Data-Driven Representations Pick 5 questions, 1 pts per question

PCA Trivia

The most popularly used dimensionality reduction algorithm is Principal Component Analysis (PCA). Which of the following is/are true about PCA?

1. PCA is an unsupervised method

2. It searches for the directions that data have the largest variance

3. Maximum number of principal components LaTeX: \leq≤ number of features

4. All principal components are orthogonal to each other

1 and 2

1 and 3

2 and 3

1, 2 and 3

1, 2 and 4

Correct Answer

All of them

Deterministic representations

Which of the following is FALSE about deterministic representations and data-driven representations?

One big difference between them is that deterministic representation already has bases while data-driven representation tries to find out bases.

Correct Answer

DCT is a data-driven representation rather than deterministic representation.

Data-driven representation is better for representing specific kinds of images.

You can use DCT bases to represent all kinds of images

PCA Methods

True or false? Eigendecomposition, Singular Value Decomposition and iterative search of Eigenvalues and Eigenvectors are three different ways of computing the PCA and they all produce the same results.

Correct Answer

True

False

Eigenfaces Reconstruction

Which one of the following statements is/are True when we reconstruct a fishbowl using typical face bases?

If we use more face bases, the reconstructed image looks more like a fishbowl

If we use more face bases, the reconstructed image looks more like a face

If we use less face bases, the reconstructed image looks more like a fishbowl

If we use less face bases, the reconstructed image looks more like a face

Correct Answer

1 and 4

1 and 3

2 and 3

2 and 4

Perfect Reconstruction

Given face images represented as LaTeX: dd-dimensional vectors LaTeX: \{{\bf x}\_i\}^N\_{i=1}{ x i } i = 1 N, you run the KL method and pick first LaTeX: PP eigenfaces. Can you always reconstruct any image LaTeX: {\bf x}\_ix i for LaTeX: i = 1,...,Ni = 1 , . . . , N from the LaTeX: PP eigenfaces with zero reconstruction error?

Correct Answer

Yes, if LaTeX: P=dP = d

Yes, if LaTeX: P<dP < d

Yes, if LaTeX: P < NP < N

No, there is no guarantee to perfectly reconstruct the faces

Space Projection

If an image is represented by a LaTeX: 28 \times 2828 × 28 matrix LaTeX: AA, and we project it onto the matrix LaTeX: BB, where LaTeX: B\_{ij} = 1B i j = 1 for every LaTeX: i,ji , j. Which of the following statements is true?

1) The projection of LaTeX: AA on LaTeX: BB is orthogonal to LaTeX: A-BA − B

2) The projection of LaTeX: AA on LaTeX: BB is a matrix where all its components have the same value

3) The projection of LaTeX: AA on LaTeX: BB allows us to have an estimation of the intensity of the background of LaTeX: AA

Correct Answer

Only 3

2 and 3

Only 2

1 and 2

Representation Options

You cannot use the eigenfaces to represent a fish bowl. Which of the following options are reasonable ways to represent a fish bowl?

1) Collect lots and lots of images of all kinds into a matrix and perform SVD on this data matrix

2) Collect lots and lots of images of all kinds into a matrix and perform eigendecomposition on the correlation matrix of the data

3) DCTs are always the best "universal bases" so just use DCT bases

4) DCTs are close to optimal bases under certain assumptions, so use DCT bases for practical purposes

Correct Answer

1, 2 and 4

1 and 3

1 and 2

2 and 4

Eigenface Representation

Which of following are true about eigenrepresentation of face?

1) The first typical face basis can be obtained by finding the eigenvector of the correlation matrix of the original face images with the largest eigenvalue

2) It is possible to reconstruct a fishbowl even if we only have face bases and no fishbowl bases

3) Typical face bases are orthogonal to each other

1 and 3

1 and 2

2 and 3

Correct Answer

1, 2 and 3

DSP Pick 5 questions, 1 pts per question

LSI System

You are given a linear shift-invariant system. The system is characterized by its impulse response, LaTeX: h[n]h [ n ], which has non-zero values for all LaTeX: n \geq 0n ≥ 0. If the input to the system is LaTeX: x[n] = [0, 1, 2, 1, 0]x [ n ] = [ 0 , 1 , 2 , 1 , 0 ], what is the output of the system at LaTeX: n = 0n = 0?

Correct Answer

LaTeX: y[0] = 0y [ 0 ] = 0

LaTeX: y[0] = 1y [ 0 ] = 1

LaTeX: y[0] = 2y [ 0 ] = 2

The output at time LaTeX: n = 0n = 0 cannot be determined with the given information

Linear Examples

In the following options, LaTeX: x[n]x [ n ] represents the input to a system and LaTeX: y[n]y [ n ] represents the output. Please select all of the options that describe linear systems.

Correct Answer

LaTeX: y[n] = x[n]y [ n ] = x [ n ]

Correct Answer

LaTeX: y[n] = nx[n]y [ n ] = n x [ n ]

LaTeX: y[n] = 2 + x[n]y [ n ] = 2 + x [ n ]

LaTeX: y[n] = x^2[n]y [ n ] = x 2 [ n ]

Impulse Response

A linear shift-invariant system has an impulse response, LaTeX: h[n]h [ n ], characterized by

LaTeX: h[n] = \begin{cases} 1 & x = 0\\ 0 & \textrm{elsewhere}.\end{cases}h [ n ] = { 1 x = 0 0 elsewhere .Given an input, LaTeX: x[n]x [ n ], to the system, you are asked to compute its output, LaTeX: y[n]y [ n ]. If LaTeX: x[n] = [1, 0.25, -1, 0.75, 1]x [ n ] = [ 1 , 0.25 , − 1 , 0.75 , 1 ], what is the output LaTeX: y[n]y [ n ]?

Correct Answer

LaTeX: y[n] = [1, 0.25, -1, 0.75, 1]y [ n ] = [ 1 , 0.25 , − 1 , 0.75 , 1 ]

LaTeX: y[n] = [1, 0, 0, 0, 0]y [ n ] = [ 1 , 0 , 0 , 0 , 0 ]

LaTeX: y[n] = [1, 0, 1.75, 2, -1]y [ n ] = [ 1 , 0 , 1.75 , 2 , − 1 ]

LaTeX: y[n] = [0, 0.25, 1.75, 4, -2]y [ n ] = [ 0 , 0.25 , 1.75 , 4 , − 2 ]

Step Function

The derivative of a unit step function is

Correct Answer

An impulse function

A sinc function

A unit step function

A rectangular function

Fourier Transform

The inverse Fourier transform of the function defined by LaTeX: F(e^{j\omega}) = u(\omega) - u(\omega - \omega\_0)F ( e j ω ) = u ( ω ) − u ( ω − ω 0 ) for LaTeX: \omega\_0 > 0ω 0 > 0 looks like

Correct Answer

A sinc function

An impulse function

A unit step function

A rectangular function

Windowing

The Fourier transform of LaTeX: \cos(\omega\_0n)cos ⁡ ( ω 0 n ) is impulses at LaTeX: +\omega\_0+ ω 0 and LaTeX: -\omega\_0− ω 0 and zero elsewhere. However, you will notice that if you plot the Fourier transform of LaTeX: \cos(\omega\_0n)cos ⁡ ( ω 0 n ) in Matlab, the resulting plot will not show perfectly narrow impulses. Why is this the case?

Correct Answer

The impulse has been multiplied by a sinc function in frequency because the representation is windowed

It is impossible for a computer to represent a Kronecker delta function with discrete points

Computers use discrete data, and the discrete-time Fourier transform of a cosine function is not impulses at LaTeX: +\omega\_0+ ω 0 and LaTeX: -\omega\_0− ω 0

The Fourier bases which Matlab uses to compute the Fourier transform are too rough of approximations to yield an accurate result

Linear Definition

Consider a system which simply sums its input. Specifically, its output can be represented as LaTeX: y[n] = \sum\_{k = -\infty}^{n}x[k]y [ n ] = ∑ k = − ∞ n x [ k ], where LaTeX: x[k]x [ k ] is the input to the function at time LaTeX: kk. Is this system linear?

Correct Answer

Yes

No

Convolution

Two discrete functions, LaTeX: f[n]f [ n ] and LaTeX: g[n]g [ n ], are defined to have non-zero values for LaTeX: -6 \leq n \leq 5− 6 ≤ n ≤ 5 and LaTeX: 0 \leq n \leq 130 ≤ n ≤ 13, respectively. What range of LaTeX: f[n] \* g[n]f [ n ] ∗ g [ n ] will include non-zero values?

Correct Answer

LaTeX: -6 \leq n \leq 18− 6 ≤ n ≤ 18

LaTeX: -\infty < n < \infty− ∞ < n < ∞

LaTeX: 0 \leq n \leq 50 ≤ n ≤ 5

LaTeX: -6 \leq n \leq 5− 6 ≤ n ≤ 5