

1. Comment on what is performed in the two phases of the Expectation Maximization optimization for the Gaussian Mixture Model. (5 points)

Two steps are performed, expectation step and the maximization step.

In the expectation step, a guess is made on which gaussian distribution best fits the data at hand.

In the maximation step, the guessed values of gaussian distribution are used to determine what would be the value of the data with that distribution. Then using the new set of data, another guess is made on the parameters of the gaussian distribution. This is done repeatedly until the gaussian distribution's parameters converge.

2. When modeling the background of the image why could we want to use multiple mixed Gaussians instead of a single Gaussian distribution for each pixel? (5 points)

Because it gives more flexibility in modelling the pixel. Since it's a background, whenever something in the foreground passes onto the pixel, its value changes, affecting the estimation on the best gaussian distribution. By having multiple guesses, the best one can be picked.

3. Describe possible inputs to a Gaussian Mixture Model for background subtractions where the background subtraction would fail. Explain why it would fail on that input. (5 points)

A background that moves or that changes due to different lighting. The main driving factor that allow the background from being identified is that it does not change frequently. It's mostly still so its mean value is mostly constant. Anything in the foreground moves often and appears for a limited amount of time, so it does not affect the average value of the pixels.

An actor that stays in the same spot for an extended period of time will also lead the background subtraction to fail, since it drastically changes the mean value for the area it occupies, making it part of the background.

4. Why would someone want an online Gaussian Mixture Model? Why would someone want a pre-computed Gaussian Mixture Model? Give examples of concrete cases. (5 points)

A precomputed Gaussian Mixture Model is useful for finding objects in a known environment. For example, if a camera is set up at a toll booth, the background will not be changing. The main changes are going to be the cars passing through which is what

is being identified. Therefore, by training the GMM (Gaussian Mixture Model) beforehand, computation time and energy can be saved.

An online GMM is useful when the environment it will operate in is not known. This could be useful in robots exploring new environments where it needs to identify objects.

5. Why does SLIC select the starting clusters not on a perfect grid but instead at the lowest gradient magnitude in a small neighborhood around the grid. (5 points)

Because by placing them at the lowest gradient magnitude, edges can be avoided, and it reduces the chance of choosing a noisy pixel.