

# Numerical Methods - Assignment 14

Due Thursday, Nov 28

Write a Matlab function

```
heun( f , a , b , yzero , N )
```

which receives a function of two variables  $f(x, y)$ , two reals  $a < b$ , a real  $yzero$  and an integer  $N > 0$ , and returns a vector  $u = [u_0, \dots, u_N]$ . Here the vector  $[x_0, \dots, x_N]$  is the regular subdivision with  $N$  steps of the interval  $[a, b]$ , the function  $y$  is the solution on  $[a, b]$  of the equation  $y' = f(x, y)$  with initial value  $y(0) = yzero$ , the vector  $[y_0, \dots, y_N]$  contains the values of  $y$  at  $x_0, \dots, x_N$ , and the vector  $u$  contains the approximation of these values obtained by the improved Euler method.

Test your function with the equation  $y' = -2xy^2$ , on the interval  $[0, 10]$ , with initial value  $y_0 = 1$  and various values of  $N$ . Draw a graph to compare the various results you obtain with the actual solution of this differential equation.

It would also be interesting (although not required) to slightly modify your function to implement the forward Euler method, and compare the speed of convergence.