PHY1112 Lab 10

Differential Diagnosis

March 19th, 2024

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| Part | 1 | 2 | Total |
| Points | 10 | 10 | 20 |
| Score |  |  |  |

Objectives

1. Write an implementation of Euler’s method in Python with numpy.
2. Validate your Euler’s method function by applying it to a differential equation for a case where the analytical function is known.

Part 1: Write an Euler method function

* 1. (10 points) Write a Python function eulers\_method()that solves a single first order ordinary differential equation of the form

by the Euler method, that is,

The inputs would be:

* a function handle for (that itself takes in two inputs)
* the starting point a,
* the end point b,
* the initial condition y(a), and
* the number of points to calculate after the initial condition,

The outputs would be

* a 1D NumPy array containing x (of size N+1)
* a 1D NumPy array containing y (of size N+1)

Part 2: Validate your Euler method function

* 1. (10 points) Consider the differential equation

1. Use your function from question 1 to calculate from to , with , for Choose
2. For each value, plot your results for along with the analytical solution.
3. Plot versus , as well as the analytical solution. What is the converged value? Comment on the error.

A graph with numbers and a red dotted line

Description automatically generated

**Figure 2.** A plot of y(3) with respect to n. y(3) obtained numerically with n of size 10, 100, and 1000 are represented by red markers, while the analytical solution is represented by a dashed red line.

It would appear that the error gets bigger as n increases (which leads me to believe I did something wrong), and the converged value is 0.011 roughly.