CHENNAI MATHEMATICAL INSTITUTE

Machine Learning

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(1) Read in a photo and convert it into a matrix. Perform an SVD of the image. Reconstruct the photo by using only the top 10%, 25% and 50% of the singular values and the corresponding singular vectors. Compare the Frobenius norms of the original matrix with that of the reconstructed image in each of the cases.

(2) SVD for face recognition. Pick up from a face database (or from you tube videos) a collection of images of faces as bit maps (say 50 of them). Then run an SVD on these images and keep the top 10 eigen faces, these correspond to the top 10 left singular vectors.

Given many more images of faces from the database and from outside, project it on to the 10 eigen faces and compare it with the projections of the 50 from the database. Fixing an error ϵ find if the projectin is ϵ close to one of the faces in the data base. And declare it to be in if that happens. Plot the success rate (predicting if the face is from the database or not!) as a function the distance to one of the faces in the database.

Change the number of eigen faces stored and see how the algorithm success changes. Think of variants. Perhaps we need to do an SVD of the images minus the mean image. Experiment.

(3) Generate points from 10 different spherical Gaussian's in 25 dimensions, with pairwise centres at a distance of at least 5 and at most 10. Generate these centres yourself. Assume all of the Gaussians have standard deviation 1. Perform an SVD on the generated points and find the best 10 dimensional approximation to the collection of date points. Check if the linear subspace contains your centres. Now project your points to this k dimensional subspace and cluster them, using say k nearest neighbours. Once you get the clusters, go to the original space, and fit a Gaussian to the points in the same cluster. Compare it with the Gaussian you generated, its covariance matrix, the centres.