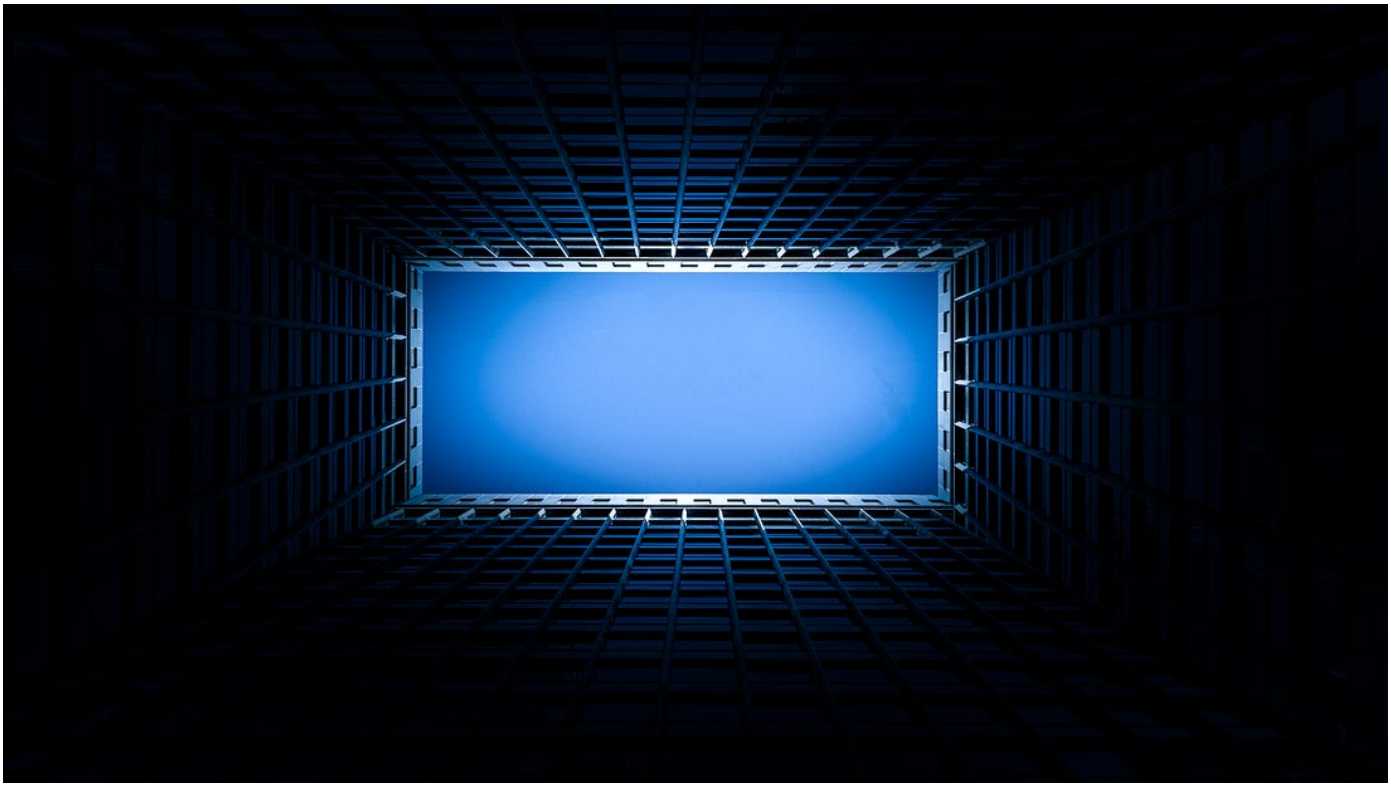

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How to Perform Image Segmentation with Thresholding Using OpenCV

Simple, Otsu, and Adaptive Thresholding Implementation with Examples

Rashida Nasrin Sucky · Follow
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One of the most commonly used segmentation techniques is thresholding. It is widely used in computer vision and is very useful to separate the object that we are interested

in from the background. This article will focus on the thresholding techniques in OpenCV.

There are three different types of thresholding. We will know how they work at a high level and basically focus on how to use them in OpenCV with examples.

What is Thresholding

Thresholding is the process of binarization of an image. If you get confused between grayscale images and binary images as I used to in my beginning, in grayscale images, there might be an array of shades. But in the binary images, the pixel values are either 0 or 255.

Simple Thresholding

This is the most basic type of thresholding and is harder to use in a lot of practical applications. But still, we need to start with learning this one to understand how thresholding actually works. We will see how simple thresholding can work well.

Simple thresholding can work well in very controlled lighting conditions where there is high contrast between the foreground (the object we are interested in, in the image) and background. The hardest part about simple thresholding is, we need to manually supply the threshold values which may take a lot of trials. In that way, it may become very time-consuming. Let's work on an example.

We will use the following image for this tutorial. Please feel free to save this image and follow along.


60%
60% hi
39% low
INDOOR HUMIDITY
73°F
73°F hi
68°F low
TEMPERATURE

Photo by Lucas Hoang on Unsplash

First, we need to import the necessary libraries.

```
import cv2
import matplotlib.pyplot as plt
```

Reading the image using OpenCV as an array:

```
image = cv2.imread("meter.jpg")
```

As thresholding is binarization, we start with a grayscale image. Also, using a Gaussian blur on the grayscale image will help get rid of some high-frequency edges and noises.

```
gray = cv2.cvtColor(image, cv2.COLOR_BGR2GRAY)
blurred = cv2.GaussianBlur(gray, (7, 7), 0)
```

Here is the simple thresholding:

```
(T, thresh) = cv2.threshold(blurred, 45, 255, cv2.THRESH_BINARY)
```

The first parameter is the blurred image,

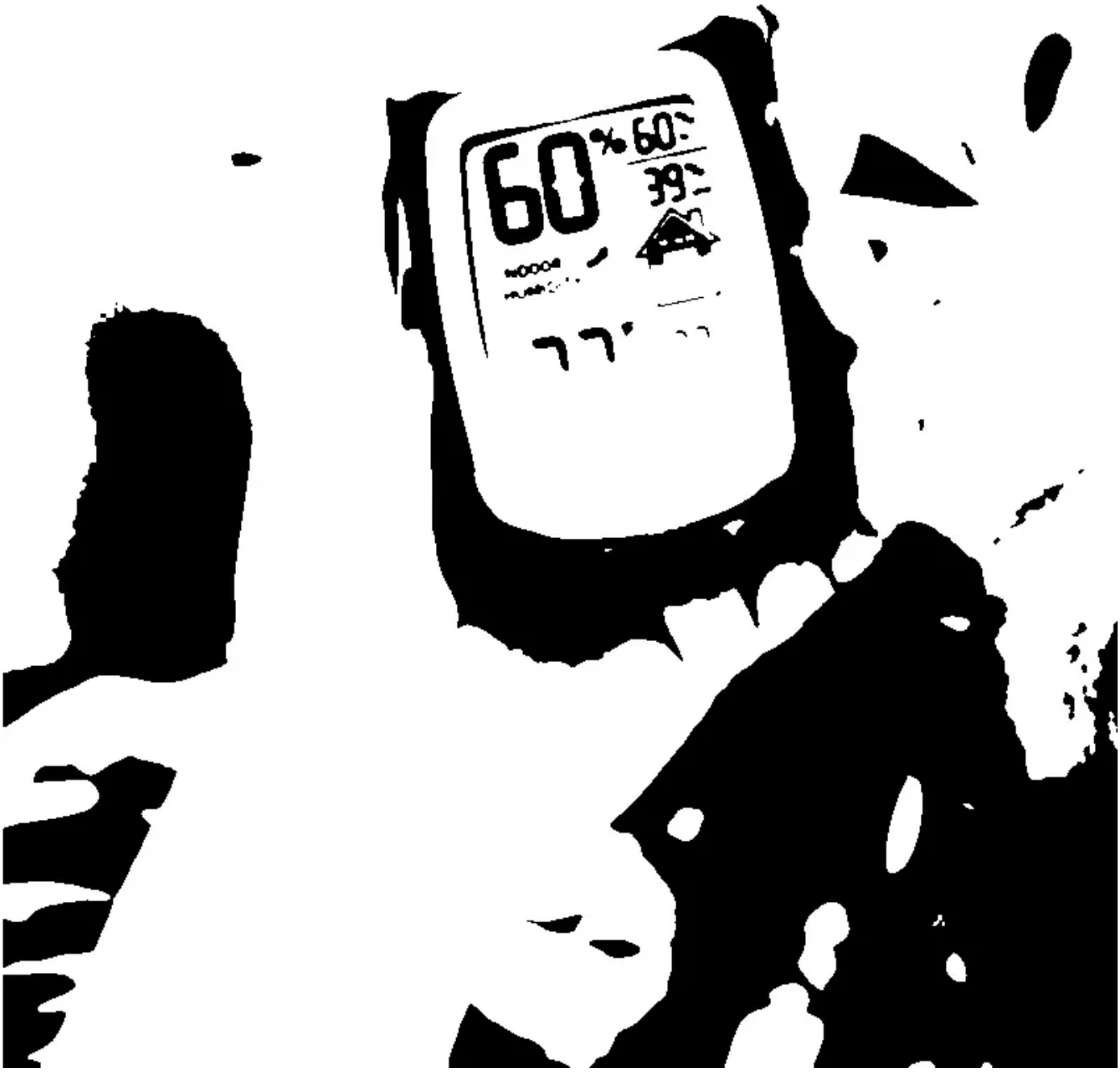
45 is the threshold value that says if the pixel value is greater than 45 it will become 255, otherwise 0. So, the third parameter is 255. If you choose a value different than 255, such as 200, the pixels greater than 45 will become 200.

Please feel free to try with a different value and see what happens.

> I decided to use a threshold value of 45 after a lot of trials.

So, it took some time. Here is what ‘thresh’ looks like:

```
cv2.imwrite('a.png', thresh)
```



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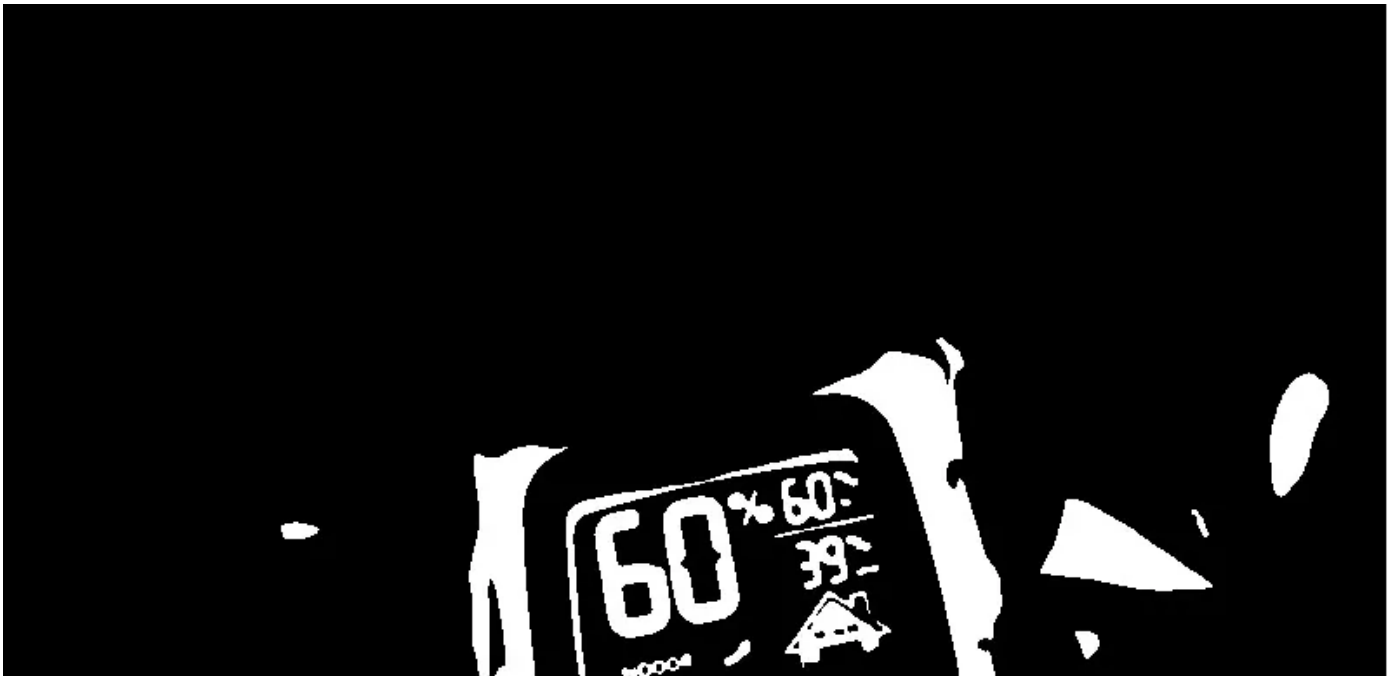
We can use cv2.THRESH_BINARY_INV as well which will do the otherwise. Let's see how it looks if the same threshold value 45 is used with cv2.THRESH_BINARY_INV:

```
(T, threshInv) = cv2.threshold(blurred, 45, 255, cv2.THRESH_BINARY_INV)
```



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In this case, when the pixel is greater than the threshold value of 45, it becomes 0 and 255 otherwise.

As I mentioned before I had to go through quite a few trials to find that threshold value of 45.

> But if the lighting conditions is different for the same picture this threshold value wouldn't work.

That's why in a real-world application where we may not have prior knowledge about the lighting condition, it is hard to work this way. **We need to find an optimum threshold value that can scale.**

Otsu Thresholding

In Otsu's thresholding, OpenCV finds an optimum threshold value for you. It takes the grayscale image and computes the optimum threshold value, T.

Here is a high-level overview of how Otsu's method chooses the threshold value. If a distribution is made with all the pixel values of a grayscale image, Otsu's method finds a threshold that optimally separates the peaks of the distribution.

```
(T, threshOtsu) = cv2.threshold(blurred, 0, 255,
                cv2.THRESH_BINARY | cv2.THRESH_OTSU)
```

Look, here we used 0 as the threshold value. Simply because Ostu's will find the optimal threshold value for us.

Let's see what is the optimal threshold value:

```
T
```

Output:

```
112.0
```

Here is the image of the ‘threshOtsu’:

```
cv2.imwrite("au.jpg", threshOtsu)
```

Image by Author

We wanted to focus on the meter reading part, right? So, how can we do that from this image? Just masking the original image using bitwise_and operation.

```
masked1 = cv2.bitwise_and(image, image, mask=threshInvOtsu)
cv2.imwrite('amasked.jpg', masked1)
```

Here is the image:

Image by Author

Lots of noises in the background are smoothed out.

The problem with both simple and Otsu's thresholding methods is they use a single thresholding value all over the image which may not be a good idea. The thresholding value that works well for one area of the image may not be good for the other areas of the image.

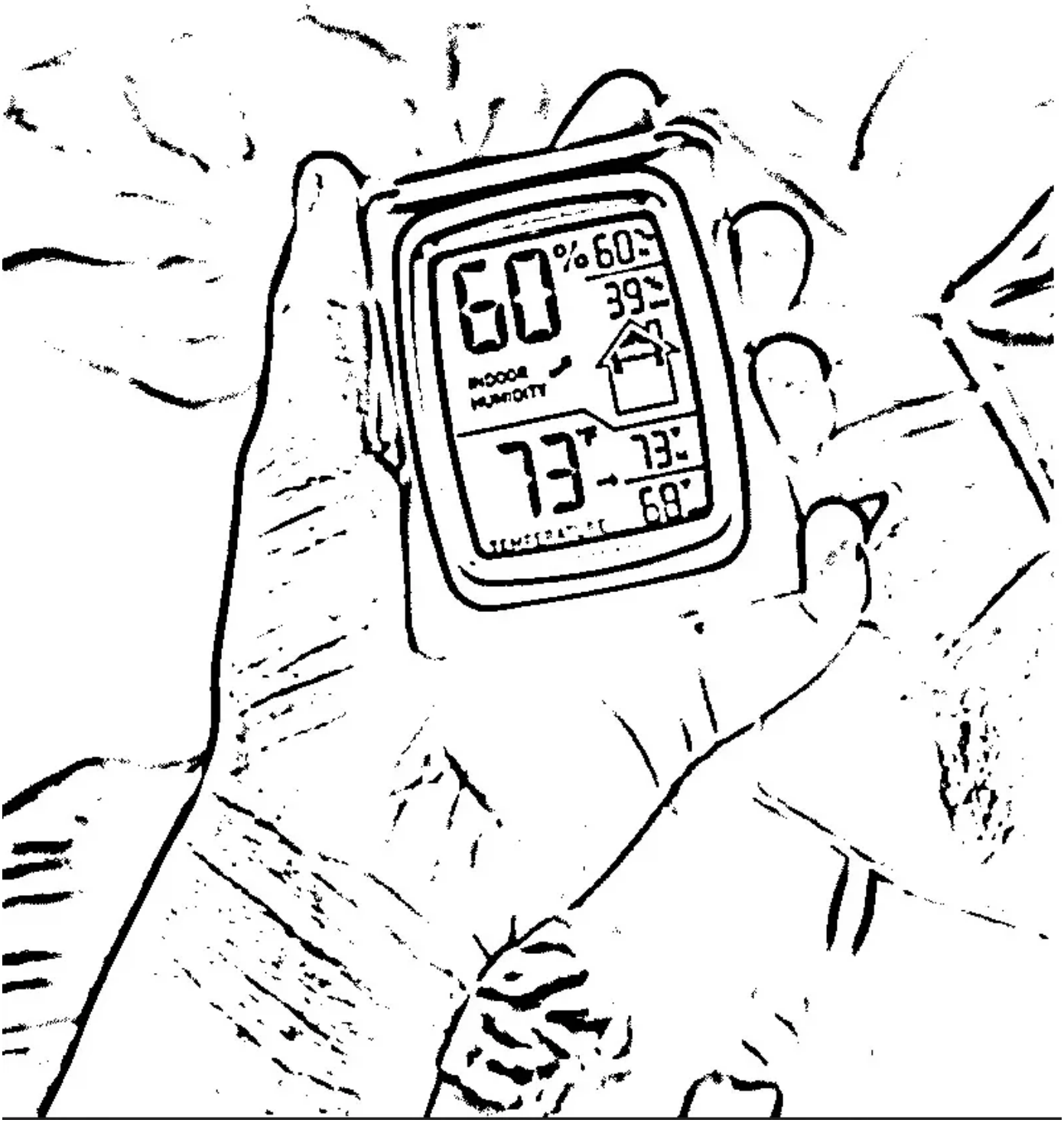
Adaptive Thresholding

The adaptive thresholding method considers a small set of pixels and computes a threshold for each small region of the image. We will explain some more after this example:

```
thresh = cv2.adaptiveThreshold(blurred, 255,
                               cv2.ADAPTIVE_THRESH_GAUSSIAN_C,
                              cv2.THRESH_BINARY, 17, 3)
cv2.imwrite('a1.jpg', thresh)
```

Here the second parameter 255 means, when the pixel is greater than the local threshold it becomes 255. The fifth parameter 17 says it will be a 17x17 region of the image to compute a local threshold. Finally, 3 is a constant. This value is subtracted from the computed threshold value. Based on your project you need to choose a region of the image to compute the local threshold and the constant.

Here is what the image looks like:



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As per the discussion above, adaptive thresholding also needs some trials to find the last two parameters. But still, the method itself does a lot for us.

Conclusion

All three thresholding methods are important. Each of them may come in handy based on your situation or your project. Please feel free to try different images.

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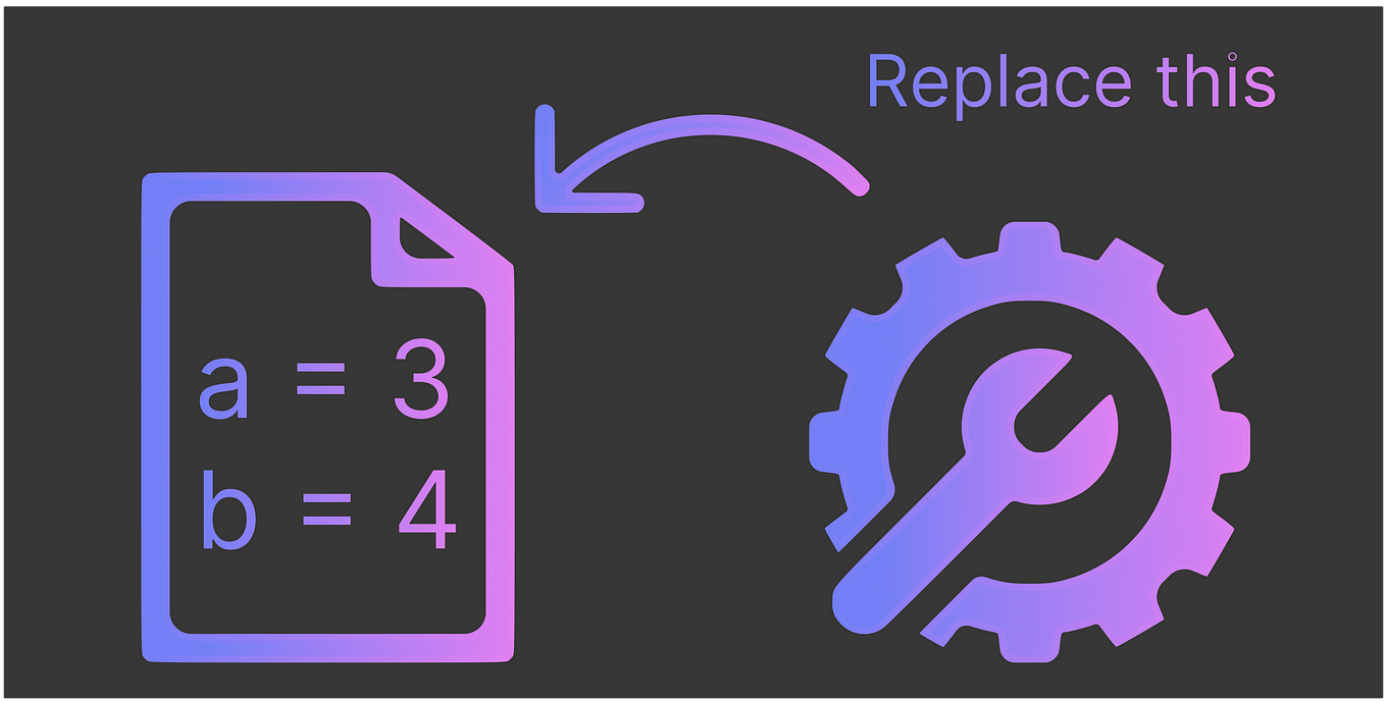

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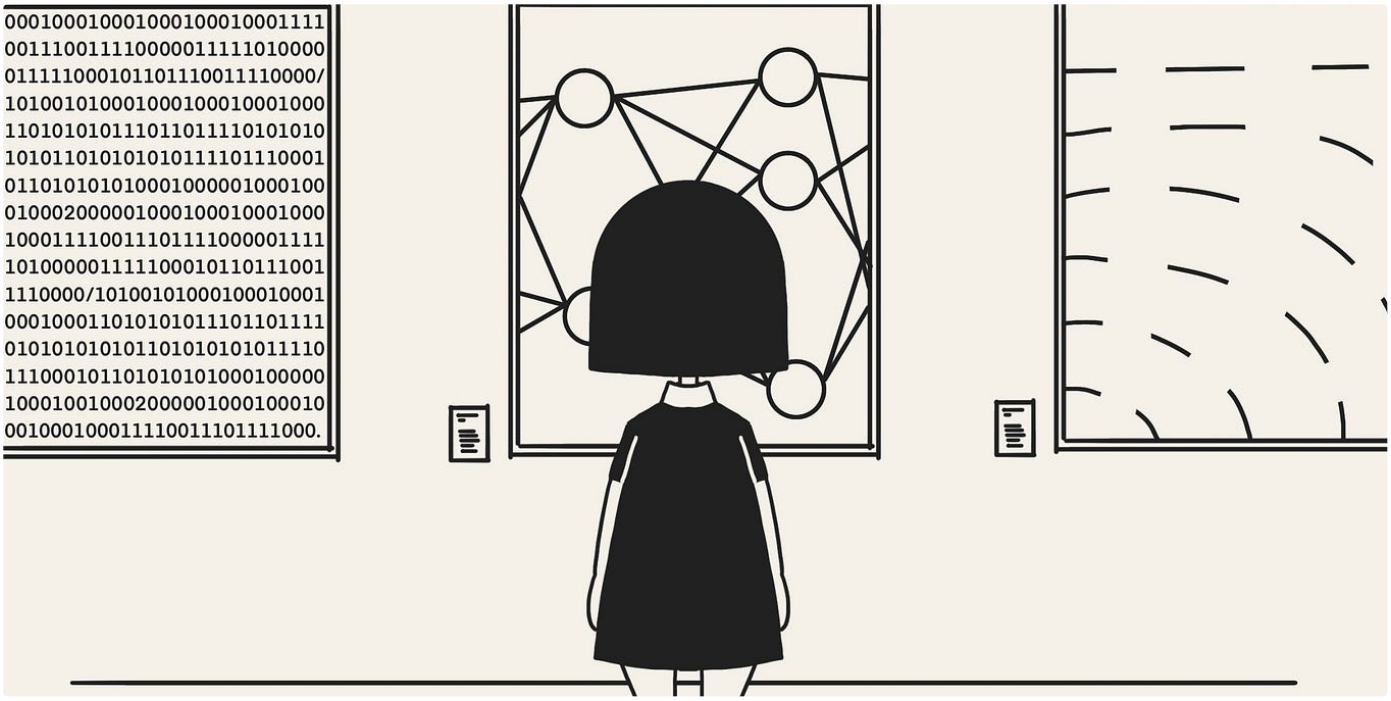

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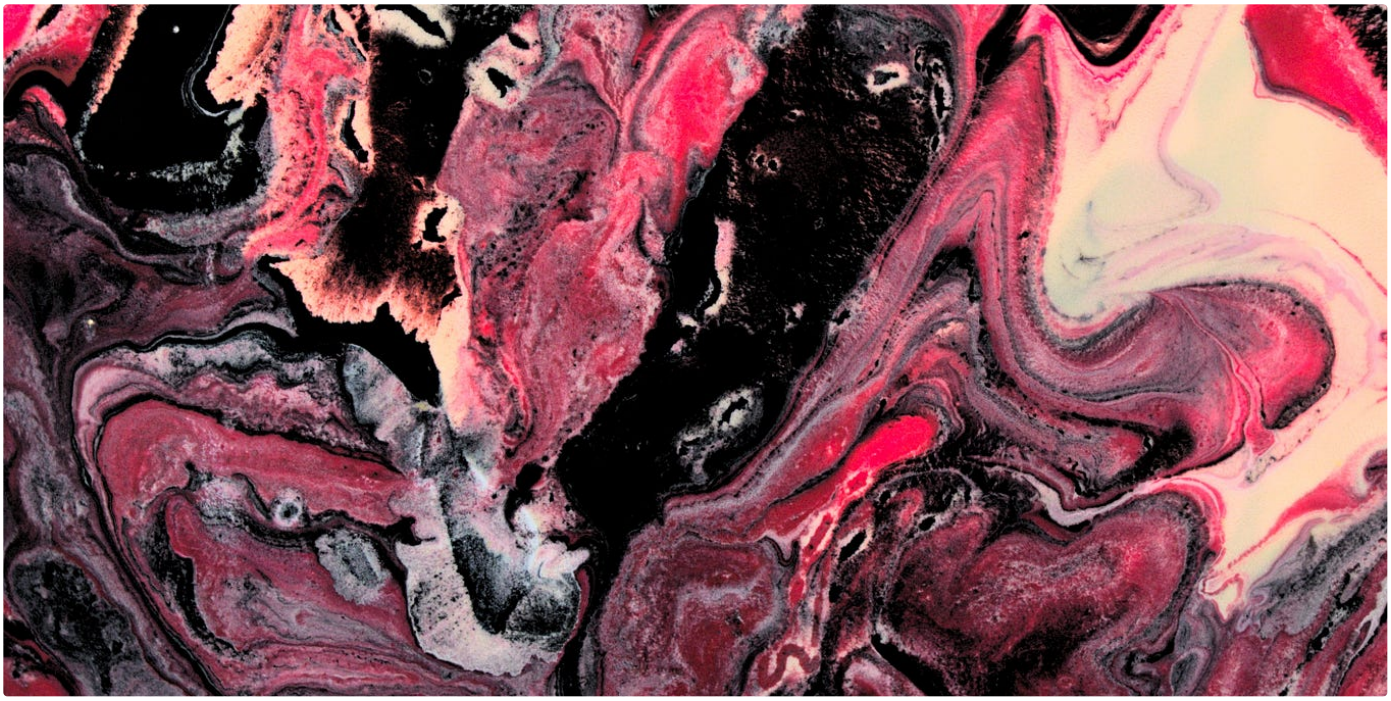

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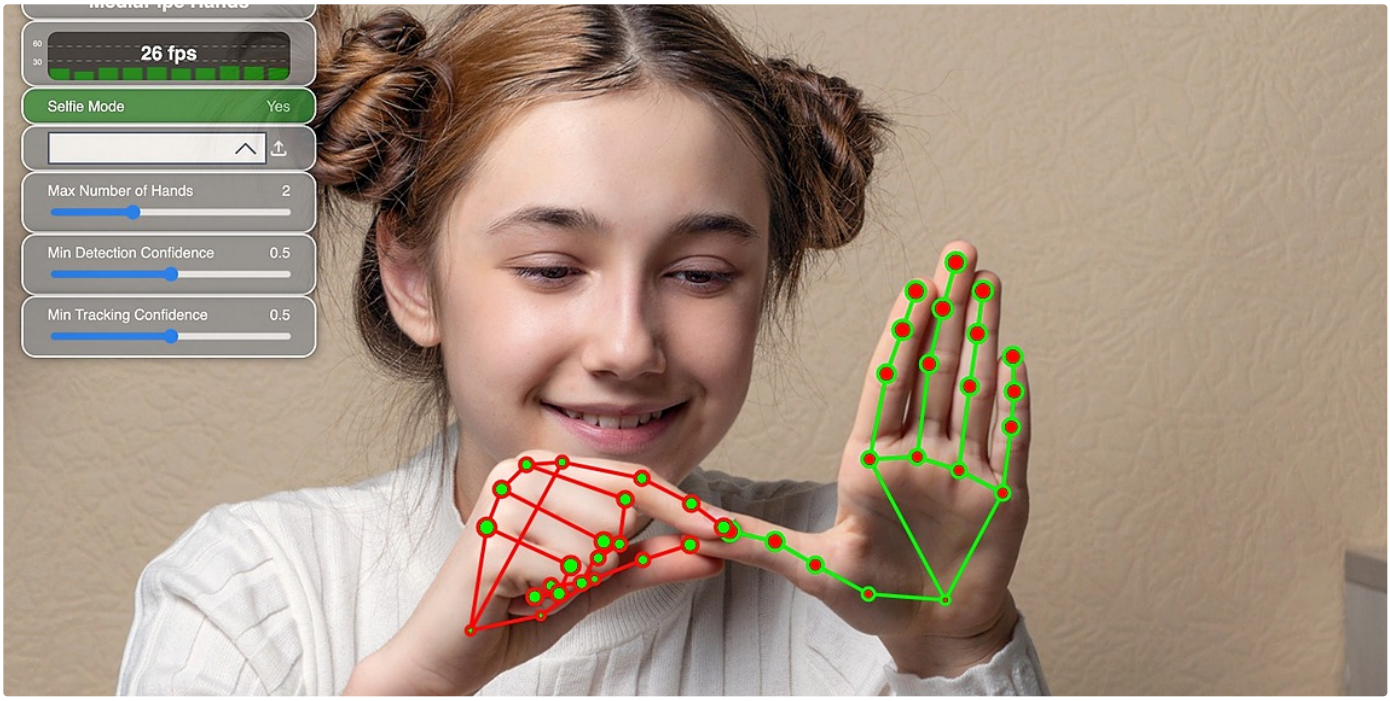

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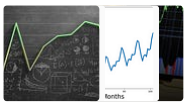

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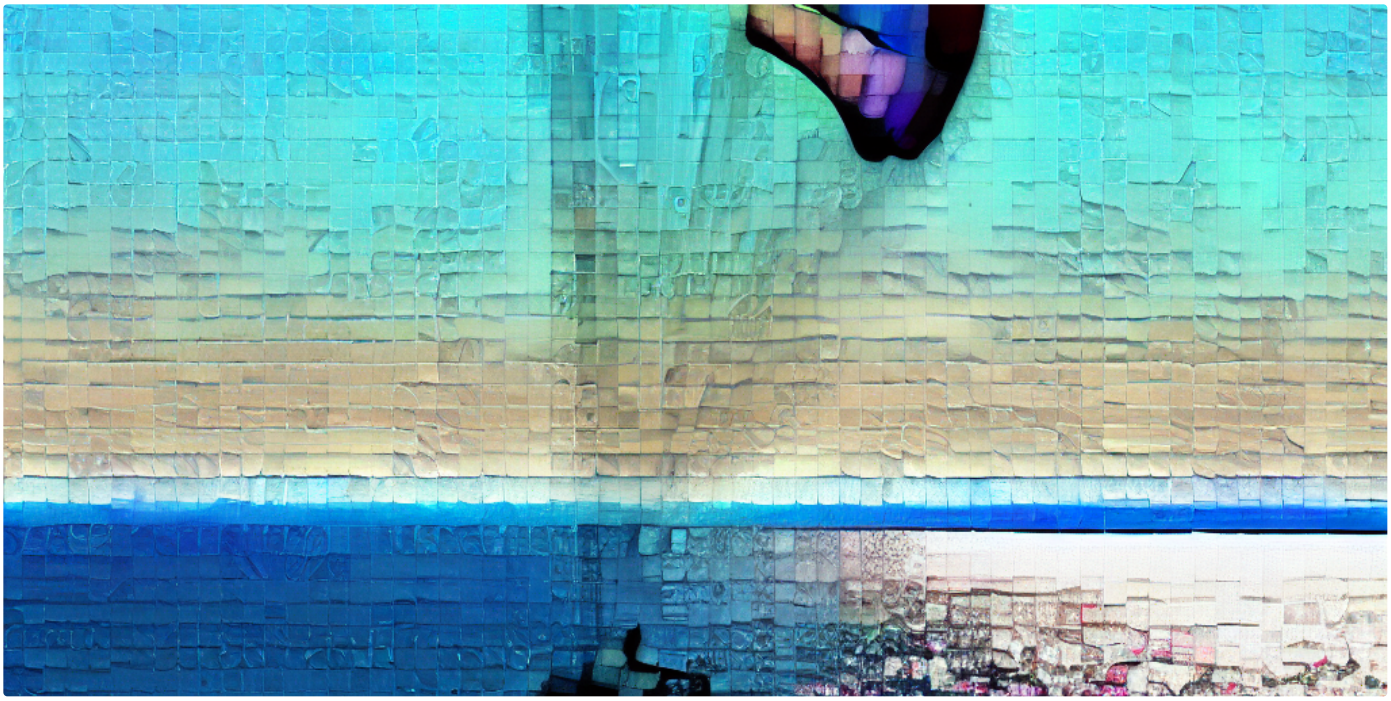

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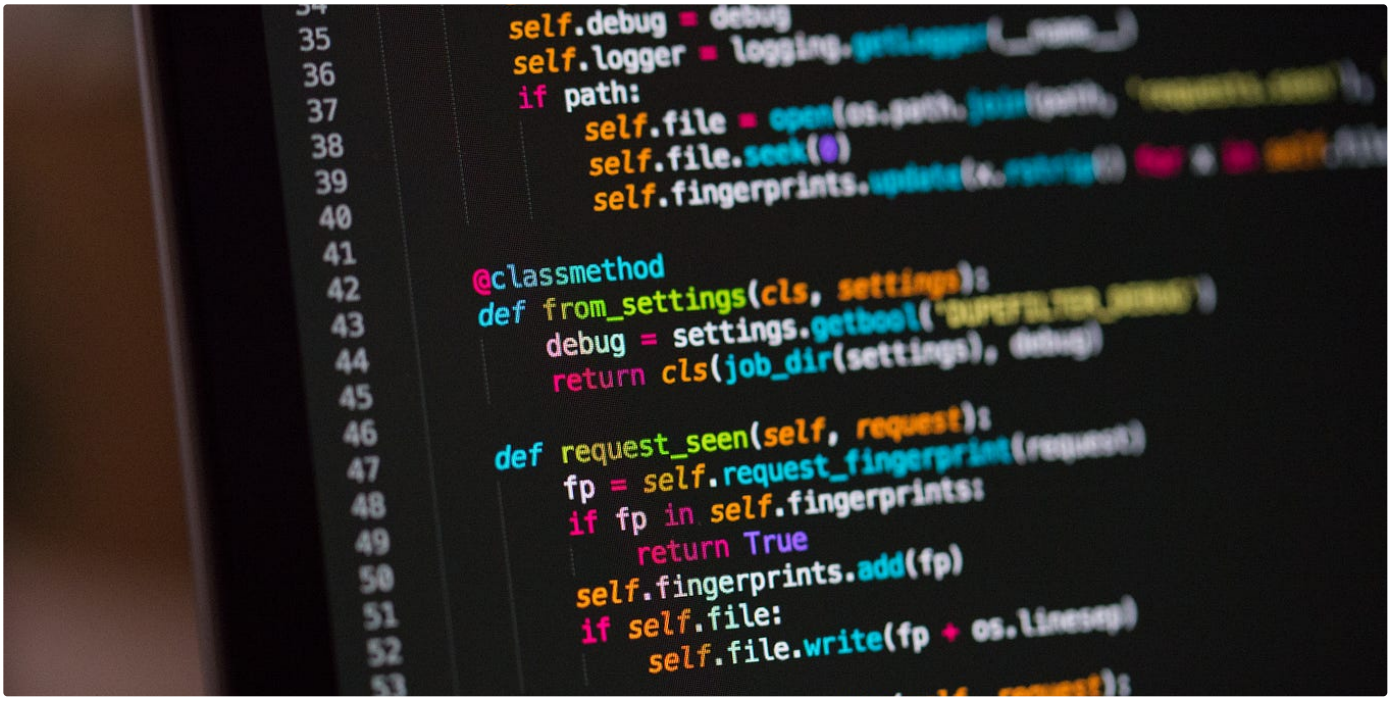

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