# Numerical Analysis

## <Home Assignment #3>

**(Deadline: June 13, 2025)**

**Problem 1**. The following data were gathered to determine the relationship between pressure and temperature of nitrogen.

| $T,\ °C$ | -40 | 0 | 40 | 80 | 120 | 160 |
|---|---|---|---|---|---|---|
| $p, N/m^2$ | 6990 | 8100 | 9350 | 10500 | 11700 | 12800 |

Use **least-squares regression** to fit a straight line to the data in the table above. Employ the equation $p = \alpha T + \beta$ to determine $\alpha$ and $\beta$ on the basis of these data.

**Problem 2.** The force on a sailboat mast can be represented by the following function:

$$F = \int_0^H 200\left(\frac{z}{5+z}\right)e^{-z^2/H}dz \qquad (\mathbf{1})$$

where $z$ = the elevation above the deck and $H$ = the height of the mast. Compute $F$ for the case where $H = 30$ using the methods below.

a) The composite trapezoidal rule ($n = 2$).

b) The composite Simpson's 1/3 rule ($n = 2$).

c) The two-point Gauss-Legendre formula.

**Problem 3.** Solve the following initial value problem over the interval from t = 0 where y(0) = 1. Display all your results on the same graph.

$$\frac{dy}{dt} = yt^2 - 1.1y$$

a) Analytically.

b) Using Euler's method with $h = 0.5$.

c) Using the midpoint method with $h = 0.5$.

d) Using the fourth-order RK method with $h = 0.5$.