NUMERICAL ANALYSIS I

Euler Method

April 25 - 27, 2023

Instructions:

- *When you have finished the exercises, prepare the command line and show me the associated programs.*
- *The exercises must be carried out under Matlab or Gnu Octave (https://octave.org/download).*
- *The work must be individual.* ***You must bring your personal computer fully charged.***
- ***It is your responsibility to install Matlab or Gnu Octave there.*** *Octave is a free open-source alternative to MATLAB; It works under GNU/Linux, macOS and Microsoft Windows.*
- *Create an easily accessible folder that will store all your files from this course. I would suggest calling it "MATH319". In the folder created above, create a first sub-folder and call it "LectureCodes".*
- *Download the MATLAB/OCTAVE script* `myeuler.m` *from the Blackboard. Go to Course Contents, click on "Computer-Based Exercises" then download* `myeuler.m`*. Make sure the file name remains* `myeuler.m` *with no spaces or parentheses. If your machine added extra characters to the file name (e.g.* `myeuler,(1).m`*) after saving the file, you must change the name without spaces or parentheses before opening or running the file in MATLAB/OCTAVE.*

Exercise 1
Consider the initial value problem

$$\frac{dy}{dt} = f(t, y(t)), \quad y(0) = y_0, \quad t \in [0, T]. \tag{1}$$

1. Use the Matlab Tutorial and Help to understand and succinctly summarize what the features of "tspan" and "odefun" are.
2. Complete the following program using "tspan" and "odefun" to solve the initial value problem (1).
3. Use the code to solve:
$$\frac{dy}{dt} = \cos(2y(t)), \quad y(0) = 0, \quad t \in [0, 1].$$

```
function [t,u]=myeuler(odefun,tspan,y0,Nh)
% ======
% STUDENT:
% ID:
% MY COMMAND LINE TO RUN THE CODE:
%
%
% ======
% MYEULER Solves differential equations using the forward Euler method.
%  [T,Y]=FEULER(ODEFUN,TSPAN,Y0,NH) with TSPAN=[T0,TF]
%  integrates the system of differential equations
%  y'=f(t,y) from time T0 to TF with initial condition
%  Y0 using the forward Euler method on an equispaced grid of NH intervals.
%  Function ODEFUN(T,Y) must return a vector, whose elements hold the evaluation of f(t,y), of the same
    dimension of Y.
%  Each row in the solution array Y corresponds to a time returned in the column vector T.
%  [T,Y] = MYEULER(ODEFUN,TSPAN,Y0,NH,P1,P2,...) passes the additional parameters P1,P2,... to the
    function
%  ODEFUN as ODEFUN(T,Y,P1,P2...).

h=(tspan("...") "...")/Nh;
y=y0(:); % always creates a column vector
w=y;
% ...
tt=linspace( "..." );
for t = tt(1: "..." )
 w= "..."
 "..."
end
t=tt';
return
```