# Assignment 3

September 18, 2023

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**Q. 1** Define a `vector` class that contains a pointer for the entries, an integer for the size of the vector and one, two and maximum norm functions. Overload the following operators appropriately:

(a) the "+" operator;

(b) the "-" operator;

(c) the "*" operator with vector multiplication;

(d) overload the operator "[ ]” to access array elements;

(e) how would you achieve scalar multiplication?

Test your definitions on a few simple vectors.

**Q. 2** Define a `matrix` class that contains a double pointer for the entries, two integers for the dimension (numbers of rows and columns) of the matrix and one, maximum and the Frobenius norm functions. Overload the following operators appropriately:

(a) the "+" operator;

(b) the "-" operator;

(c) the "*" operator with matrix multiplication.

Test your definitions on a few simple matrices.

**Q. 3** A numerical quadrature has the general form:

$$\int_a^b f(x)dx = \sum_{i=0}^{n-1} w_i f(x_i)$$

where $x_i$ are called quadrature points and $w_i$ are called weights. In a Gauss quadrature, $x_i$ and $w_i$ are chosen such that the quadrature is exact if $f(x)$ is a polynomial of degree $k$, for $k$ as big as possible. Such $x_i$ are called Gauss points and such $k$ is called the degree of exactness. It can be shown that the degree of exactness of a Gauss quadrature is $2n-1$, where $n$ is the number of Gauss points. An example of a Gauss quadrature is:

$$\int_{-1}^1 f(x)dx = \frac{8}{9}f(0) + \frac{5}{9}f\left(-\sqrt{\frac{3}{5}}\right) + \frac{5}{9}f\left(\sqrt{\frac{3}{5}}\right).$$

Implement this Gauss quadrature as a class with Gauss points and weights as private members. Check that this quadrature is exact when the integrand $f(x)$ is a polynomial of degree less than or equal to 5.