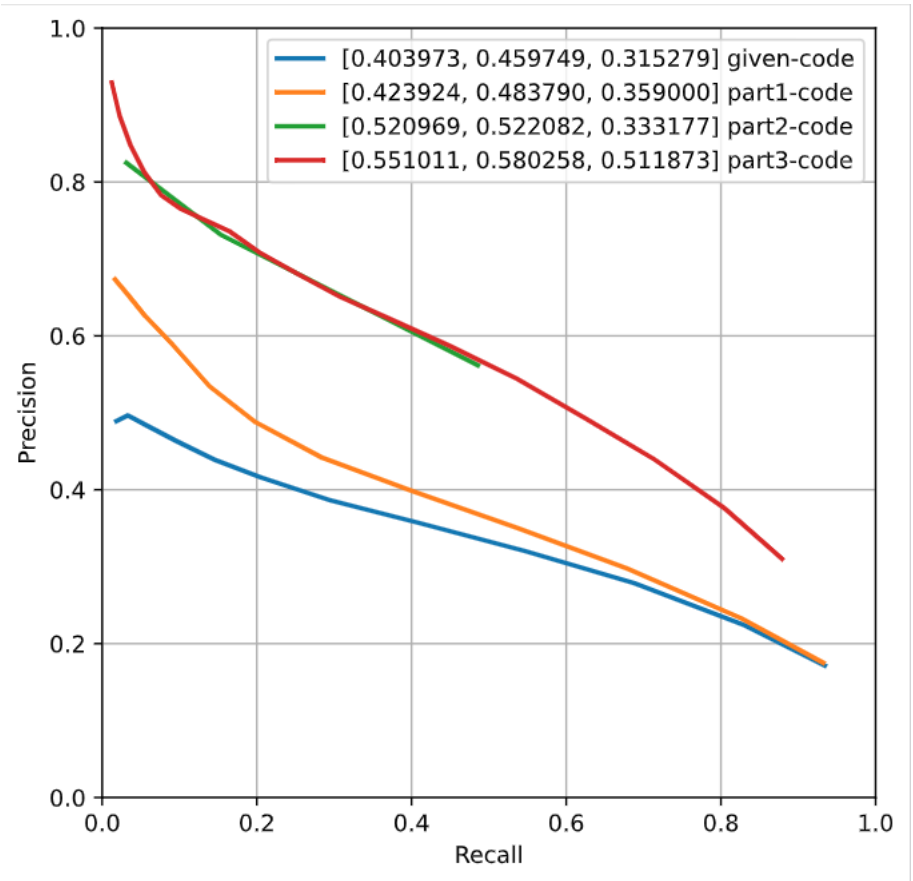
Contour Detection - Solution

Method Description:

For Part 1(Warm-up), to reduce the image artifacts, I tried padding the image on its left, right, up, down directions 3 pixels, which fits the size of the filter. The convolution will have larger overlap area with the images, which will reduce the artifacts of the image boundaries. Then I used the gaussian filter from scipy.ndimage to achieve the gaussian filter, start from 1, I tried sigma = 2, sigma = 3. From 1 to 2, the performance increased, and from 2 to 3, the performance decreased. Eventually after multiple experiments I picked sigma = 2.5 as the best parameter. For the non-maximum suppression, I first calculate the angle (in radians) between the positive x-axis and the point (x, y) in the xy-plane with np.arctan2(). Then I continue to determine the direction of the edge at each pixel based on its gradient direction angle. This is done by comparing the gradient angle to a set of predefined threshold values, which correspond to four different edge directions: horizontal, vertical, and two diagonal directions, in other words, I round the gradient direction angle to 45*n, n is the integer. However, even though I tried multiple parameters, the eventual result still have 0.001 distance to the final results.

Precision Recall Plot:

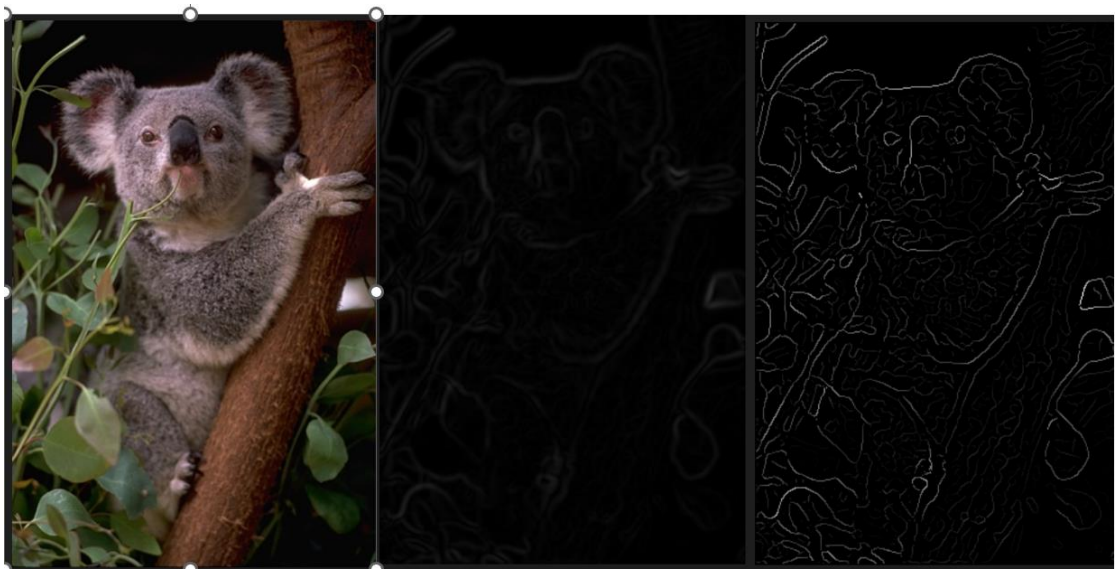


Results Table:

Method	Overall F-	Average max	AP	Runtime(seconds)

	max score	**F-score**		
Initial implementation	**0.404**	**0.460**	**0.315**	**0.006**
Warm-up [remove boundary artifacts]	**0.424**	**0.483**	**0.359**	**0.006**
Smoothing	**0.520**	**0.522**	**0.333**	**0.007**
Non-maximum Suppression	**0.551**	**0.580**	**0.511**	**0.147**
Val set numbers of best model [From gradescope]	**0.551**	**0.580**	**0.511**	**0.147**

Visualizations:



My code works relatively well for the contours that was formed by large piece geometry pieces. However, when the image is shattered, or having condensed geometries, or especially with condense, line-like objects(like grass), my code does not behave so well. Also, my contour detected is not smooth enough and I also did not completely remove the artifacts. I think it might be the problem of implementation of NMS. Or the sigma of Gaussian filter.