Raster Imagery and Deep Learning

Deep Learning in Remote Sensing

Episode-3

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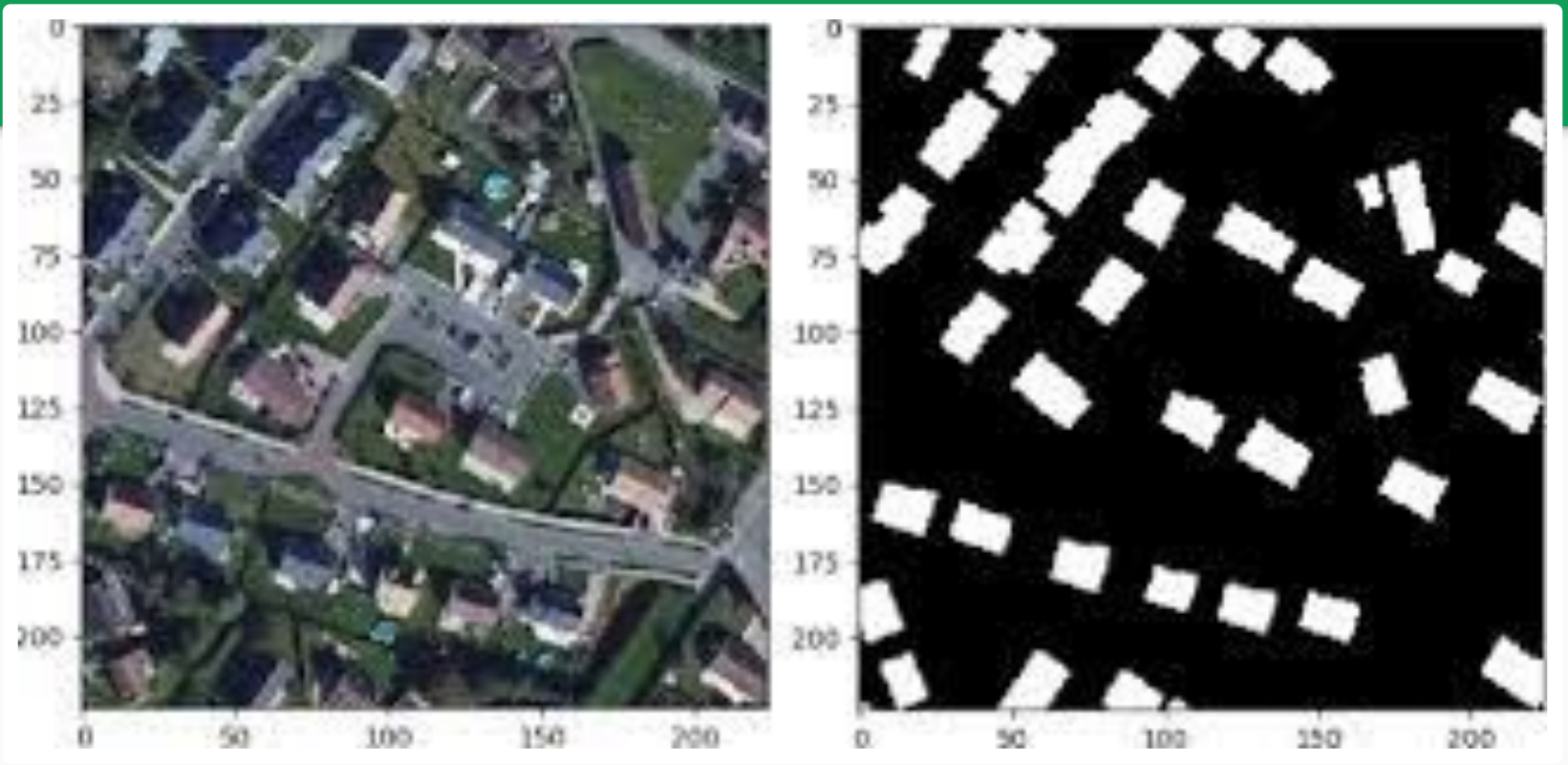
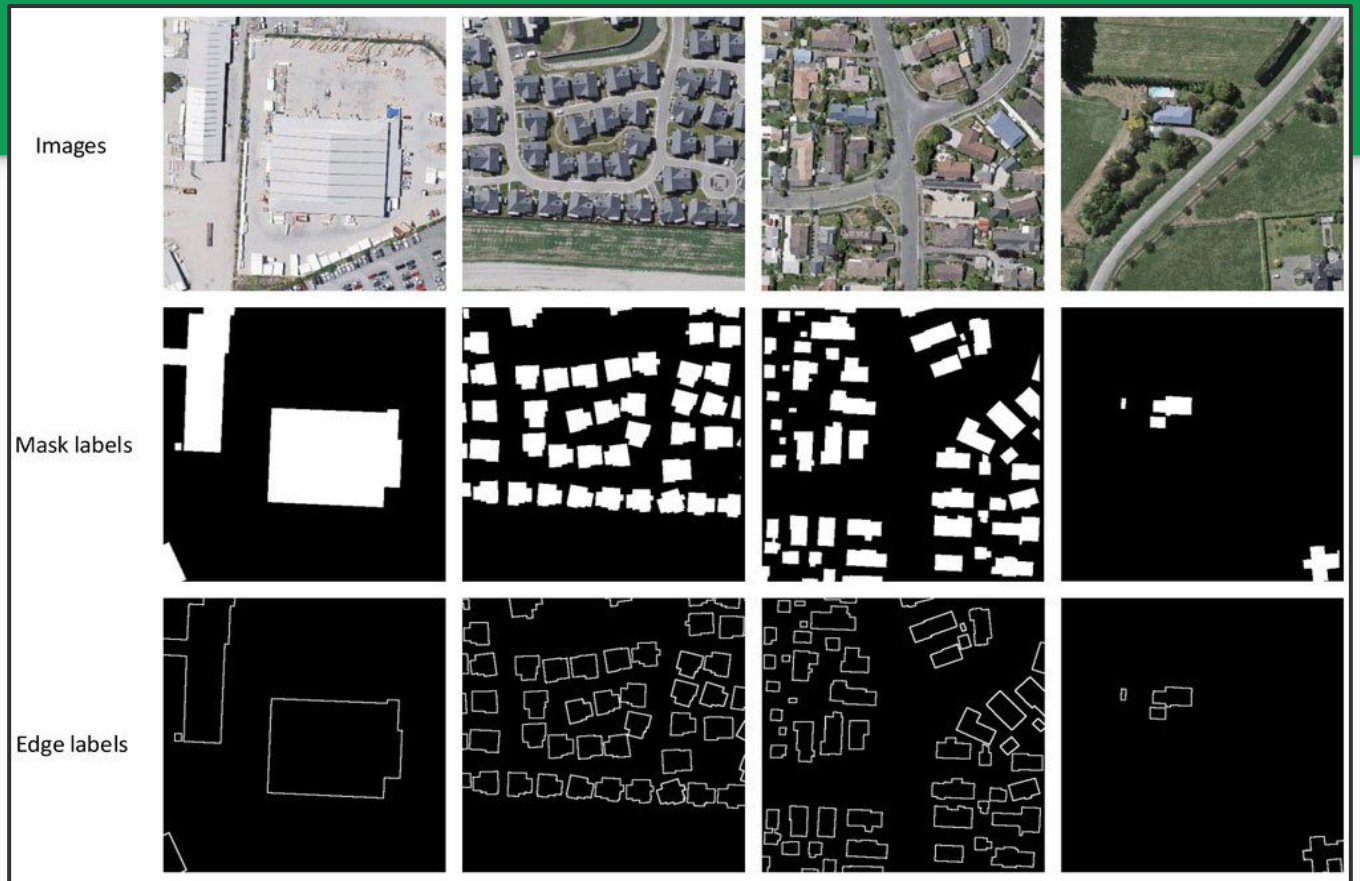
Building Segmentation



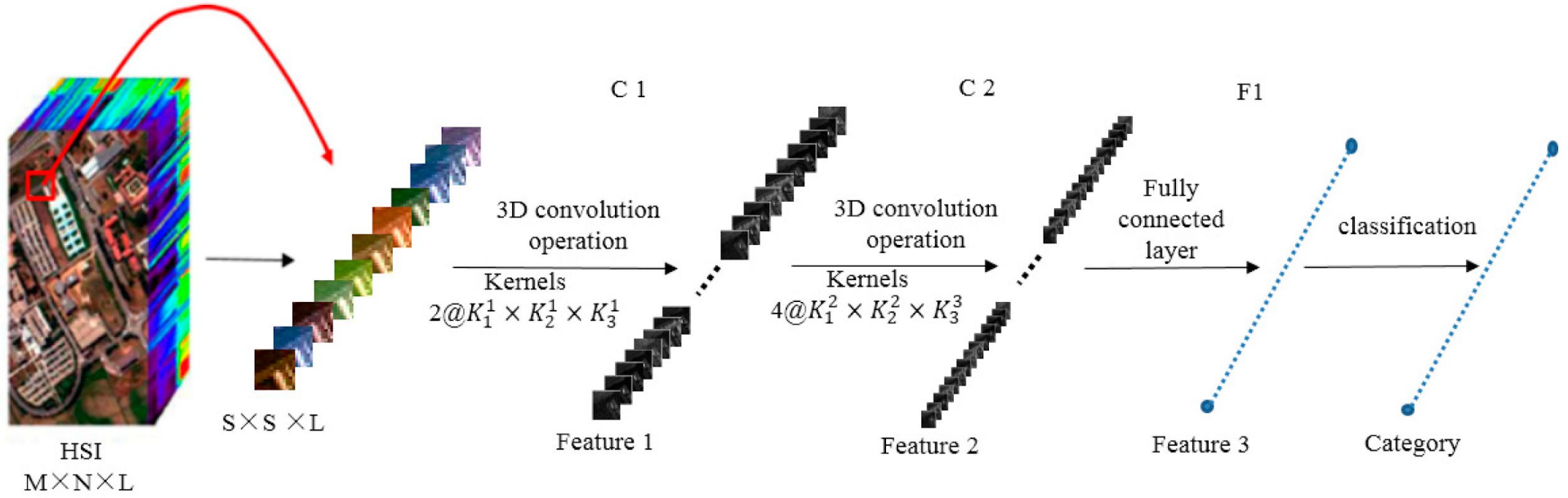
Chhor, Guillaume and Cristian Bartolome Aramburu. “Satellite Image Segmentation for Building Detection using U-net.” (2017).

Building Segmentation



Classification of Hyperspectral Data

Hyperspectral data cube: Houston (Texas, USA) – IEEE GRSS IADF TC's Data Fusion Contest 2018



Classification of Hyperspectral Data

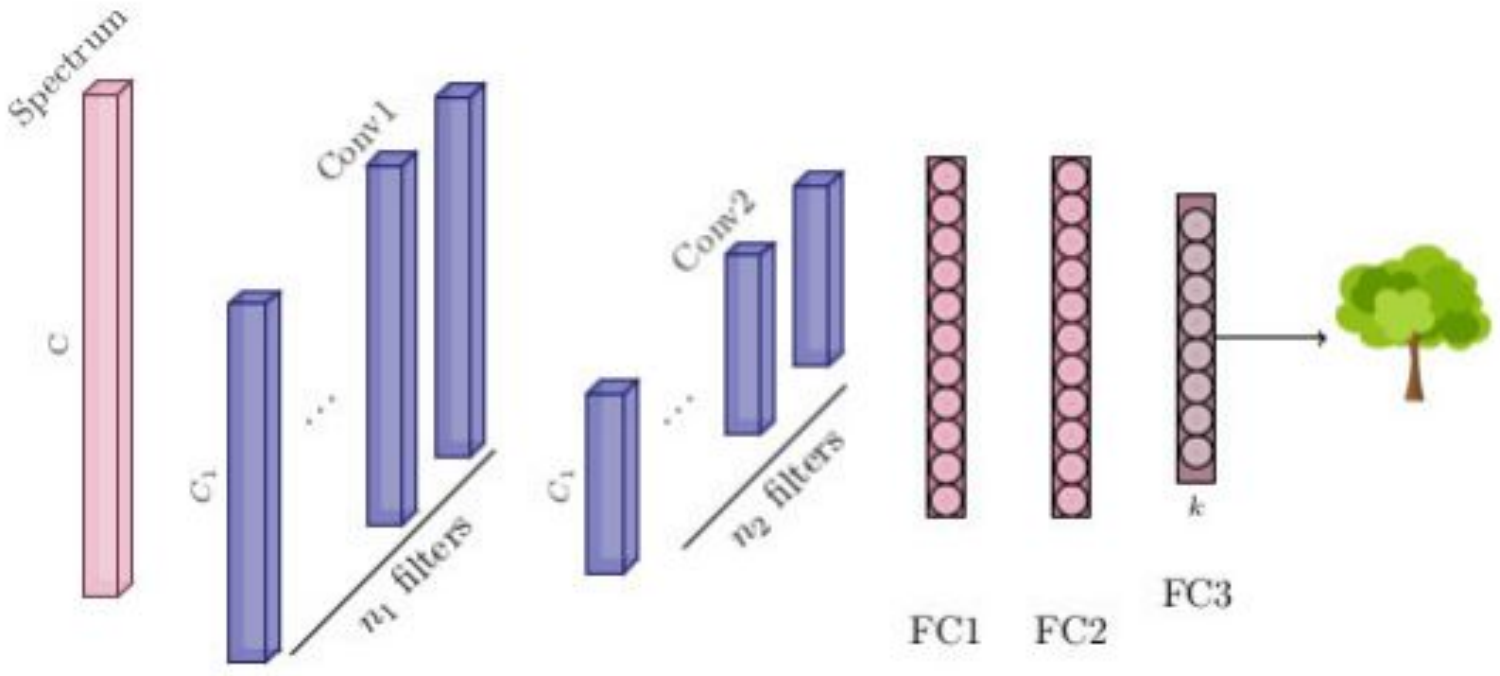
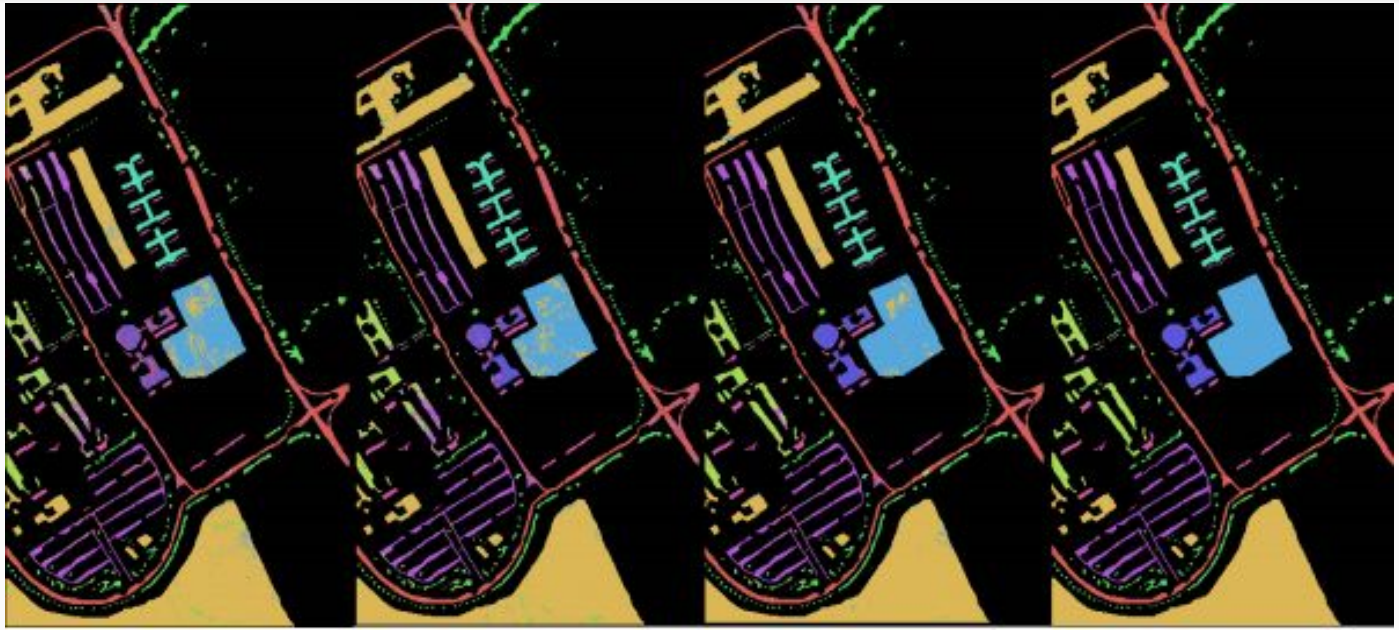


Figure: CNN 1D

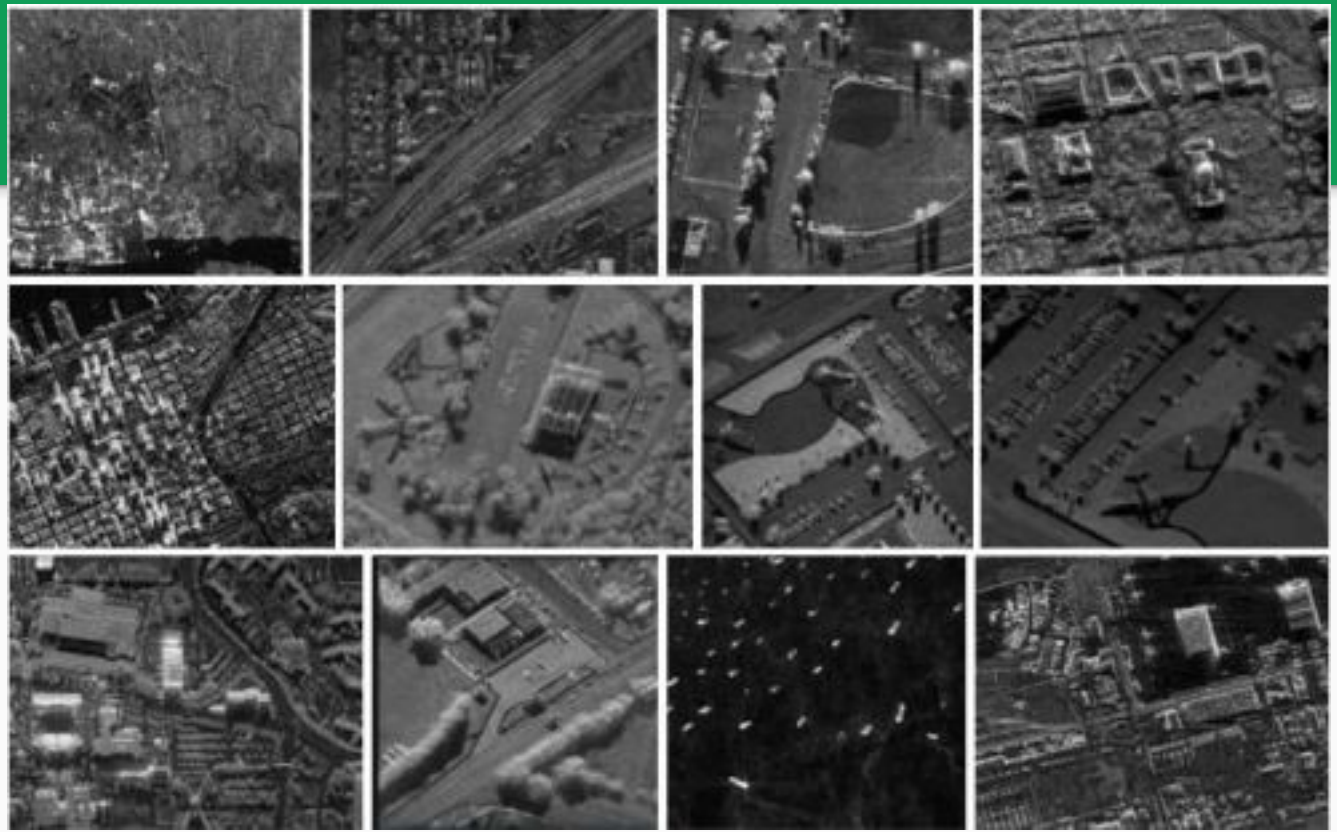
blesaux.github.io/courses/JURSE_Deep Learning_for_Remote_Sensing_Tutorial.pdf

Classification of Hyperspectral Data



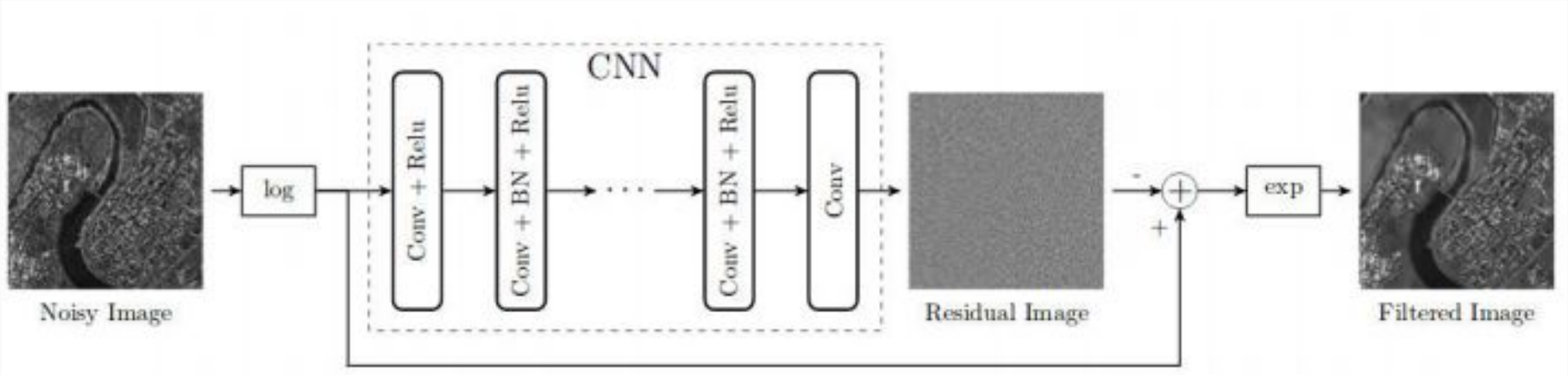
blesaux.github.io/courses/JURSE_Deep Learning_for_Remote_Sensing_Tutorial.pdf

Deep Learning on SAR



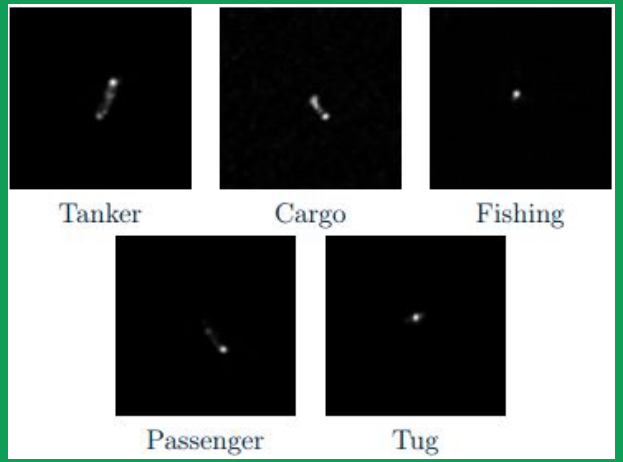
blesaux.github.io/courses/JURSE_Deep Learning_for_Remote_Sensing_Tutorial.pdf

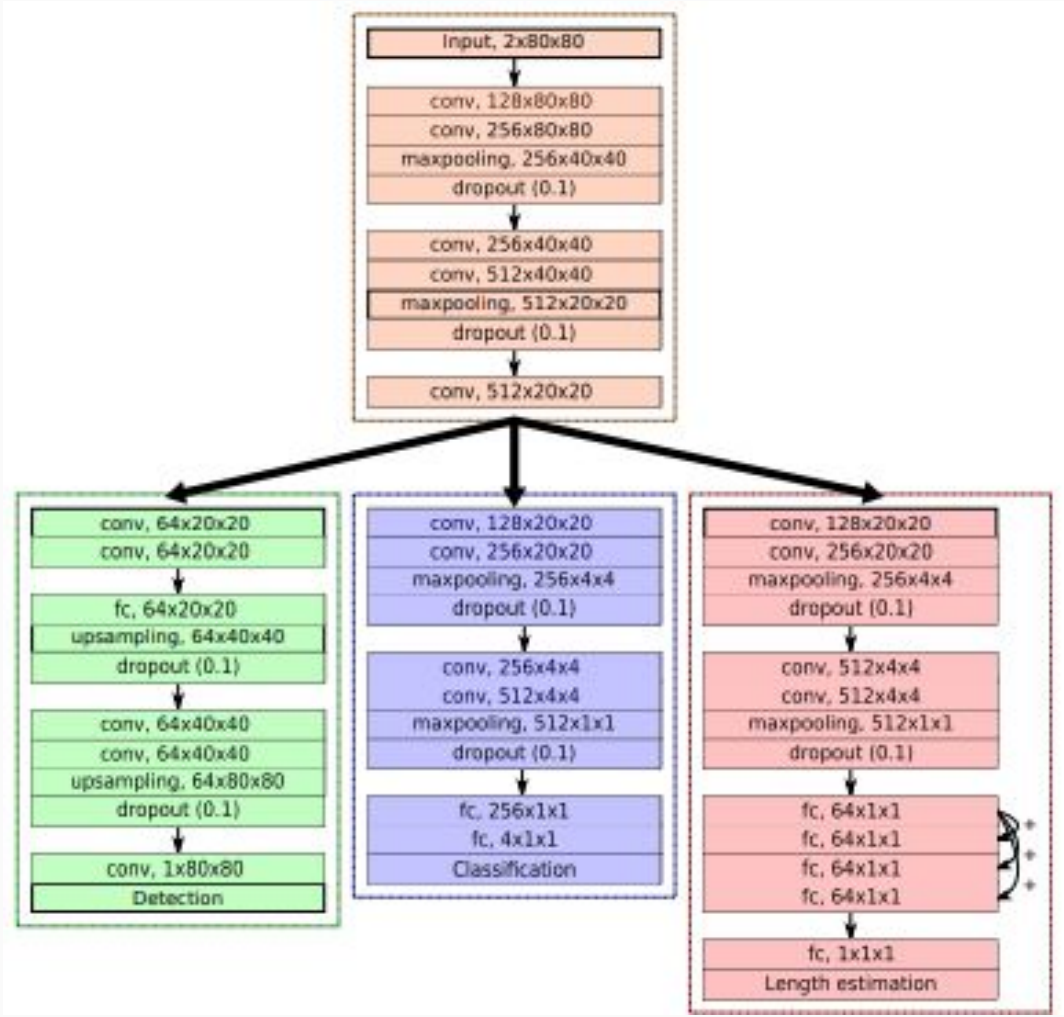
Despeckling of SAR Data



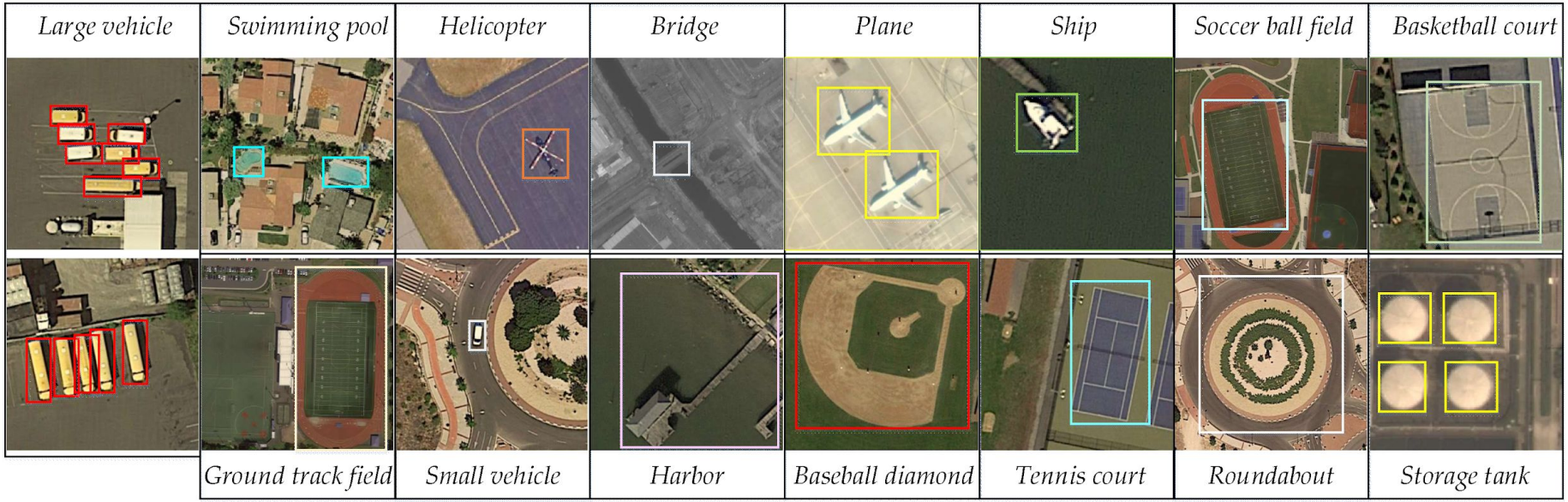
blesaux.github.io/courses/JURSE_Deep Learning_for_Remote_Sensing_Tutorial.pdf

Object characterization for SAR Data

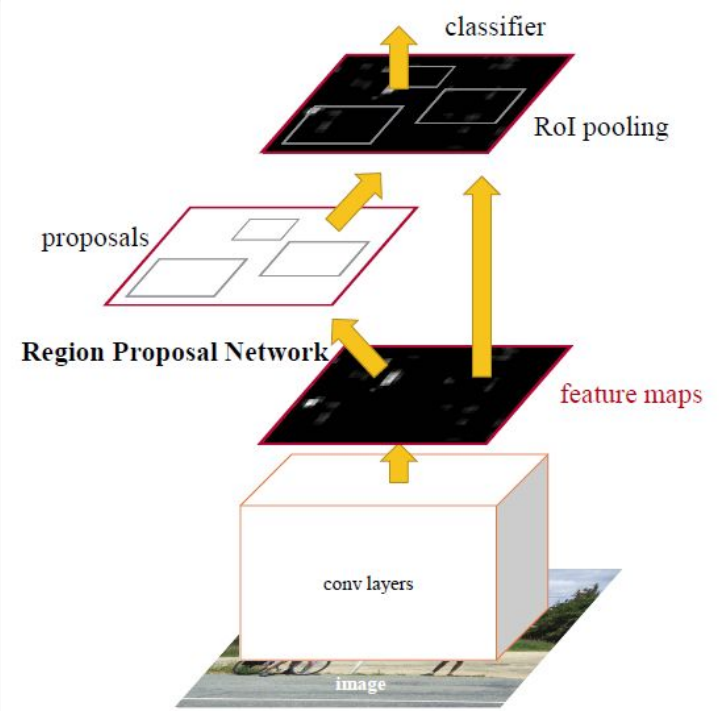


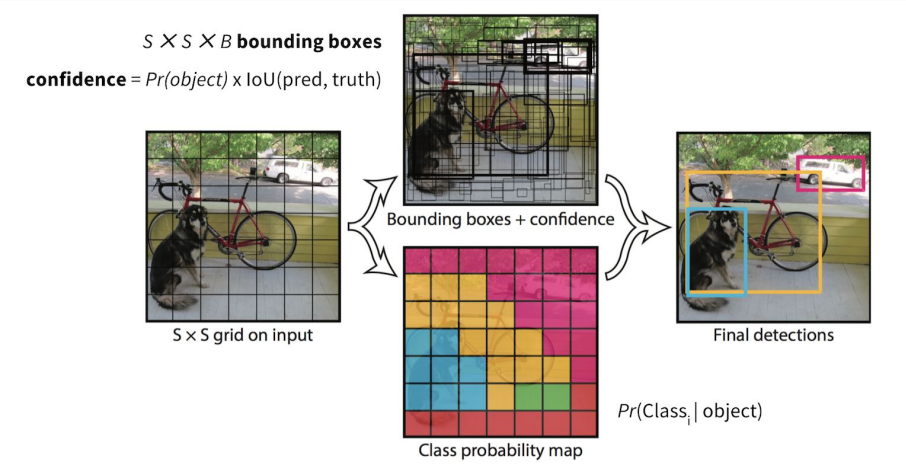


Remote Sensing and Object Detection



Two-Step Object Detection and One-Step Object Detection





Source1: Medium, Towards Data Science, Prakhar Ganesh
Source2: lilianweng.github.io/lil-log

ML And DL Based Object Detection

ML Based Object Detection:

- Viola–Jones object detection framework based on Haar features
- Scale-invariant feature transform (SIFT)
- Histogram of oriented gradients (HOG) features

DL Based Object Detection

- R-CNN
- Fast R-CNN
- Faster R-CNN
- YOLO (You Only Look Once)
- SSD (Single Shot MultiBox Detector)
- Retina Net
- RefineDet (Single-Shot Refinement Neural Network for Object Detection)
- Deformable convolutional networks

Object Detection and OpenCV

Frameworks

- Caffe
- TensorFlow
- Torch DarkNet

Models

- AlexNet
- GoogLeNet
- ResNet
- SqueezeNet
- VGG
- ENet
- VGG-based SSD
- MobileNet-based SSD

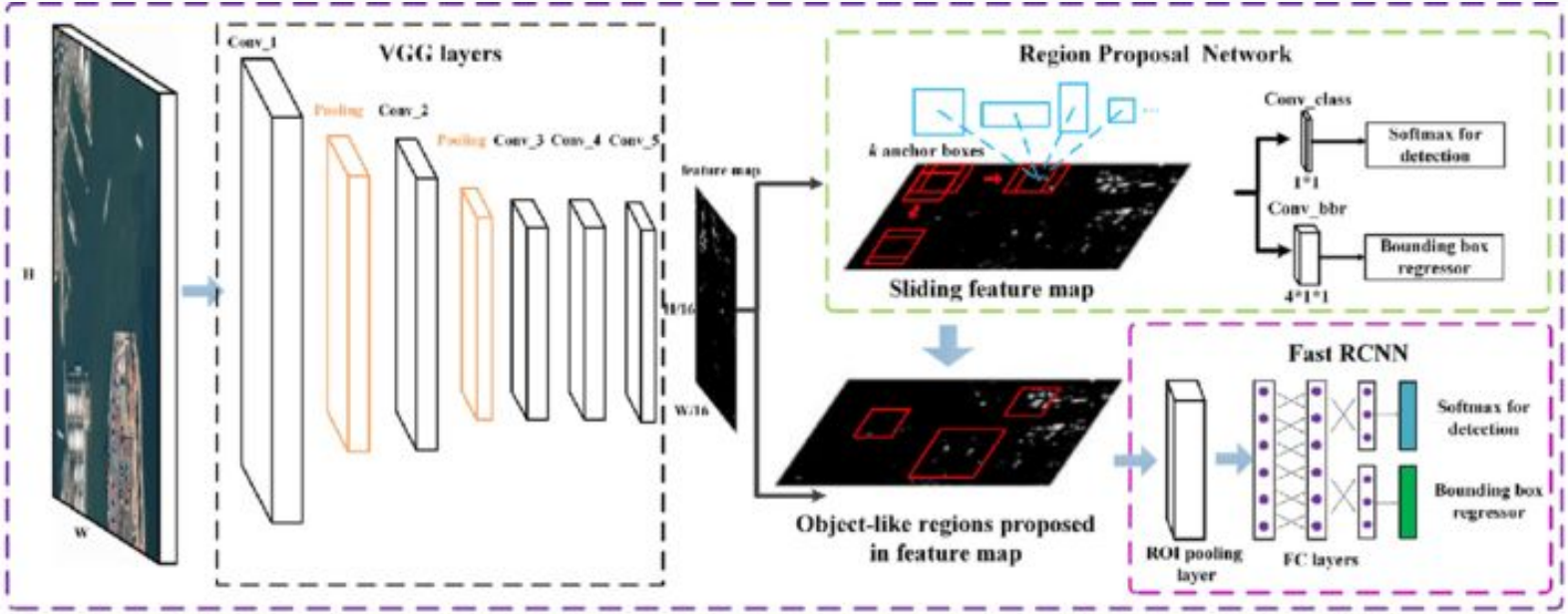
Object Detection and OpenCV Algorithm

- Template Matching
- Cascade Classifier
- LBP – Local Binary Pattern
- HOG – Histogram of Oriented Gradients
- Convolutional Neural Network (CNN)

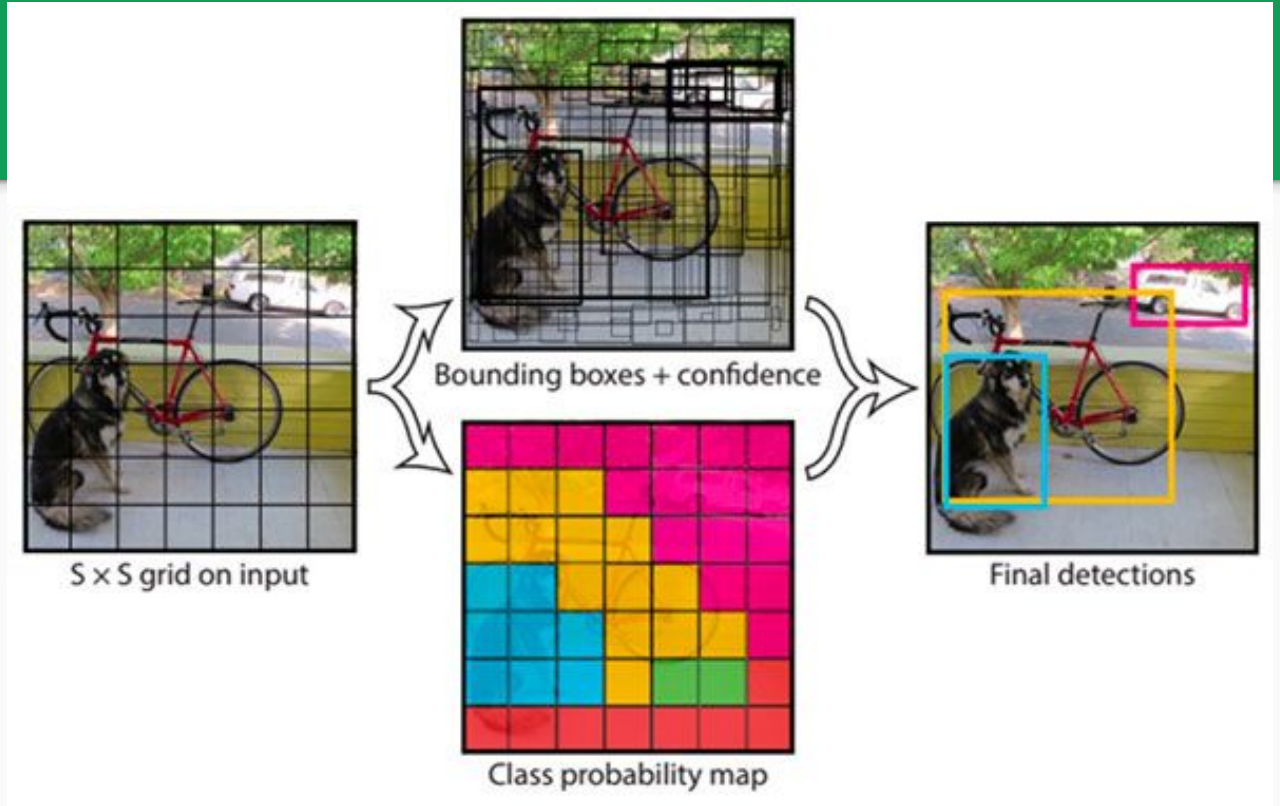
Tensorflow Object Detection API

Model name	Speed (ms)	COCO mAP[^1]	Outputs
ssd_mobilenet_v1_coco	30	21	Boxes
ssd_mobilenet_v1_0.75_depth_coco ☆	26	18	Boxes
ssd_mobilenet_v1_quantized_coco ☆	29	18	Boxes
ssd_mobilenet_v1_0.75_depth_quantized_coco ☆	29	16	Boxes
ssd_mobilenet_v1_ppn_coco ☆	26	20	Boxes
ssd_mobilenet_v1_fpn_coco ☆	56	32	Boxes
ssd_resnet_50_fpn_coco ☆	76	35	Boxes
ssd_mobilenet_v2_coco	31	22	Boxes
ssd_mobilenet_v2_quantized_coco	29	22	Boxes
ssdlite_mobilenet_v2_coco	27	22	Boxes
ssd_inception_v2_coco	42	24	Boxes
faster_rcnn_inception_v2_coco	58	28	Boxes
faster_rcnn_resnet50_coco	89	30	Boxes
faster_rcnn_resnet50_lowproposals_coco	64		Boxes
rfcn_resnet101_coco	92	30	Boxes
faster_rcnn_resnet101_coco	106	32	Boxes
faster_rcnn_resnet101_lowproposals_coco	82		Boxes

Faster R-CNN


H
W
Conv_1
VGG layers
Pooling
Conv_2
Pooling
Conv_3
Conv_4
Conv_5
feature map
H/16
W/16
Region Proposal Network
k anchor boxes
Sliding feature map
Conv_class
1*1
Softmax for detection
Conv_bbr
4*1*1
Bounding box regressor
Object-like regions proposed in feature map
Fast RCNN
ROI pooling layer
FC layers
Softmax for detection
Bounding box regressor

YOLO



Pyimagesearch, 2018, Adrian Rosebrock

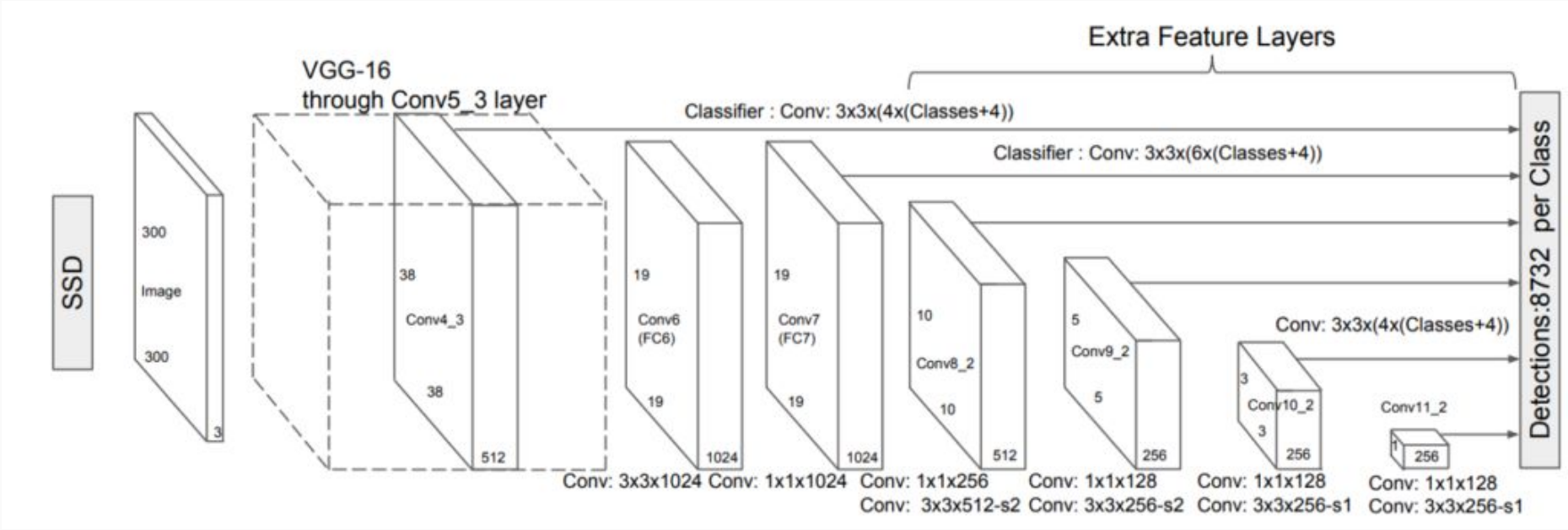
TF	miss detection rate	Recall	FP	false detection rate	TP	all
16	7.34%	92.66%	29	13.30%	206	218

Test süresi

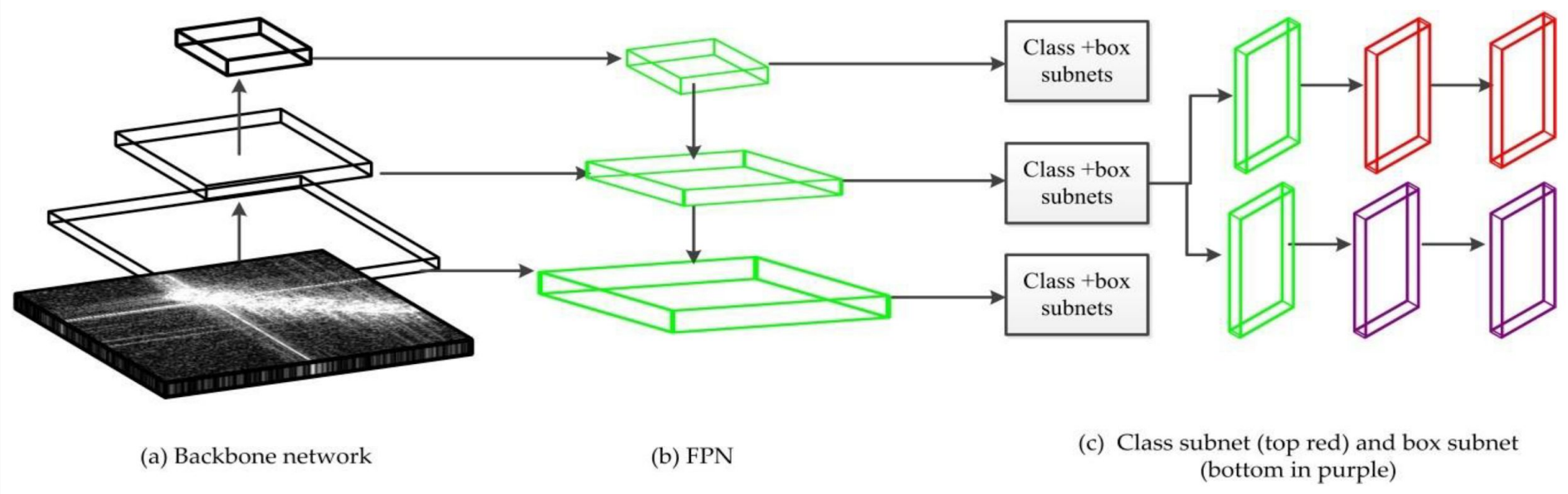
R-CNN	Fast R-CNN	Faster R-CNN	YOLO
64.8	3.3	0.9	0.1

Ref. : RAPID TARGET DETECTION IN HIGH RESOLUTION REMOTE SENSING IMAGES USING YOLO MODEL, April 2018; DOI: 10.5194/isprs-archives-XLII-3-1915-2018

SSD - Single Shot Detector



RetinaNet



https://www.mdpi.com/422234

Object Detection Dataset

- COCO (Common Objects in Context)
- Kitti
- Open_images_v4
- Pascal VOC()
- Wider_Face

COCO
(Common Objects in Context)

Pascal VOC()

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  "licenses": [license],
  "categories": [category],
  "images": [image],
  "annotations": [annotation]
}
```

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        <filename>00001.jpg</filename>
        <path>./Kangaroo/stock-12.jpg</path>
        <source>
                <database>Kangaroo</database>
        </source>
        <size>
                <width>450</width>
                <height>319</height>
                <depth>3</depth>
        </size>
        <segmented>0</segmented>
        <object>
                <name>kangaroo</name>
                <pose>Unspecified</pose>
                <truncated>0</truncated>
                <difficult>0</difficult>
                <bndbox>
                        <xmin>233</xmin>
                        <ymin>89</ymin>
                        <xmax>386</xmax>
                        <ymax>262</ymax>
                </bndbox>
        </object>
</annotation>
```

Proposed - Public General Datasets

- ISPRS datasets: semantic labeling, reconstruction

  https://www.isprs.org/data/
- Toronto Massachusetts Roads and Buildings Dataset

  https://www.cs.toronto.edu/~vmnih/data/
- IEEE GRSS Data Fusion Contests:

  http://www.grss-ieee.org/community/technical-committees/data-fusion/data-fusion-contest/
- IEEE GRSS: hyperspectral datasets with standard train/test splits (DFC2018, Pavia, Indian Pines)

  http://dase.grss-ieee.org/
- INRIA Aerial Semantic labeling dataset: buildings

  https://project.inria.fr/aerialimagelabeling/
- XView: objects in aerial images

  http://xviewdataset.org/
- DOTA: Detecting Objects in Aerial images

  https://captain-whu.github.io/DOTA/dataset.html

Practical Session and Sources

https://colab.research.google.com/drive/1Om2H3T9Kt4CtBBMieN0JHdR5-ZqJ1Cbe
https://drive.google.com/drive/folders/10AgLjM52sbEsMSO44tC7yvh93IFKcfv_

https://github.com/qubvel/segmentation_models

https://github.com/AlexeyAB/darknet

Please visit on YouTube video to talk about this presentation and practice session.
You can find the video link in the my GitHub repo.

THANKS

Does anyone have any questions?

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