# 2023-August-Mathematics of Network Algorithms

## Assignment 1

- Deadline: 5 pm on $11^{th}$ August, 2023. Please drop the assignment at A-405.
- Please submit the assignment only on A4 sheets with your name and roll number.
- Total Marks for the assignment: 30 ( x pts for presentation, where $x \in \{0, 1, 2, 3, 4\}$, will be added if you score at least 10 pts in the following questions.)

1. ( 5 pts) Define the following terms (and every term used to define them) with an illustrative example:
   - (a) Linear dependence and span of vectors
   - (b) Norm of a vector
   - (c) Eigenvalue, eigenvector and eigendecomposition
   - (d) Random variables
   - (e) Frequentist probability and Bayesian probability

2. ( 5 pts) Write a $3 \times 3$ matrix $\mathbf{A}$ that is *not* identity, nor symmetric nor orthogonal. Also, write $\mathbf{A} \times \mathbf{A}$ and its transpose, inverse, determinant, eigenvalues, and eigenvectors.

3. ( 3 pts) Write a (non-trivial) system of linear equations with at least 4 variables and 5 constraints both in equation form and matrix form.

4. ( 3 pts) Prove that $\ell_1$, $\ell_2$, and $\ell_\infty$ norm satisfies the properties mentioned while answering 1 (b).

5. ( 5 pts) Define the following distributions:
   - (a) Bernoulli Distribution
   - (b) Gaussian Distribution
   - (c) Laplace Distributions
   - (d) Multinoulli Distribution
   - (e) Uniform Distribution

6. ( 5 pts) Select your favourite distribution and derive expressions for its (i) expectation, (ii) variance, and (iii) standard deviation.