Homework for Constraint-based Modeling of Cellular Networks
27 October 2022

Homework should be sent to Anika Küken (ankueken@uni-potsdam.de) by 3.11.2022

Homework

1. (10 points)
   Given matrix $M = \begin{bmatrix} 2 & 3 & 4 & 5 \\ 1 & 2 & 2 & 3 \\ 0 & 1 & 9 & 10 \end{bmatrix}$
   a. Write down MATLAB code including the elementary row operations that put the matrix in reduced row echelon form.
   b. What is the rank of the matrix? How can you read the information from the reduced row echelon form of matrix M?
   c. Use the reduced row echelon form of matrix M to solve $Mx = 0$. Write down the general solution vector! How many variables are free? What is the number of constraints?
   d. Does system $Mx = 0$ have a unique solution?
   e. Check if vectors $x_1 = [2 \; -1 \; -1 \; 1]^T$ and $x_2 = [2 \; -2 \; -2 \; 2]^T$ are in the null space of M. Are vectors x_1 and x_2 linearly dependent?

2. (5 points)
   Given subspace *W*, spanned by the vectors V={[1 2 3]^T,[0 2 1]^T,[1 1 1]^T}
   a. Is vector $b = [4 \; 3 \; 1]^T$ in subspace *W*?
   b. Is *V* a basis for subspace *W*?
   c. Form a matrix A, with its columns corresponding to the vectors in V, and then use appropriate MATLAB functions to confirm that the equation dim($col(A)$)+dim($N(A)$)=$number\ of\ columns\ in\ A$ holds for this matrix. (hint: dim($col(A)$) is equal to the number of pivots in the reduced echelon form of the matrix)