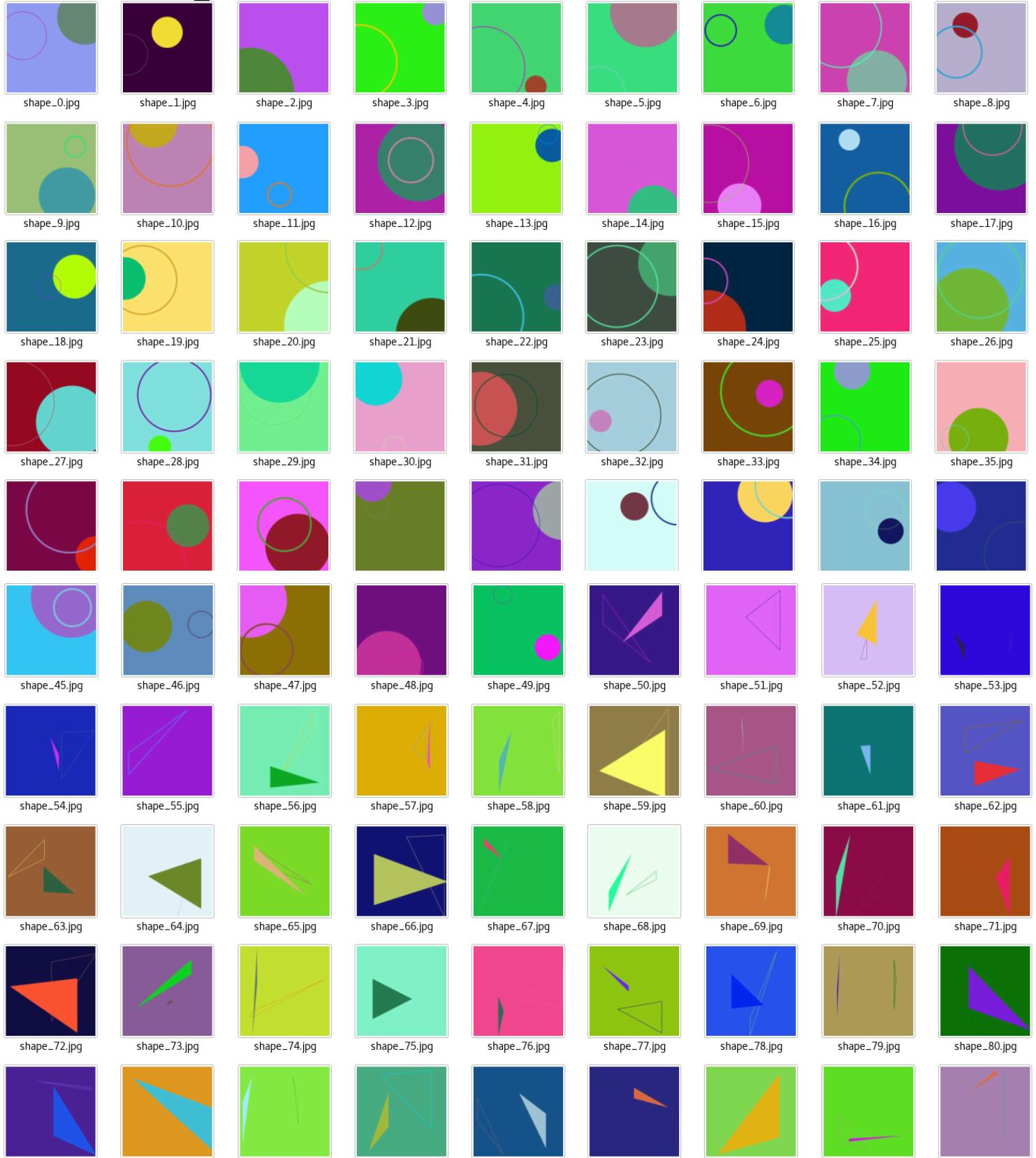
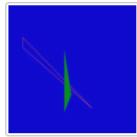
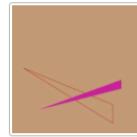


Step 1: get_edges get original images from dataset

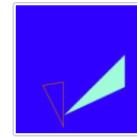




shape_90.jpg



shape_91.jpg



shape_92.jpg



shape_93.jpg



shape_94.jpg



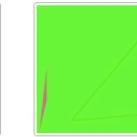
shape_95.jpg



shape_96.jpg



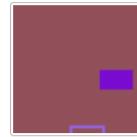
shape_97.jpg



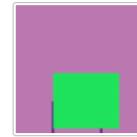
shape_98.jpg



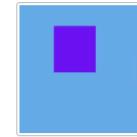
shape_99.jpg



shape_100.jpg



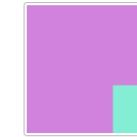
shape_101.jpg



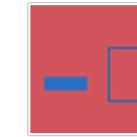
shape_102.jpg



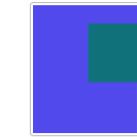
shape_103.jpg



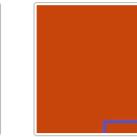
shape_104.jpg



shape_105.jpg



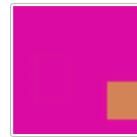
shape_106.jpg



shape_107.jpg



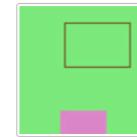
shape_108.jpg



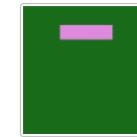
shape_109.jpg



shape_110.jpg



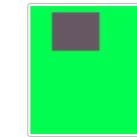
shape_111.jpg



shape_112.jpg



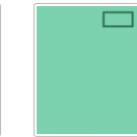
shape_113.jpg



shape_114.jpg



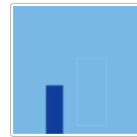
shape_115.jpg



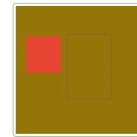
shape_116.jpg



shape_117.jpg



shape_118.jpg



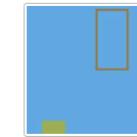
shape_119.jpg



shape_120.jpg



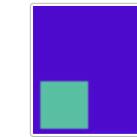
shape_121.jpg



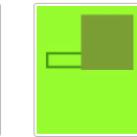
shape_122.jpg



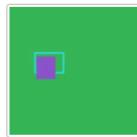
shape_123.jpg



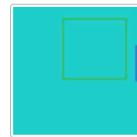
shape_124.jpg



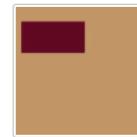
shape_125.jpg



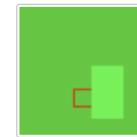
shape_126.jpg



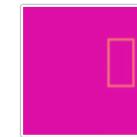
shape_127.jpg



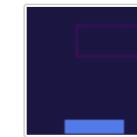
shape_128.jpg



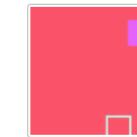
shape_129.jpg



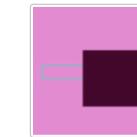
shape_130.jpg



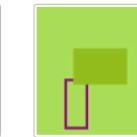
shape_131.jpg



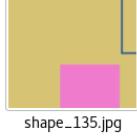
shape_132.jpg



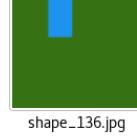
shape_133.jpg



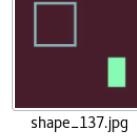
shape_134.jpg



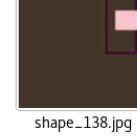
shape_135.jpg



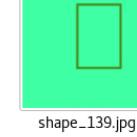
shape_136.jpg



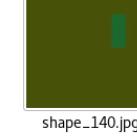
shape_137.jpg



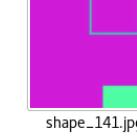
shape_138.jpg



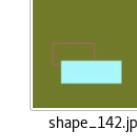
shape_139.jpg



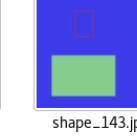
shape_140.jpg



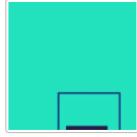
shape_141.jpg



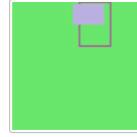
shape_142.jpg



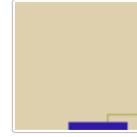
shape_143.jpg



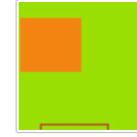
shape_144.jpg



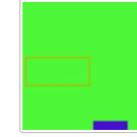
shape_145.jpg



shape_146.jpg



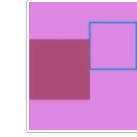
shape_147.jpg



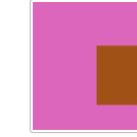
shape_148.jpg



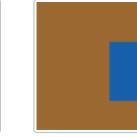
shape_149.jpg



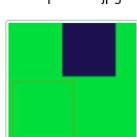
shape_150.jpg



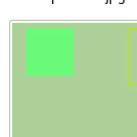
shape_151.jpg



shape_152.jpg



shape_153.jpg



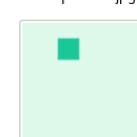
shape_154.jpg



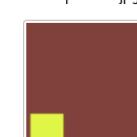
shape_155.jpg



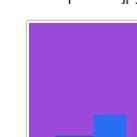
shape_156.jpg



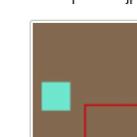
shape_157.jpg



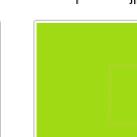
shape_158.jpg



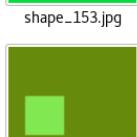
shape_159.jpg



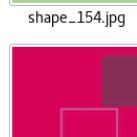
shape_160.jpg



shape_161.jpg



shape_162.jpg



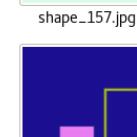
shape_163.jpg



shape_164.jpg



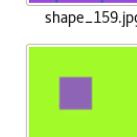
shape_165.jpg



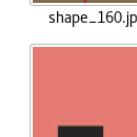
shape_166.jpg



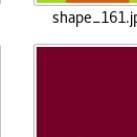
shape_167.jpg



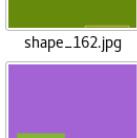
shape_168.jpg



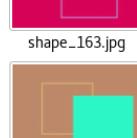
shape_169.jpg



shape_170.jpg



shape_171.jpg



shape_172.jpg



shape_173.jpg



shape_174.jpg



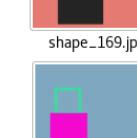
shape_175.jpg



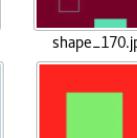
shape_176.jpg



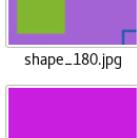
shape_177.jpg



shape_178.jpg



shape_179.jpg



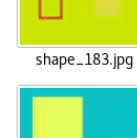
shape_180.jpg



shape_181.jpg



shape_182.jpg



shape_183.jpg



shape_184.jpg



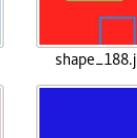
shape_185.jpg



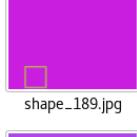
shape_186.jpg



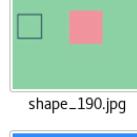
shape_187.jpg



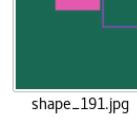
shape_188.jpg



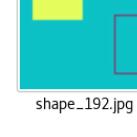
shape_189.jpg



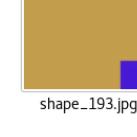
shape_190.jpg



shape_191.jpg



shape_192.jpg



shape_193.jpg



shape_194.jpg



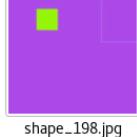
shape_195.jpg



shape_196.jpg



shape_197.jpg

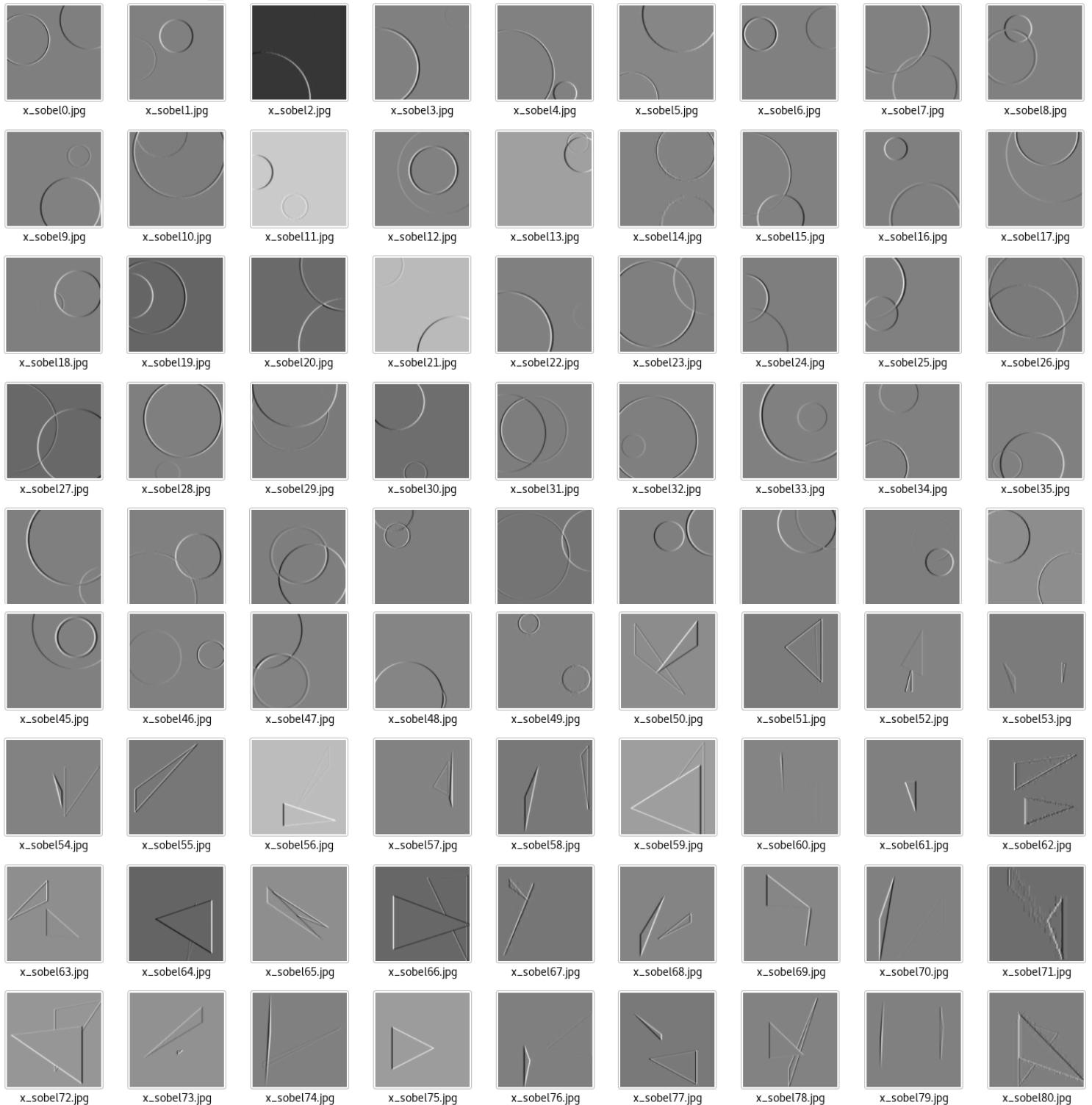


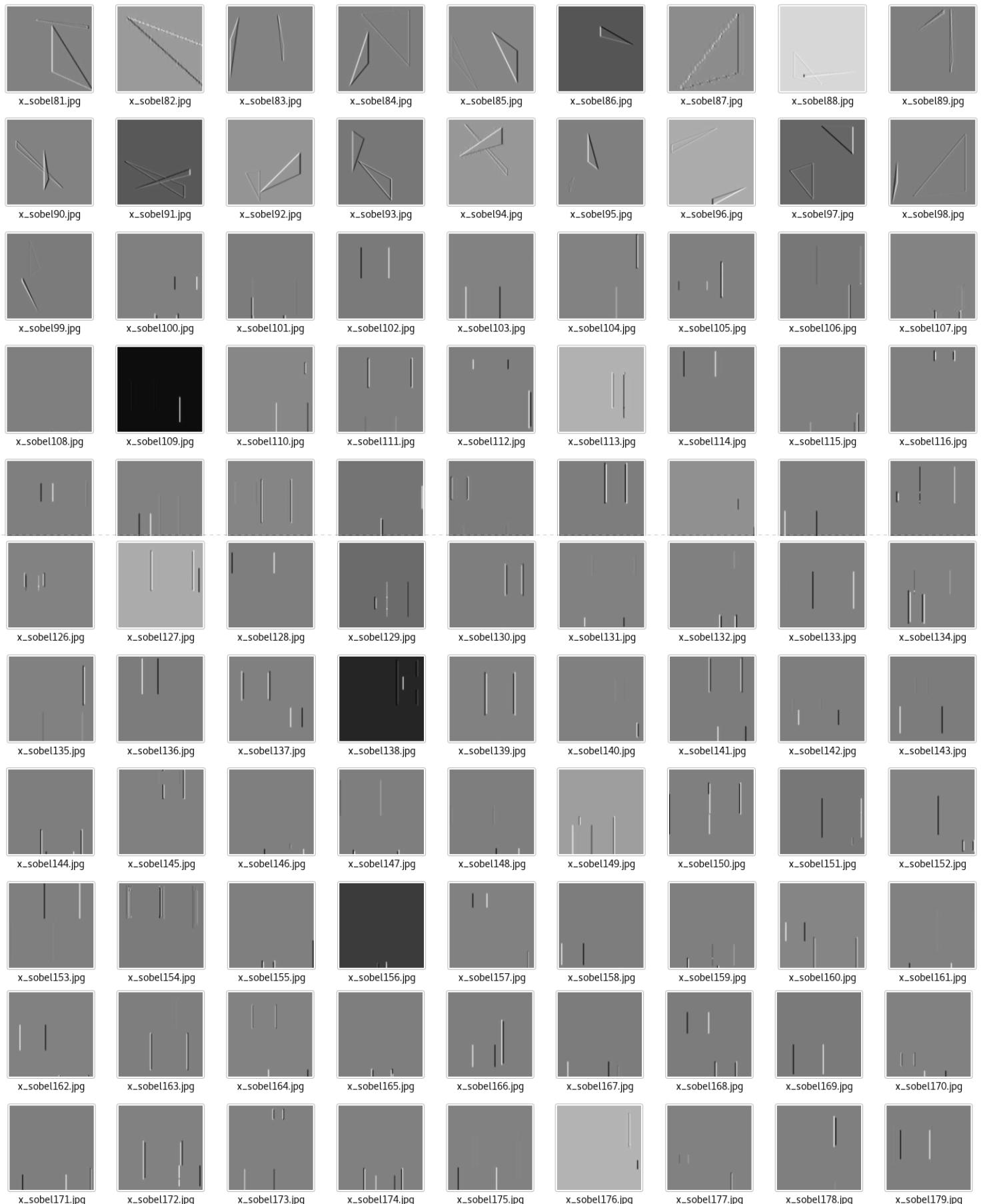
shape_198.jpg

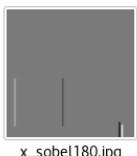


shape_199.jpg

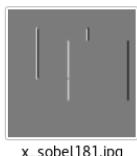
Step 2: Sobel_x algorithm detects contours in the horizontal derivative



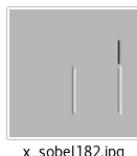




x_sobel180.jpg



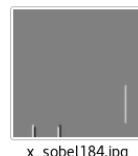
x_sobel181.jpg



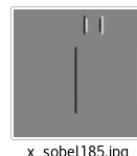
x_sobel182.jpg



x_sobel183.jpg



x_sobel184.jpg



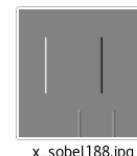
x_sobel185.jpg



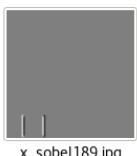
x_sobel186.jpg



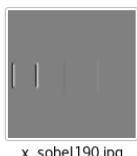
x_sobel187.jpg



x_sobel188.jpg



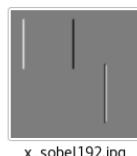
x_sobel189.jpg



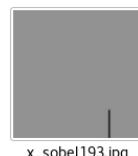
x_sobel190.jpg



x_sobel191.jpg



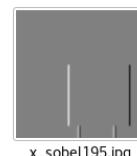
x_sobel192.jpg



x_sobel193.jpg



x_sobel194.jpg



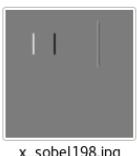
x_sobel195.jpg



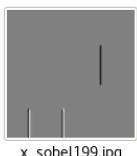
x_sobel196.jpg



x_sobel197.jpg



x_sobel198.jpg



x_sobel199.jpg

Step 3: Sobel_y algorithm detects contours in the vertical derivative



y_sobel0.jpg



y_sobel1.jpg



y_sobel2.jpg



y_sobel3.jpg



y_sobel4.jpg



y_sobel5.jpg



y_sobel6.jpg



y_sobel7.jpg



y_sobel8.jpg



y_sobel9.jpg



y_sobel10.jpg



y_sobel11.jpg



y_sobel12.jpg



y_sobel13.jpg



y_sobel14.jpg



y_sobel15.jpg



y_sobel16.jpg



y_sobel17.jpg



y_sobel18.jpg



y_sobel19.jpg



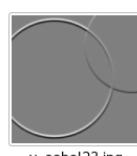
y_sobel20.jpg



y_sobel21.jpg



y_sobel22.jpg



y_sobel23.jpg



y_sobel24.jpg



y_sobel25.jpg



y_sobel26.jpg



y_sobel27.jpg



y_sobel28.jpg



y_sobel29.jpg



y_sobel30.jpg



y_sobel31.jpg



y_sobel32.jpg



y_sobel33.jpg



y_sobel34.jpg



y_sobel35.jpg



y_sobel36.jpg



y_sobel37.jpg



y_sobel38.jpg



y_sobel39.jpg



y_sobel40.jpg



y_sobel41.jpg



y_sobel42.jpg



y_sobel43.jpg



y_sobel44.jpg



y_sobel45.jpg



y_sobel46.jpg



y_sobel47.jpg



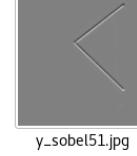
y_sobel48.jpg



y_sobel49.jpg



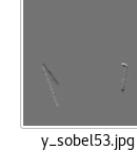
y_sobel50.jpg



y_sobel51.jpg



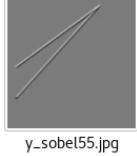
y_sobel52.jpg



y_sobel53.jpg



y_sobel54.jpg



y_sobel55.jpg



y_sobel56.jpg



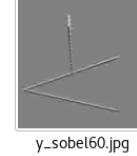
y_sobel57.jpg



y_sobel58.jpg



y_sobel59.jpg



y_sobel60.jpg



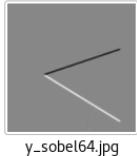
y_sobel61.jpg



y_sobel62.jpg



y_sobel63.jpg



y_sobel64.jpg



y_sobel65.jpg



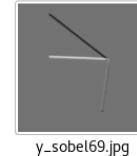
y_sobel66.jpg



y_sobel67.jpg



y_sobel68.jpg



y_sobel69.jpg



y_sobel70.jpg



y_sobel71.jpg



y_sobel72.jpg



y_sobel73.jpg



y_sobel74.jpg



y_sobel75.jpg



y_sobel76.jpg



y_sobel77.jpg



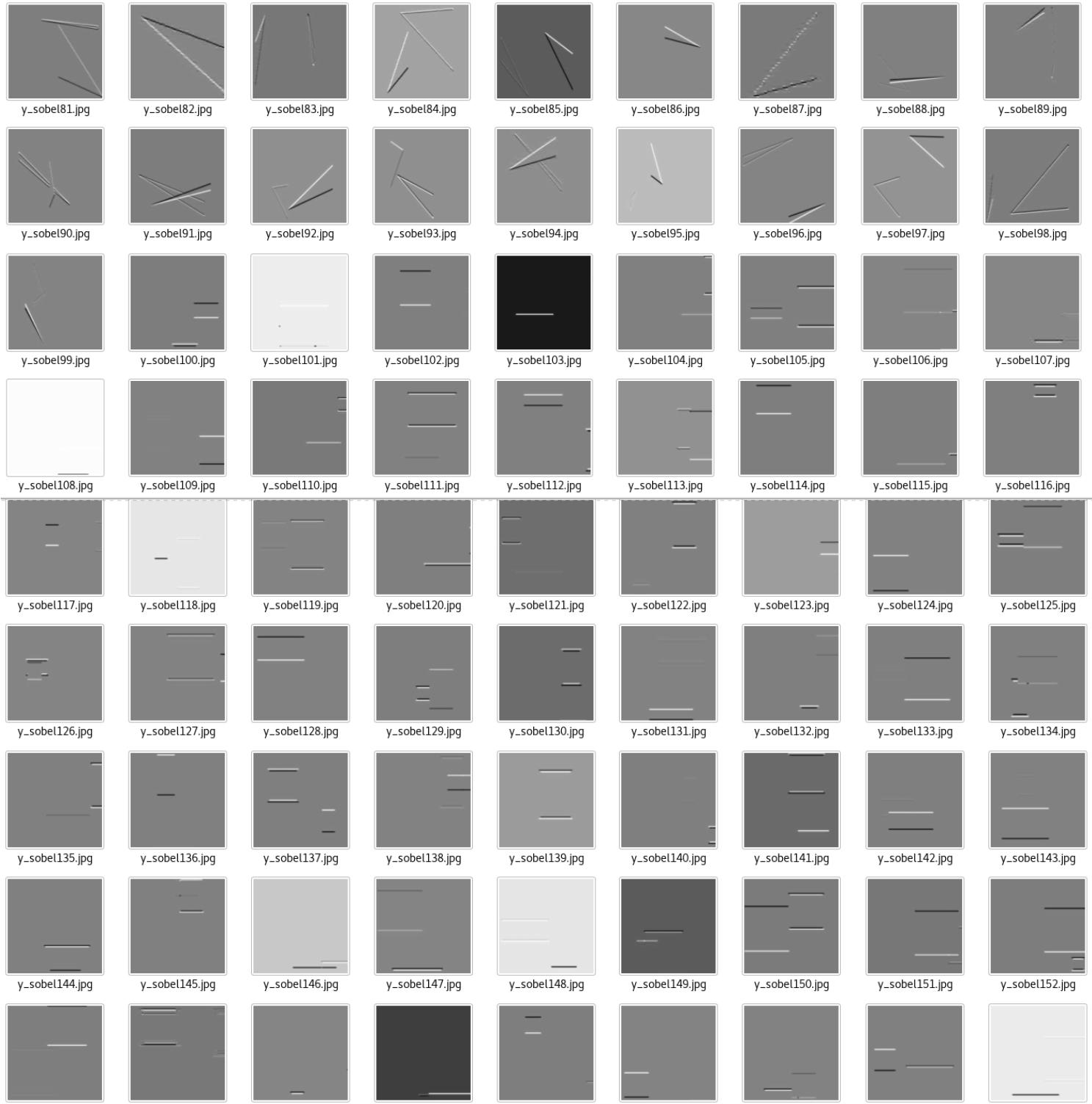
y_sobel78.jpg

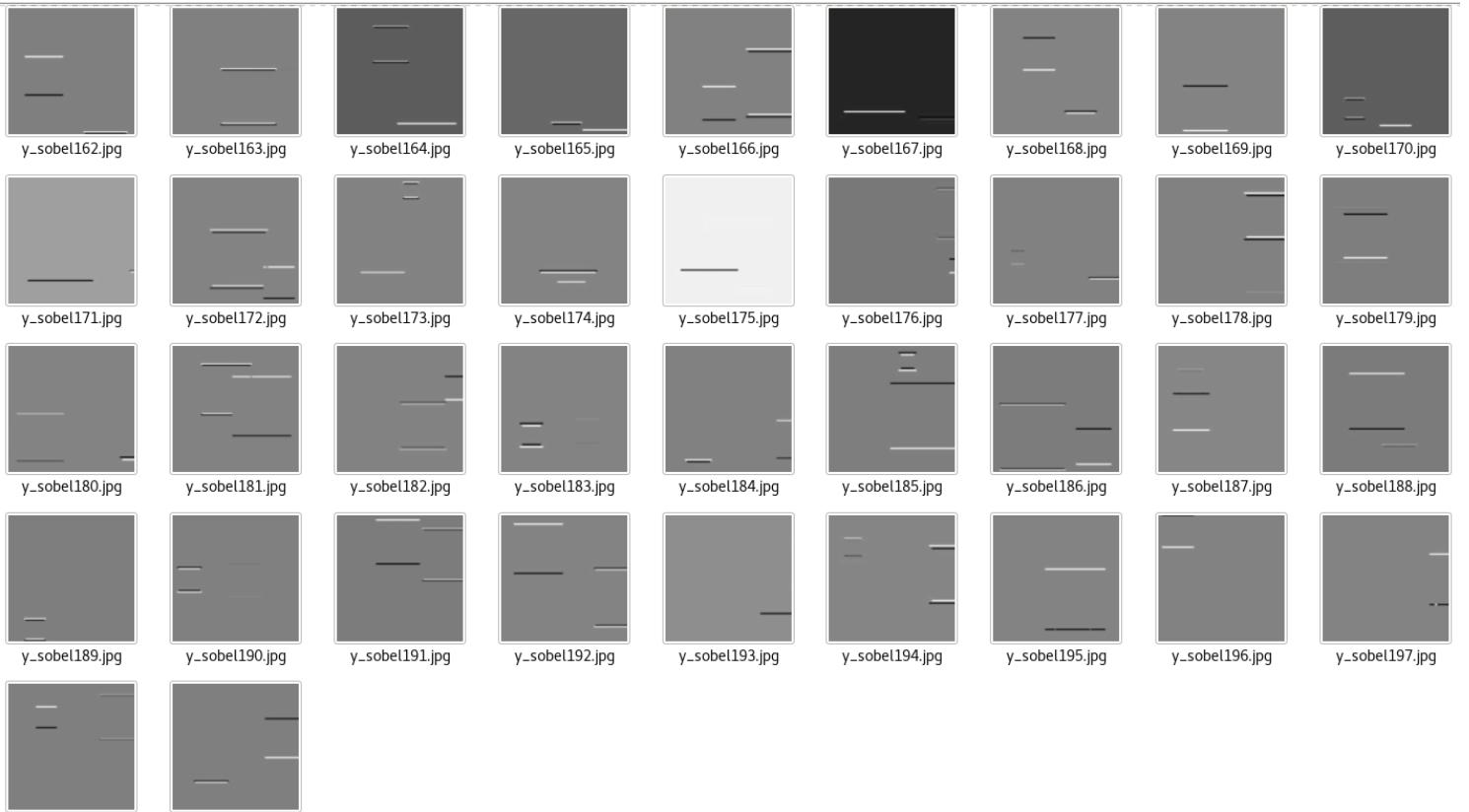


y_sobel79.jpg

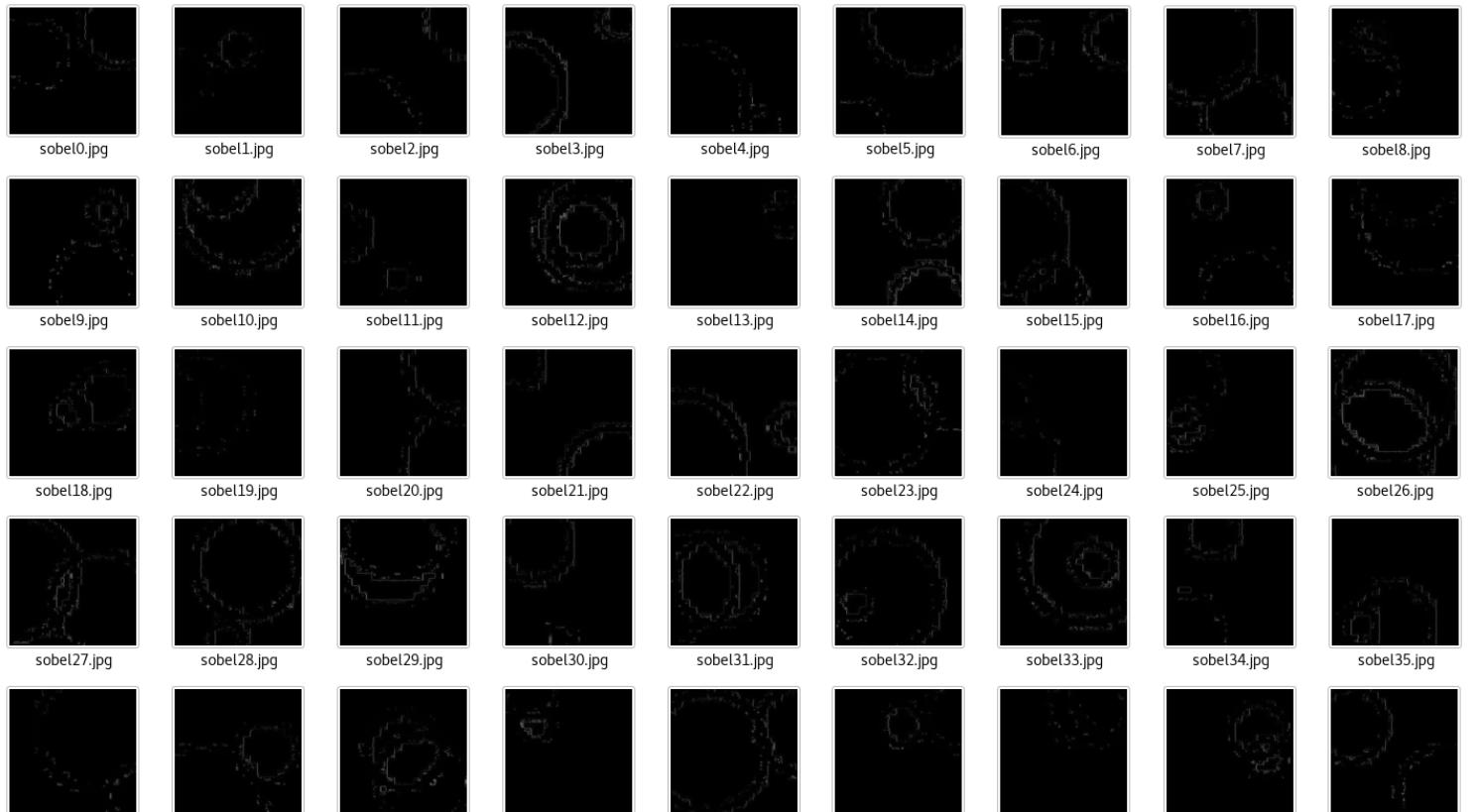


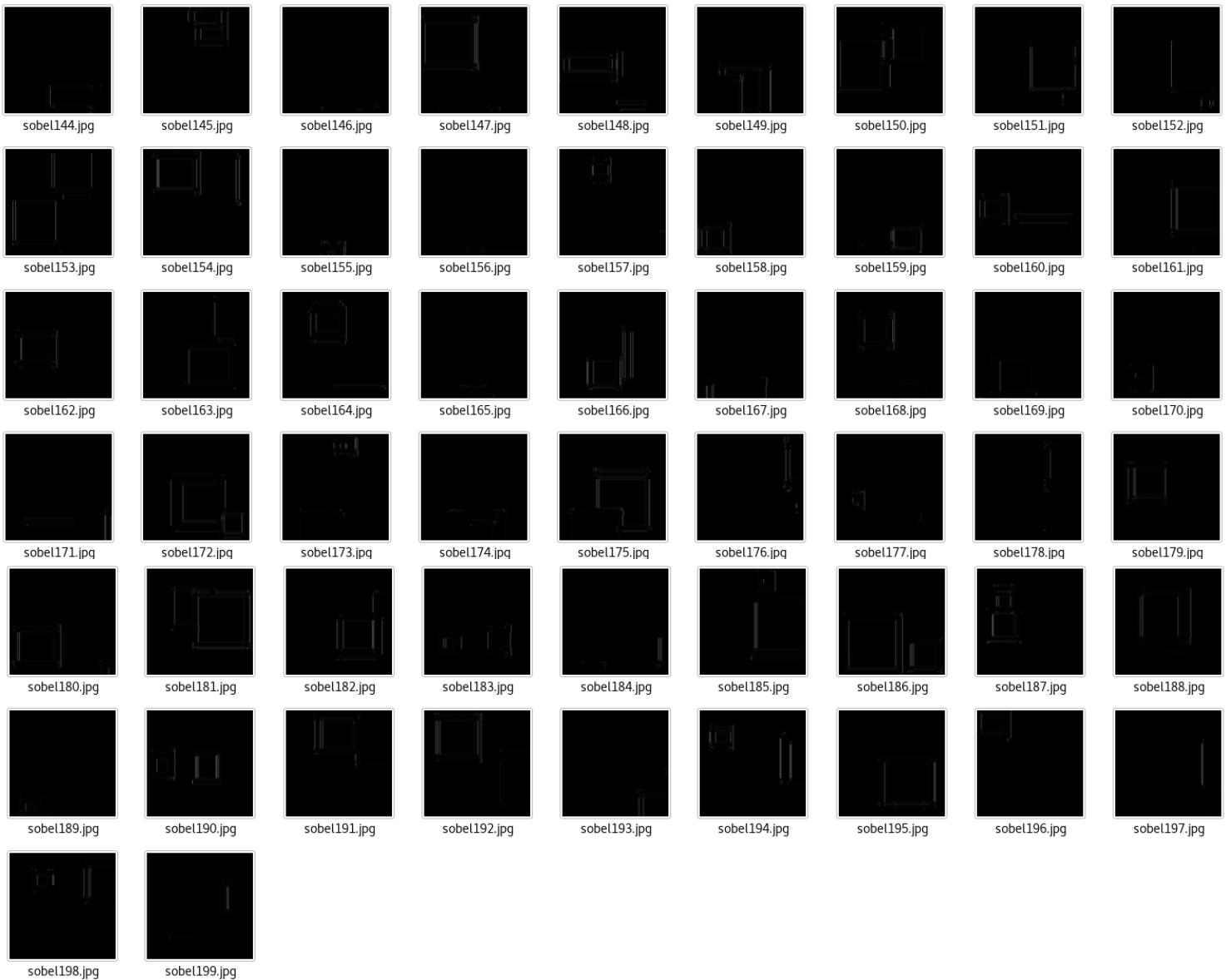
y_sobel80.jpg



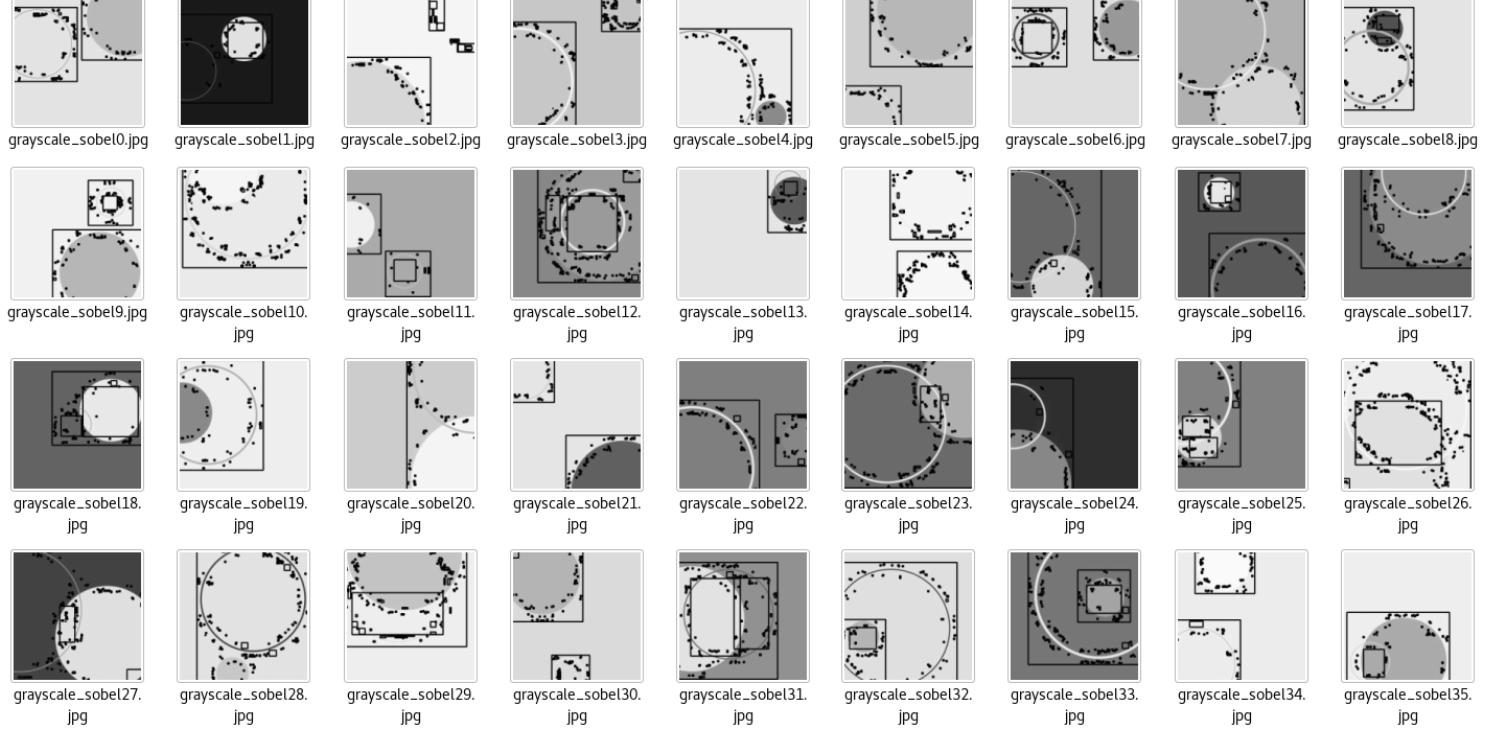


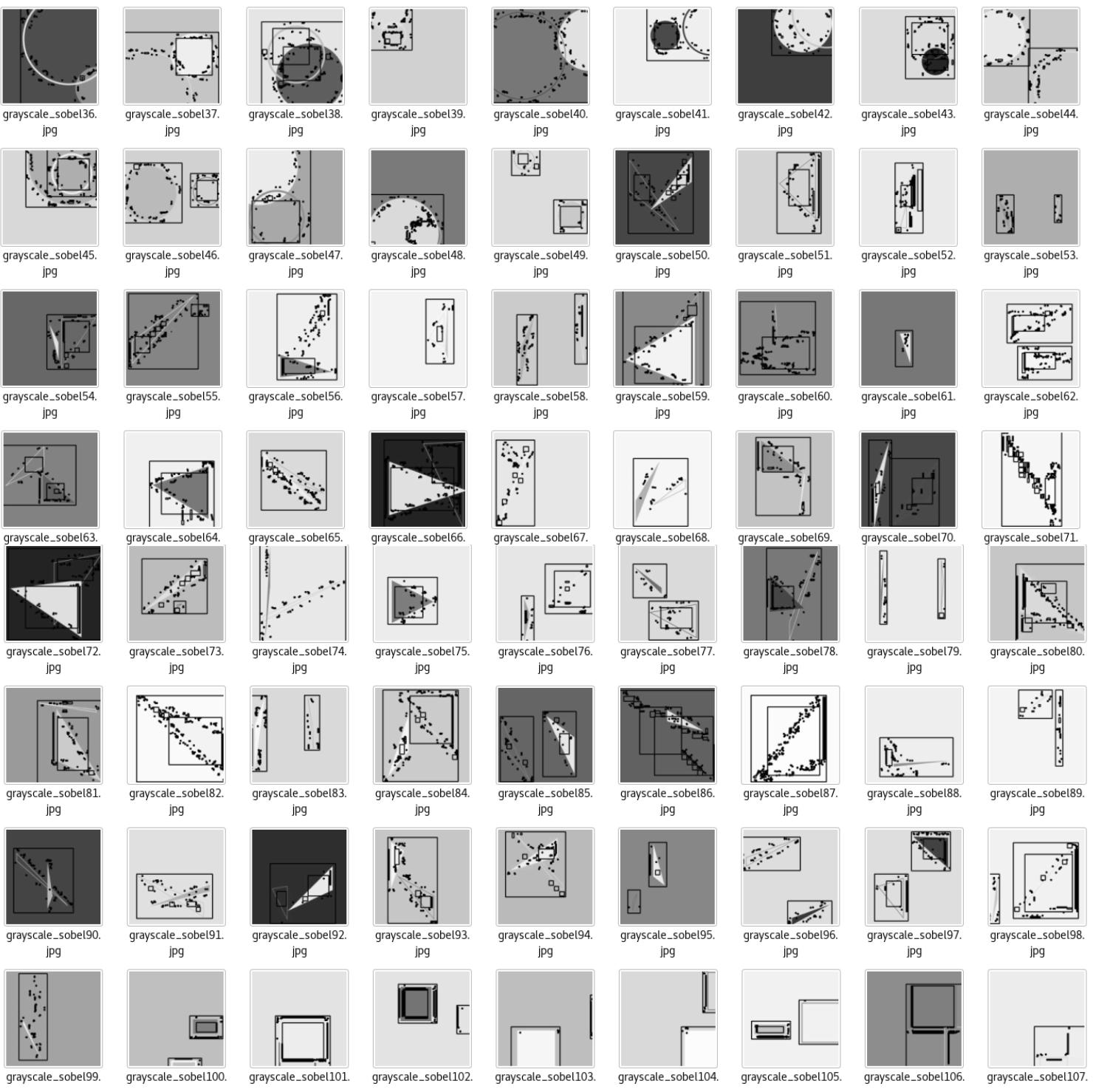
Step 4: Combine gradients of x and y changes



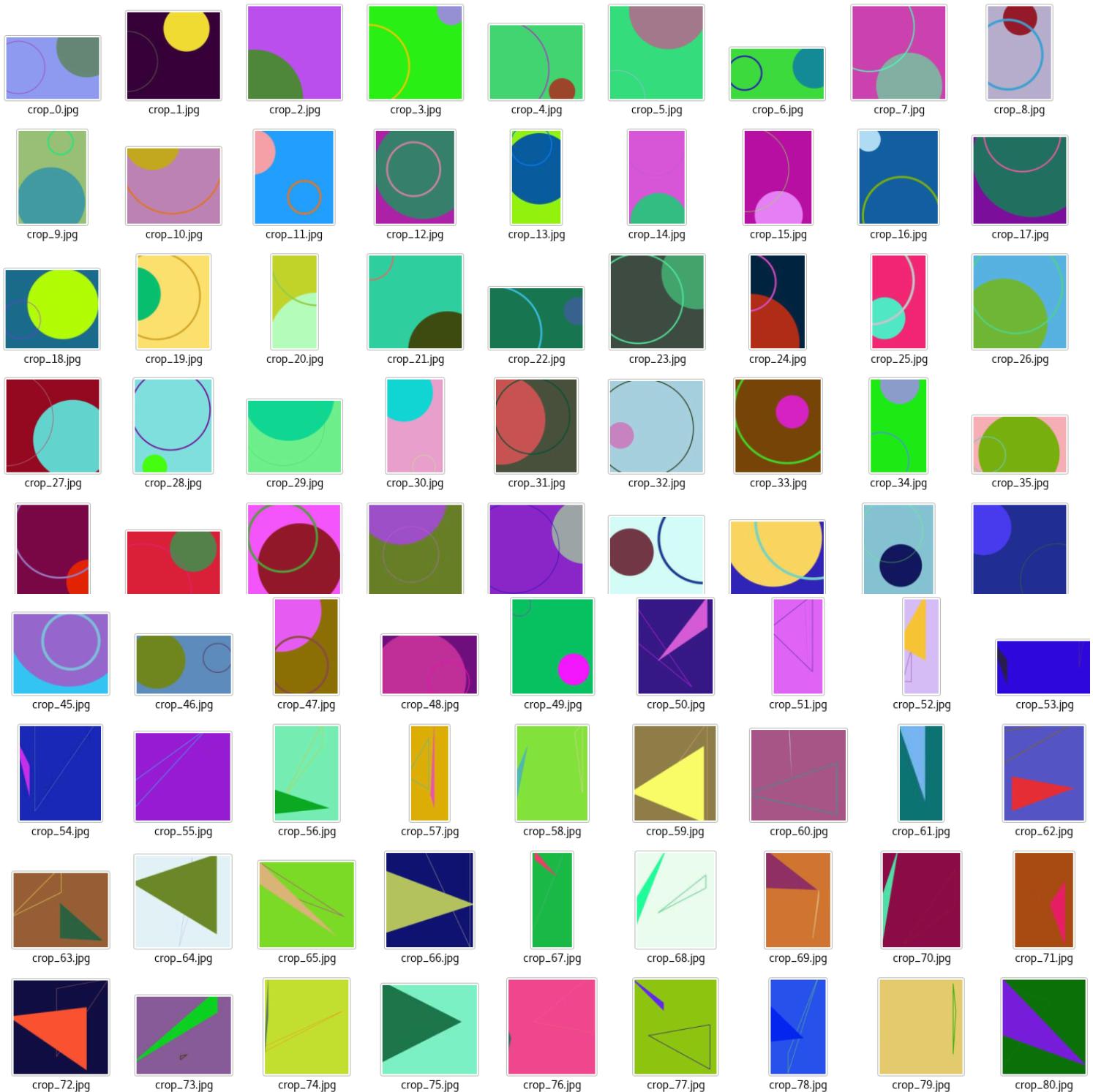


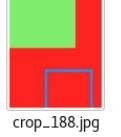
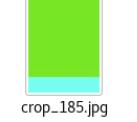
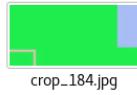
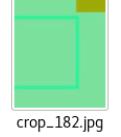
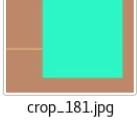
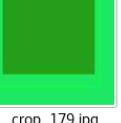
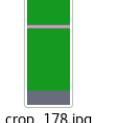
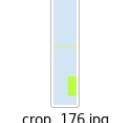
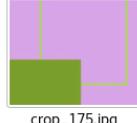
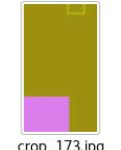
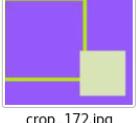
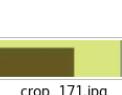
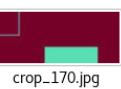
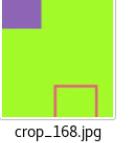
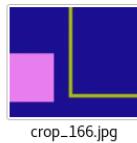
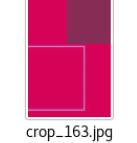
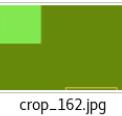
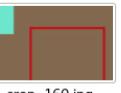
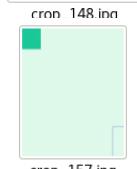
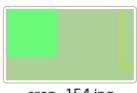
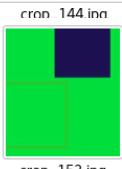
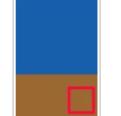
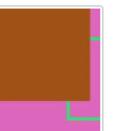
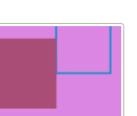
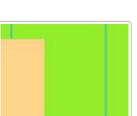
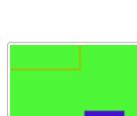
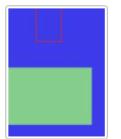
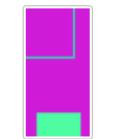
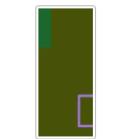
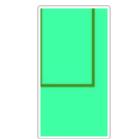
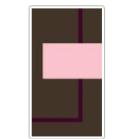
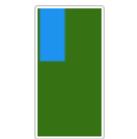
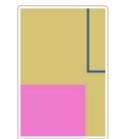
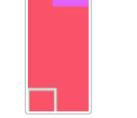
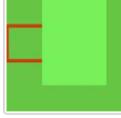
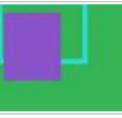
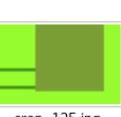
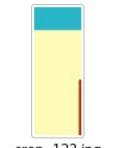
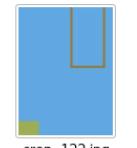
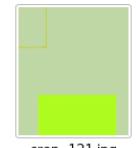
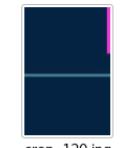
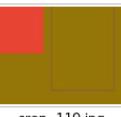
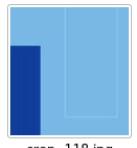
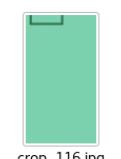
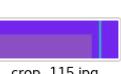
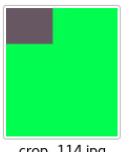
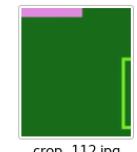
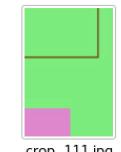
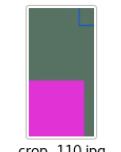
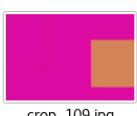
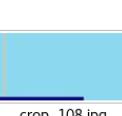
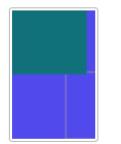
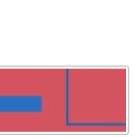
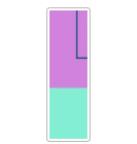
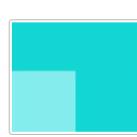
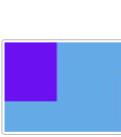
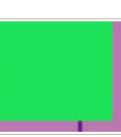
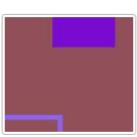
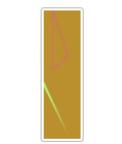
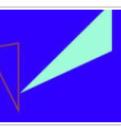
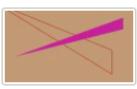
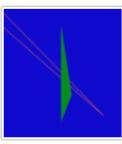
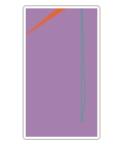
Step 5: sobel detects edges, which are the boundary conditions

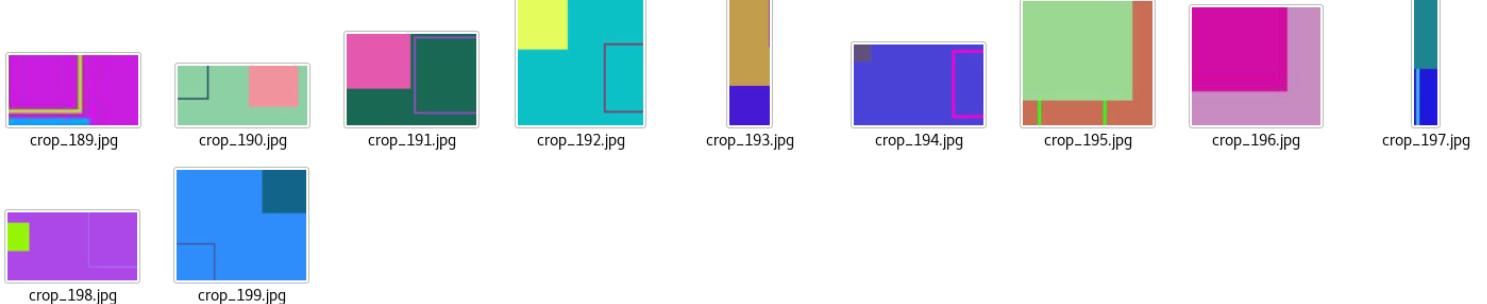




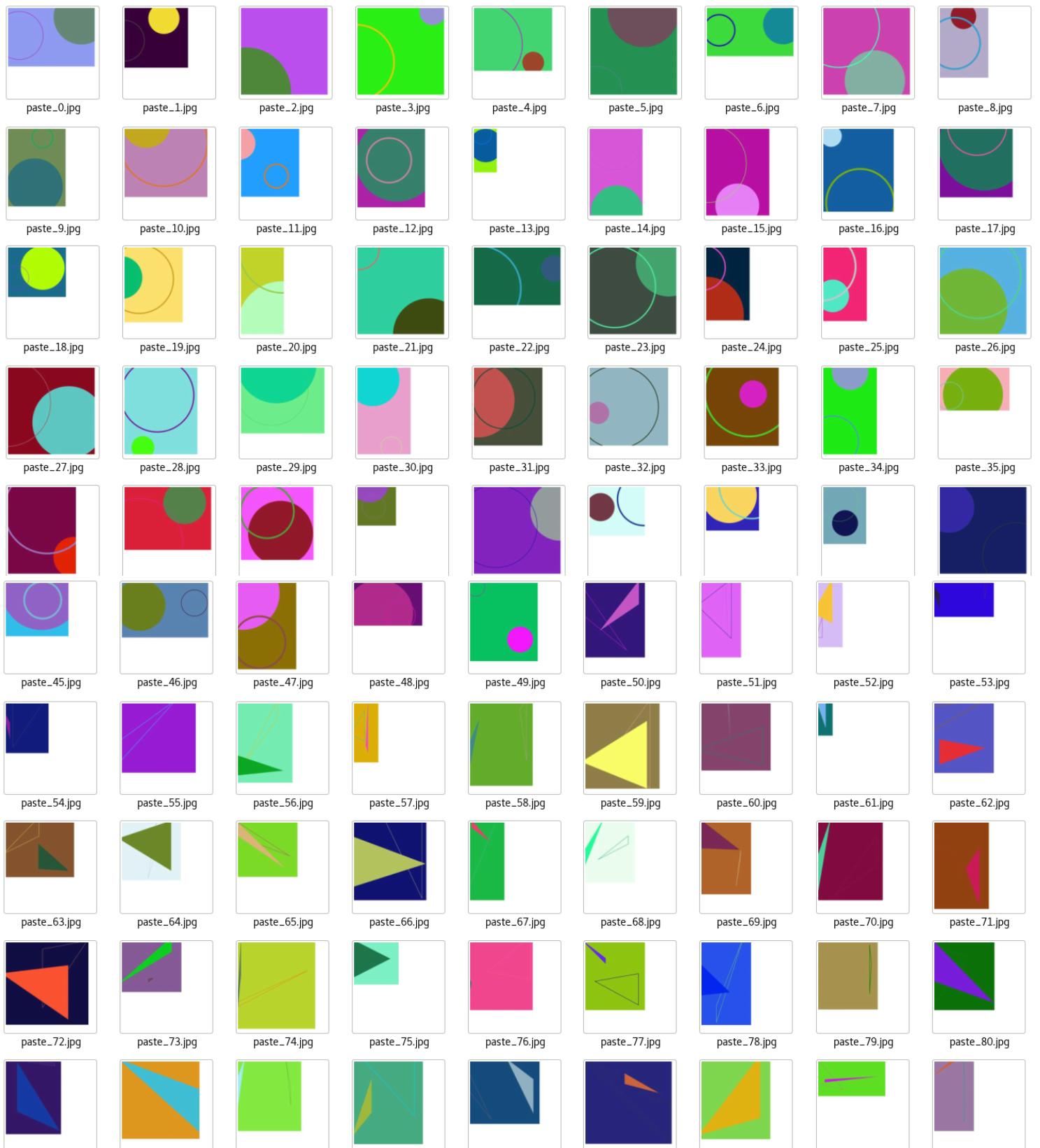
Step 6: Original dataset is cropped by boundaries through sobel's Edae detection and contours search

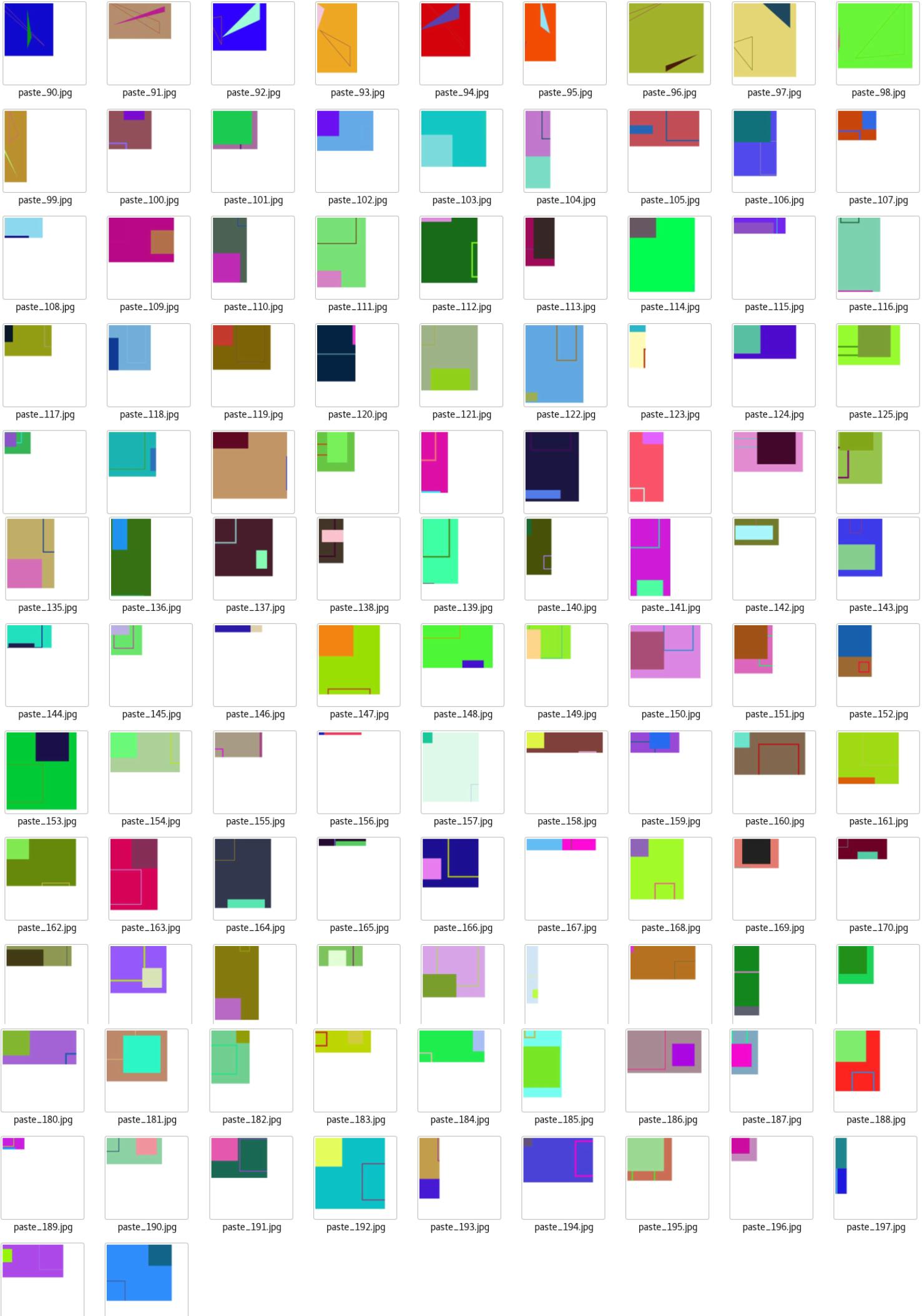






Step 7: Keras' generator requires the dataset to be in the same shape; pasting cropped images on the white background of the same area.





Step 8: Scaling the images to a fixed width of 300 with an aspect ratio for the cropped height of the image

