Authors:

- Name: Mhd Jawad Al Rahwanji - MatrikelNummer: 7038980 - Email: mhal00002@stud.uni-saarland.de
- Name: Christian Singer - MatrikelNummer: 7039059 - Email: chsi00002@stud.uni-saarland.de

Exercise 3.1 - Eigenvalue Decomposition

a) Yes, M is symmetrical. Eigenvalue decomposition is possible.

b) M is singular because det(M) = 0. One of its eigenvalues is 0.

c) Using the characteristic equation, $\det(A-\lambda I) = \lambda(\lambda(4-\lambda)-3) = 0$. After solving it we get $\lambda_1 = 0$, $\lambda_2 = 1$ and $\lambda_3 = 3$. The corresponding eigenvectors would be: $v_1 = k(1,1,1)^T$, $v_2 = (0,0,0)^T$ and $v_3 = k(1,\frac{-1}{2},1)^T$.

Exercise 3.2 - Linear Regression

a) In the case of predicting illness, Accuracy is how often the model made a correct prediction. Precision is how many of its positive predictions were ill. Recall (Sensitivity) reports how many of the ill were identified. F1 combines Precision and Recall.

   It's a trade-off. Precision is preferred to reduce false alarms. Recall is preferred in sensitive tasks. Accuracy is used with balanced class distributions and the classes are of equal importance. Whereas F1 is used in cases when the class distribution is unbalanced.

b) Elaborations:

   a) One unit change in X_1 adds 10 to Y which may cause the described effect but not at all times.
   b) The 3rd term has a very small contribution to Y due to its logarithmic nature and plus the value of the intercept. A 1 unit change wouldn't cause a 50% change in Y.
   c) One 100% change in X_2 in the range [0, 1] subtracts from Y which may cause the described effect but not at all times.
   d) A company with \$0 raised, \$1 initial stock value and \$0 debt would be valued at 1 million dollars the year after but that wouldn't make sense.