Bonus Assignment Image Processing
Affinity Propagation for Image Clustering

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Perform a image segmentation (clustering) of an image of the Iron-man using affinity propagation, reducing the number of colour in the image, while preserving the overall appearance quality. Affinity propagation (AP) is a clustering algorithm based on the concept of "message passing" between data points. Unlike clustering algorithms such as k-means or k-medoids, affinity propagation does not require the number of clusters to be determined or estimated before running the algorithm. Similar to k-medoids, affinity propagation finds "exemplars" or "sampling data", members of the input set that are representative of clusters.

First, load the image then we quantisize the image using numpy to get the pixel array data by transforming the image into to 2D numpy array. After that I make a small sub sample of the image data as an exemplars for doing the clustering process. I use the open source library of sklearn to do the affinity propagation. The algorithm consists of some parameters and we can adjust the parameter to see the effect of different size of parameter. In this task I will adjust the damping and size of exemplars or sampling data. The calculation of distance between data points are fix using Euclidean distance. The damping (between 0.5 and 1) is the extent to which the current value is maintained relative to incoming values (weighted 1 - damping). This in order to avoid numerical oscillations when updating these values (messages). Here are the result of image clustering using affinity propagation with different damping size and exemplar/sampling data size.
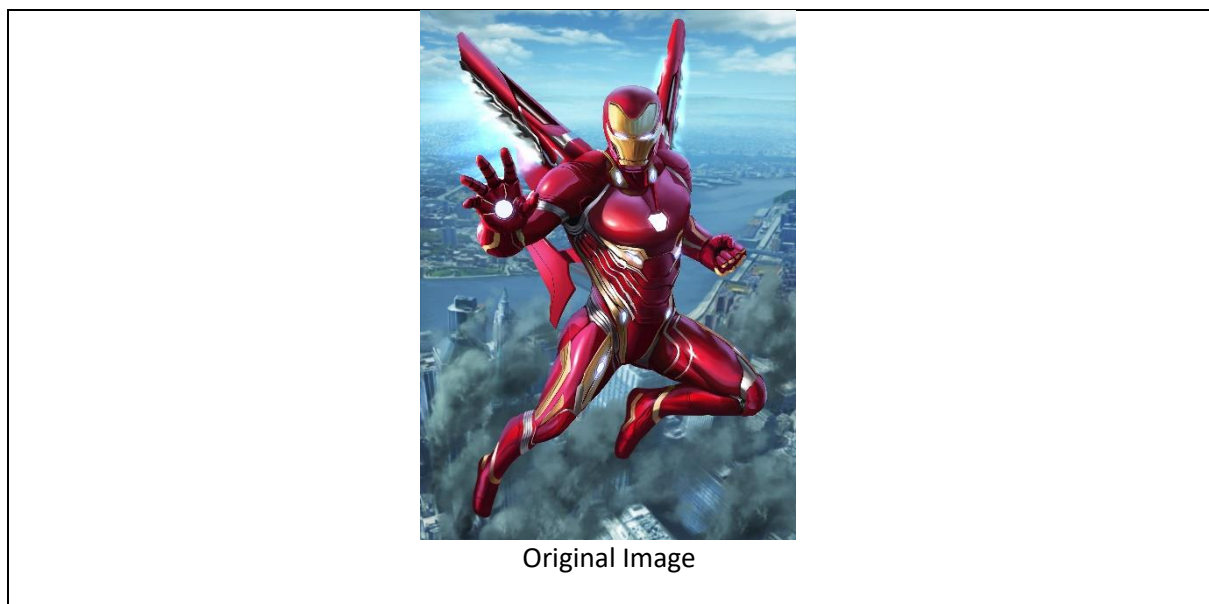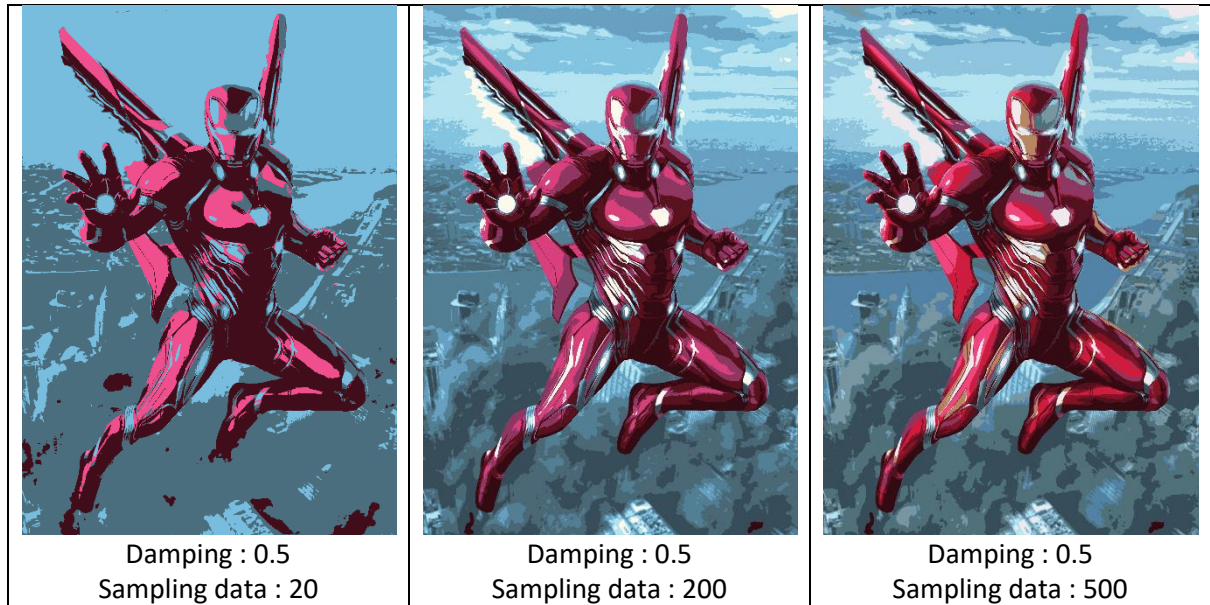
- **Different damping size**

Original Image

Damping : 0.5 Sampling data : 500	Damping : 0.7 Sampling data : 500	Damping : 0.9 Sampling data : 500
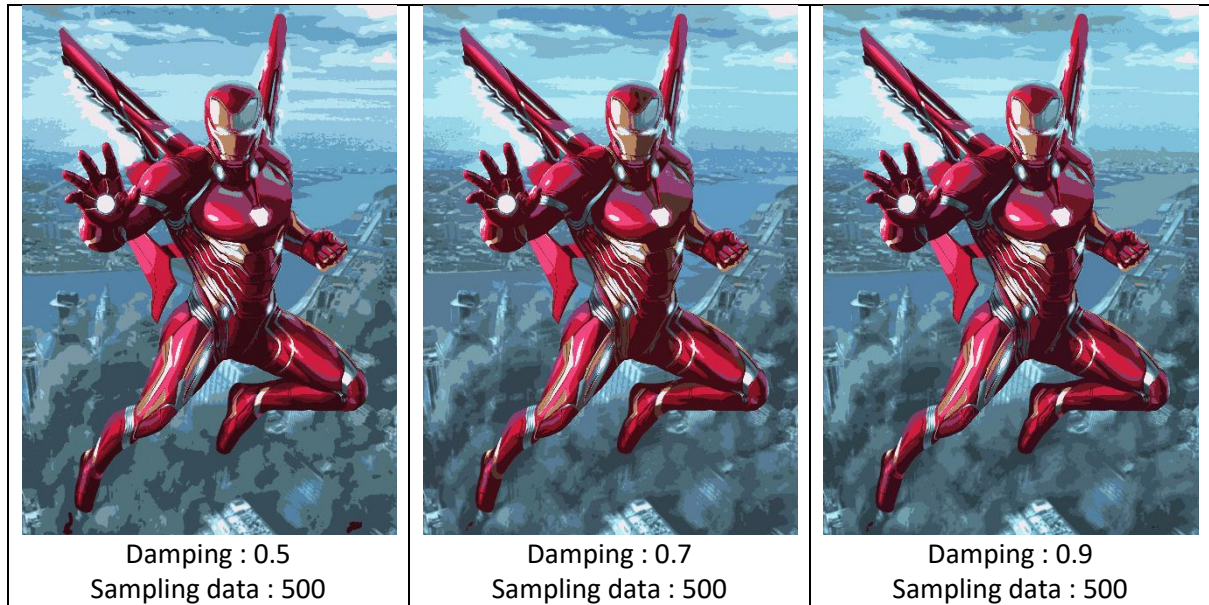
The experiment using sampling data of 500. The result of using different damping size is not too significant in a glance, however if we see clearly, the segmentation of bigger damping size makes the segmentation of pixel is getting neater.

- **Different sampling data**

Original Image

| Damping : 0.5 | Damping : 0.5 | Damping : 0.5 |
| Sampling data : 20 | Sampling data : 200 | Sampling data : 500 |

In this experiment, I set the damping size fixed of 0.5. Then I adjust the sampling data, we can see the result that with different sampling size has the effect in the output of segmented image. The smaller sampling data so then the less the coloration we get. It makes sense due to the less amount of pixel we use to do the clustering which makes the colors in pixels simpler.