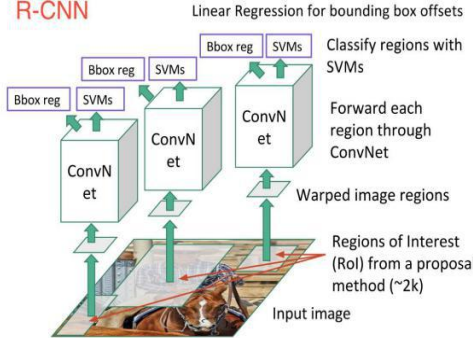
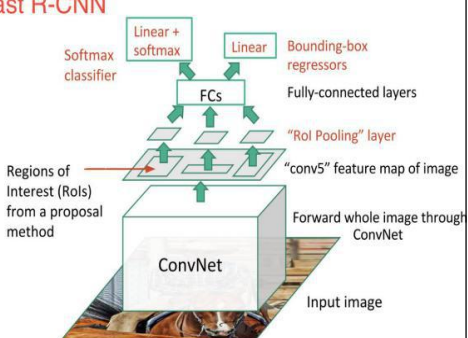


Compare R-CNN to Fast R-CNN

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	R-CNN	Fast R-CNN
Insight	<ul style="list-style-type: none"> •Apply high-capacity CNNs to <u>bottom-up region proposals</u> to localize and segment objects. •When labeled training data is scarce,<u>supervised pre-training + domain-specific fine-tuning</u> 	<ul style="list-style-type: none"> •Run the CNN just once per image and share computation(<i>RoIPool</i>). •Combine three models into one network (<i>single-stage training using multi-task loss</i>).
model	 <p>R-CNN</p> <p>Linear Regression for bounding box offsets</p> <p>Bbox reg SVMs Classify regions with SVMs</p> <p>Forward each region through ConvNet</p> <p>Warped image regions</p> <p>Regions of Interest (RoI) from a proposal method (~2k)</p> <p>Input image</p>	 <p>Fast R-CNN</p> <p>Linear + softmax</p> <p>Linear</p> <p>Bounding-box regressors</p> <p>Fully-connected layers</p> <p>“RoI Pooling” layer</p> <p>“conv5” feature map of image</p> <p>Regions of Interest (RoIs) from a proposal method</p> <p>Forward whole image through ConvNet</p> <p>Input image</p>
input	Image	Images with region proposals
output	Bounding boxes + labels for each object	Tighter bounding boxes + labels for each object
process	<ol style="list-style-type: none"> 1.Selective search creates RoI(~2k) from image. 2.Warping turn RoI into fixed-size CNN input. 3.CNN extract feature for every RoI. 4.SVM classify object + bounding-box regression reduce localization errors. 	<ol style="list-style-type: none"> 1.CNN extract feature for entire image only one. 2.Selective Search creates RoI from feature map. 3.RoI pooling layer extract fixed-length feature vector from feature map. 4.Through FC layers, softmax classifier classify object + bounding-box regressors.
result	<p>Train: Fast R-CNN 9x faster than R-CNN(VGG16)</p> <p>Testing: Fast R-CNN 0.3s vs. 47s (per image) for R-CNN</p> <p>mAP: Fast R-CNN 66% vs.62% for R-CNN(PASCAL VOC 2012)</p>	
drawback	<ol style="list-style-type: none"> 1.Training is a mult-stage pipeline and expensive in space(<i>disk</i>) and time. 2.Testing is slow because each RoI pass CNN without share computation. 	<ol style="list-style-type: none"> 1.The region proposer(<i>Selective Search</i>) is slow.