

# Exercise

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TUM Department of Informatics

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## Dimensionality Reduction & Clustering

**Problem 1:**

**Problem 2:**

(Linear) Autoencoder:

Input data  $X$ :  $D$ -dimensional

Hidden layer:  $K$ -dimensional

No biases, activations = identity.

This results in a linear transformation:  $f(x) = f_{dec}(f_{enc}(x)) = XW_1W_2$

With dimensions:  $X : N \times D, W_1 : D \times K, W_2 : K \times D$

With  $K < D$ ,  $XW_1$  forces  $X$  into a  $K$  dimensional subspace.

Since this transformation is not the identity ( $K < D$ ) perfect reconstruction is not achievable unless the input data  $X$  is already in a  $K$ -dimensional subspace despite being  $D$ -dimensional data.

**Problem 3:**

**Problem 4:**

**Problem 5:**

# Appendix

We confirm that the submitted solution is original work and was written by us without further assistance.  
Appropriate credit has been given where reference has been made to the work of others.

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