DEPARTMENT OF MATHEMATICS, I.I.T. GUWAHATI

MA 322: Scientific Computing Lab - 10

1. Use the forward-difference formulas and backward-difference formulas to determine each missing entry in the following tables.

(a).

x	$f(x)$	$f'(x)$
0.5	0.4794	
0.6	0.5646	
0.7	0.6442	

(b).

x	$f(x)$	$f'(x)$
1.0	1.0000	
1.2	1.2625	
1.4	1.6595	

2. The data in Exercise 1 were taken from the following functions. Compute the actual errors in Exercise 1, and find error bounds using the error formulas.
(a). $f(x) = \sin x$, (b). $f(x) = x^2 \ln x + 1$.

3. In a circuit with impressed voltage $\mathcal{E}(t)$ and inductance L, Kirchhoff's first law gives the relationship

$$\mathcal{E}(t) = L\frac{di}{dt} + Ri,$$

where R is the resistance in the circuit and i is the current. Suppose we measure the current for several values of t and obtain:

t	1.00	1.01	1.02	1.03	1.0
i	3.10	3.12	3.14	3.18	3.24

where t is measured in seconds, i is in amperes, the inductance L is a constant 0.98 henries, and the resistance is 0.142 ohms. Approximate the voltage $\mathcal{E}(t)$ when $t = 1.00, 1.01, 1.02, 1.03,$ and 1.04.

4. Use Explicit-Euler's method to approximate the solutions for each of the following initial-value problems.

(a) $y' = 1 + y/t$, $1 \le t \le 2$, $y(1) = 2$ with $h = 0.25$,

(b) $y' = \cos 2t + \sin 3t$, $0 \le t \le 1$, $y(0) = 1$ with $h = 0.25$,

(c) $y' = -y + ty^{1/2}$, $2 \le t \le 3$, $y(2) = 2$ with $h = 0.25$,

5. Given the initial-value problem

$$y' = -y + t + 1,\ 0 \le t \le 5,\ y(0) = 1,$$

which has solution $y(t) = e^{-t} + t$. Approximate $y(5)$ using Explicit-Euler's method with $h = 0.2, h = 0.1,$ and $h = 0.05$.