Module 5

Kernel Principal Component Analysis and Multidimensional Scaling

Nonlinear Transformations

- Traditional PCA and singular value decomposition are linear transformations used for dimensionality reduction.
- Nonlinear features in data can lead to failures in dimensionality reduction when using linear PCA.

Kernel PCA

- Kernel functions can be applied to map data to a higher-dimensional space, revealing nonlinear structures.
- After mapping to a higher dimension, linear PCA can be used to reduce dimensions while preserving variance.

Manifold Learning

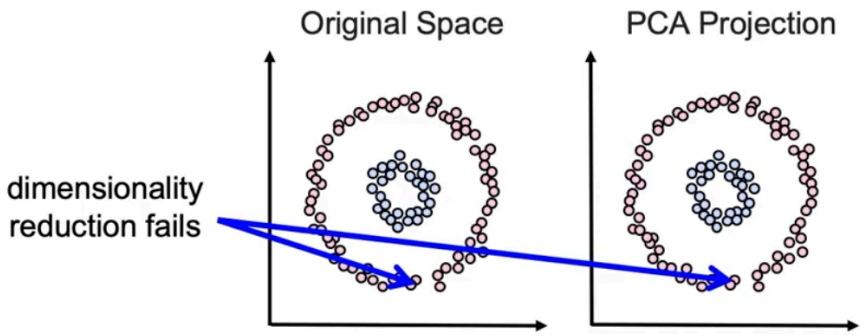
- Manifold learning methods, such as Multidimensional Scaling (MDS), focus on maintaining geometric distances rather than variance.
- Other methods like ISO map and t-SNE are also mentioned, which help in visualizing data by preserving relationships between points.

Moving Beyond Linearity

– Transformations calculated with PCA/SVD are linear.

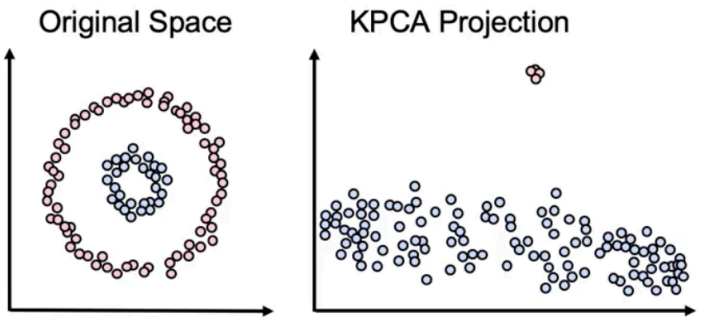
– Data can have non-linear features.

– This can cause dimensionality reduction to fail.



Kernel PCA

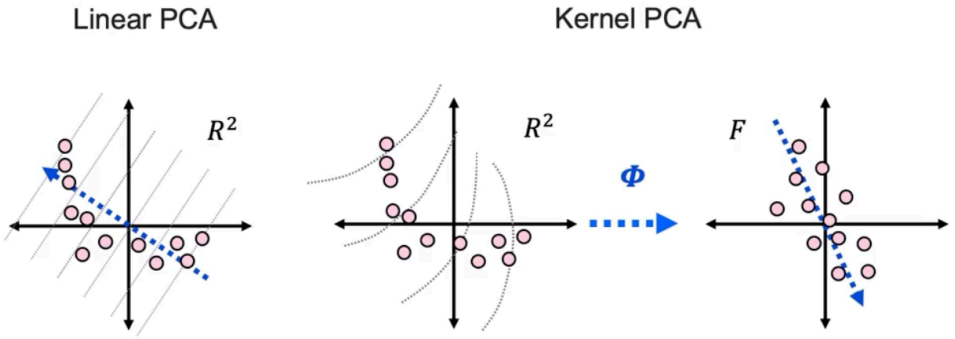
– Solution: kernels can be used to perform non-linear PCA.



Kernel PCA

– Solution: kernels can be used to perform non-linear PCA.

– For example: the kernel trick introduced for SVMs.



Multi-Dimensional Scaling (MDS)

– Non-linear transformation

– Doesn't focus on maintaining overall variance.