1 Basics

1.1 General questions

1. What is the difference between Classification and Regression?
2. What metrics are commonly used in classification and regression tasks? Give their mathematical derivations.
3. Consider a Machine Learning Model for the automatic detection of breast tumors. Will such a model rather optimize for Recall or Precision?
4. Define supervised and unsupervised learning.
5. What is overfitting? How can it be prevented?
6. Explain the Curse of Dimensionality.

1.2 Linear algebra

1. What is the trace of a matrix A? How is it defined?
2. What is the determinant of a matrix A? How is it defined?
3. Let $A = \begin{bmatrix} 8 & 1 & 6 \\ 3 & 5 & 7 \\ 4 & 9 & 2 \end{bmatrix}$. Compute the determinant, the trace and the rank of A.

For a square matrix $\mathbf{A}$ of size $n \times n$, a vector $\mathbf{u}_i \neq 0$ which satisfies

$$\mathbf{A}\mathbf{u}_i = \lambda_i \mathbf{u}_i$$

is called an eigenvector of $\mathbf{A}$, and λ_i is the corresponding eigenvalue. For a matrix of size $n \times n$, there are n eigenvalues λ_i (which are not necessarily distinct).

4. How are Eigenvectors and Eigenvalues defined?
5. Find the Eigenvalues of the matrix

$$B = \begin{bmatrix} -2 & -1 \\ 5 & 2 \end{bmatrix}.$$

6. Find all the Eigenvalues and Eigenvectors of the matrix $A = \begin{bmatrix} 3 & -2 \\ 6 & -4 \end{bmatrix}$.