Critical Thinking 6 - Adaptive Thresholding Scheme for Simple Objects

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CSC 515: Foundations of Computer Vision

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November 21, 2021

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"Thresholding is one of the naive approaches of image segmentation" (Bhuyan, 2019, p. 143). When it comes to more straightforward instances of image segmentation, a thresholding approach can often be a viable solution. Thresholding for segmentation purposes generally results in a binary image, which can be useful for separating objects in a scene from their background. For this to be done accurately, however, it is vital to select a proper threshold value. One approach to this adaptive selection is through the use of *entropy*.

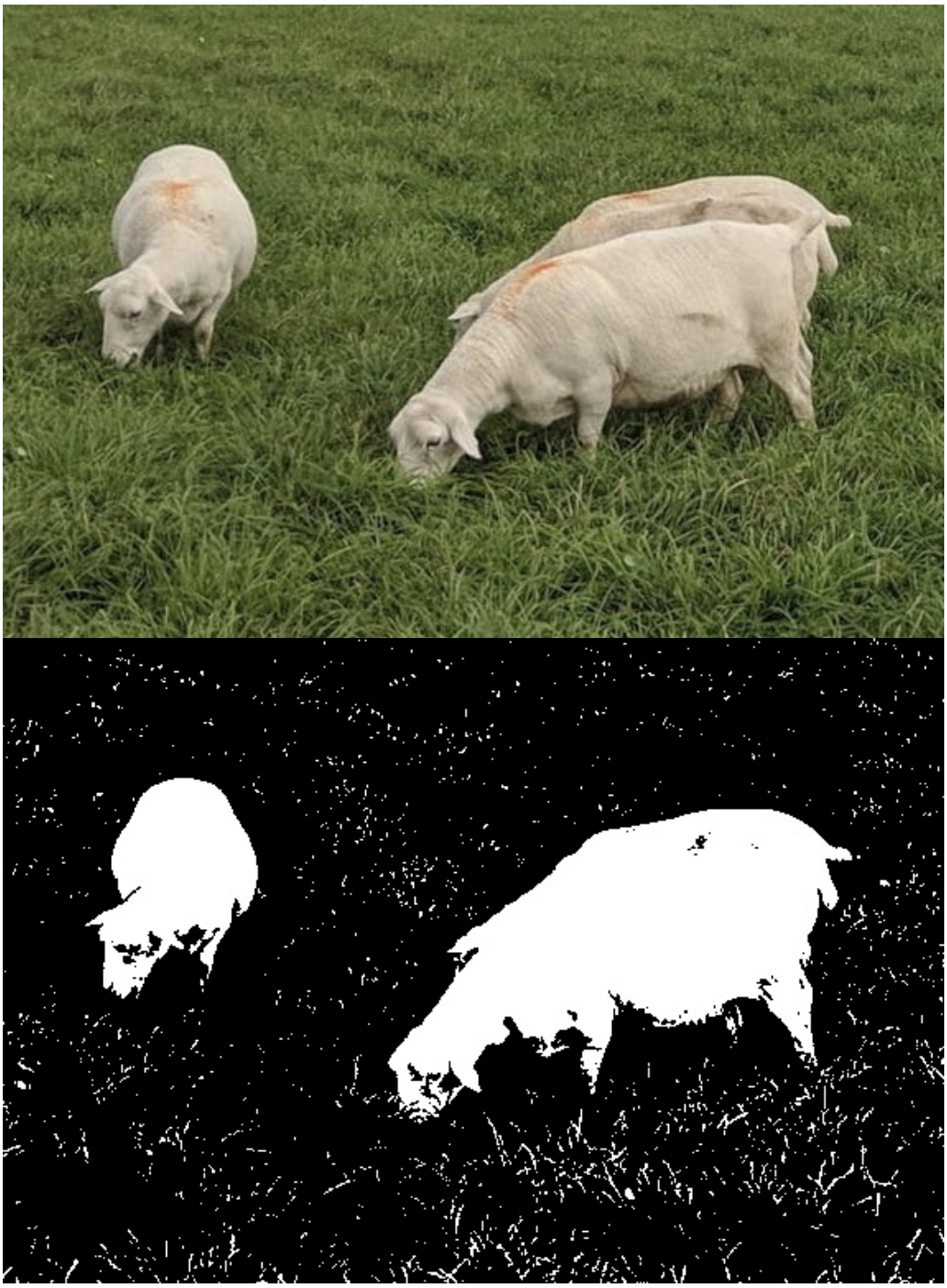
Entropy thresholding is based on calculating the threshold value with the maximal entropy so that the greatest order can be brought to the system through binarization (entropic reduction). Imposing the greatest order on the system should lead to the most meaningful results, and this approach has been gaining traction in computer vision over the past 20 years (Davies, 2018). Figures 1, 2, and 3 each show an image pair (original and binarized) where an entropy system was used to calculate the threshold value. Each figure was converted to grayscale before the entropy algorithm and binarization were employed.

While the entropy algorithm successfully selected a threshold value, examination of the three resulting binary images highlights a few issues with the global thresholding approach that was utilized. As an image segmentation technique, thresholding is limited in resulting incomplete edges around segmented object (Karthick et al., 2014). This resulted primarily from two things in the images above. First, as seen in figure 3, when an object is comprised of multiple colors, colors similar to the background can be mapped to the same color in the binary image. This can result in object features being mapped to the background.

Figure 1

Thresholding can also suffer when there are significant illumination differences in the image. While this can be seen in all three image pairs, it is extremely evident in the grass of the images in Figure 2. Some of the grass blades that appear lighter mapped to the same color in the binarized image as the sheep themselves. This phenomenon is also readily apparent in the curtains in Figure 1. There is an illumination difference between the folds of the curtains, and in

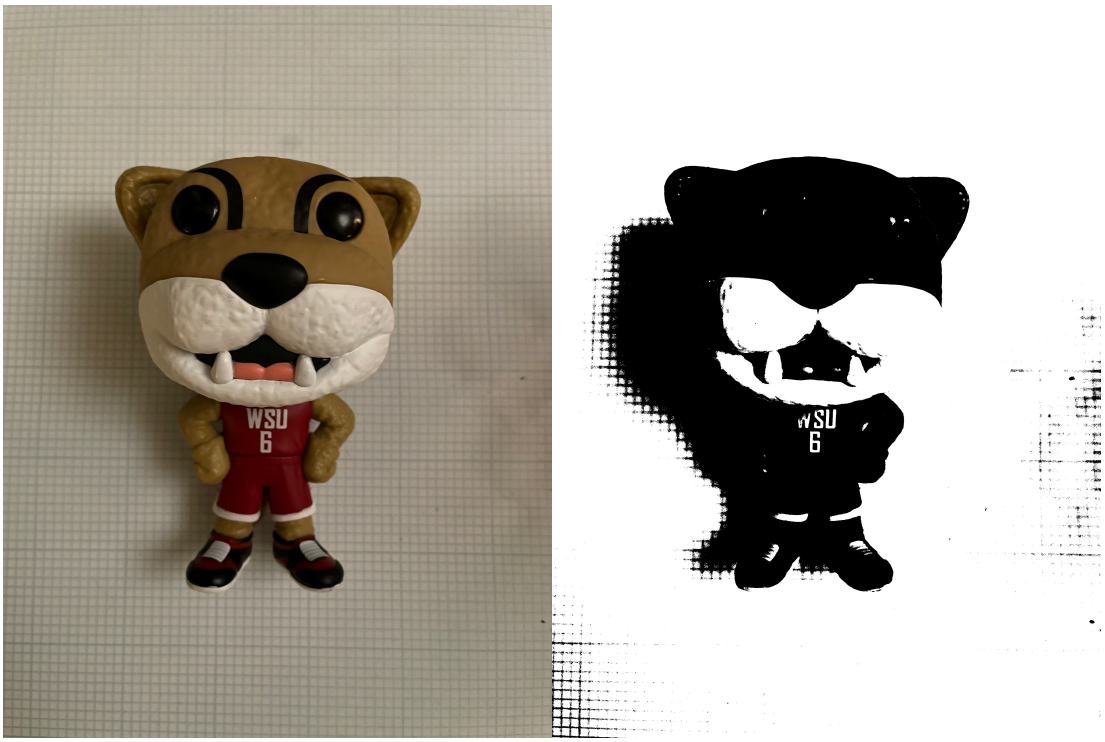
Figure 2



the binarized images, the curtains are not segmented as a distinct object. Rather, each peak and valley is roughly segmented, highlighting the illumination differences.

While the entropy algorithm was able to determine an optimal threshold value, restricting it to global processing without other pre-processing for things like illumination did not result in

Figure 3



the most accurate segmented images. Utilization of gamma correction, contrast equalization, and localized thresholding are all possible techniques that could be used to refine this process and result in better-segmented images.

References

Bhuyan, M. K. (2019). *Computer vision and image processing: Fundamentals and applications*. CRC Press/Taylor & Francis Group.

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Karthick, S., Sathiyasekar, K., & Puraneeswari, A. (2014). A Survey Based on Region Based Segmentation. *International Journal of Engineering Trends and Technology*, *7*(3), 143–147.