EECS545 Lecture 17 Quiz Solutions

March 16, 2025

1. Select all that are true.

   (a) The goal of PCA is to interpret the underlying structure of the data in terms of the principal components that are best at predicting the output variable.

   (b) The number of source for the ICA can be larger than the input dimension.

   (c) The number of basis vectors for sparse coding can be larger than the input dimension.

   (d) tSNE is useful for pre-processing the data for downstream tasks (e.g., classification, regression, etc.)

   > **Solution:** (c)

2. Select all that are true about ICA.)

   (a) ICA can be used to reduce the dimensionality of data.

   (b) ICA can be used to discover independent components from data.

   (c) ICA finds directions (e.g., basis vectors) of maximal variance in the data.

   (d) ICA finds directions (e.g., basis vectors) that are maximally independent from data following a Gaussian distribution.

   (e) ICA finds directions (e.g., basis vectors) that are maximally independent from data following a non-Gaussian distribution.

   > **Solution:** (a) (b) (e)

3. What is the main benefit of applying PCA whitening before performing ICA on a dataset?

   (a) It reduces the dimensionality of the data by discarding low-variance components.

   (b) It makes the data more Gaussian by transforming it to a standard normal distribution.

   (c) It decorrelates the data by making its covariance matrix diagonal.

   (d) It rotates the data by aligning it with its principal directions.

   > **Solution:** (a)(c)(d)
   > PCA whitening decorrelates the data by making its covariance matrix diagonal. This simplifies the ICA problem by reducing it to finding a rotation matrix that maximizes non-Gaussianity.

4. Select all that are true about the sparse coding objective function.

   (a) Increasing β will result in a basis that better approximate the input data

   (b) Using an L2 loss for the sparsity penalty is viable for sparse coding as long as β is increased

   (c) The sparse coding objective is convex when maximizing b or s independently (while fixing the other), but not both.

   > **Solution:** (c)
   > Note for (b), L2 does not work well as a sparsity penalty (unlike L1, L0 and log penalty).

5. Select all that are true about tSNE vs. ISOMAP

   (a) ISOMAP preserves global distances while tSNE does not

   (b) ISOMAP preserves local distance by preserving geodesic distance, while tSNE preserves (noisy) euclidean distance.

   (c) tSNE and ISOMAP are both relatively computationally intensive.

   (d) tSNE is less sensitive to noise than ISOMAP.

   > **Solution:** (b), (c), (d)