Welcome to Module 4's Isomap Labs!

In order to complete the Isomap labs in this module, please make sure you download and unarchive this .zip file with all the datasets and files necessary.

Lab Assignment 4

After having a brief conversation with Joshua Tenenbaum, the primary creator of the isometric feature mapping algorithm, it only seems right that we make your first lab assignment be replicating his canonical, dimensionality reduction research experiment for visual perception! In fact, you will also be using his original dataset from December 2000. It consists of 698 samples of 4096-dimensional vectors. These vectors are the coded brightness values of 64x64-pixel heads that have been rendered facing various directions and lighted from many angles. Replicate Dr. Tenenbaum's experiment by:

1. Applying both PCA and Isomap to the 698 raw images to derive 2D principal components and a 2D embedding of the data's intrinsic geometric structure.
2. Project both onto a 2D scatter plot, with a few superimposed face images on the associated samples.
3. Extra: If you're feeling fancy, increase n_components to three, and plot your scatter plot on a 3D chart.

Lab Questions

(4/4 points)

Between linear PCA and the non-linear Isomap, which algorithm is better able to capture the true nature of the faces dataset when reduced to two component?

- PCA
- IsoMap ✔

Each coordinate axis of your 3D manifold should correlate highly with one degree of freedom from the original, underlying data. In the isomap plot of the first two components (0 and 1), which 'degree of freedom' do you think was encoded onto first component (the X-axis) encoded? In other words, what varies as you move horizontally in your manifold rendering?

Left and Right Head Position ▾ ✔ **Answer:** Left and Right Head Position

Alter your code to graph the second and third components (index=1 and 2) instead of the 0th and 1st, for both PCA and Isomap. Look *closely* at the Isomap plot. Can you tell what 'degree of freedom' the X axis represents?

Down and Up Head Position ▾ ✔ **Answer:** Down and Up Head Position

In his experiment, Dr. Tenenbaum set his K-parameter (n_neighbors is SciKit-Learn) to 8. Try reducing that figure down to 3 and re-running your code. Does the X-Axis still represent the same degree of freedom?

Yes ▾ ✔ **Answer:** Yes

EXPLANATION

To get the code up and running, add in either PCA or Randomized PCA, and then the isomap building code. The questions in this lab might seem a bit subjective, but the purpose is really to get you examining the *results* of your data. Isomap correctly encodes the non-linear relationships or degrees of freedom found in the dataset by mapping the head motions across the two axes you projected your manifold onto.

You have used 2 of 2 submissions