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Image Segmentation

Alli Khadga Jyoth - M23CSA003

Ratio Cut Segmentaion

Steps:

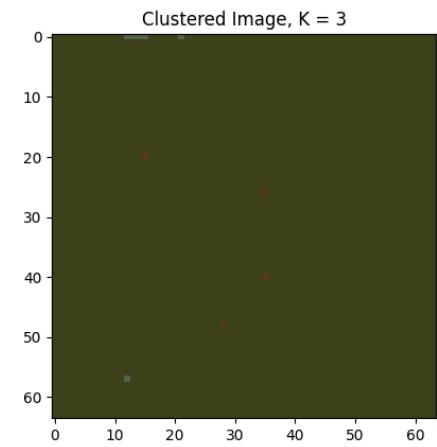
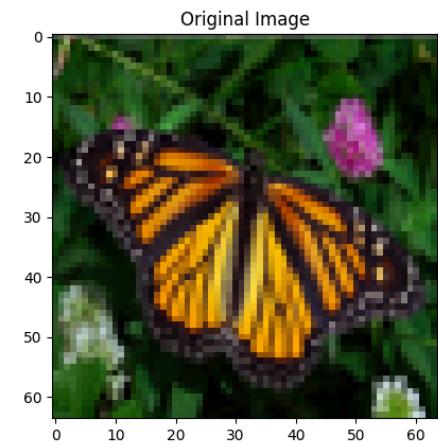
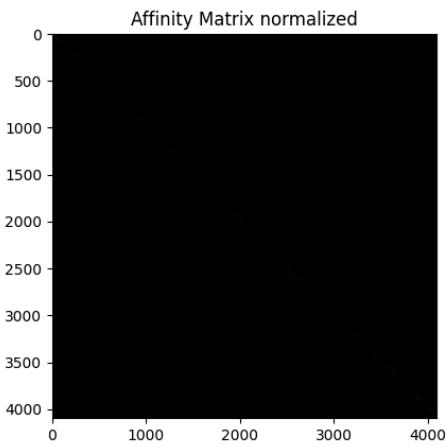
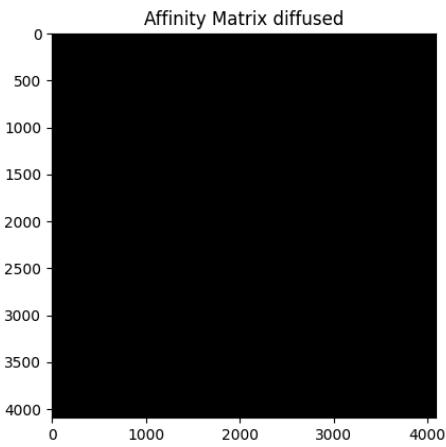
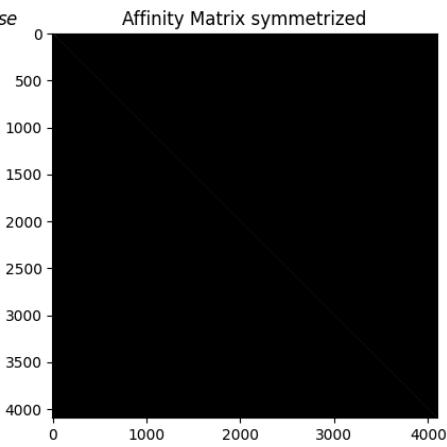
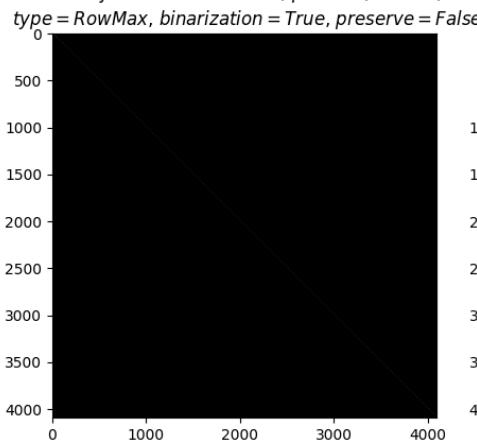
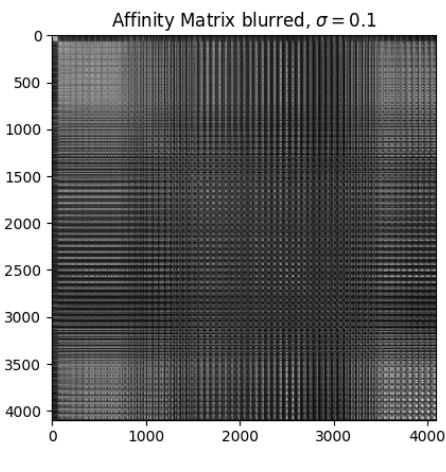
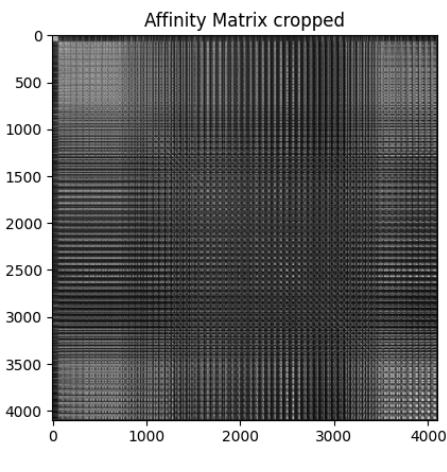
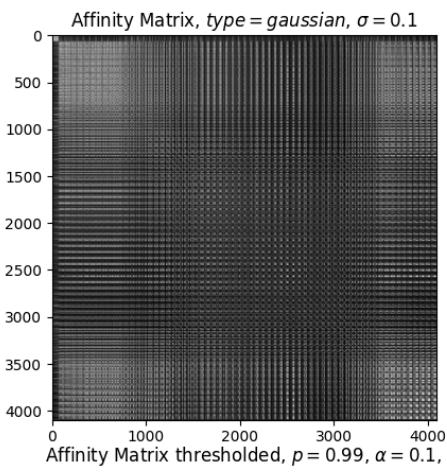
1. Convert the image into a Graph. This can be done by simply reshaping the image into a vector of $N = \text{height} * \text{width}$ nodes.
2. Compute the affinity of each node of the graph/image w.r.to all other nodes/pixels.
Therefore $\text{Affinity (A)} = (N, N)$ matrix. We can either use the euclidean based affinity : $e^{\|I(i)-I(j)\|_2^2}$ or we can use the Cosine Similarity: $A_{i,j} = \frac{I(i) \cdot I(j)}{\|I(i)\| \cdot \|I(j)\|}$.
3. Refine Affinity Matrix
4. Compute the Degree Matrix. $D_i = \sum_{j=1}^N A_{ij}$
5. Compute the Laplacian of the graph. $L = D - A$. Normalize Laplacian Matrix.
6. Compute the eigenvalues and eigenvectors of the Laplacian matrix.
7. Take eigenvectors corresponding to K^{th} smallest eigenvalue.
8. Perform Clustering on K.

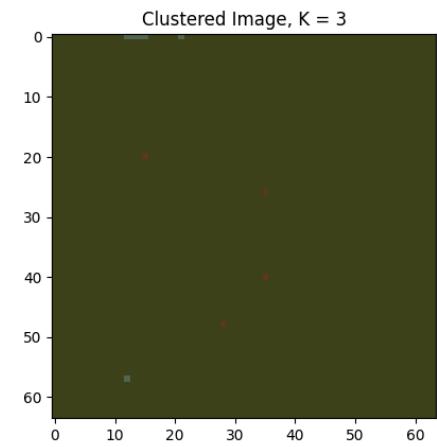
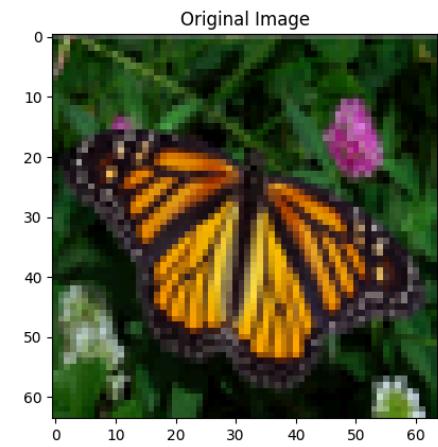
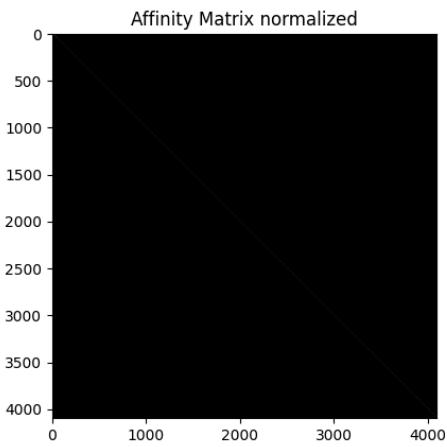
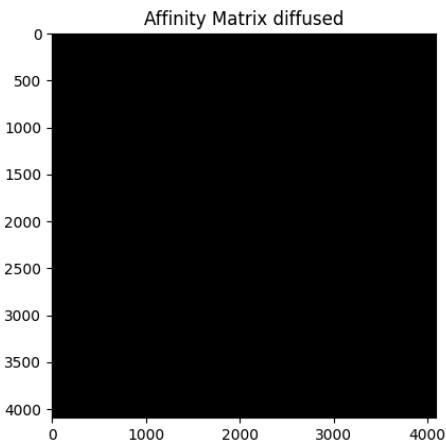
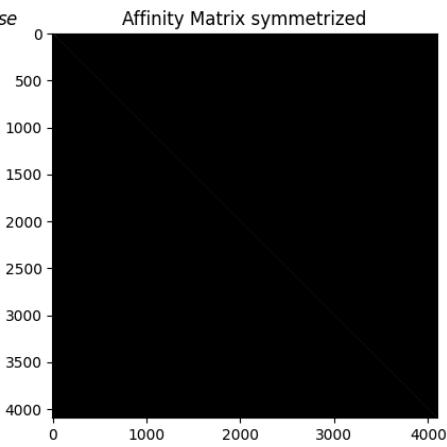
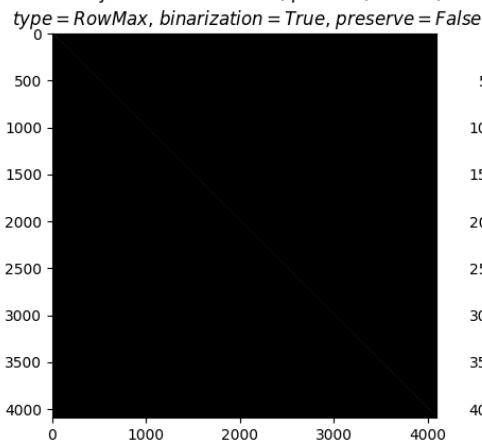
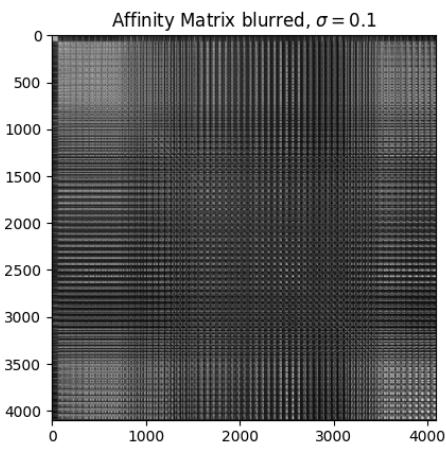
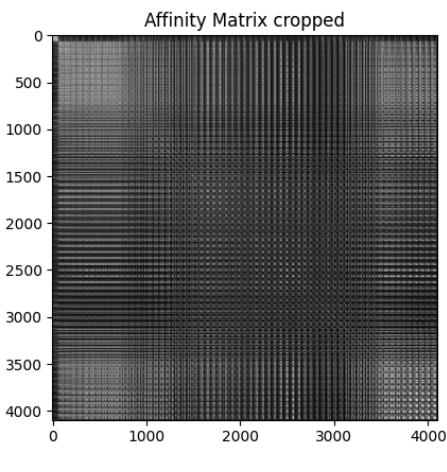
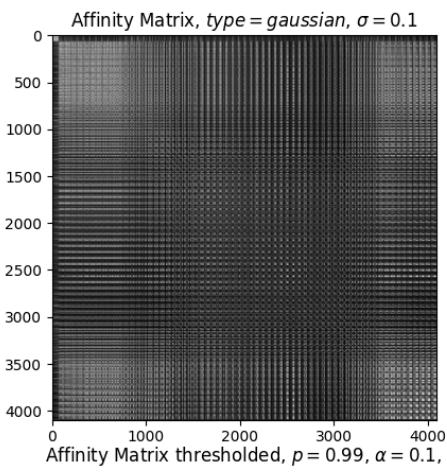
Please See Appendix Section for exact details.

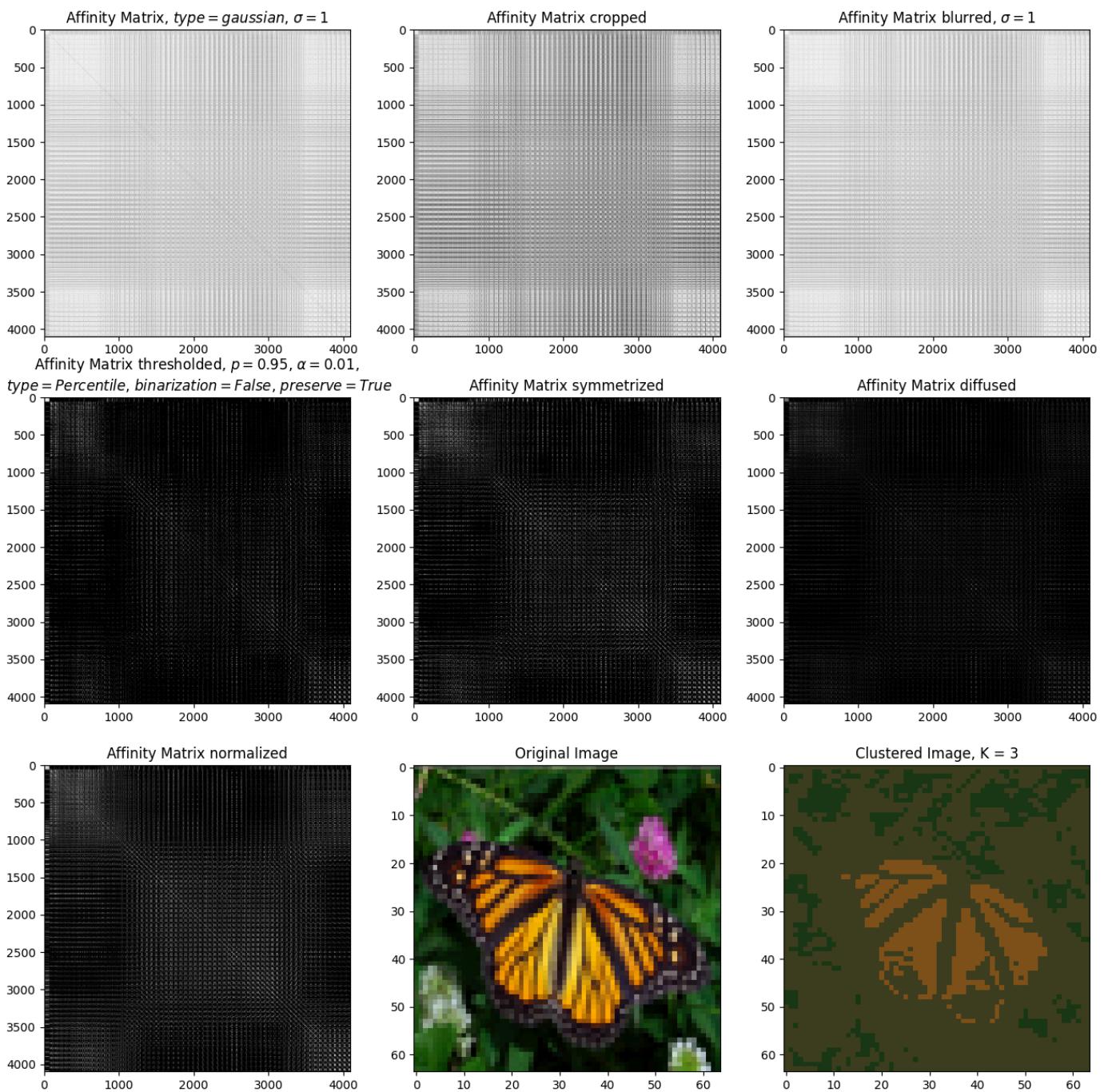
Segmentation Results

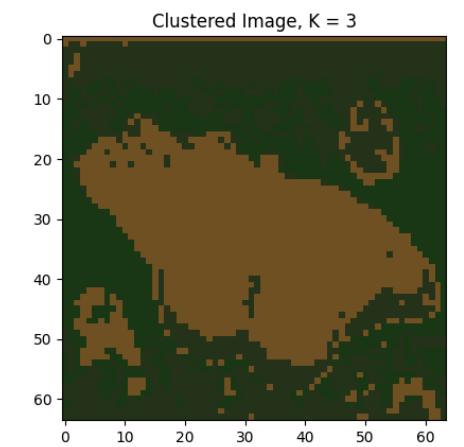
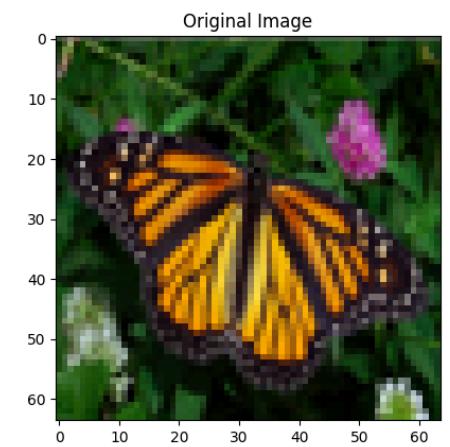
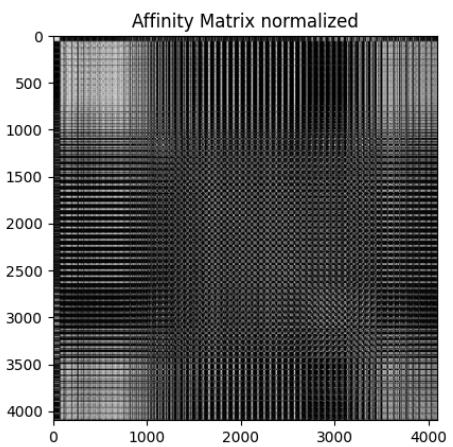
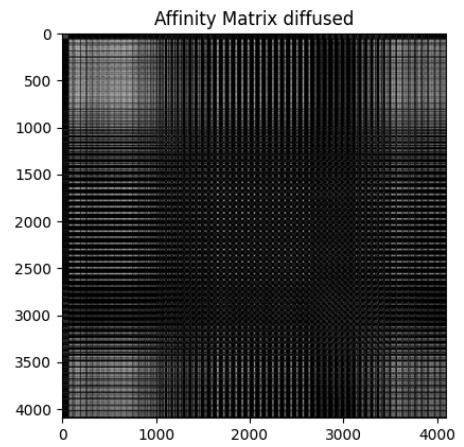
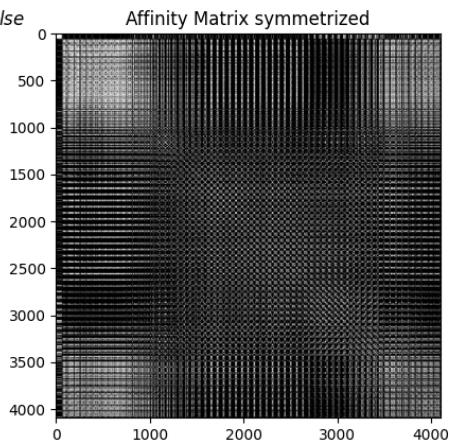
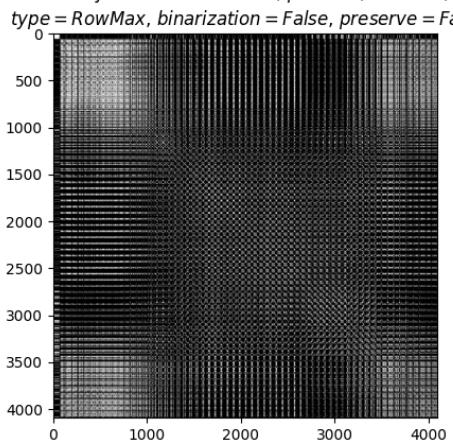
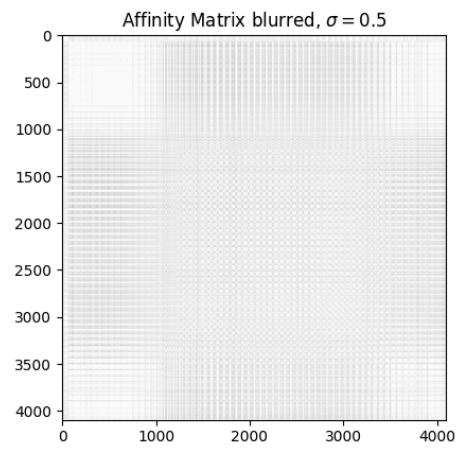
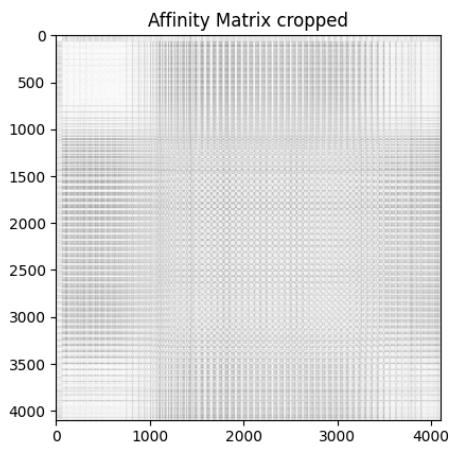
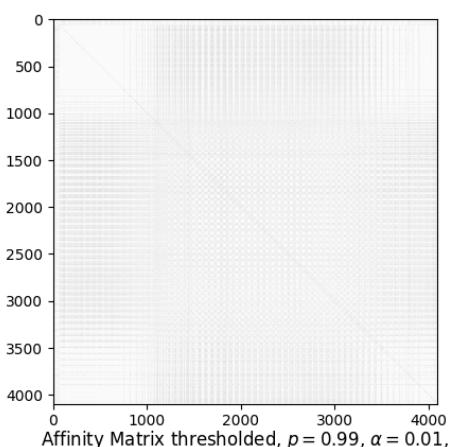
Image 1:











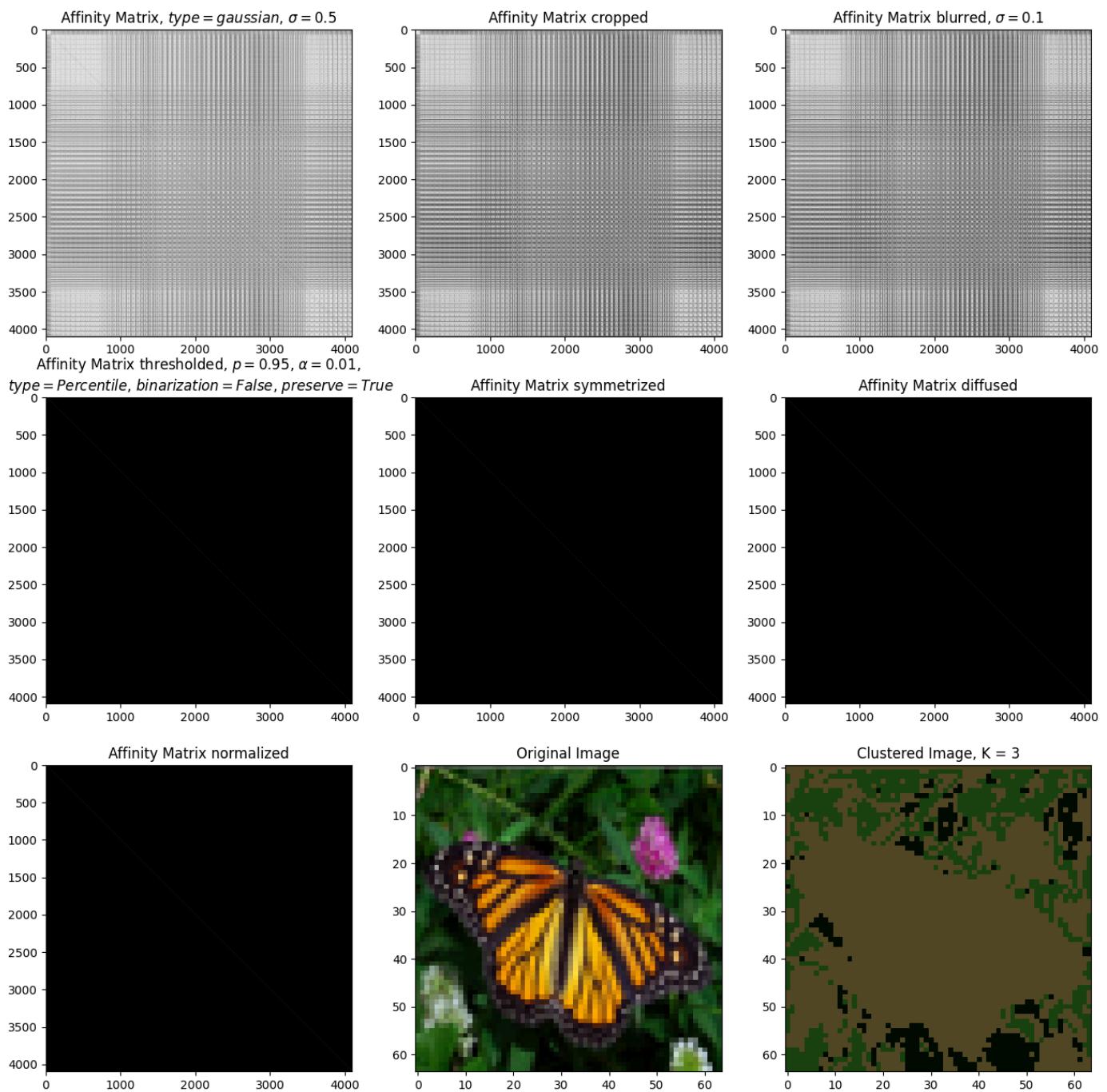
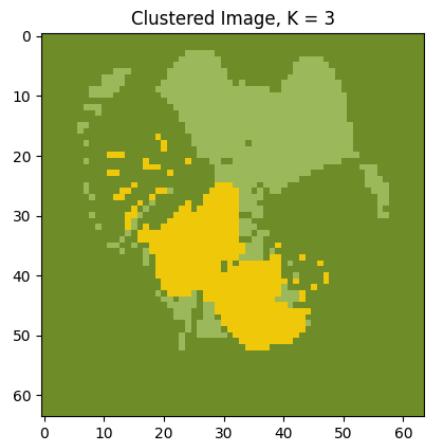
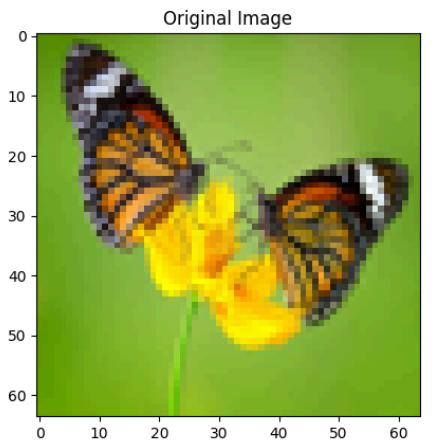
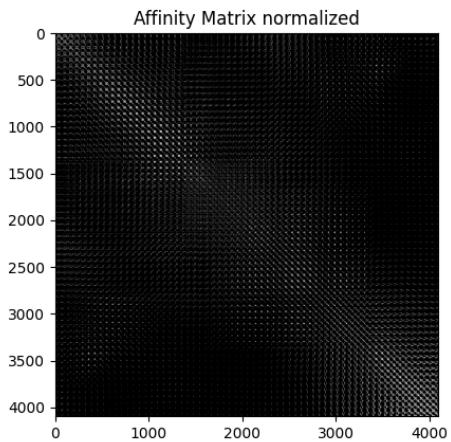
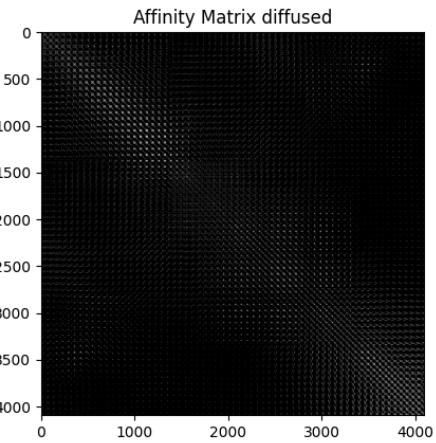
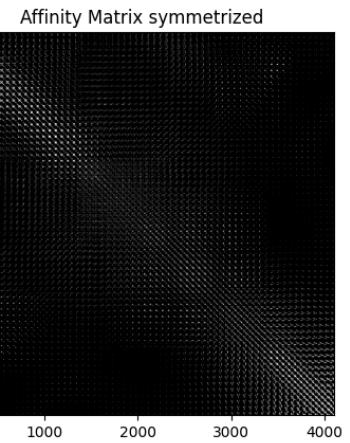
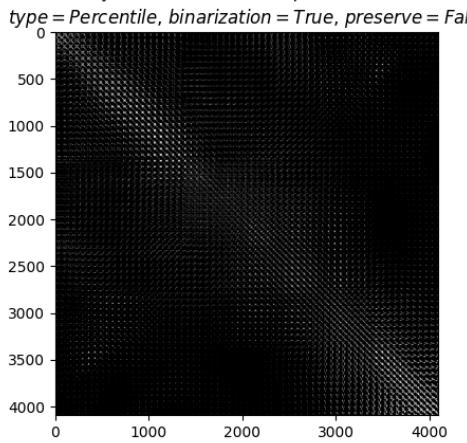
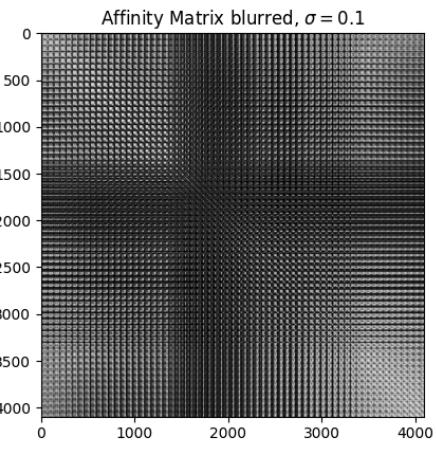
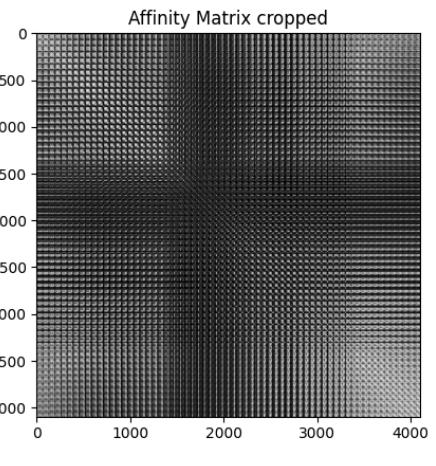
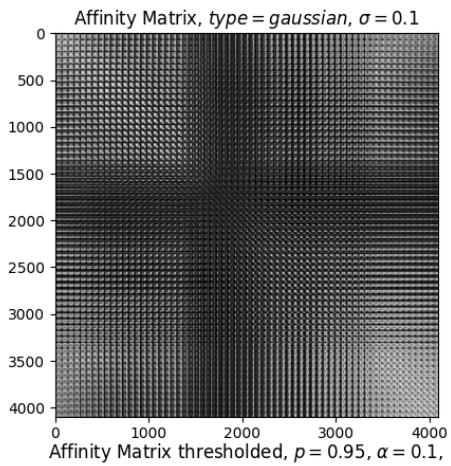
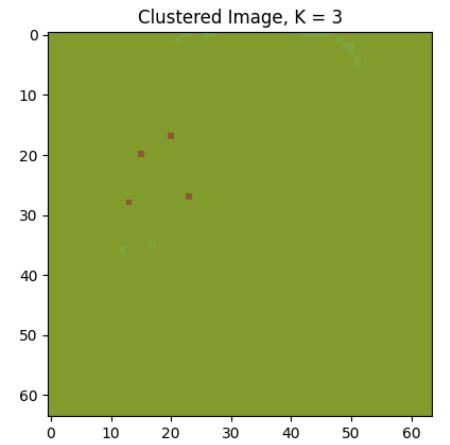
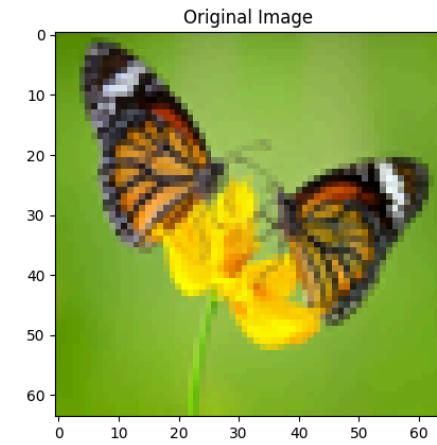
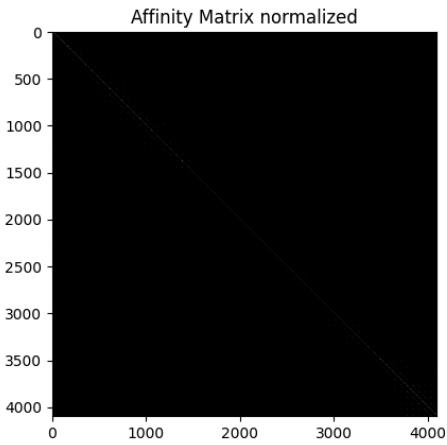
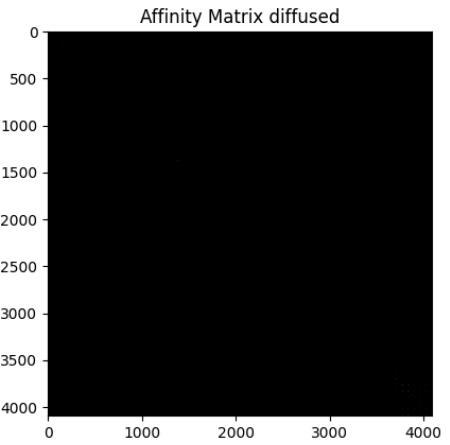
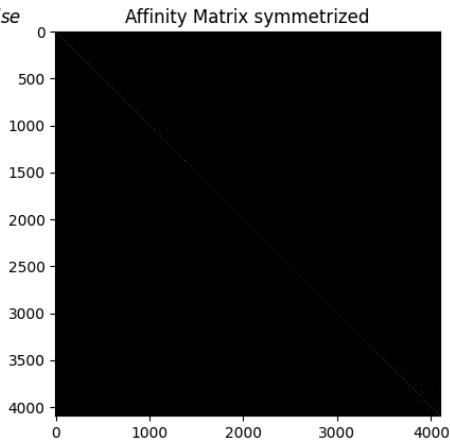
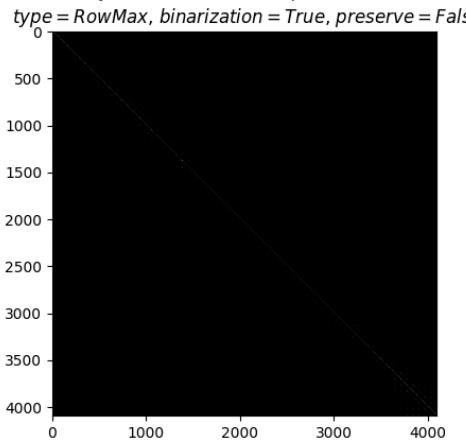
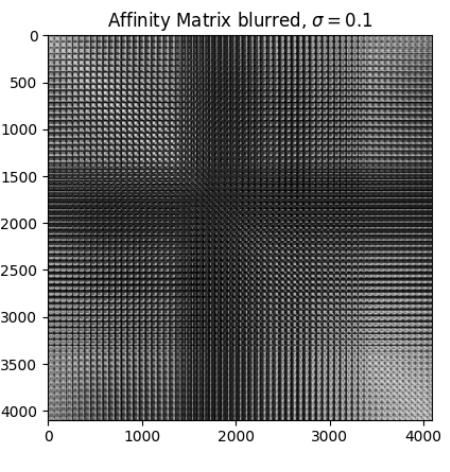
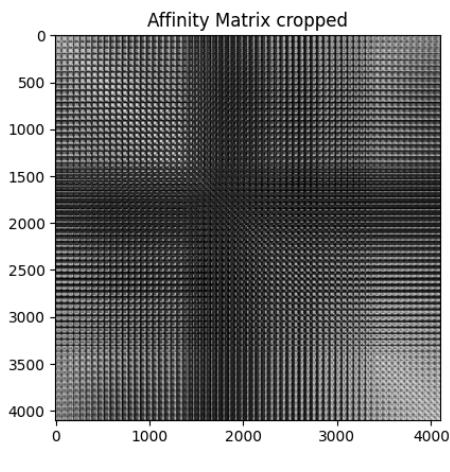
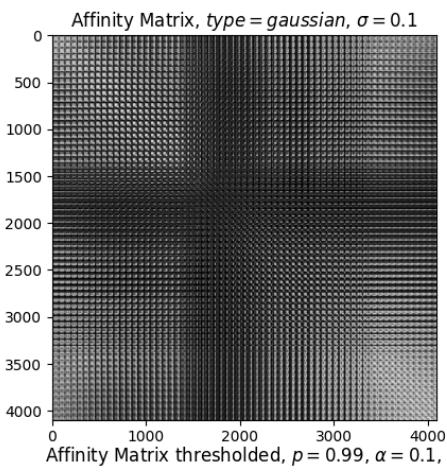
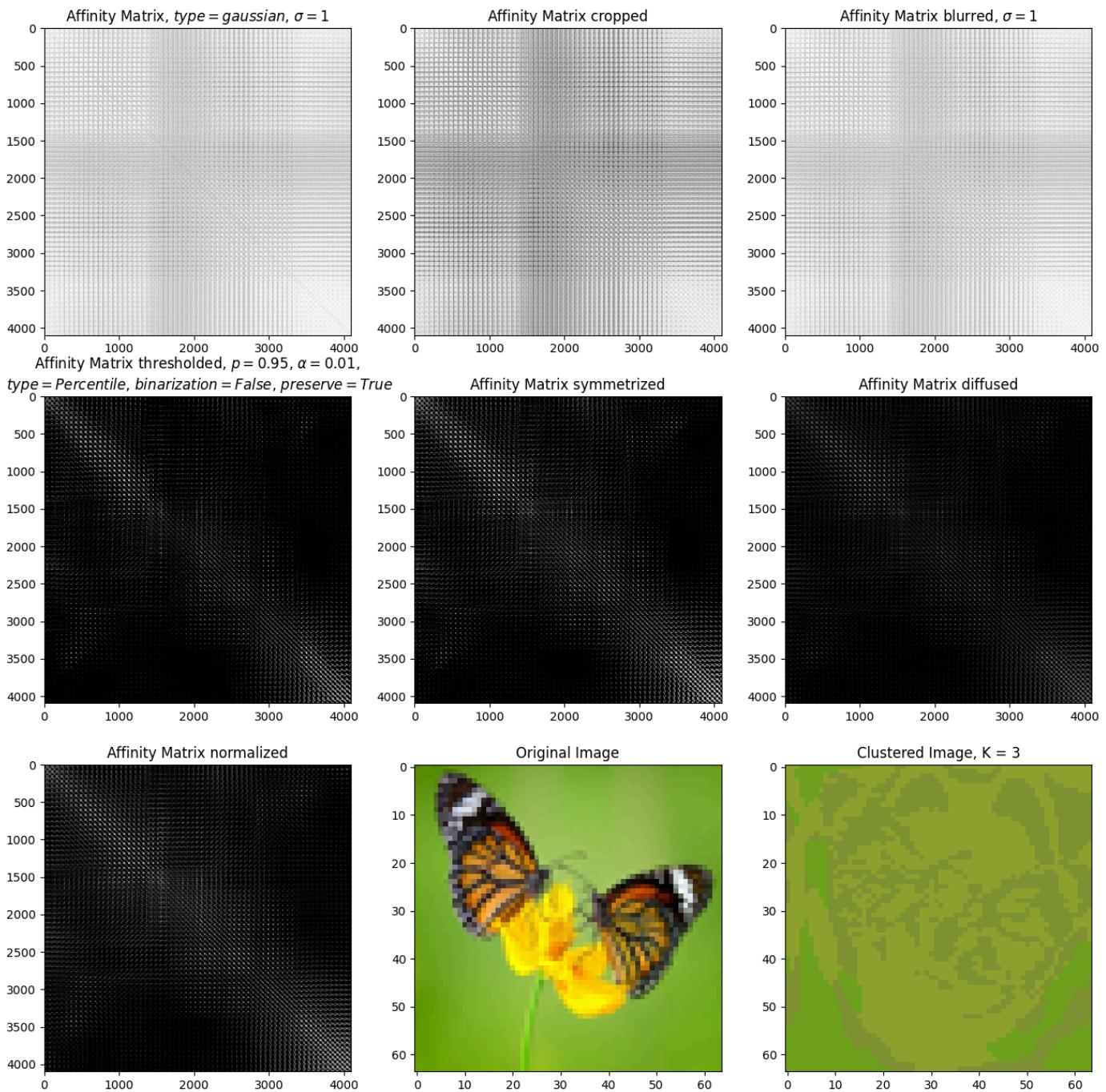


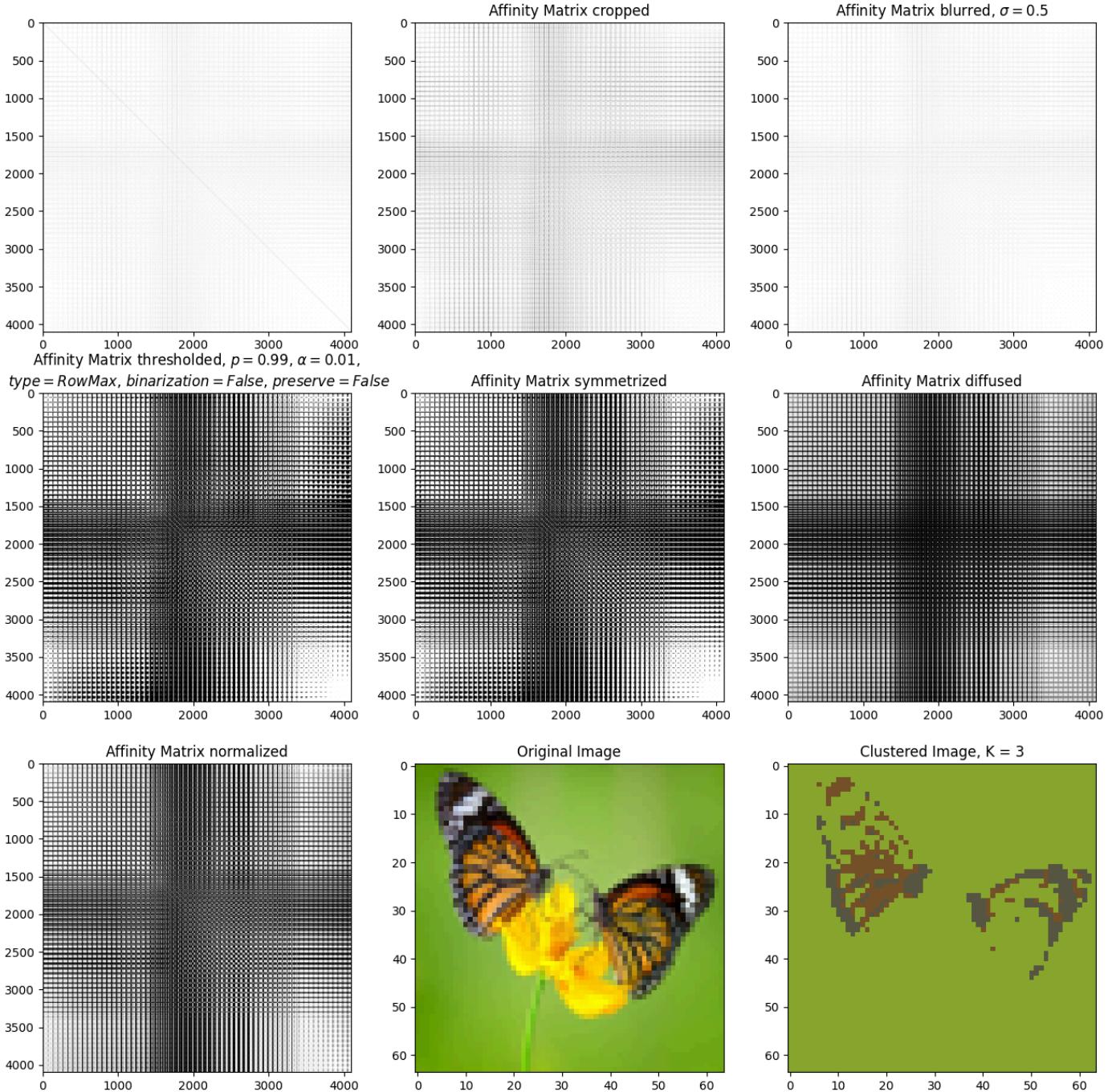
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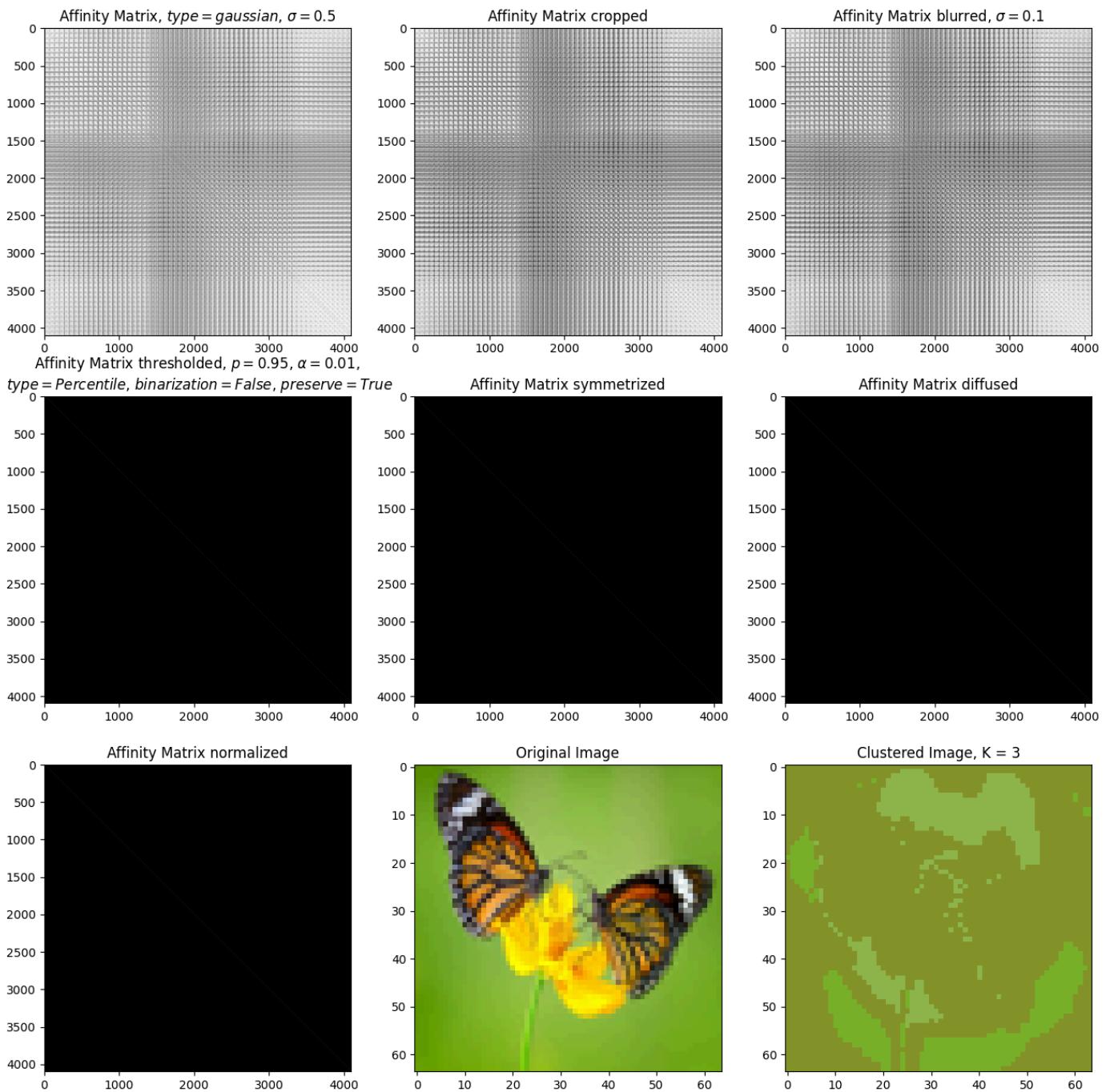




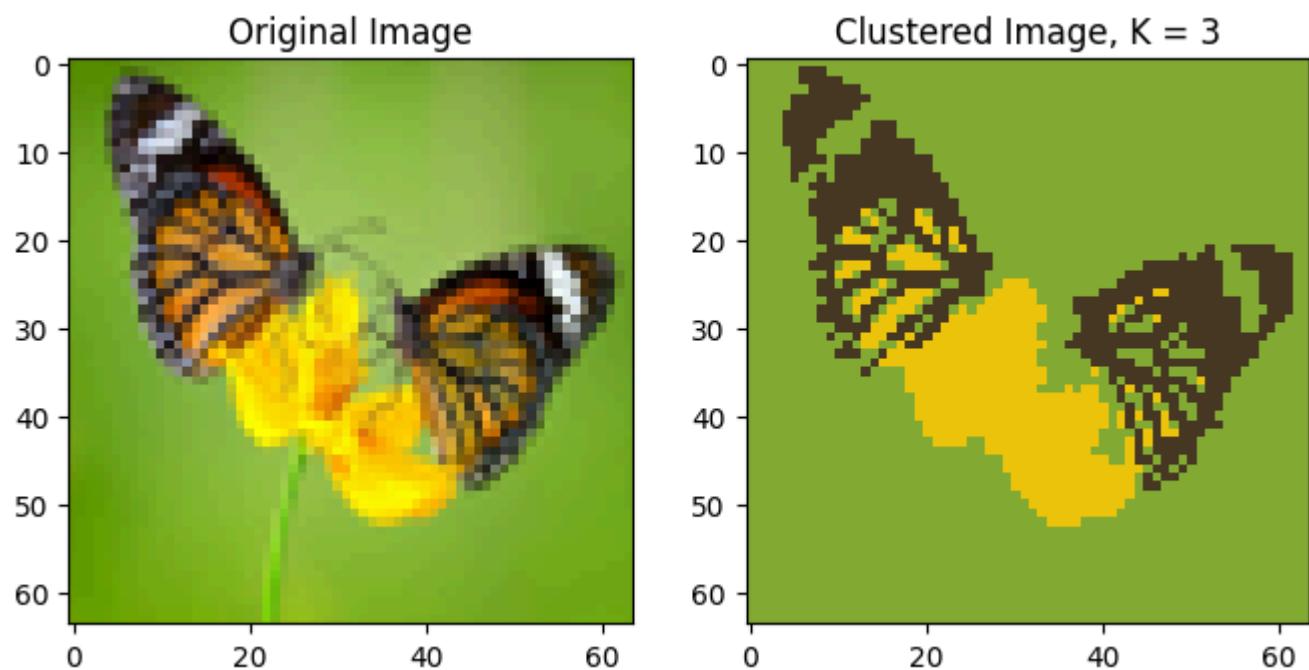
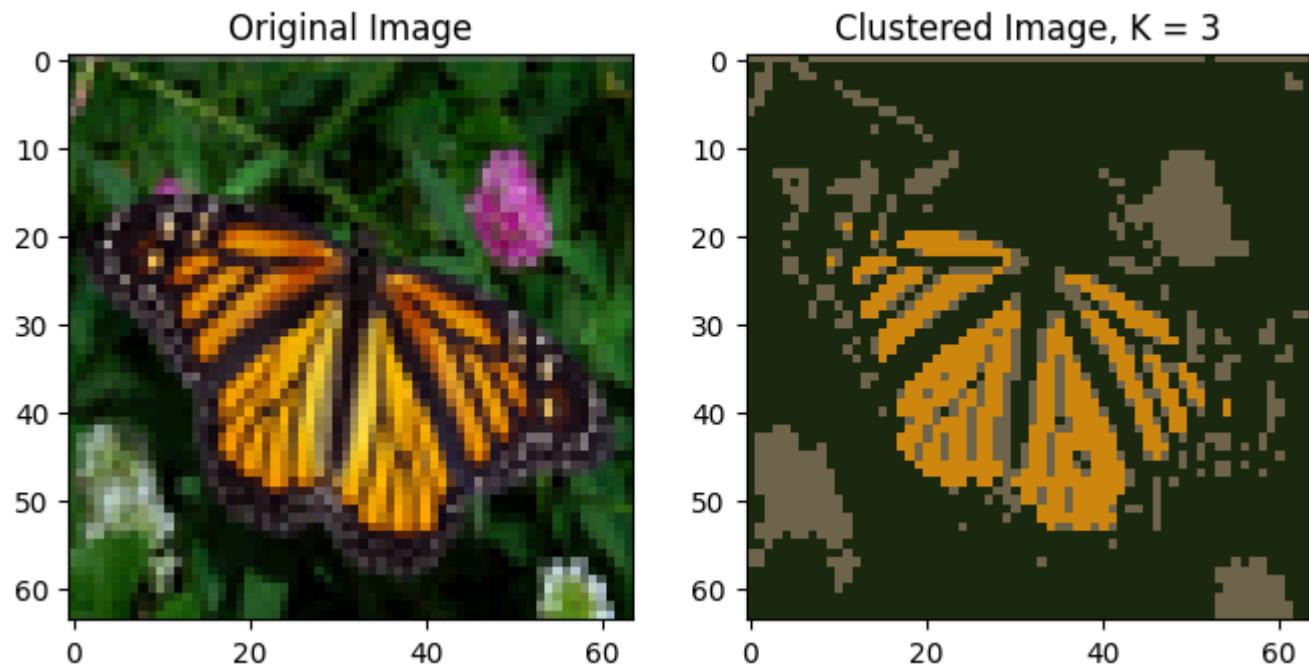








KMeans Clustering:



Appendix

Affine Matrix Refinement

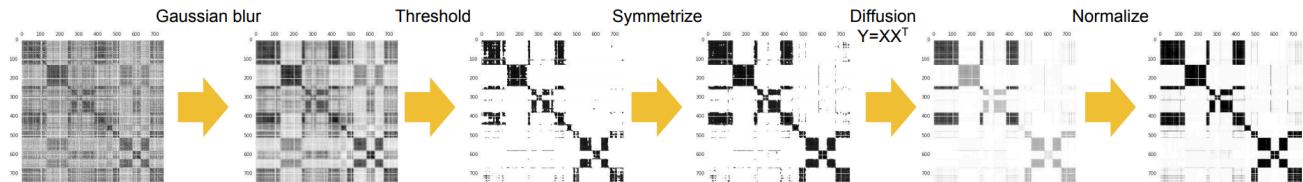
Steps:

1. Blurring : Perform Gaussian Blurring on Affinity Matrix to smoothout the Affinities
2. Thresholding: Perform thresholding on the matrix to remove outliers, and constraint the Laplacian Matrix Range

3. Symmetrize: Since Blurring followed by Thresholding is non linear operation and non-symmetric. It will messup the symmetric property of Laplacian Matrix. Therefore we Re-Symmetrize the Laplacian.

4. Diffusion: Its done as XX^T

5. Normalization: Normalize each row of Laplacian, since each row of Laplacian is a different Vertex of the Graph.



The Parameters for each of the operations is dependent on the problem at hand.

References

```
@misc{wang2022speaker,
  title={Speaker Diarization with LSTM},
  author={Quan Wang and Carlton Downey and Li Wan and Philip Andrew Mansfield and Ignacio Lopez Moreno},
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  github = {https://github.com/wq2012/SpectralCluster}
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