Part A – General Questions:

1. From Bayes’ theorem :

The posterior probability of a random event or an uncertain proposition is the conditional probability that is assigned after the relevant evidence or background is taken into account.

The prior probability of a random event or an uncertain proposition is the unconditional probability that is assigned before any relevant evidence is taken into account.

The likelihood function measures the goodness of fit of a statistical model to a sample of data for given values of the unknown parameters.

The Kalman/Particle filter is a process that helps us combine a model and measurements to provide better estimation. The filter uses prior data and model to estimate the observed state vector value in real time – If the input data is very noisy, the estimation would be based more on the model and if the model prediction produces a large error when compared to the real time samples, , the estimation would be based more on the input data.

1. For the measurement step in the particle filter, we used the histogram of the two patches:
2. The histogram shows us the difference of pixel values between patches. The advantage of using the histogram to score the patches is the simplicity of the method. Also we don’t force each pixel to be at the same coordinate, but we allow movement inside the patch as long we see the same values – we allow the object to have small movements which aren’t only translation movement. The con is that we might give high score to a picture that contains same colors of our object. For example, let’s say that we see a yellow duck in the background of the top of the original patch. If we catch a yellow duck in the bottom of our next patch it will be high scored and will cause wrong scoring.
3. Because our object is moving, it is very unlikely to find every pixel in the same coordinates as it was in the original patch. We expect to see small changes in our object, but the overall pixel color should remain about the same.
4. We can compare the frequencies inside a patch if our object has many edges and a unique pattern. We can look at the frequencies map and compare between them. The advantage of this method is that it will score other objects very low and the difference at scoring will be very dramatic. The con is that our object need to have clear anchors – corners or patterns that will not change while tracking.
5. Particle filter will work when the tracked object changes it scale if we use dynamic update rules.

For a person walking towards and away from the camera we should update the height and width of the object which change as the person walks. We will need to keep update the state vector (location (x,y), height and width) for each step.

For a person dancing when the viewpoint of the object changes we will need to add rotation parameters to the state vector. In addition, we can choose the center of the person as the object and by that improve the algorithm chances of success.

1. We can set a threshold so every time we have patch with high enough weight, we replace its histogram values with our reference patch. It means our object has changed a little but its still fits our previous match so we can adopt that small changes.

We can also average it so we will use the average of the last 5 patches that crossed the threshold. At this method we will make more smooth changes in our reference patch so we won’t be affected by noise or 1 wrong scored patch.