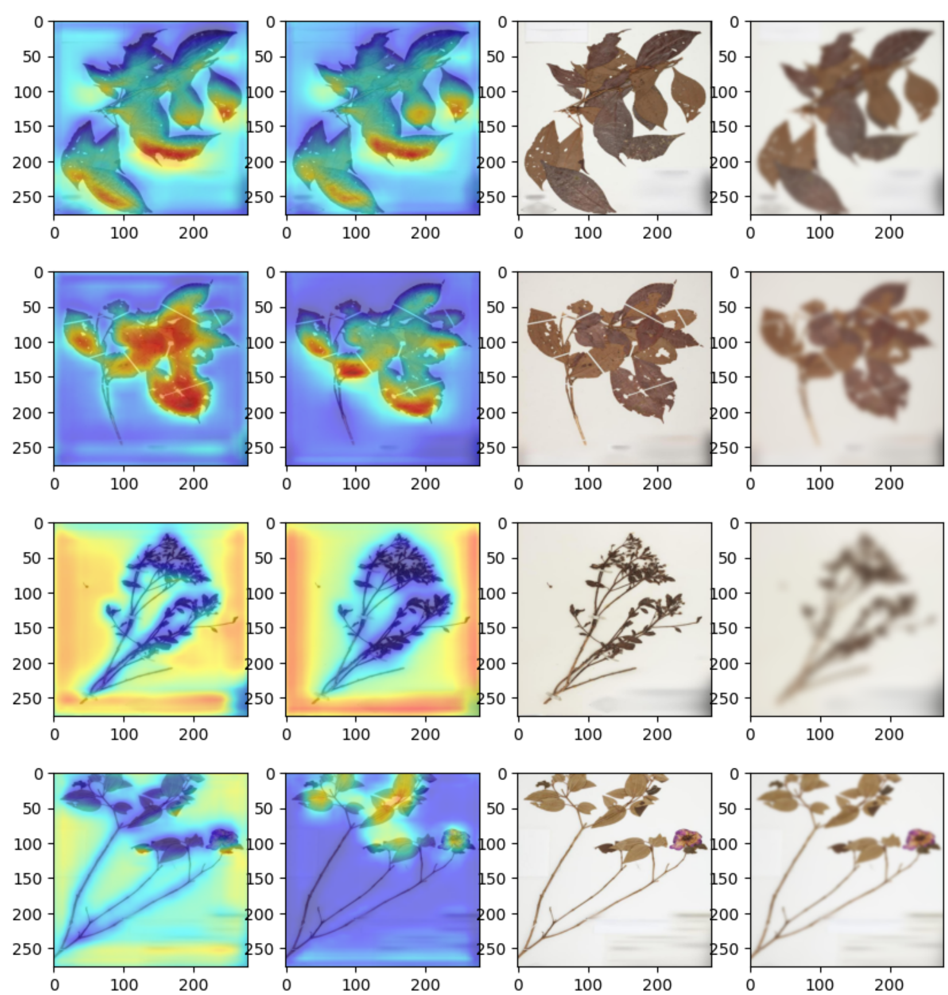
Why images is classified wrongly by manipulating the images and how:

1- Gaussian blur

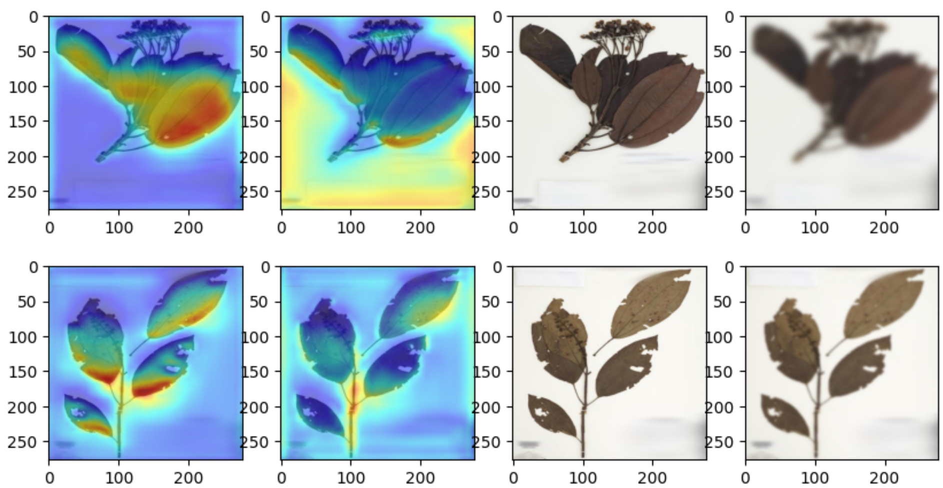
When using ResNET50 for classification, some images are correctly classified when they are in their original form, but are not well classified when they are altered. An example of an alteration is adding a Gaussian blur filter to the image. This means that some images may appear to be correctly classified by the model, but when the same images are altered, the model may misclassify them. As a result, it is important to be aware of the limitations of the model and the potential impact of image alterations on its performance.

These are some of the images that is classified correctly in their original form, but misclassified when I add Gaussian Blur with kernel_size=23, sigma=(0.1, 10.0):



As the kernel size used in image classification with ResNET50 increases, we observe a higher number of misclassified images. This is likely due to the fact that, when the kernel size is increased, the model begins to rely more heavily on the edges of the image in some cases rather than the actual patterns and features in the image. This is supported by observations made using GradCAM, which shows that the model is more likely to classify images based on the edges rather than the actual patterns in some images, such as the leaf pattern in this case. Therefore, increasing the kernel size can have a negative impact on the model's ability to accurately classify images based on the underlying features and patterns.

Below are the images that are misclassified with 23 but not with 1:



To clarify, the rate of misclassification does not have a fixed pattern as the kernel size is changed gradually. In other words, increasing the kernel size does not always result in a higher misclassification rate. For instance, the misclassification rate may increase from K=1 to K=1.9, but then decrease when the kernel size is further increased to K=3 and K=3.1.

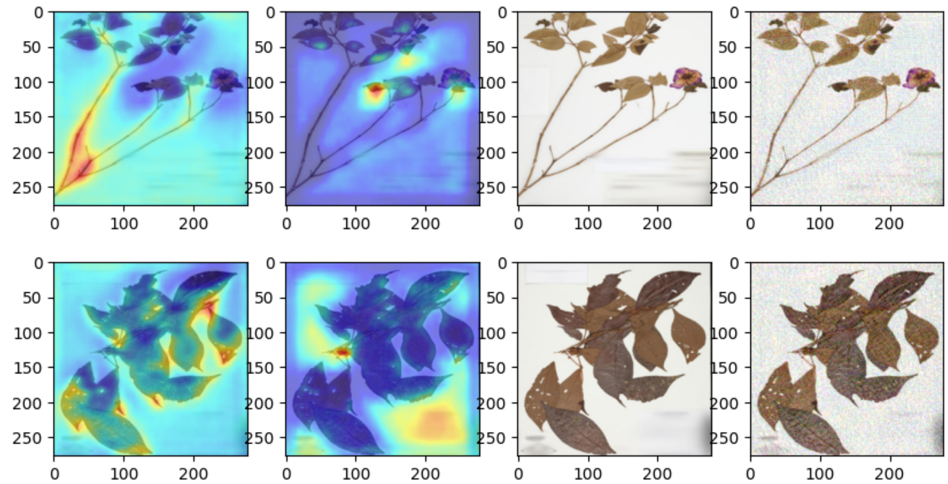
Furthermore, there are certain patterns on some plant leaves that are caused by the Corrosion of leaves. The model seems to interpret these patterns as edges, which leads to incorrect classifications of the images.

2- Adding Noise:

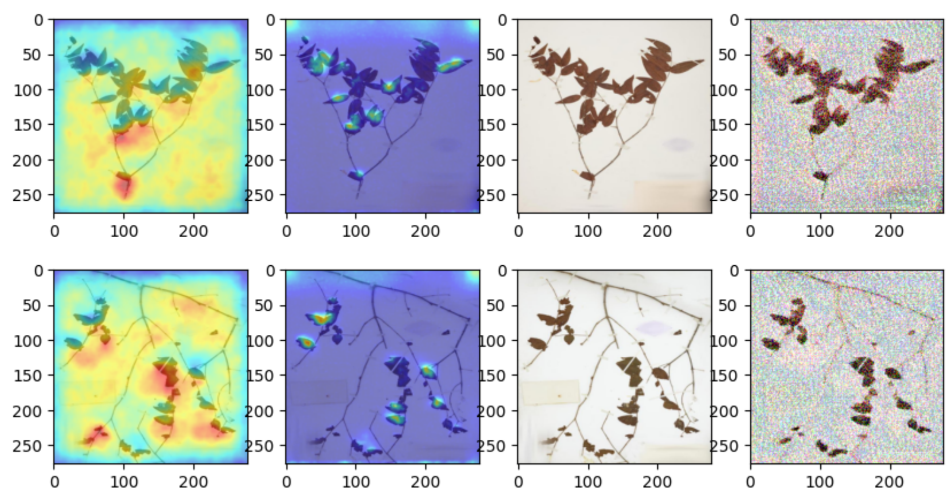
To put it differently, similar to the effect of a Gaussian filter, adding noise to images during classification can also lead to more misclassifications. Moreover, increasing the amount of noise added to the images can further worsen the classification performance, leading to more misclassified images.

Adding a small amount of noise to an image can lead to misclassification even if the image was originally classified correctly. For instance, in the images presented below, adding a small amount of noise resulted in misclassification by the model.

To elaborate, when analyzing the GradCAM visualization, it becomes apparent that after adding noise to the images, the model made incorrect classifications based on certain color dots that appeared in the background as a result of the added noise. In other words, the model was misled by these dots and made incorrect classifications.



As the amount of noise increases, the number of misclassified images also increases. In particular, there are some images that are misclassified when the noise level is set to 0.3, but are classified correctly when the noise level is only 0.1. Upon further analysis, it appears that in these cases the model is having difficulty recognizing the leaves in the images, which ultimately leads to misclassification.



3- Contrast: adjusts the contrast of the image:

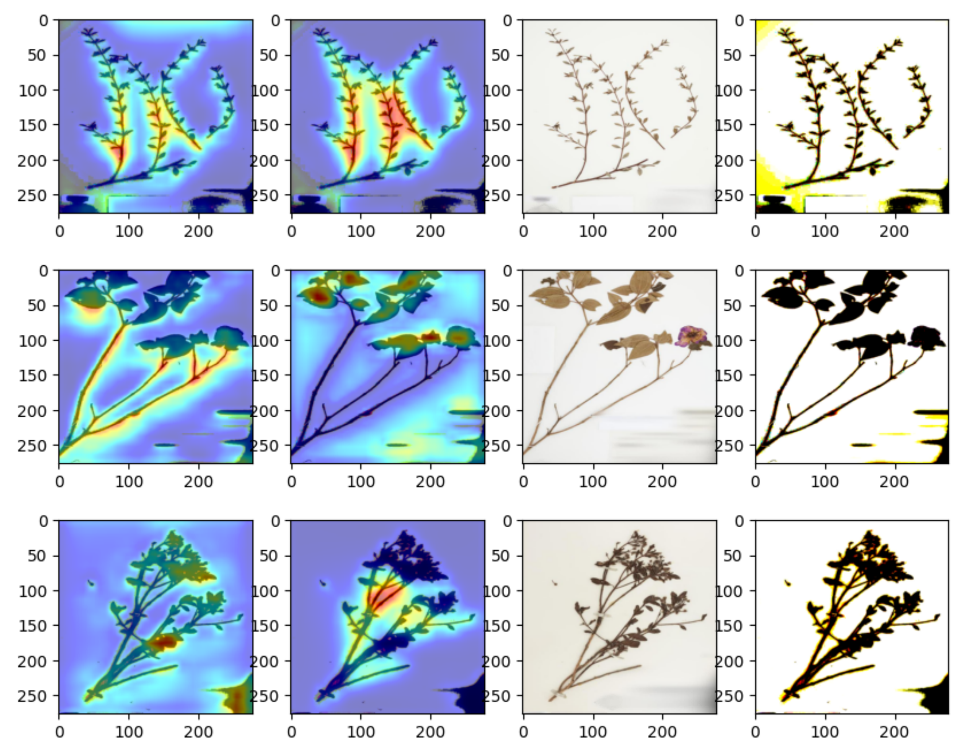
It seems adjusting the contrast of an image can help to improve the visibility of features and patterns, which can potentially improve the classification performance of an image recognition model like ResNet50. By adjusting the contrast, the differences between pixel intensities become more pronounced, making it easier for the model to distinguish between different regions of the image.

In the context of misclassified images, adjusting the contrast can potentially help to bring out features that were not clear enough for the model to correctly classify the image. This can help to improve the accuracy of the model on these images.

To put it differently, when adjusting the contrast of misclassified images using ResNet50, the effect of enhancing the contrast on the misclassification rate is not straightforward. It has been observed that increasing the amount of contrast enhancement does not always lead to an increase in misclassification. In fact, in some cases, such as when the contrast enhancement amount is increased from 0.01 to 0.3, the misclassification rate actually decreased.

It is worth mentioning that adjusting the contrast of an image can lead to some images being misclassified, which were classified correctly in the normal case. On the other hand, there are also some images that are classified correctly after contrast adjustment, but were misclassified in the normal case.

Look at yellow color that cause misclassified in some images:



4- UnsharpMask:

The UnsharpMask filter has three parameters: radius, percent, and threshold. Percent controls the magnitude of the overshoot, which determines how much contrast is added at the edges. In more detail, when we apply the UnsharpMask filter to an image, it enhances the edges by increasing the contrast at the edge borders. This means that the areas of the image where there is a sharp transition from one color to another (such as the edges of leaves) become darker, while the areas with smoother transitions (such as the background) become lighter.

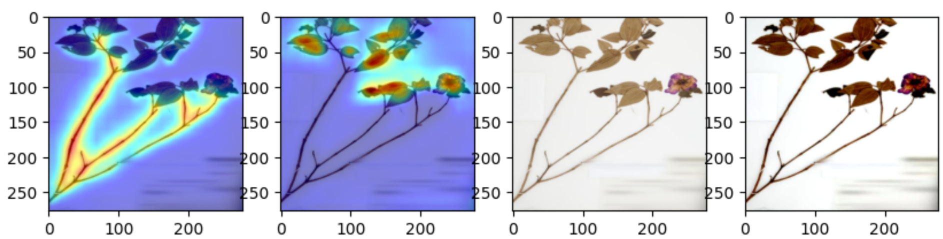
When we look at the GradCAM visualizations, we can see that the model is focusing on the darker areas, which are the edges of the leaves. However, sometimes these edges become too dark and lose some of the original color information, which can cause the model to misclassify the image. Essentially, the model is focusing on the wrong features because the UnsharpMask filter has changed the contrast of the image in a way that causes it to prioritize the wrong visual cues.

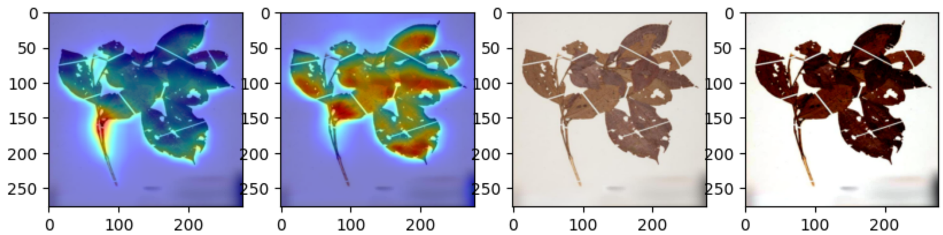
Additionally, the UnsharpMask filter has three parameters: radius, percent, and threshold. Out of these three parameters, the radius parameter is the most important when it comes to the potential for misclassification. A higher radius can cause halos to appear around objects, which can lead to false positives. On the other hand, a lower radius might not be effective at enhancing the edges, which can lead to false negatives.

Furthermore, we have observed that large changes in the percent parameter can also lead to more misclassification. The percent parameter controls the magnitude of each overshoot, or how much darker and how much lighter the edge borders become. If this value is too high, it can cause the edges to become too dark and lose important information.

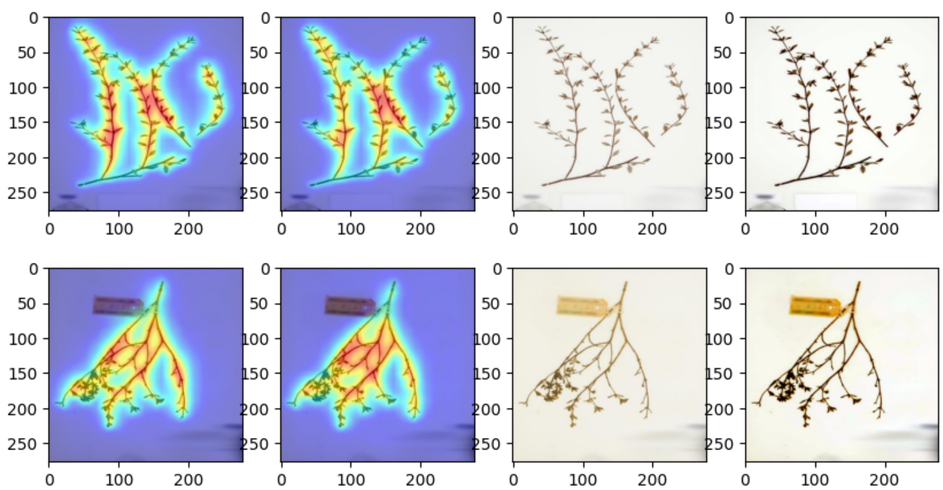
Interestingly, we have also found that increasing the threshold parameter can actually decrease the misclassification rate. The threshold parameter controls the minimal brightness change that will be sharpened, or how far apart adjacent tonal values have to be before the filter does anything. A higher threshold value means that areas of lower contrast will be excluded, which can prevent smooth areas from becoming speckled and leading to false positives.

These are misclassified with filter that are classified in normal case:





These are misclassified with increasing the radius and Percent that are classified correctly with lowest amount of those two parameters:



And these are images that are misclassified with lowest amount of thresholds that are classified correctly when I increased that: