PRINCIPAL COMPONENT ANALYSIS

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Principal Component Analysis (PCA)

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- PCA: Data Analysis Technique

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PCA

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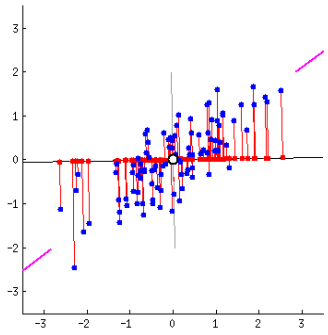
- The optimal direction: The direction of maximum variance of the projected data



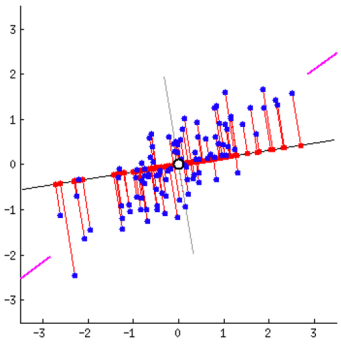
PCA

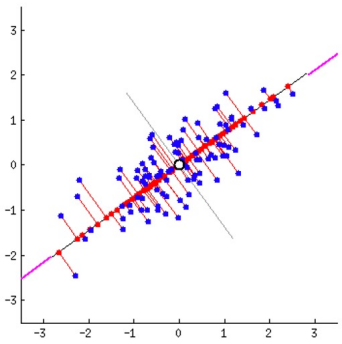
3

PCA

4

- The optimal direction: The direction of maximum variance of the projected data





PCA

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PCA

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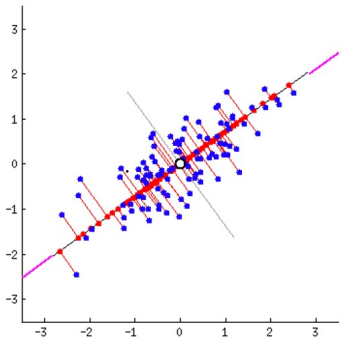
- The optimal direction: The direction of maximum variance of the projected data



Principal eigenvector of the covariance matrix of the data >> Direction of maximum variance of data

Eigenvalue determines the projection variance of the corresponding eigenvector

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PCA: Fundamental Concepts

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- Variance of a random variable fluctuating about its mean value
  - Average of the square of the fluctuations
- Covariance for a pair of random variables, each fluctuating about its mean value
  - Average of product of fluctuations
- N random variables: Covariance matrix
  - N x N symmetric matrix
  - Diagonal elements are variances of individual random variables

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PCA: Fundamental Concepts

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- Eigenvalues and eigenvectors of a square matrix A satisfy the following

$$Av_i = \lambda_i v_i$$

- Principal eigenvector
  - Eigen vector corresponding to maximal eigenvalue

Principal eigenvector of the covariance matrix of the data >> Direction of maximum variance of data

Eigenvalue determines the projection variance of the corresponding eigenvector

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PCA Example

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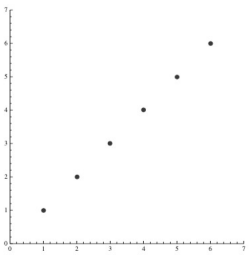
- Dataset

$$(1,1),(2,2),(3,3),(4,4),(5,5),(6,6)$$

- Covariance matrix

	Column 1	Column 2
Column 1	2.91666667	
Column 2	2.91666667	2.91666667



- Eigen values

$\lambda_1 = \frac{2917}{500}$

$\lambda_2 = 0$

- Eigen vectors

$v_1 = (1, 1)$

$v_2 = (-1, 1)$

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PCA: Applications

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- General Dimensionality Reduction
  - Feature vector
- Visualization of High-dimensional Data
  - Feature space visualization

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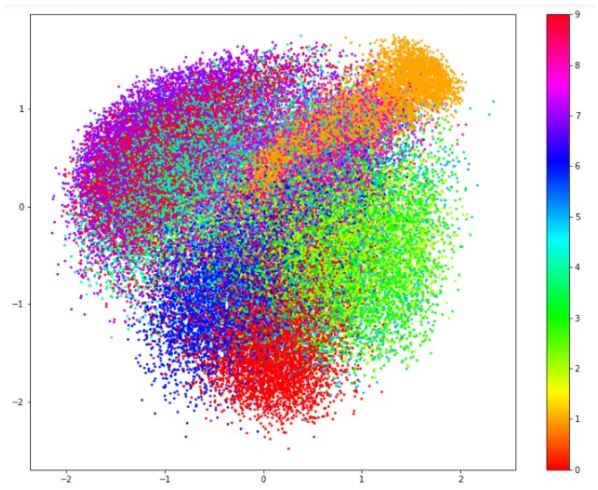
PCA for Feature Space Visualization



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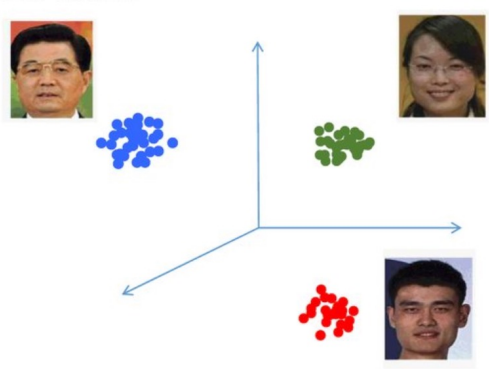
PCA for Feature Space Visualization



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Thank You!

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