Instructions

For the LAB project, follow the following guidelines:

(1) **MATLAB codes**:

i. The MATLAB codes must include four separate scripts including three MATLAB functions and one solver. Functions include the Euler method, Runge-Kutta (RK) method, and exact solution.
ii. Use RK_method, Euler_method, and Exact_method as function names and Solver_IVP as the solver name. The function inputs are the ODE, step size, initial condition, etc and the outputs are the approximate or exact values of solutions.
iii. In the solver, you pass input variables to functions and call appropriate functions to solve the given IVP. Then, it calculates the absolute error of approximate values obtained from each method and sketches the three solution curves obtained from Euler, RK, and exact methods in the same graph.

(2) Report:

i. The first page is the cover page including the title, your name, course number, etc.
ii. The final project report includes descriptions for problem 1, six tables (three tables for Euler methods and three for RK methods) for problems 2 and 3, and one figure for problem 4.
iii. Appendices: At the end of the report, copy and paste your MATLAB codes as four appendices: Appendix 1: Euler_method, Appendix 2: RK_method, Appendix 3: Exact method, and Appendix 4: Solver IVP

(3) Submission:

i. Zip your files including four MATLAB files (RK_method.m, Euler_method.m, Exact_method.m, and Solver_IVP.m) and one PDF file of the report (Report.pdf) into a single folder with the format of *MostafaBadroddinLab.zip and* upload it on Canvas.
ii. Due: Sunday, May 01, 2022, at 11:59 pm.

PROBLEMS

Problem 1. Review Chapter 8, Sections 8.1 and 8.3 of the textbook. Summarize the Euler and Runge-Kutta methods.

Problem 2. The IVP $y' = 3 - 2t - \frac{1}{2}y$, $y(0) = 1$ is given in interval [0 , 1.0]:

(a). Find the approximate values of the solution of the given IVP at t = 0.2, 0.4, 0.6, 0.8, and 1.0 using the Euler method with the step size h= 0.05, 0.1, and 0.025.
(b). Find the exact solution using MATLAB built-in functions (e.g., *dsolve*).

(c). Compare the approximate values with those obtained by the exact solution and find the absolute errors.

Note: In your final report, for each step size, a separate table must be used to present the approximated and exact solutions and absolute error. A sample table has been provided below. Round numbers to four decimal places.

Table 1. Approximated and exact solutions using the Euler method with h=0.1

t	Approximated solution	Exact solution	Absolute error
0.2			
0.4			
0.6			
0.8			
1.0			

Problem 3. Repeat (a) and (c) in problem 2 using the Runge-Kutta (RK) method.

Problem 4. Compare the results obtained from the Euler method with the RK method (i.e., using the absolute error). Sketch the approximate values and exact values of solutions obtained from Problems 2 and 3 in the same figure (i.e., three curves).