Compressing a Tortoise Image

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February 3, 2025

Figure 1: Original tortoise image. Source.

Contents

1 Main Objective of Analysis

The stakeholders in a tortoise business want a specific tortoise picture compressed to only maximum eight colors, since their respective marketing devices (displays), which they bought in huge quantities, are only able to show eight different colors to their customers. The main objective of this analysis is to identify the best clustering method to compress the original image color spectrum to maximum only eight fixed colors. Three different clustering algorithms with different hyperparameters are examined, namely K-Means with different clusters k, GMM with different n, and Mean-Shift-Clustering (MSC). The human eye is used as metric.

2 Desription of Data

The data is one image with RGB colors. It is the image of a tortoise with size 533x760 see Fig. 1.

3 Data Cleaning and Feature Engineering

No data cleaning and feature engineering is required. The image can be directly used as input for the algorithms after reshaping the matrix.

4 Variations of Unsupervised Learning Models

4.1 K-Means

In Figure 2 the inertia for different even k is visualized. Using the elbow method one can identify k equals 4 or 6 as suitable k. The comparison between the original image and the compressed image with $k = 8$ can be found in Figure 3. As one can see the compressed image is highly detailed with colors similar to the original image.

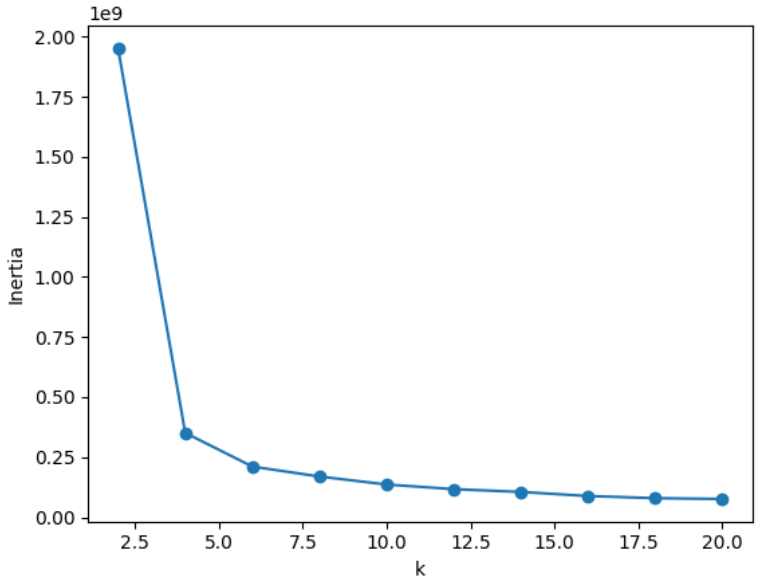
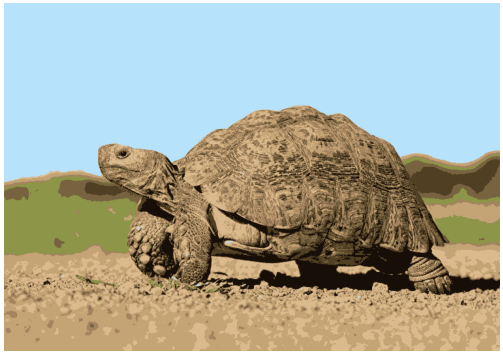


Figure 2: Inertia for different k.

(a) Original Image.



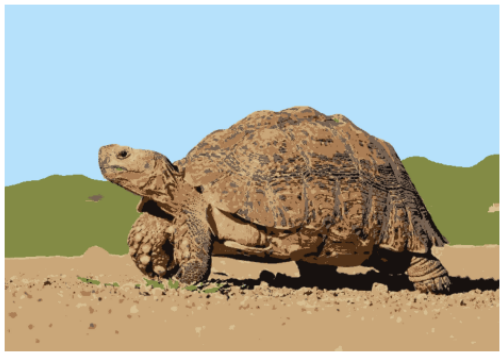
(b) Result of K-Means with $k = 8$.

Figure 3: Comparison Original Image vs. K-Means Compressed Image

4.2 GMM

The comparison between the original image and the compressed image with $n = 8$ can be found in Figure 4. The tortoise and its surroundings is visible. However, the landscape in the background and the small stones in the foreground are not as detailed as with the K-Means algorithm result.

(a) Original Image.

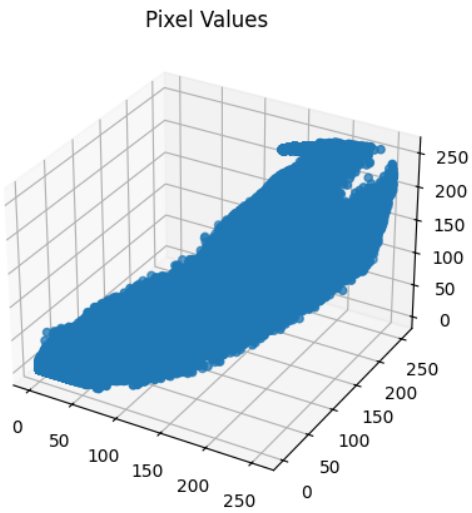


(b) Result of GMM with $n = 8$.

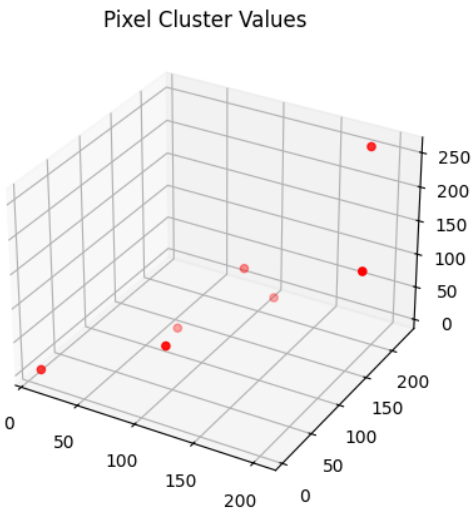
Figure 4: Comparison Original Image vs. GMM Compressed Image

4.3 Mean-Shift-Clustering (MSC)

In Figure 5 the original pixel values and the pixel cluster values found by the MSC algorithm are displayed in the RGB Pixel Space. As one can see, the MSC algorithms finds 7 different clusters.



(a) Original Pixel Values.

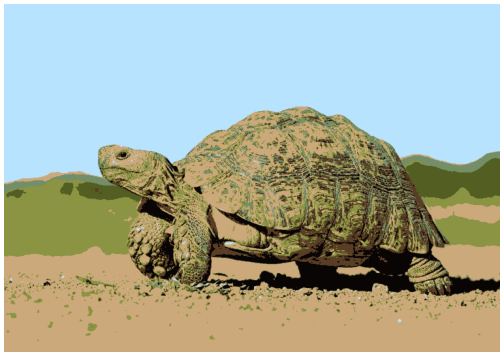


(b) Cluster Centroids found by MSC.

Figure 5: RGB Pixel Space.

The comparison between the original image and the compressed image using the MSC algorithm can be found in Figure 6. The tortoise and its surroundings is visible. However, the color choice of the turtle shell is not inline with the original image. In the compressed image the tortoise is more green than in the original image.

(a) Original Image.



(b) Result of Mean-Shift-Clustering.

Figure 6: Comparison Original Image vs. Mean-Shift-Clustering Compressed Image

5 Final Result and reasoning

For this specific tortoise image with only maximum eight different colors, I would advice the stakeholders to use the compressed image generated by the **K-Means algorithm** with $k = 8$. Since it shows more details of the surface and background and correct coloring than the other algorithms (GMM and MSC).

6 Flaws in model and Revisiting Analysis

The metric used for identifying the best algorithm was the human eye. This is highly subjective, and a quantative comparison should be made. If more time is available, one could also try the DBSCAN algorithm and compare the results wtih the K-Means and GMM results.

A K-Means results for different k

In Figure 7 the results for different k are displayed.

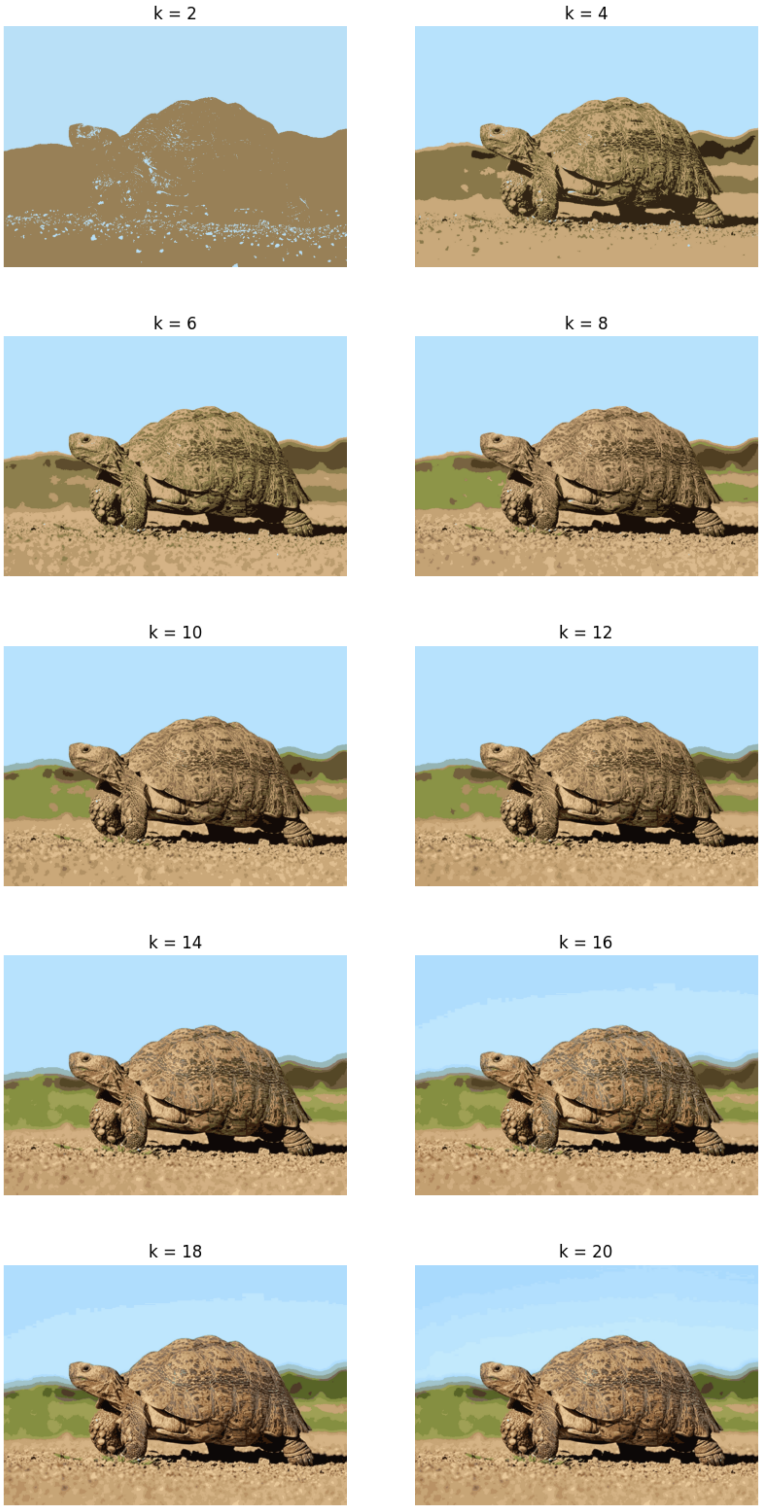


Figure 7: K-Means results for different k.

B GMM results for different n

In Figure 8 the results for different n are displayed.

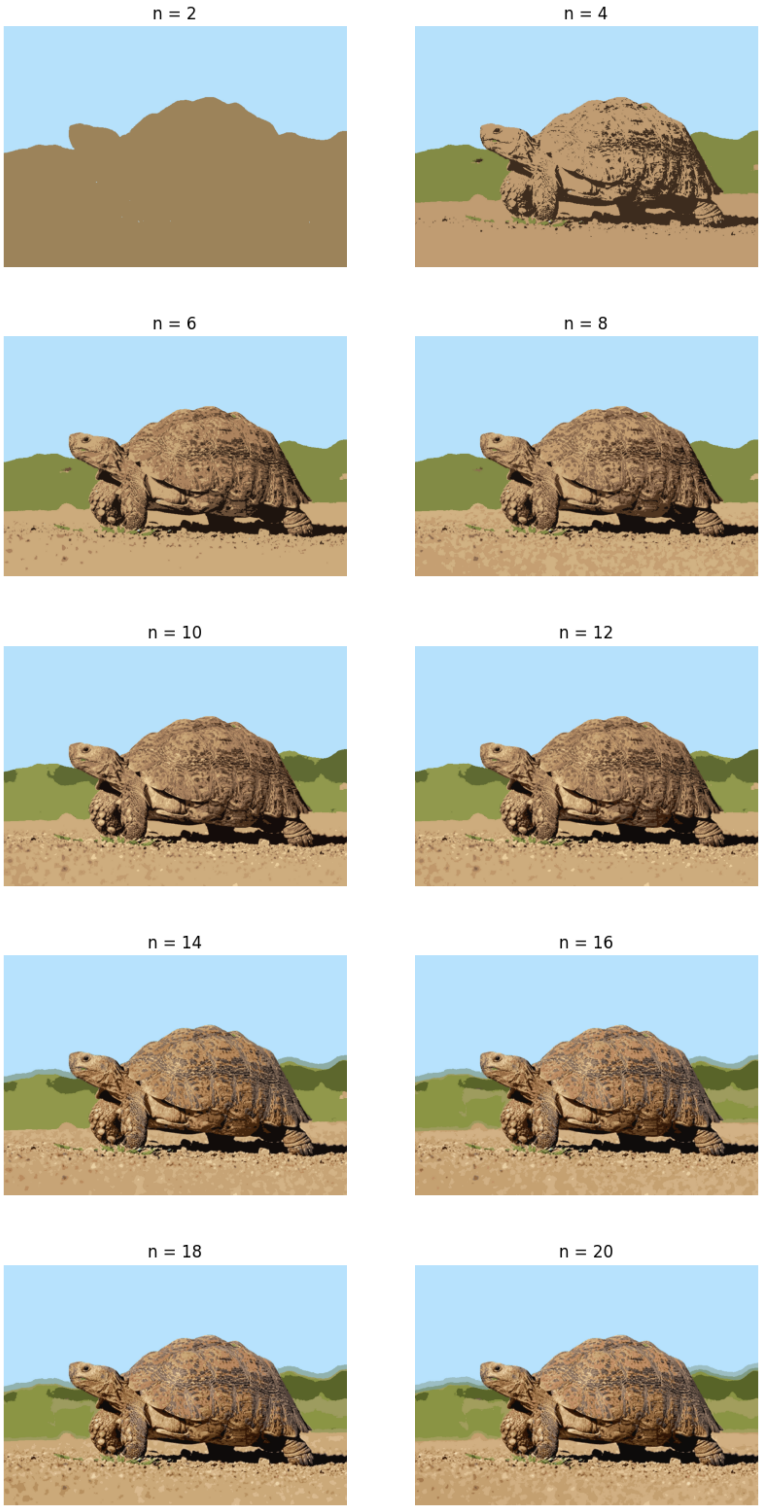


Figure 8: GMM results for different n.

C Different components of Mean-Shift-Clustering