

ML Week 0xJ3-3 PCA

L'analyse en composantes principales (ACP)

Also known as...

- Discrete Kosambi-Karhunen-Loève transform (KLT) (signal processing)
- Hotelling transform (multivariate quality control)
- Proper orthogonal decomposition (POD) (ME)
- Singular value decomposition (SVD), Eigenvalue decomposition (EVD) (linear algebra)
- Etc.

Uses

- Exploratory data analysis
- Compression

Think of it as fitting an n -dimensional ellipsoid to the data.

- Each axis is a principle component
- Think about linear transformations as mapping basis vectors

Eigenfaces

- Sirovich and Kirby (1987)
 - searching for low-dimensional representation of face images
 - PCA to get set of basis vectors (eigenpictures)
- Turk and Pentland (1991)
 - Actually worked on computers of the time
 - PCA on face space was too expensive
 - So compute eigenvectors of a covariance matrix instead
 - Matrices sized by the number of images rather than number of pixels

- Each component represents some abstract features
- Also used in
 - handwriting recognition
 - lip reading
 - voice recognition
 - sign language/gesture interpretation
 - medical image analysis
- Advantages
 - Easy, relatively inexpensive
 - Preprocessing more expensive than recognition
 - A reasonably large database is possible
- Disadvantages
 - Sensitive to lighting, scale, translation; requires controlled environment
 - Sensitive to expression changes
 - The most significant eigenfaces (basis vectors) encode more about lighting than about the faces
 - Head-on view