INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY
THIRUVANANTHAPURAM 695 547

First Year B. Tech. - Assignment Sheet
MA122-Computer Programming and Applications

10.03.2017 **Maximum Marks: 10** **Assignment Sheet 9**

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a. Consider a first order ordinary differential equation

$$\frac{dy}{dx} = f(x, y) \tag{1}$$

with the initial condition

$$y(x_0) = y_0. \tag{2}$$

Construct a system of equally spaced points $x_i = x_0 + i\,h$, where $i = 0, 1, 2, \ldots N$ and h is a sufficiently small interval in x. In Euler's first improved method approximate values of $y(x_i) \approx y_i$ are computed successively by the formula

$$y_{i+1} = y_i + h f_{i+1/2}, \tag{3}$$

where

$$\begin{aligned} x_{i+1/2} &= x_i + \frac{h}{2}, \\ y_{i+1/2} &= y_i + \frac{h}{2} f_i, \\ f_i &= f(x_i, y_i), \\ f_{i+1/2} &= f(x_{i+1/2}, y_{i+1/2}). \end{aligned}$$

Implement the above method for solving first order differential equations. Use the following function:

```
double euler(double (*pf)(double x, double y), double x_0,double y0,double h)
```

Here, `pf` points to a function f that defines the finction $f(x, y)$ in Eq. (1), $y0$ is the initial condition given in Eq. (2) and h is the interval. The function `euler` returns $y(x0 + h)$ (See Eq. (3)). Ask the user to enter x_0, x_{max} and h, where $x_{max} = x_0 + Nh$. Submit your program for the function $f = \exp(x)$.

Program submission:

Name the programs as XXXA9Y.cpp, where XXX is the last three digits of your student id and Y is program number. For example, if the student id is 'sc17b150' and your program number is 'a' then the file name should be 150A9a.cpp. Submit the programs using ftp to the server: 172.20.2.200