

CSCI 677: Advanced Computer Vision - Fall 2021

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Assignment 2

USC ID

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Task: We are asked to experiment with Selective Search on the given images (3) with groundtruth bounding boxes.

Selective Search Algorithm:

- Start with over segmented regions (uses F-H regions which are also called “superpixels” but one could use others)
- Compute similarities between neighboring regions
 - Merge the pair that has the highest similarity
 - Compute similarity of merged region with its neighbors
 - Repeat the above process
 - Result is a hierarchy of merged regions; use all, let a classifier do further selection

Selective Search using color strategy vs multiple strategy

Image1

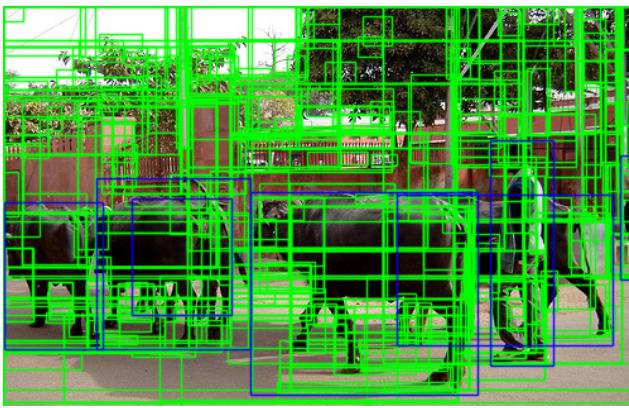
Image: 2007_006841.jpg [original image]



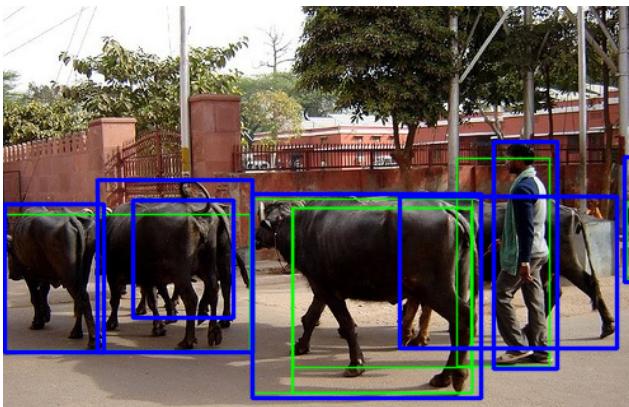
Image shape: (316, 500, 3)

Strategy: color

Total Number of Region Proposals: **354**



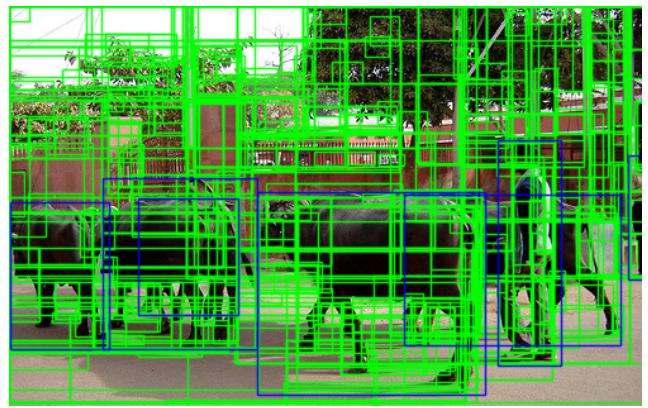
Number of Qualified Boxes with IOU > 0.5 = **7**



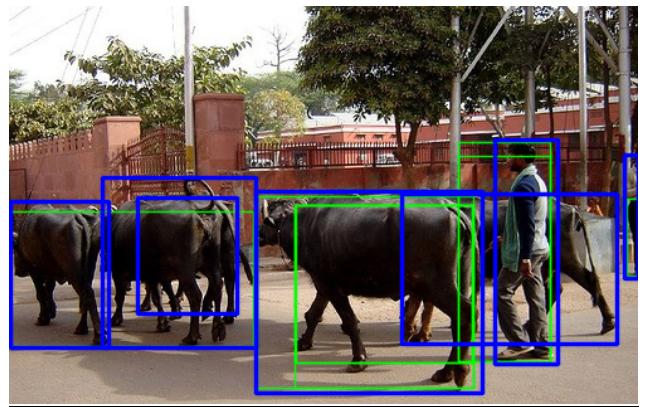
Qualified Boxes = `[[0, 163, 194, 270], [227, 158, 369, 303], [228, 158, 368, 283], [197, 151, 369, 303], [228, 158, 369, 303], [357, 119, 430, 282], [491, 153, 500, 214]]`

Strategy: multiple (all)

Total Number of Region Proposals: **388**

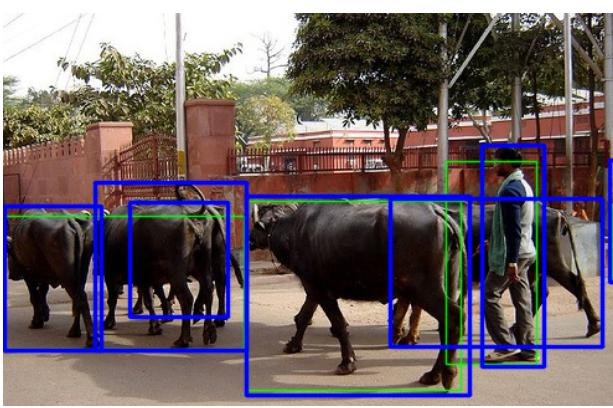


Number of Qualified Boxes with IOU > 0.5 = **8**

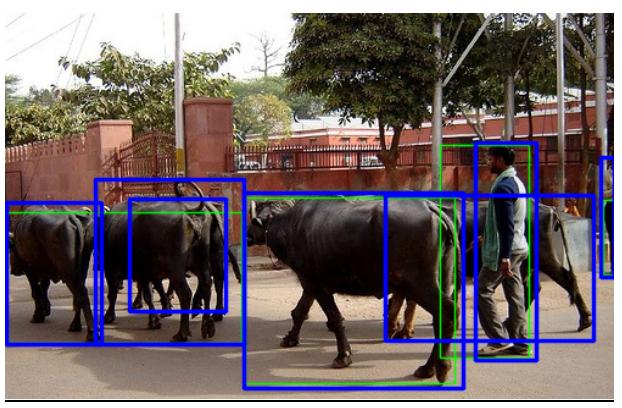


Qualified Boxes = `[[0, 163, 194, 270], [227, 158, 369, 303], [228, 158, 368, 283], [227, 158, 368, 283], [197, 151, 369, 303], [357, 119, 430, 282], [357, 108, 430, 282], [491, 153, 500, 214]]`

Number of final boxes = **4**



Number of final boxes = **4**



Final boxes = [[0, 163, 194, 270], [197, 151, 369, 303], [357, 119, 430, 282], [491, 153, 500, 214]]	Final boxes = [[0, 163, 194, 270], [197, 151, 369, 303], [357, 108, 430, 282], [491, 153, 500, 214]]
Recall = 0.5714285714285714	Recall = 0.5714285714285714

Fig1: Selective search on Image1: Left-side highlights color strategy and Right-side highlights multiple strategies.

Image2

Image: 2007_001526.jpg [original Image]



Image Shape: (298, 500, 3)

Strategy: color

Total Number of Region Proposals: **289**



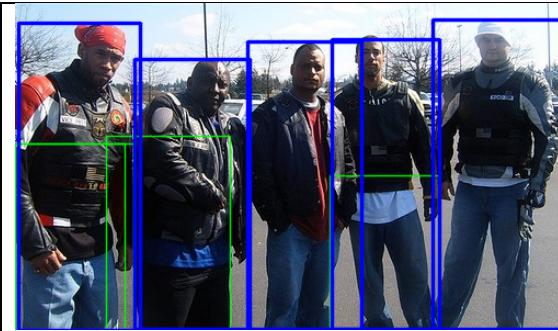
Number of Qualified Boxes with IOU > 0.5 = 4

Strategy: multiple(all)

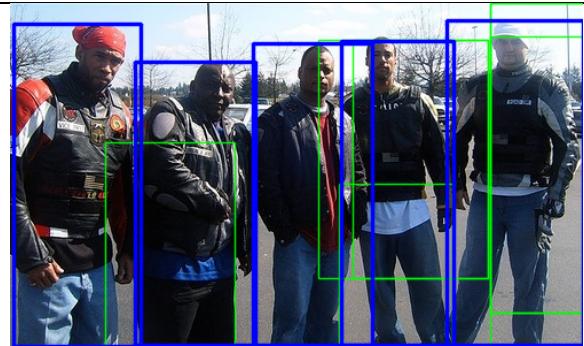
Total Number of Region Proposals: **301**



Number of Qualified Boxes with IOU > 0.5 = 7

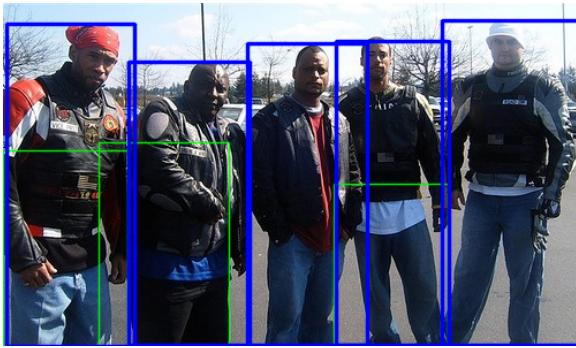


Qualified Boxes = [[0, 128, 100, 298], [0, 128, 108, 298], [83, 121, 196, 298], [287, 157, 386, 298]]



Qualified Boxes = [[83, 121, 196, 298], [269, 32, 417, 239], [299, 32, 417, 239], [287, 157, 386, 298], [419, 29, 500, 269], [419, 0, 500, 269], [419, 0, 500, 298]]

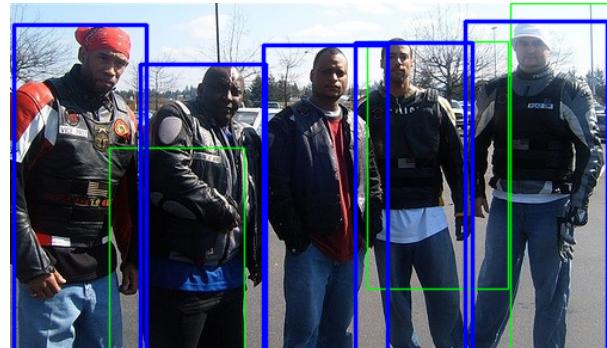
Number of final boxes = 3



Final boxes = [[0, 128, 108, 298], [83, 121, 196, 298], [287, 157, 386, 298]]

Recall = 0.6

Number of final boxes = 3



Final boxes = [[83, 121, 196, 298], [299, 32, 417, 239], [419, 0, 500, 298]]

Recall = 0.6

Fig2: Selective search on Image2: Left-side highlights color strategy and Right-side highlights multiple strategies.

Image3:

Image: 007_009323.jpg [Original Image]



Image Shape: (375, 500, 3)

Strategy: color

Total Number of Region Proposals: 250



Number of Qualified Boxes with IOU > 0.5 = 6

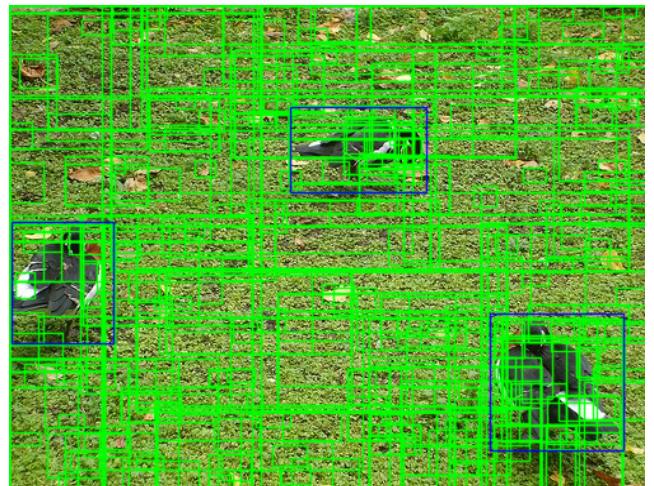


Qualified Boxes = [[381, 243, 482, 375], [387, 243, 462, 338], [220, 87, 303, 138], [0, 170, 74, 284], [0, 175, 73, 263], [0, 175, 73, 284]]

Number of final boxes = 3

Strategy: multiple(all)

Total Number of Region Proposals: 319



Number of Qualified Boxes with IOU > 0.5 = 11



Qualified Boxes = [[381, 243, 482, 375], [387, 243, 462, 338], [220, 87, 303, 138], [220, 78, 324, 138], [220, 78, 303, 138], [220, 78, 318, 138], [0, 170, 83, 284], [0, 170, 74, 263], [0, 175, 73, 263], [0, 170, 74, 284], [0, 170, 83, 296]]

Number of final boxes = 3

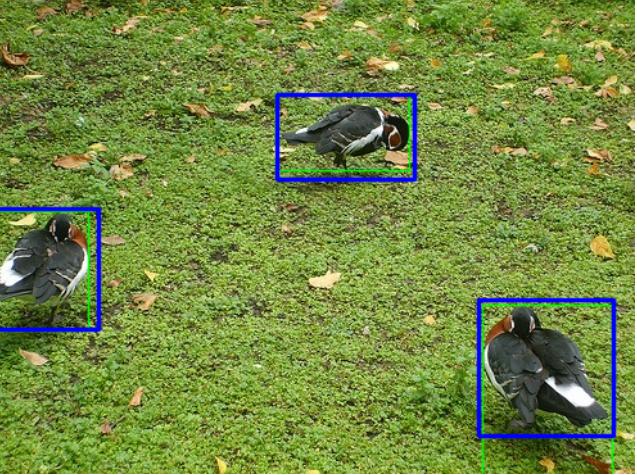
 <p>Final boxes = [[381, 243, 482, 375], [220, 87, 303, 138], [0, 175, 73, 263]]</p> <p>Recall = 1.0</p>	 <p>Final boxes = [[381, 243, 482, 375], [220, 78, 324, 138], [0, 170, 74, 263]]</p> <p>Recall = 1.0</p>
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Fig3: Selective search on Image3: Left section talks about color strategy and right section talks about multiple strategies.

Selective Search using multiple strategy

```

strategy_color = cv2.ximgproc.segmentation.createSelectiveSearchSegmentationStrategyColor()
strategy_fill = cv2.ximgproc.segmentation.createSelectiveSearchSegmentationStrategyFill()
strategy_size = cv2.ximgproc.segmentation.createSelectiveSearchSegmentationStrategySize()
strategy_texture = cv2.ximgproc.segmentation.createSelectiveSearchSegmentationStrategyTexture()
strategy_multiple = cv2.ximgproc.segmentation.createSelectiveSearchSegmentationStrategyMultiple(strategy_color,
                                                                                           strategy_fill, strategy_size, strategy_texture)
ss.addStrategy(strategy_multiple)

```

Analysis

- We do see that the total number of Region Proposals given by the selective search is different when strategy is color vs multiple. This is evident with all the 3 images as mentioned above.
- The IoU proposals > 0.5 also changes with different strategies. We do see that with multiple strategies, IoU is comparatively greater than color strategy which means we have higher chances of getting more accurate segments when merge will happen (intuitively).
- The Final boxes and hence Recall is better in case of multiple strategy as compare to color strategy. Although we have Recall of 1 for image 3 in both the cases but final boxes capturing the objects is more accurate in case of multiple strategy.

[References]

- <https://learnopencv.com/selective-search-for-object-detection-cpp-python/>
- <https://www.pyimagesearch.com/2020/06/29/opencv-selective-search-for-object-detection/>