Assignment 8

A. Write a MATLAB script with the name Assignment8A_Groupxx.m[1] that solves the following problem. Use local functions or nested functions if required.

The differential equation $y' = y^2 - y^3$ is stiff[2] for small $y(0)$. Use the solvers ode23 and ode23s to compute the solution with initial condition $y(0) = \delta$ in the time interval $0 \le t \le 2/\delta$, for $\delta = 10^{-3}, 10^{-4}, 10^{-5}$. Use the options set by

```
opts = odeset('RelTol',1.e-5,'stats','on');
```

Plot the solutions and compare the number of function evaluations and running time of the two solvers. Plot also the exact solution given by

$$y(t) = \frac{1}{1 + W(k * \exp(k - t))},$$

where $k = (1 - \delta)/\delta$ and W is Lambert's W-function (function lambertw).

B. Write a MATLAB script with the name Assignment8B_Groupxx.m[1] that solves the following problem. Use local functions or nested functions if required.

Find two eigenvalues λ_i and the corresponding eigenfunctions $y_i(x)$ of the non-linear differential equation

$$y'' + \lambda\, x\, y(1 - y) = 0$$

such that $y_i(0) = y_i(1) = 0,\ y_i'(0) = 0.1$, for $i = 1, 2$. Plot the eigenfunctions.

Hint: Initialize the solution with $y = \sin(\pi x)$ and λ with 10 and 100.

☛ Pack both scripts in a zip file with the name Assignment08_Groupxx.zip. Please submit in time!

[1] xx is your group number

[2] see https://en.wikipedia.org/wiki/Stiff_equation