**Task1:**

1. Your own Kmeans clustering based implementation – 1 mark

**Answer:**

After reading paper about Kmeans on image segmentation, choose Gaussian-means(sigma=0.01) to implement the task. This method is that when the distribution is normal distribution, finish the clustering otherwise find the centroids and update them. Use histogram to get every channel dataset for Kmeans. Then use Kmeans to assign new pixel to cartoon.

1. Bilateral filtering-based implementation – 2 mark

**Answer:**

A bilateral filter is a non-linear, edge-preserving, and noise-reducing smoothing filter for images. It replaces the intensity of each pixel with a weighted average of intensity values from nearby pixels. This weight can be based on a Gaussian distribution. (From Wikipedia) The bilateral function in skimage module has two important parameters, which are sigma\_color (the larger value the larger radiometric differences) and sigma\_spatial (the larger value the larger spatial differences). I choose sigma\_color equal to 0.01 that is the same as Kmeans’ sigma.

1. Improved (your own/inspired) method and implementation – 3 mark

**Answer:**

1. For task 1 part 2 bilateral filtering, it is a technical processing that choosing the appropriate parameters. To improve the bilateral filtering performance, I choose to do the image processing several times with the same parameter as part 2. The final result is much better than performing once.
2. Combine Kmeans and bilateral filtering. Firstly, use Kmeans do the clustering. Then, smooth the image via bilateral filtering. The two images that are from part1 and part3\_2 show no big difference.

Task 2 (5 Marks total)

The task is to find the number of rings (semi-circles, spheres and complete circles) in the attached image. Code function CountShapes\_ID(image). It takes the input image as a parameter and outputs the

number of semi-circles, spheres and complete circles and also displays and saves the output image

with highlighted objects.

CountShapes\_ID(image) in python file– 3 marks

Report containing details – 2 marks

Reference:

https://github.com/PavanGJ/Circle-Hough-Transform

https://www.codingame.com/playgrounds/38470/how-to-detect-circles-in-images