SMAI-M20-Lec 17 Review questions

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Review Question - I (one, none or more correct)

1. Consider we are using PCA to compress face images using top K eigenvectors and then we do the reconstruction. Then
   1.1 Compression (for face images) is lossy
   1.2 Compression (for face images) is lossless
   1.3 Reconstruction will be bad for non-face images (say buildings)
   1.4 Reconstruction will be good for non-face images (say buildings)
   1.5 None of these

   Ans AC

Review Question - II (one, none or more correct)

Consider we are dong PCA to go from R^2 data to R^1. Consider each point is denoted by (X_i, Y_i). Then in which of these situations will PCA work reasonably well:

1. $Y_i = X_i + 10$
2. $Y_i = X_i + 10 + \epsilon_i$ where $\epsilon_i \sim N(0, 1)$
3. $X_i^2 + Y_i^2 = 10$
4. $X_i^2 + Y_i^2 <= 10$
5. None of these

Ans: AB (A,B have near-linear relationship which will get captured in PCA)

Review Question - III (one, none or more correct)

Consider we have data in R^2. Then the linear regression line and the PCA line

1. will always be the same
2. will never be the same
3. can sometimes be the same
4. None of these

Ans: C

Review Question -IV (one, none or more correct)

We want to do PCA using gradient descent. Then the update rule is

1. $u_{k+1} = \eta \Sigma u_k$
2. $u_{k+1} = (I + \eta \Sigma) u_k$
3. $u_{k+1} = (I - \eta \Sigma) u_k$
4. None of these

Assume that Σ is the covariance matrix, η is the learning rate.
Ans: B (The +ve sign comes because we are solving a maximization problem)

Review Question - V (one, none or more correct)

PCA solves this problem:

$$\max_u u^T \Sigma u - \lambda(u^T u - 1)$$

where Σ is the covariance matrix. Which of the following are true regarding PCA

1. λ is the variance captured by the eigen vector u
2. Sum of variances captured by all eigenvectors is $\text{tr}(\Sigma)$
3. If all data points are on a line then at least one of the eigenvalues is 1
4. If all data points are on a line then at least one of the eigenvalues is 0

Ans: ABD