Homework 11, due November 24th, 11:59pm

November 16, 2023

1. Download the dataset `faces.zip` from Blackboard. It contains 2429 faces of size 19×19 pixels each, and `background.zip` , containing background samples somehow resembling faces. If there are any unreadable images, discard them.

    a) Perform Principal Component Analysis on the face images. Discard the two largest eigenvalue and plot the graph of the remaining eigenvalues sorted in decreasing order. (1 point)

    b) Plot a graph of the coordinates of the faces projected to the 2D plane generated by the first and second principal component. (1 point)

    c) On the same graph, display the coordinates of the projections from b) using one color (red or light gray) and the projections of the background patches on the same two principal components (PCs) using another color (e.g. black). Be sure to subtract the mean of the faces and project to the PCs of the faces. (1 point)

    d) Using the model from a), display the image `face_00067.pgm` and its reconstruction using 20 PCs. (1 point)

    e) Using the model from a), display the image `B1_00192.pgm` and its reconstruction using 20 PCs. (1 point)

    f) Compute the distances of the faces and the background points to the plane generated by the 20 largest PCs. On the same graph, plot the computed distances (on the y-axis) vs the coordinates of the projections on the second PC (on the x-axis) for the faces and background patches using two different colors. (2 points)

    g) On the same graph, plot the histogram of the distances obtained at f) for the faces in one color and for the background patches in another color. (2 points)