Deep Object Detection

Ali Farhadi
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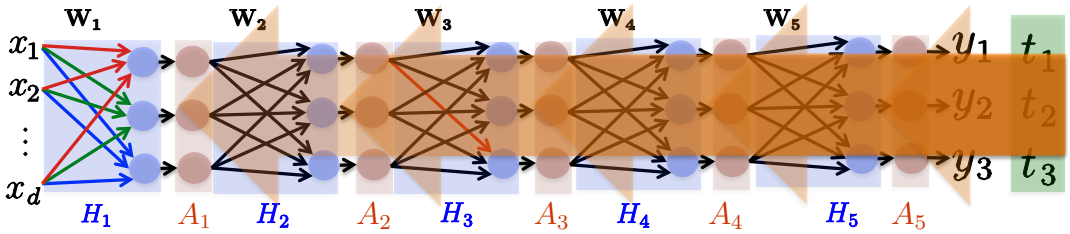
CSE 576

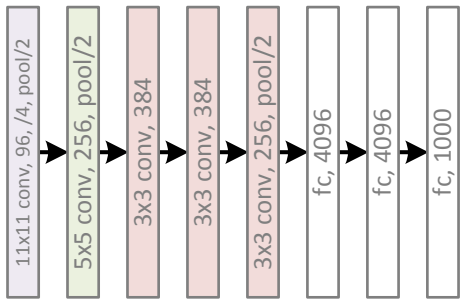
So Far

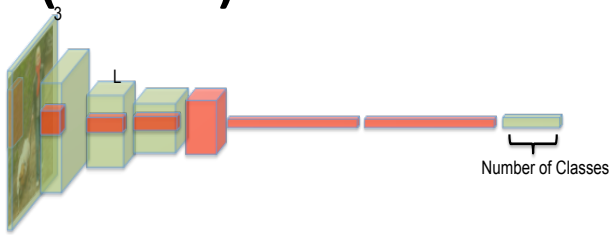
- Backpropagation



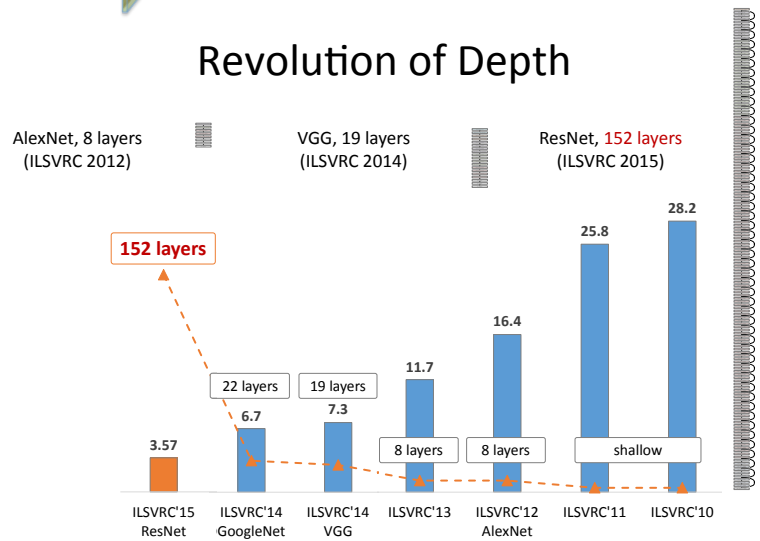
- Convolutional Neural Networks(CNN)

- AlexNet



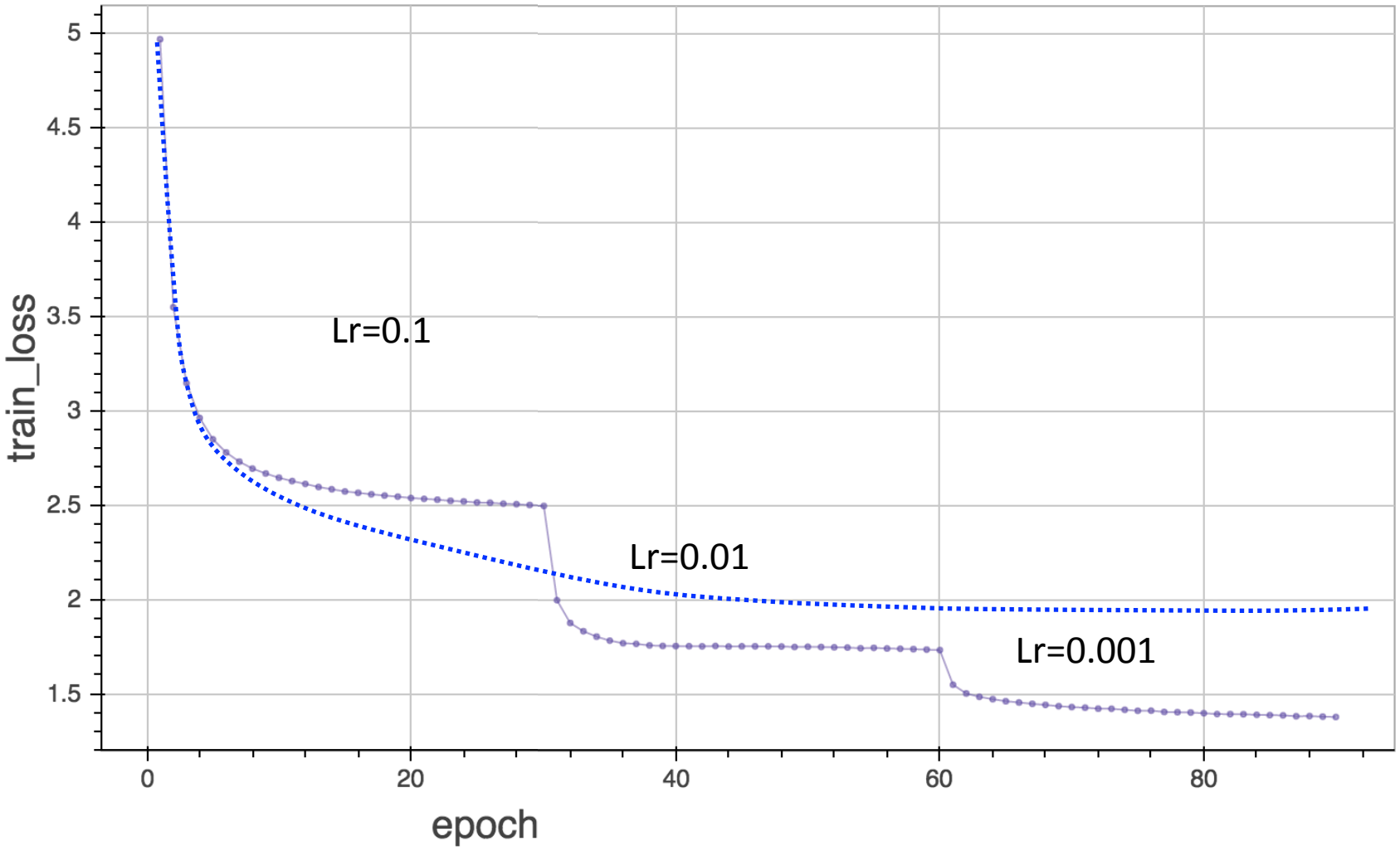


- Deeper Architectures

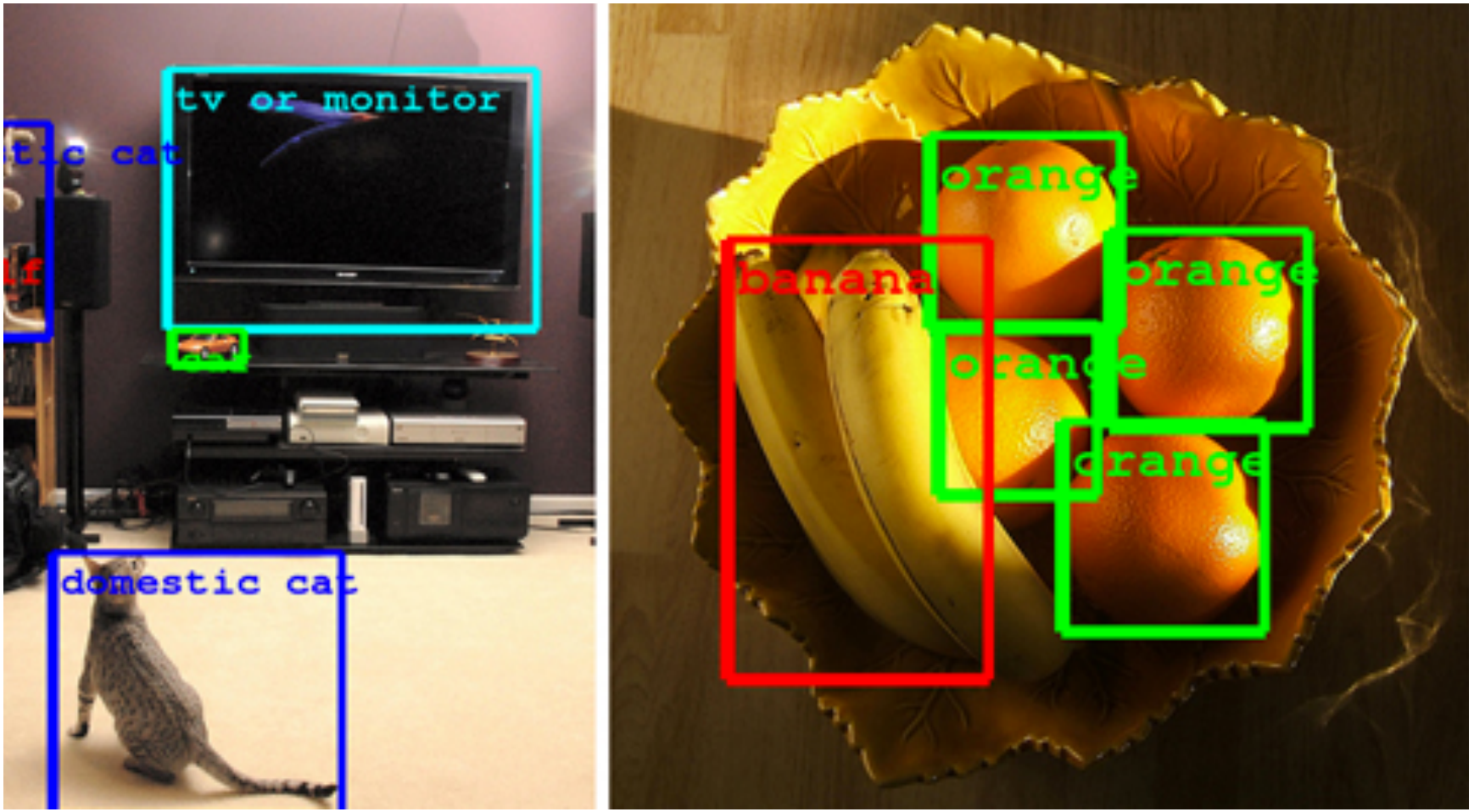


Deep Leaning Practical Tips

- Use off-the-shelf architectures
- Verify the correctness of your network by training over a single batch.
  - Overfit : Good to go!
  - Did not converge : Something is wrong with forward/backward functions or data!
- Use a proper learning rate regime.


train_loss
epoch
Lr=0.1
Lr=0.01
Lr=0.001
5
4.5
4
3.5
3
2.5
2
1.5
0
20
40
60
80

Object Detection

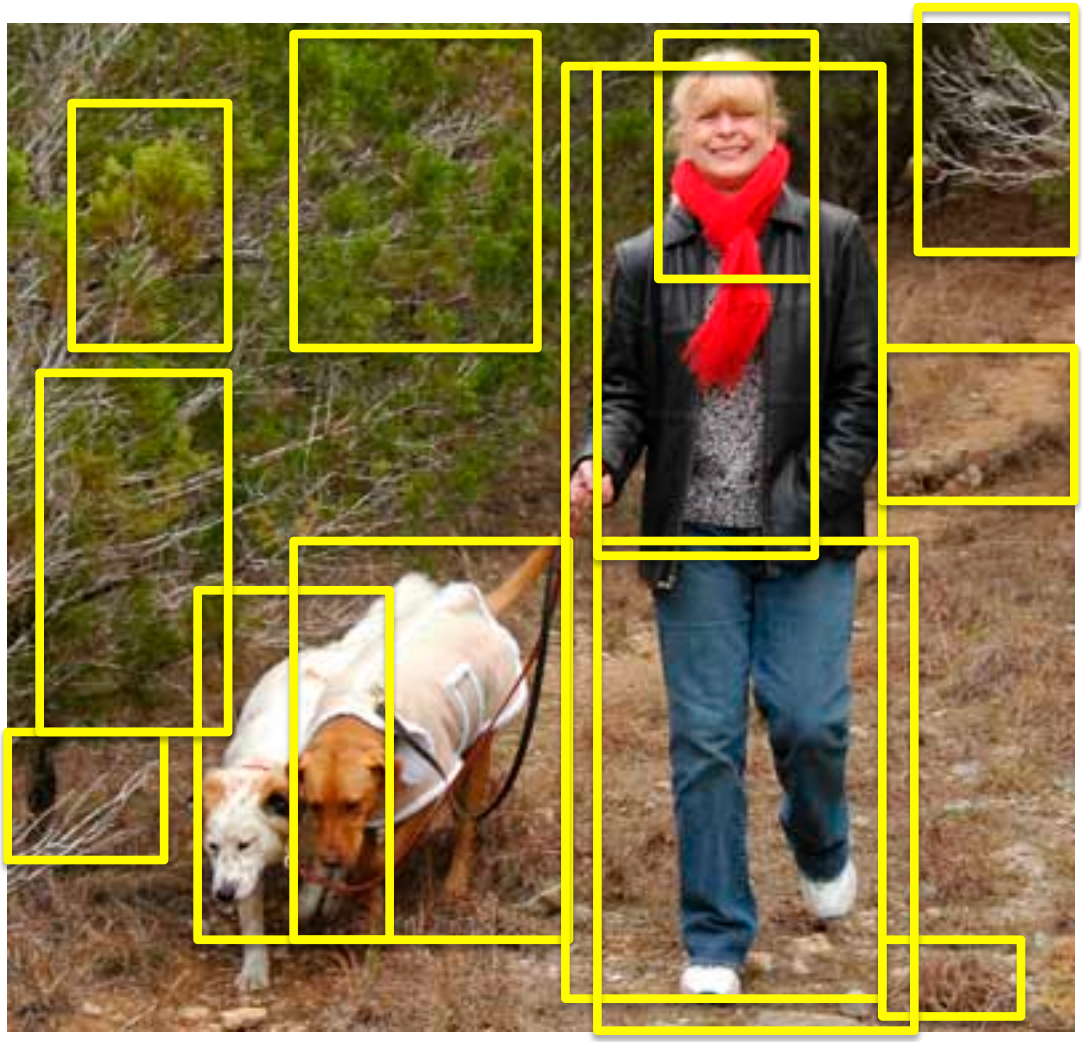


Sliding Window

Sliding Window

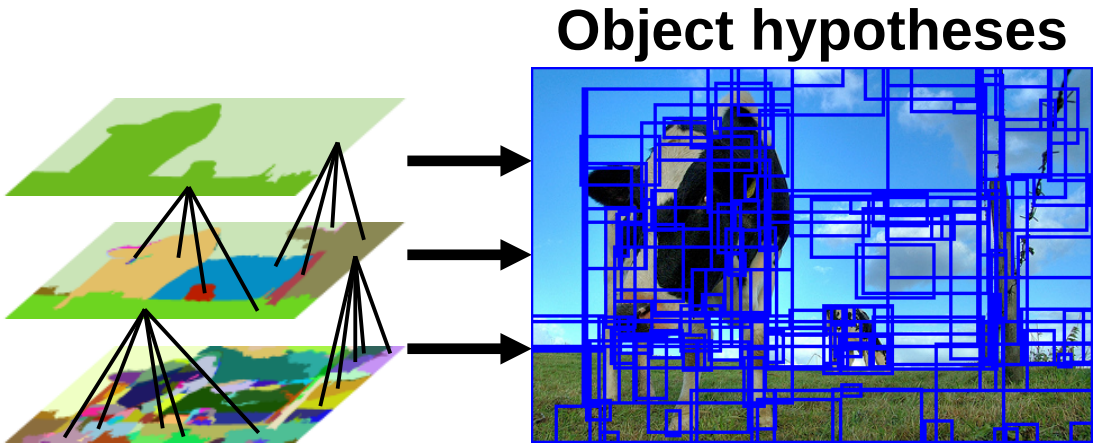
Sliding Window

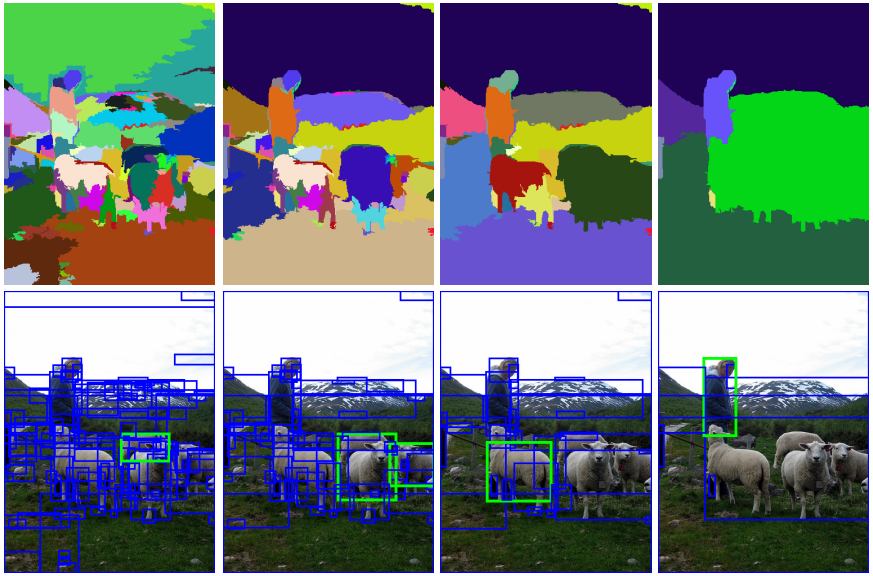
Object Proposal



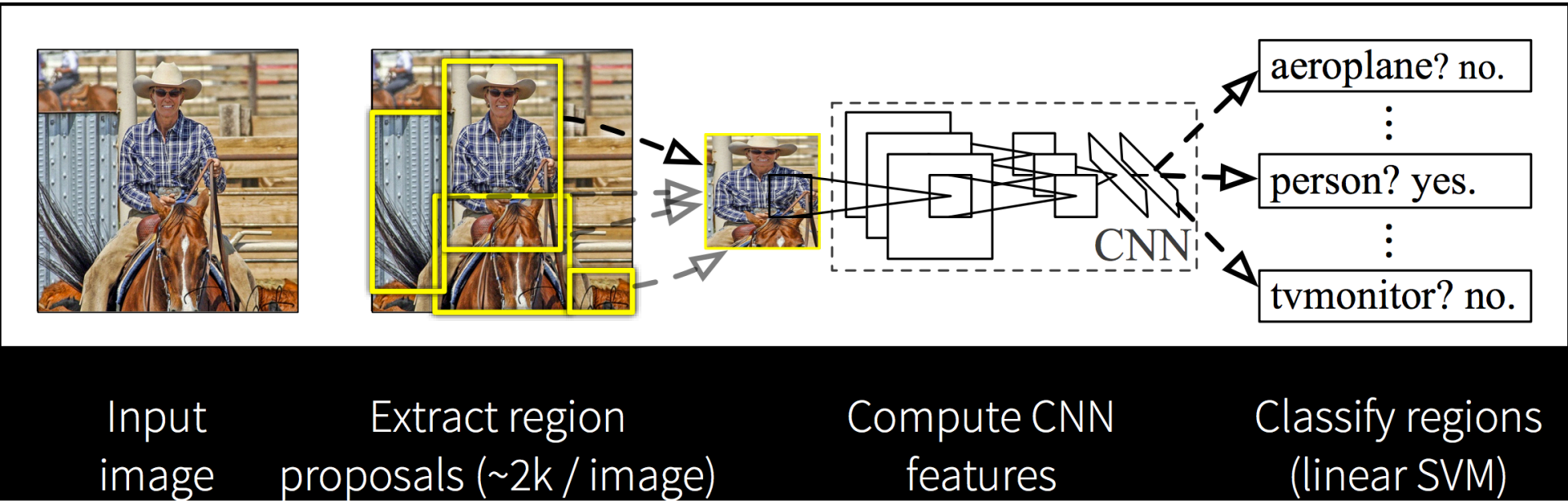
Selective Search

Uijlings, Jasper RR, et al. "Selective search for object recognition." International journal of computer vision (2013).



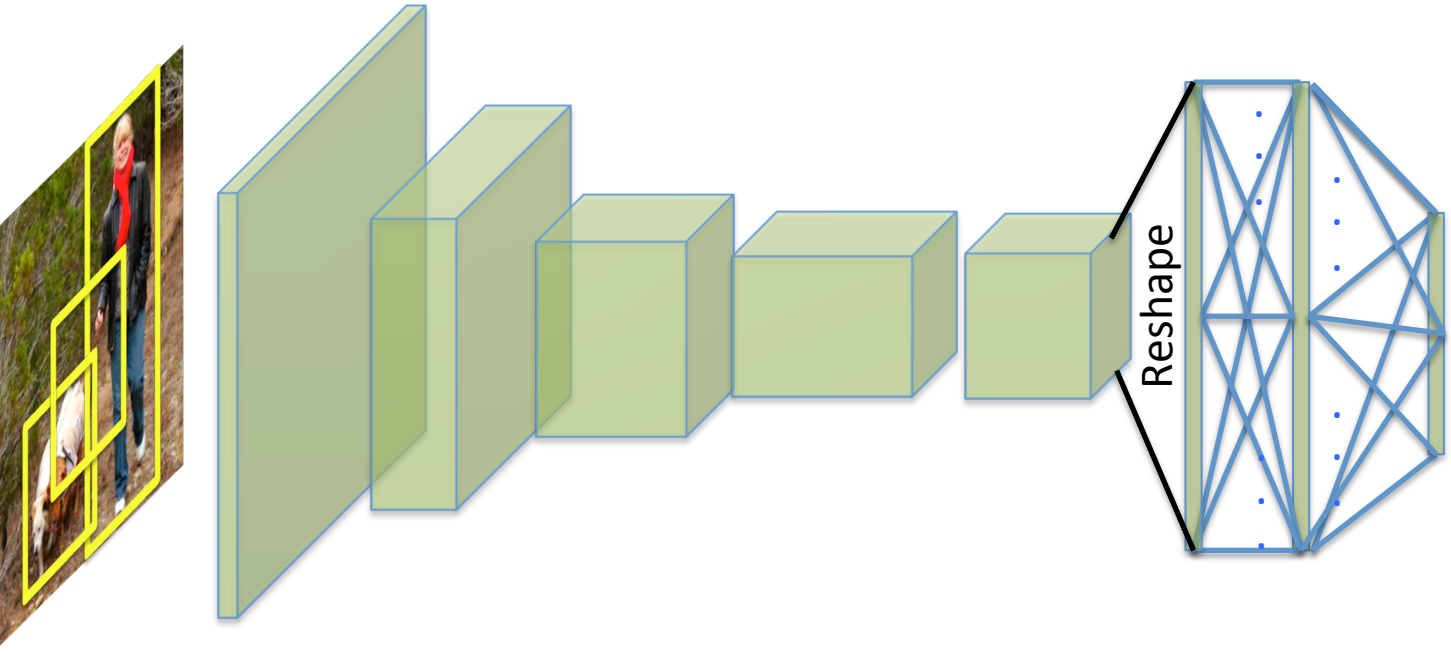


Region-Based CNN (R-CNN)

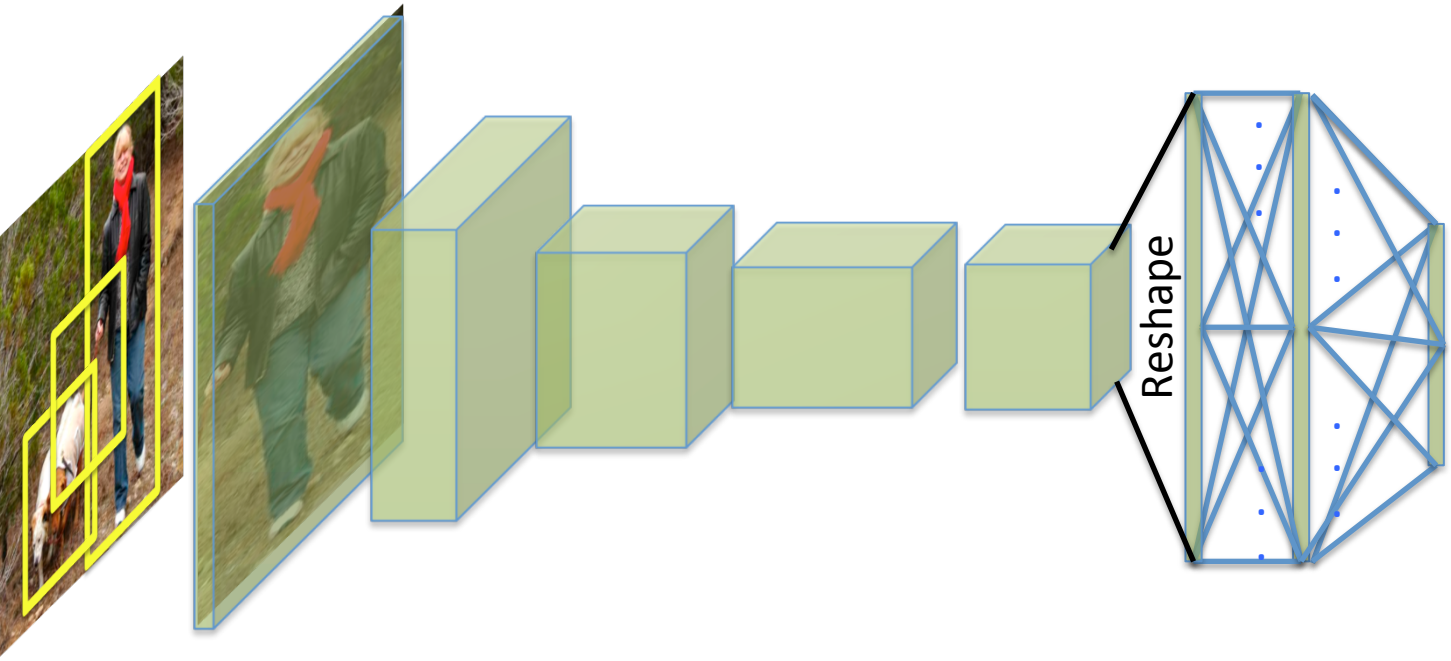


Grishick et al [CVPR'14]

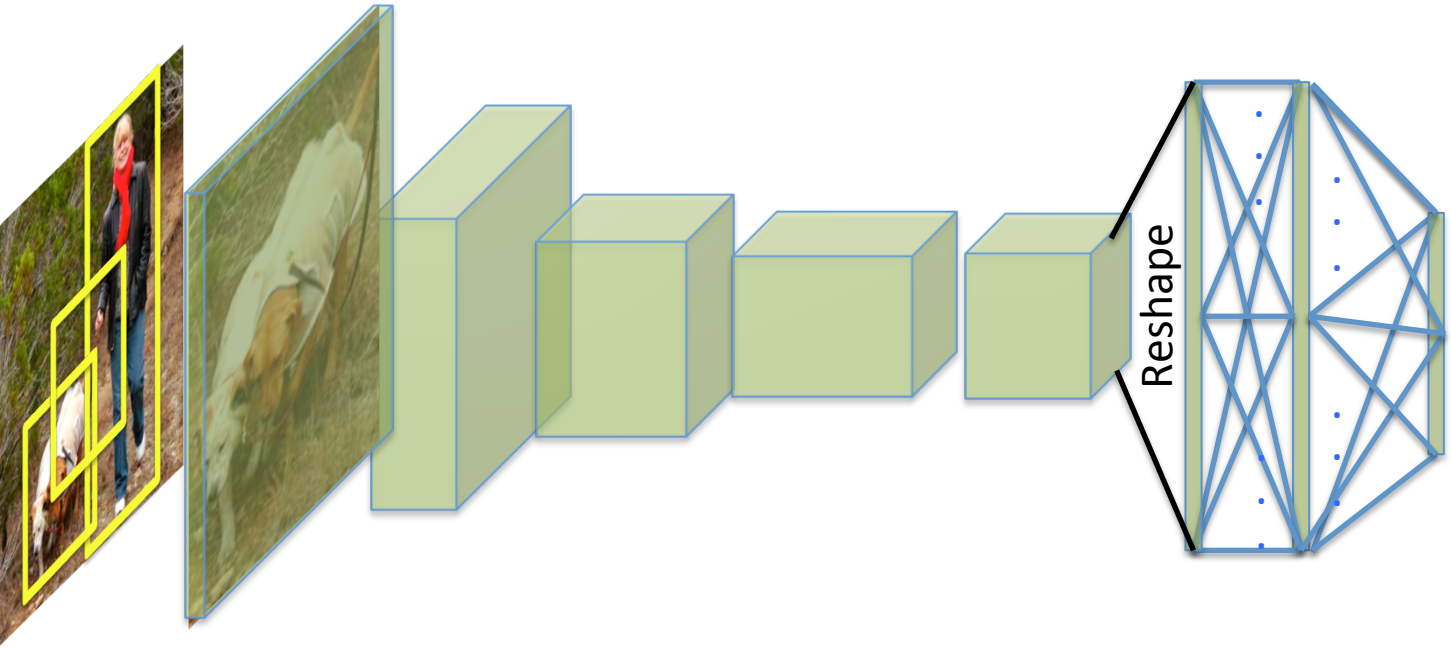
Object Detection by R-CNN



Object Detection by R-CNN

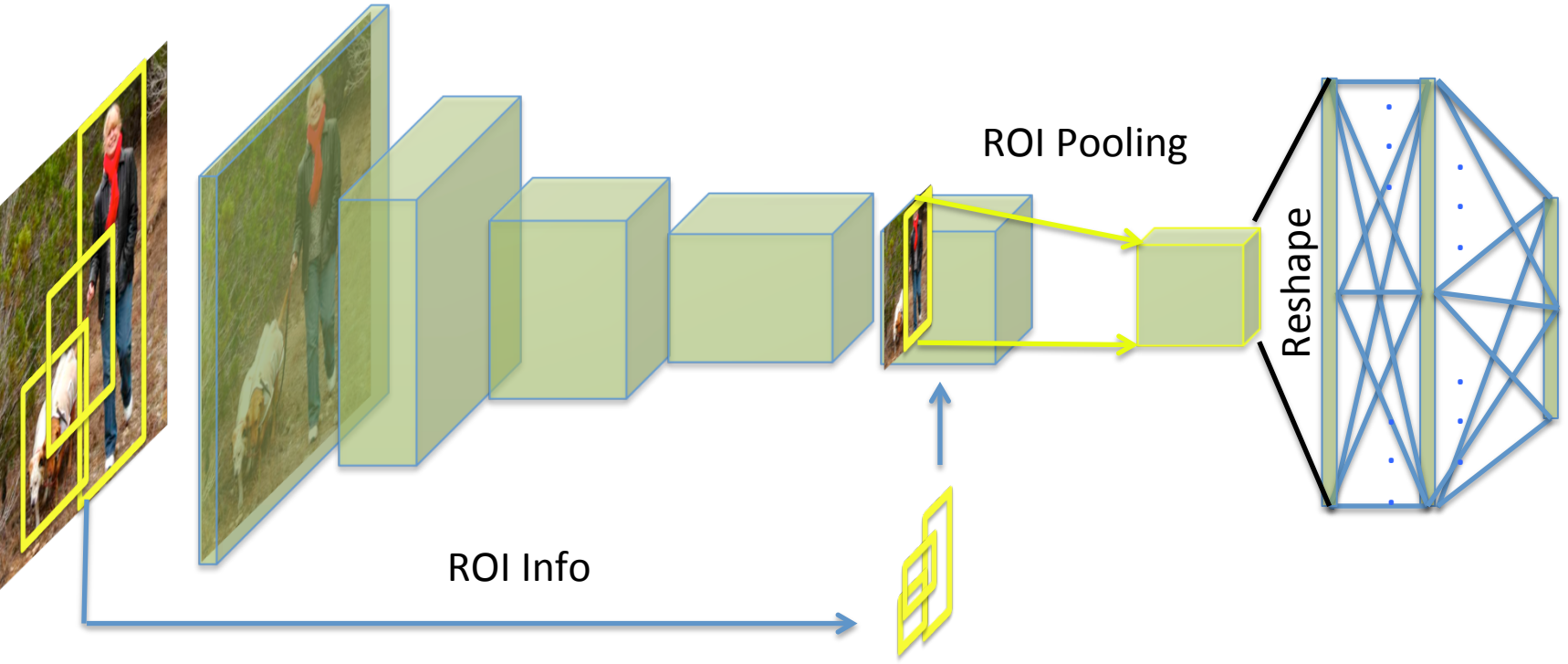


Object Detection by R-CNN

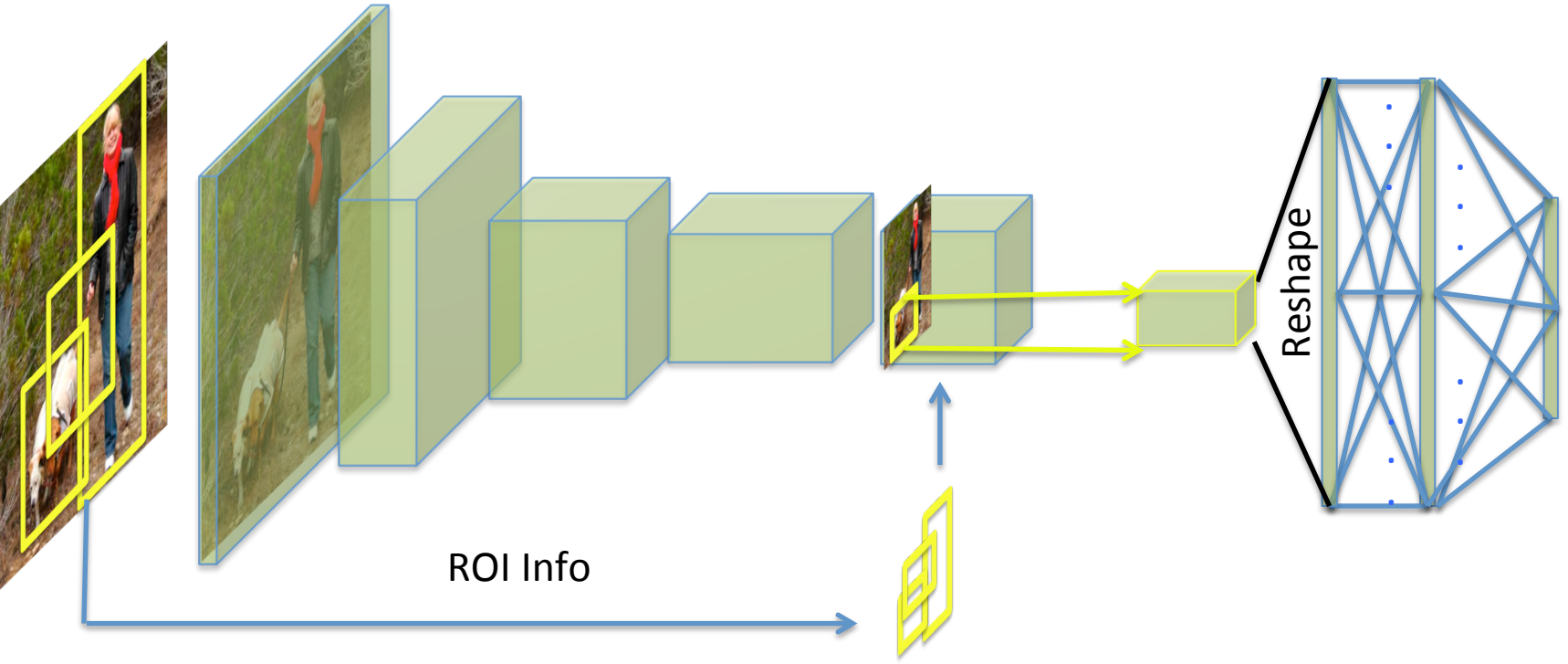


- Depending on region proposal
- Need to apply CNN ~2K times per image

Fast R-CNN

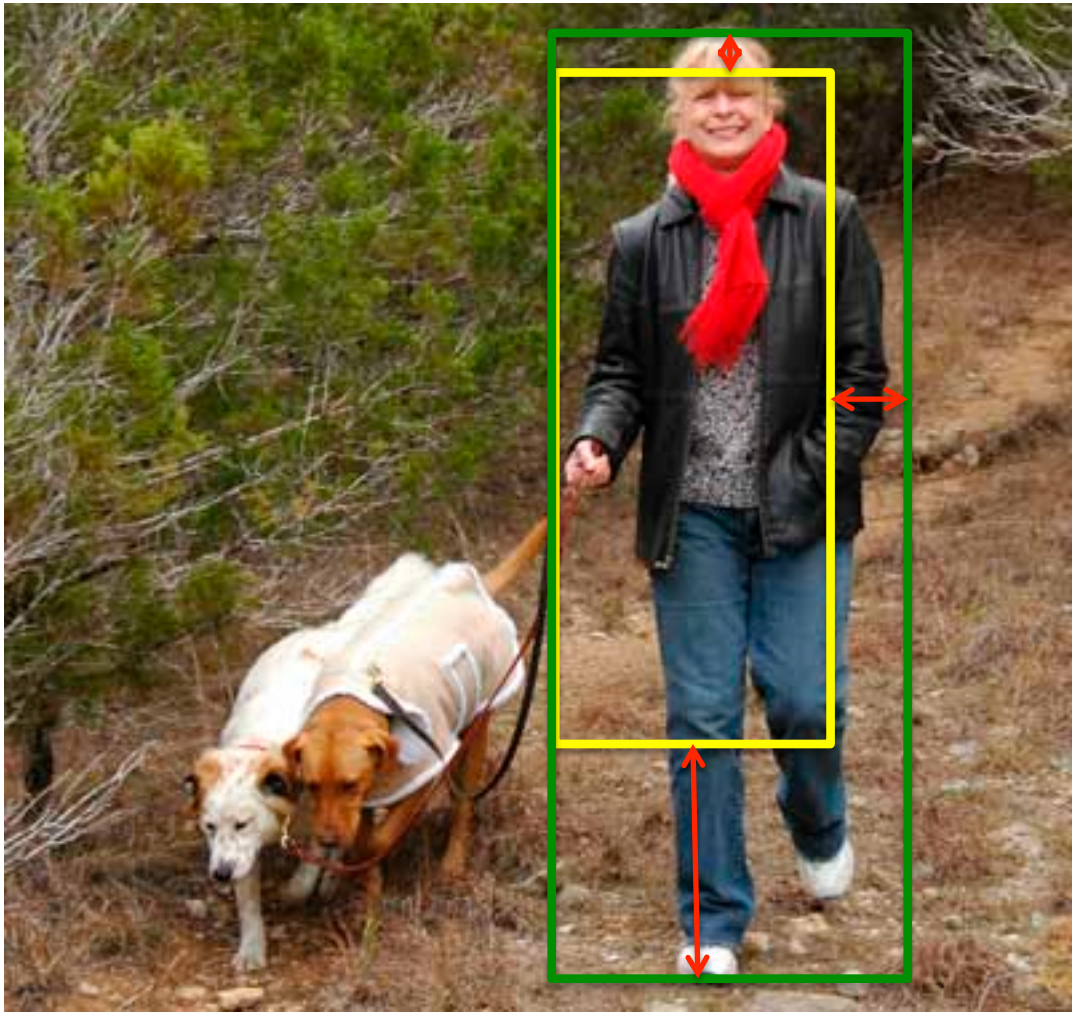


Fast R-CNN

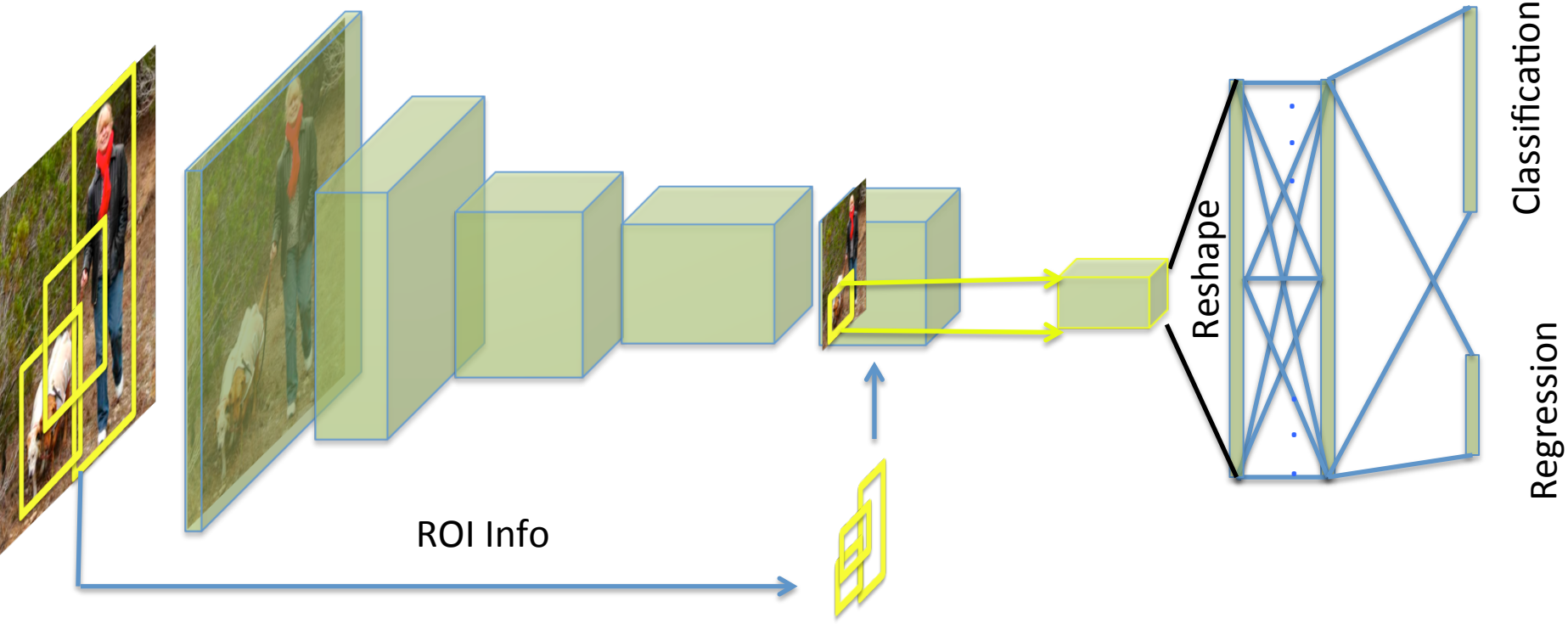


Bounding Box Regression

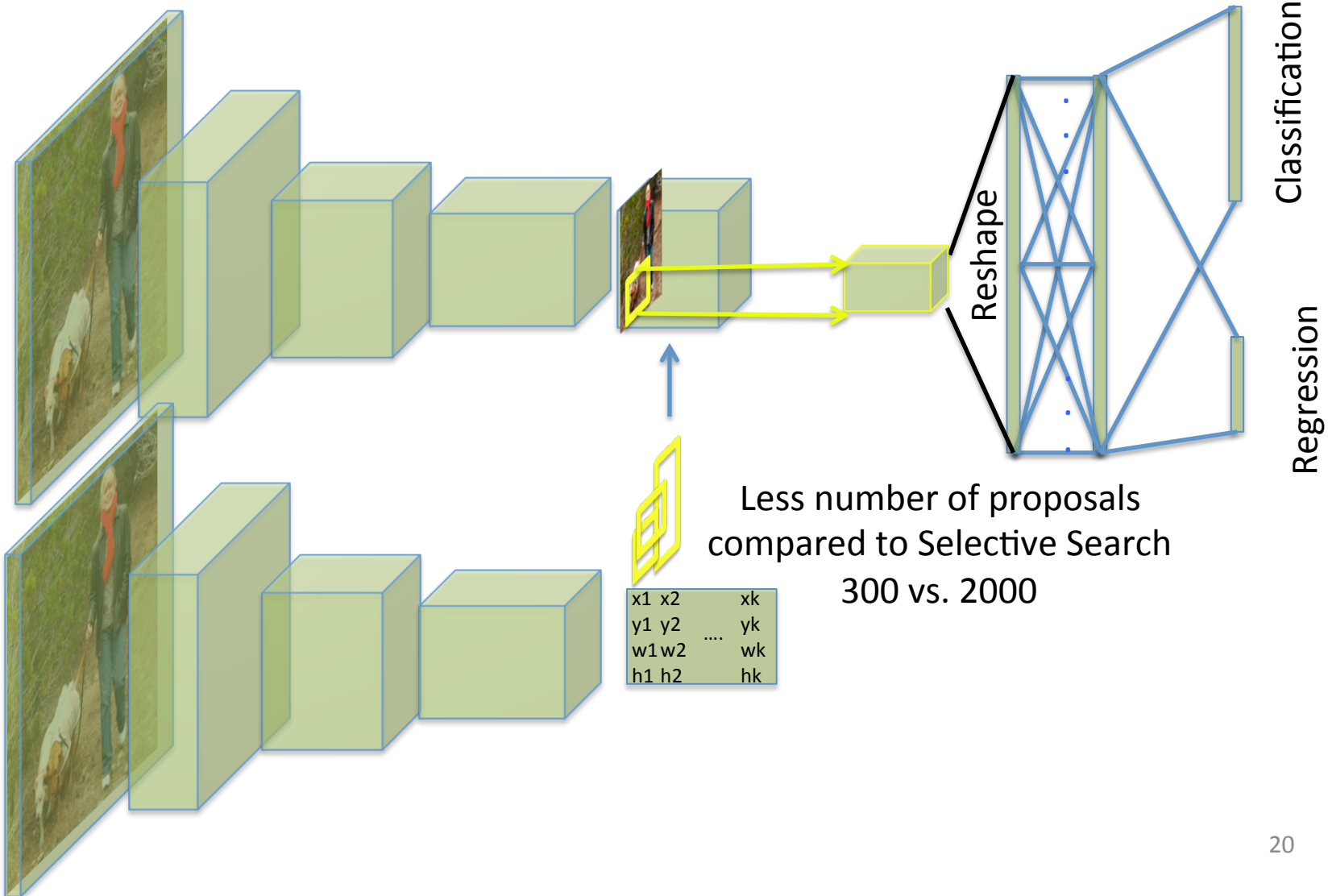
Bounding Box Regression



Bbox Regression



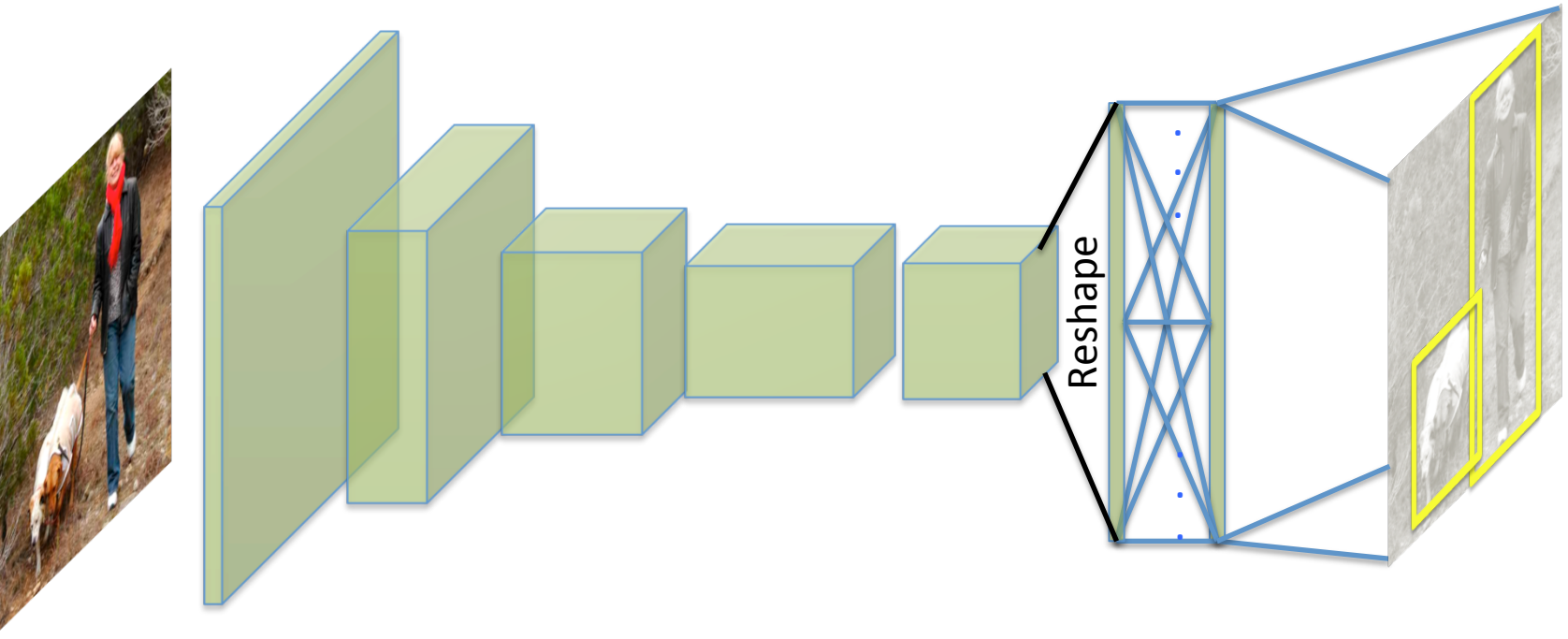
Faster R-CNN


Reshape
Classification
Regression
x1 x2 xk
y1 y2 .... yk
w1 w2 wk
h1 h2 hk
Less number of proposals
compared to Selective Search
300 vs. 2000

Pascal 2012

Method	mAP	Sec/im
R-CNN	59.2	20
Fast R-CNN	68.4	2
Faster R-CNN	72.1	0.5

Direct Regression
No Proposal



We do not know the number of objects in an image

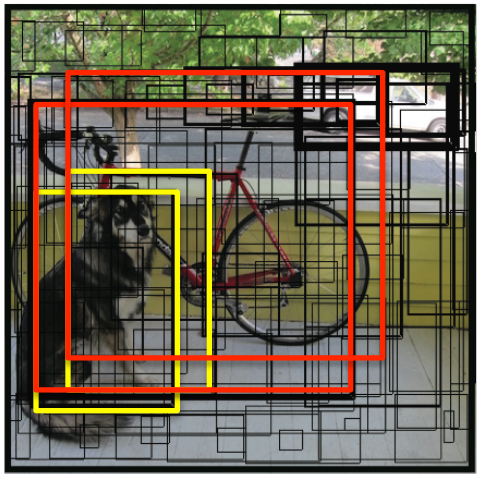
Joseph Redmon
Ross Girshick
Santosh Divvala
Ali Farhadi

Most Accurate Real-Time Detector 2016

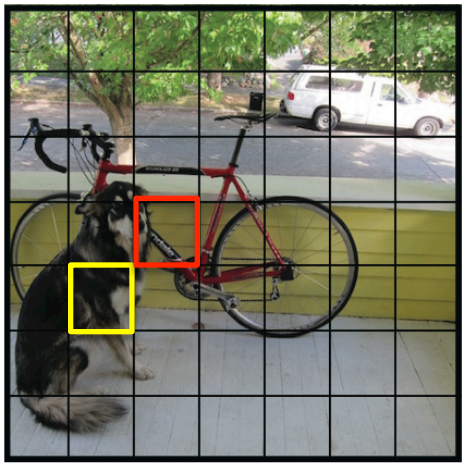
Fastest object detector in the literature 2016

"You Only Look Once"

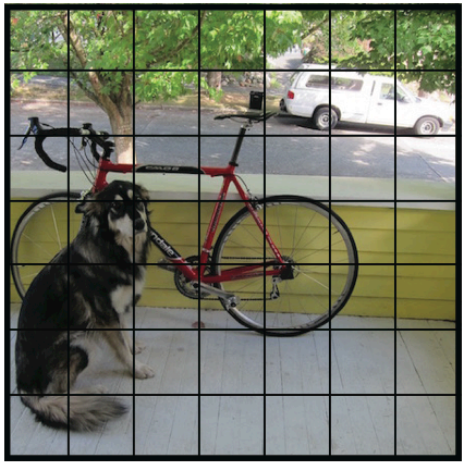
Real-Time Detection



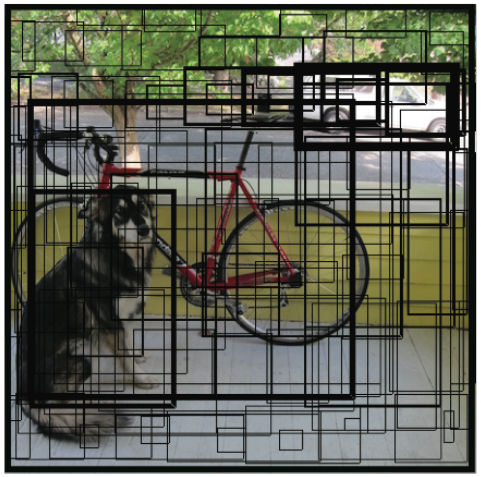
Bounding boxes + confidence



S × S grid on input

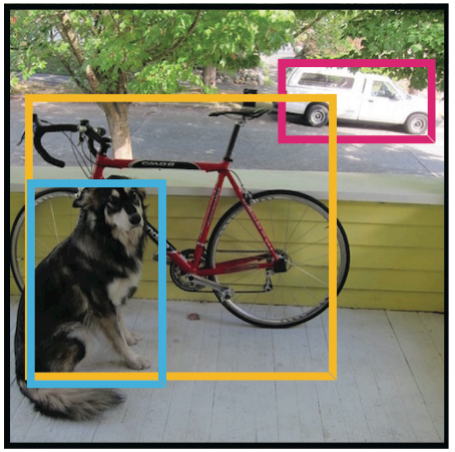


S × S grid on input



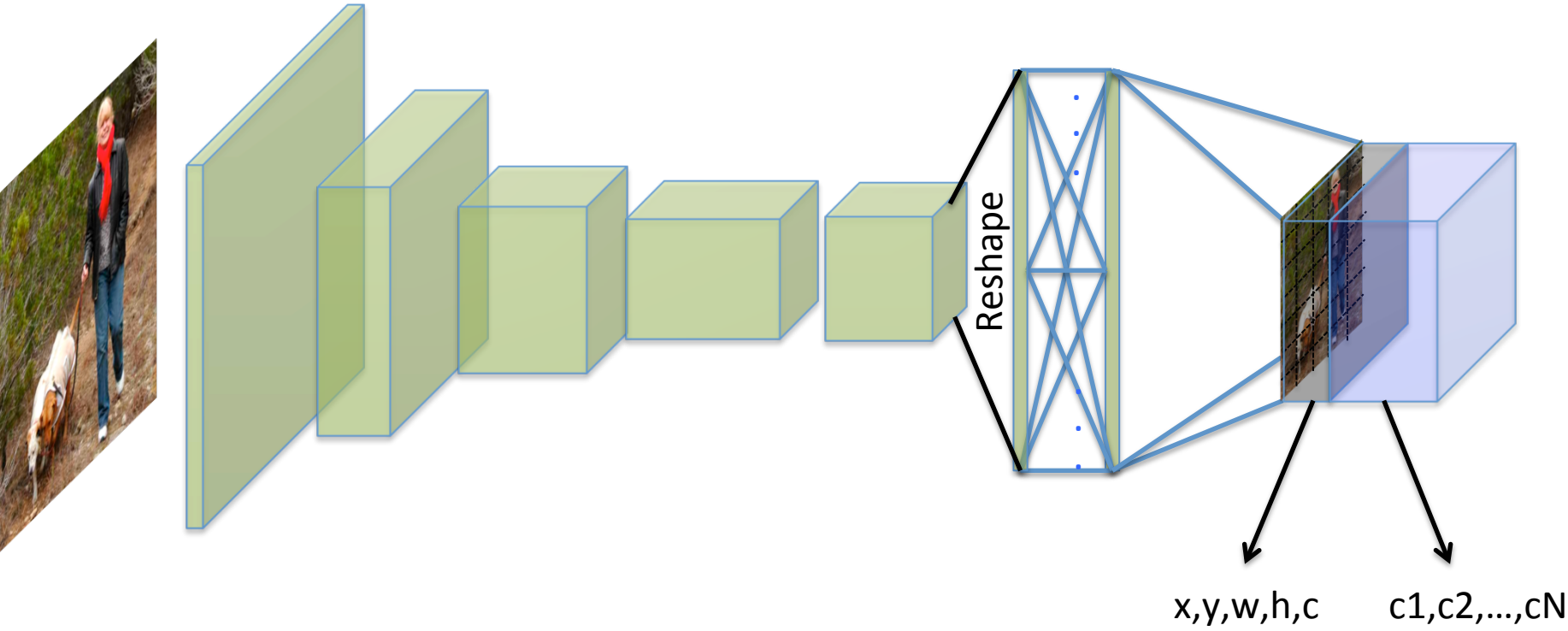
Bounding boxes + confidence

Class probability map



Final detections

YOLO



Pascal 2012

Method	mAP	Sec/im
R-CNN	59.2	20
Fast R-CNN	68.4	2
Faster R-CNN	**72.1**	0.5
YOLO	57.9	**0.02**

Source Code

- Fast R-CNN
  - https://github.com/mahyarnajibi/fast-rcnn-torch
  - https://github.com/rbgirshick/fast-rcnn
- YOLO
  - https://github.com/pjreddie/darknet/blob/master/src/yolo.c