Experiment Name : Runge Kutta's Method for ordinary differential equations.

Experiment Objectives : Runge Kutta's Iterative Rule is a numerical method which we used for solving ordinary differential equations.

Theory : The Runge Kutta's iterative method is a method of numerically integrating ordinary differential equations by using a trial step at midpoint of an interval to cancel out lower order error terms. It is used to generate a numerical solution to an initial value problem of the form,

$$y' = f(x, y)$$

Where $y(x_0) = y_0$

So the Runge Kutta's iterative method can be written as,

$$m1 = f(x_i, y_i)$$

$$m2 = f(x_i + \frac{h}{2}, y_i + \frac{m1*h}{2})$$

$$m3 = f(x_i + \frac{h}{2}, y_i + \frac{m2*h}{2})$$

$$m4 = f(x_i + h, y_i + m3 * h)$$

$$y_{i+1} = y_i + h * \left(\frac{m1+2m2+2m3+m4}{6}\right)$$

Program Code :

```
% Runge Kutta method

h = input('Enter the step size: ');
x = 1:h:2;
y = zeros(size(x));
y(1) = 2;
n = numel(y);
h1 = h/2;
for i = 1:n-1
   m1 = (2*y(i))/x(i);
   m2 = ((2*(y(i)+m1*h1)))/(x(i)+h1);
```

```
   m3 = ((2*(y(i)+m2*h1)))/(x(i)+h1);
   m4 =((2*(y(i)+m1*h)))/(x(i)+h) ;
   y(i+1) = y(i)+(((m1+(2*m2)+(2*m3)+m4)/6)*h);
end
y(i+1)
```

Output :

```
>> rungekutta
Enter the step size: 0.25

ans =

    7.9486
```

Discussion : In this experiment, we have experimented the Runge Kutta's iterative method which is a numerical method for solving ordinary differential equation. The results of the experiment were accurate and there were no errors while doing the experimental calculations. We also came to the conclusions that, the values we got by using Runge Kutta's method are more efficient than the normal method and less efficient than Euler , Heun and Polygon's method for solving ordinary differential equations.

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