SSD: Single Shot MultiBox Detector

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We present a method for detecting objects in images using a single deep neural network. Our approach, named SSD, discretizes the output space of bounding boxes into a set of default boxes over different aspect ratios and scales per feature map location. At prediction time, the network generates scores for the presence of each object category in each default box and produces adjustments to the box to better match the object shape. Additionally, the network combines predictions from multiple feature maps with different resolutions to naturally handle objects of various sizes. Our SSD model is simple relative to methods that require object proposals because it completely eliminates proposal generation and subsequent pixel or feature resampling stage and encapsulates all computation in a single network. This makes SSD easy to train and straightforward to integrate into systems that require a detection component. Experimental results on the PASCAL VOC, MS COCO, and ILSVRC datasets confirm that SSD has comparable accuracy to methods that utilize an additional object proposal step and is much faster, while providing a unified framework for both training and inference. Compared to other single stage methods, SSD has much better accuracy, even with a smaller input image size. For 300×300 input, SSD achieves 72.1% mAP on VOC2007 test at 58 FPS on a Nvidia Titan X and for 500×500 input, SSD achieves 75.1% mAP, outperforming a comparable state of the art Faster R-CNN model. Code is available at https://github.com/weiliu89/caffe/tree/ssd . (show less)

PDF Abstract

Code

Edit

weiliu89/caffe official	★ 4,380	
open-mmlab/mmdetection	★ 13,715	PyTorch
amdegroot/ssd.pytorch	★ 4,170	PyTorch
balancap/SSD-Tensorflow	★ 3,991	TensorFlow
tryolabs/luminoth	★ 2,344	TensorFlow

See all 194 implementations

Tasks

Edit

OBJECT DETECTION

Datasets

Edit

PASCAL VOC

Results from the Paper

Edit

Ranked #1 on Object Detection on PASCAL VOC 2012

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TASK	DATASET	MODEL	METRIC NAME	METRIC VALUE	GLOBAL RANK	RESULT	BENCHMARK
Object Detection	COCO test-dev	SSD512	box AP	28.8	# 104		Compare
			AP50	48.5	# 89		Compare
			AP75	30.3	# 96		Compare

Object Detection	PASCAL VOC 2007	SSD512 (07+12+COCO)	MAP	81.6%	# 9	Compare
Object Detection	PASCAL VOC 2012	SSD512 (07+12+COCO)	MAP	80	# 1	Compare

Methods used in the Paper

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METHOD	TYPE
1x1 Convolution	Convolutions
Convolution	Convolutions
Dense Connections	Feedforward Networks
Dropout	Regularization
Max Pooling	Pooling Operations
Non Maximum Suppression	Proposal Filtering
ReLU	Activation Functions
SGD with Momentum	Stochastic Optimization
Softmax	Output Functions
SSD	Object Detection Models
VGG	Convolutional Neural Networks
Weight Decay	Regularization