Assignment 3 - Real Time Tracking using Gaussian Mixture Models

About the Assignment:

Implemented a real-time object-tracking algorithm using background subtraction and a Mixture of Gaussians from scratch.

Background Subtraction:

The background subtraction algorithm is a popular approach to detect moving objects. This algorithm finds and isolates **foreground** objects by comparing them to the frames with no object present. It compares the difference in the pixel value of two frames, one without the object and one with the objects, with the threshold value (**thres_bf** in the submitted code), which is predefined by using the first few frames of the video. Therefore, if this difference in the value of two frames is greater than the threshold value, the object is detected as moving. Else, not.

Gaussian Mixture Models:

Gaussian Mixture Modeling has been a popular method to tackle the problem of background subtraction. It is a method of modeling data as a weighted sum of Gaussians. Data are frequently clustered using GMMs, where each point in the n-dimensional feature space is assigned a probability for belonging to each cluster. Each of these clusters is parameterized by the cluster mean, covariance and weight.

About the dataset:
- The "WavingTrees" dataset was downloaded and extracted from this GitHub link.
- I uploaded the dataset to the google collab session storage as a zip file and proceeded to run the code.
- The dataset contains 287 images, where I have taken the first 220 images in the training_set and the following 67 images in the testing_set.

About the code:
- The code is self-explanatory.

- Follow the comments in the code very carefully before running a block, as it might want to create new folders to write or save output images.
- I have also finally compared our Background modeling algorithm using Gaussian Mixture Models outputs with the inbuilt function's (`cv2.createBackgroundSubtractorMOG2()`) outputs.

References:

- https://ieeexplore.ieee.org/document/784637
- https://hal.archives-ouvertes.fr/hal-00338206/en/
- https://doi.org/10.1016/j.cosrev.2019.100204
- https://github.com/ZiyangS/BackgroundSubtraction