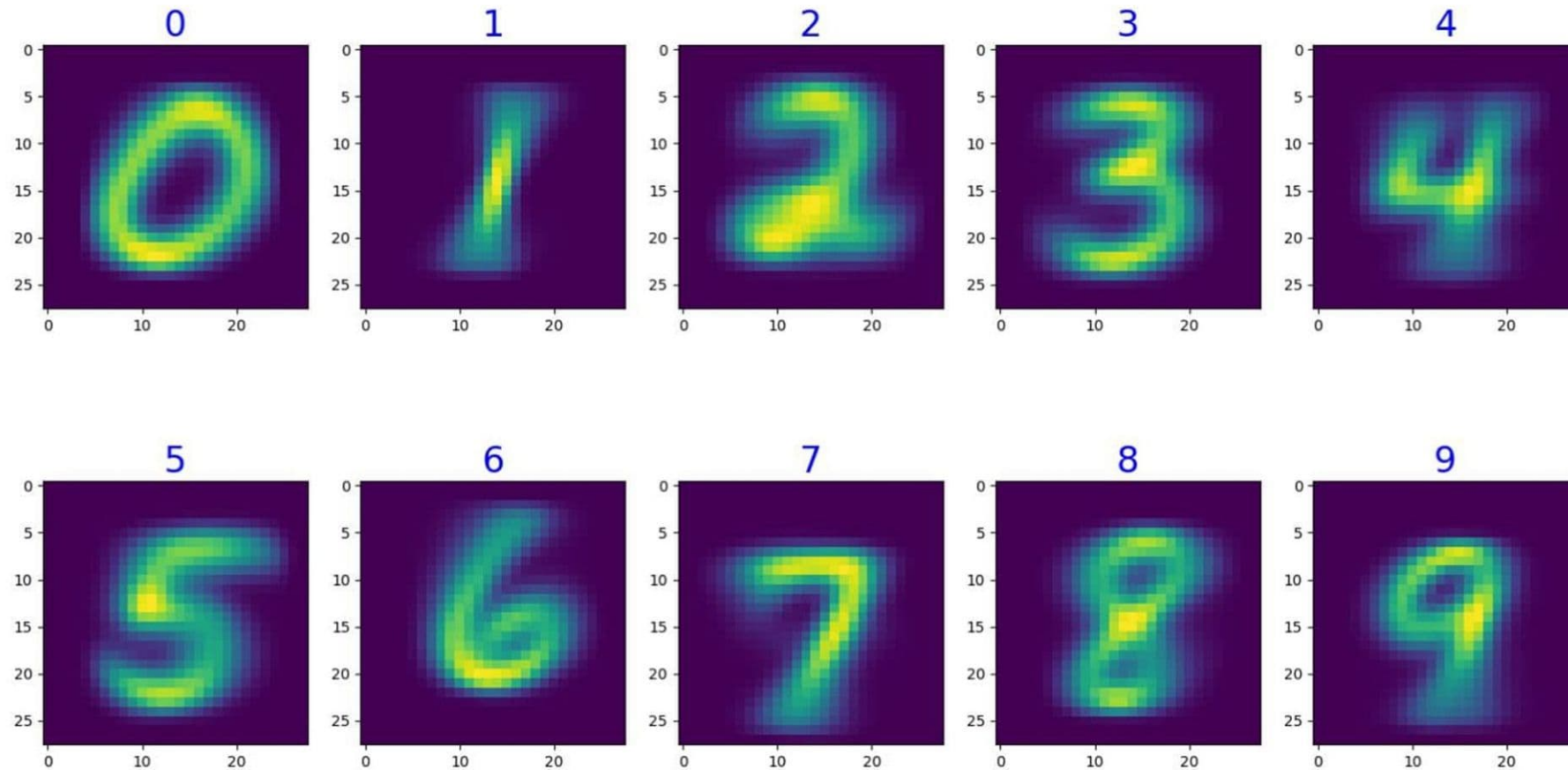


Q4 File containing mean, co-variance matrix and principal modes of variation exceeds max. upload limit on moodle, so. ~~or~~ if we can't submit it but it can be generated in results folder results/Q4_data.mat on running Q4.py.

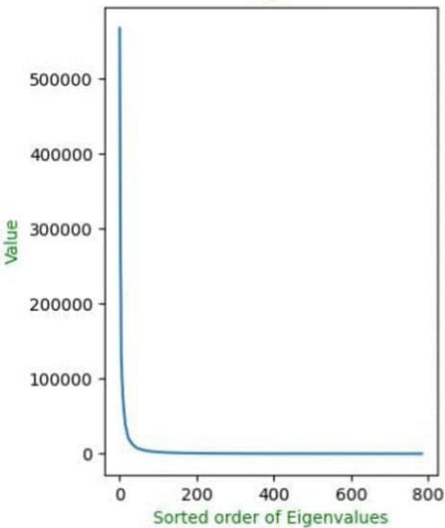
Images of mean for each digit



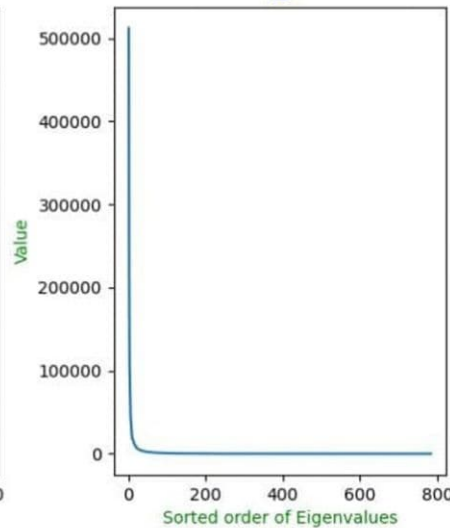
(b) From the graphs of eigenvalues for each ~~eigenvector~~ ~~mode~~ digit, we can infer that significant modes of variation are much less than 28^2 (so largest values seems to be enough) for each digit. As we can see for each digit, these sample images will always be a lot similar, therefore a most of the ~~eigen~~ modes of variations are associated with a digit disturbances or noise. Hence it justifies our observations.

Graphs of sorted eigenvalues

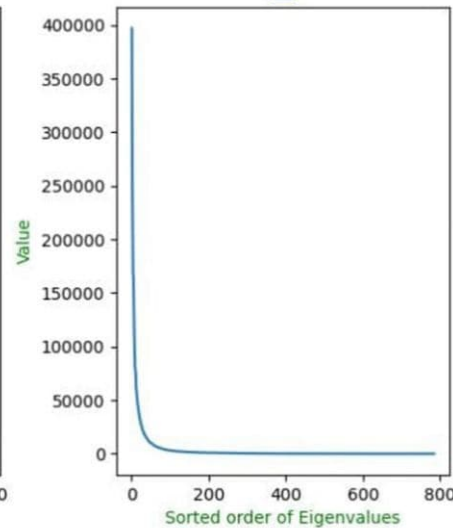
0



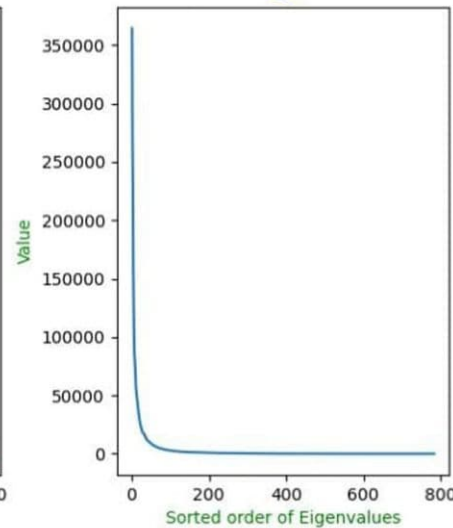
1



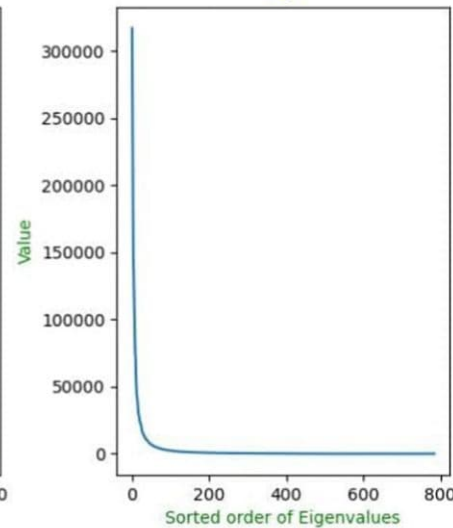
2



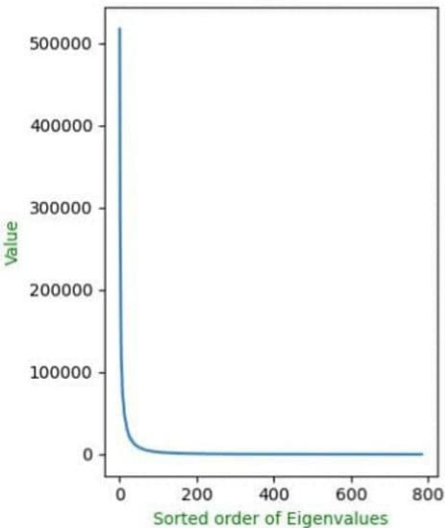
3



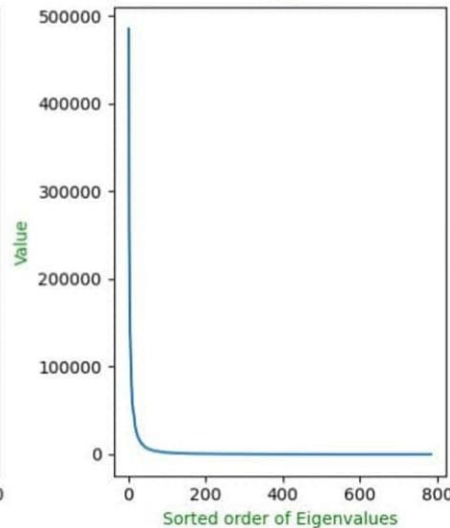
4



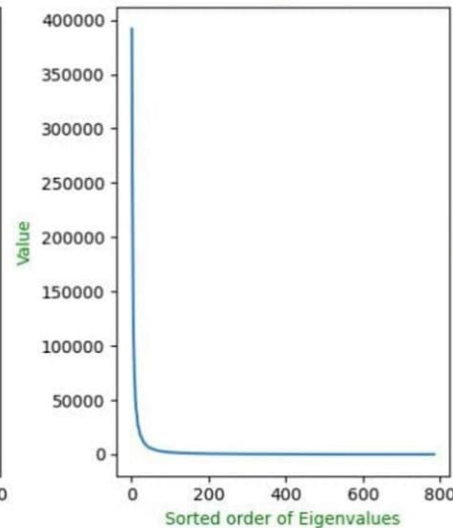
5



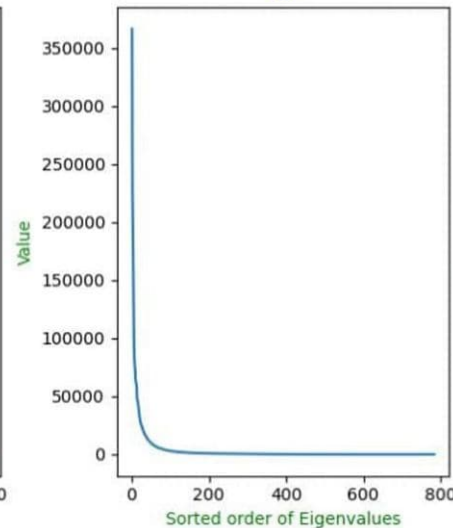
6



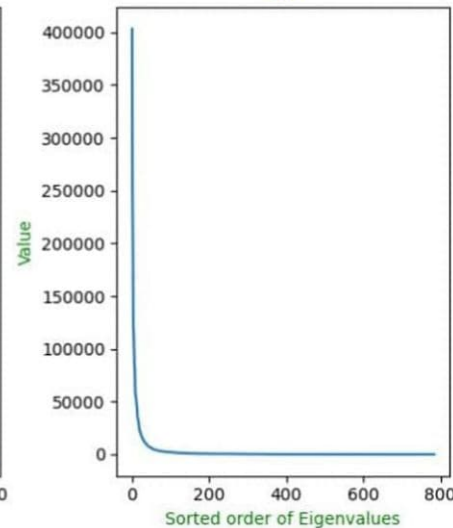
7



8



9



(c) For each digit, the principal mode of variation around the mean shows something like two extreme cases of drawing a digit that most of the people draw like for '2' some people draw it like '2' (pointed bottom) while some '2' (knot at the bottom), most of these images are either between two or a little off from ~~to~~ one of them, same goes for '1' tilted or straight. In most digits, tilt is one variation we can observe and slight other variation too. This is because these are the major variation occurring in writing these digits therefore sample data has most spread along v_1 . That's why we got those extremes.

