.com/models-hao/mb2-ssd-lite-mp-0_686.pth*

And run the training script.

> *python3 train_ssd.py — dataset_type open_images — datasets ./dataset — net mb2-ssd-lite — pretrained_ssd models/mb2-ssd-lite-mp-0_686.pth — scheduler cosine — lr 0.001 — t_max 100 — validation_epochs 5 — num_epochs 100 — base_net_lr 0.001 — batch_size 5*

The results of the training and `open-images-model-labels.txt` will be output to the `models` folder, which will take about 38 hours to train on a MacBookPro13 CPU.

Finally, check your training results.

> *python3 run_ssd_example.py mb2-ssd-lite models/mb2-ssd-lite-Epoch-80-Loss-2.4882763324521524.pth models/open-images-model-labels.txt input.jpg*

Since ailia SDK requires export with `opset=10`, add `opset_version=10` to `torch.onnx.export` in `convert_to_caffe2_models.py`

> *torch.onnx.export(net, dummy_input, model_path, verbose=False, output_names=['scores', 'boxes'], opset_version=10)*

Export to ONNX so that it can be used with ailia SDK.

> *python3 convert_to_caffe2_models.py mb2-ssd-lite models/mb2-ssd-lite-Epoch-80-Loss-2.4882763324521524.pth models/open-images-model-labels.txt*

See below for a sample that goes from training to conversion to ONNX.

axinc-ai/mobilenetssd-face

Pytorch 1.0 Windows is not working...

github.com

Related topics

YOLOv3 : A machine learning model to detect the position and type of an object

This is an introduction to「YOLOv3」, a machine learning model that can be used with ailia SDK. You can easily use this...

medium.com

YOLOv4 : A Machine Learning Model to Detect the Position and Type of an Object

This is an introduction to「YOLOv4」, a machine learning model that can be used with ailia SDK. You can easily use this...

medium.com

YOLOv5 : The Latest Model for Object Detection

This is an introduction to「YOLOv5」, a machine learning model that can be used with ailia SDK. You can easily use this...

medium.com

M2Det : Highly Accurate Object Detection Model

medium.com

ax Inc. has developed ailia SDK, which enables cross-platform, GPU-based rapid inference.

ax Inc. provides a wide range of services from consulting and model creation, to the development of AI-based applications and SDKs. Feel free to contact us for any inquiry.

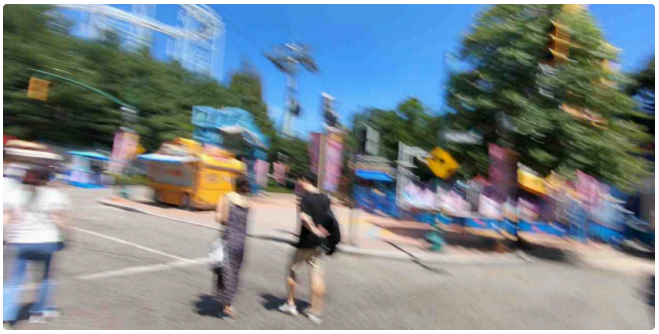
Ailia Models | Machine Learning | Deep Learning | AI | Yolo

Written by David Cochard

434 Followers · Editor for axinc-ai

Follow

More from David Cochard and axinc-ai



David Cochard in axinc-ai

NAFNET : A Machine Learning Model to Deblur Images

This is an introduction to「NAFNET」, a machine learning model that can be used wit...

4 min read · Mar 28, 2024

4

David Cochard in axinc-ai

RVC: An AI-Powered Voice Changer

This is an introduction to「RVC」, a machine learning model that can be used with ailia...

7 min read · Jan 7, 2024

20