Maple Tutorial Practice Question

The Midpoint method, like Euler's method, is a method of approximating a differential equation. It works in a similar way as Euler's method, but improves Euler's method by adding a midpoint in the step. Another name for this method is the improved Euler's method.

For a differential equation

$$\frac{dy}{dx} = f(x, y), \;\; y(x_0) = y_0, \;\; \Delta x = h = \text{ stepsize}$$

the approximations are given by the formula:

$$y_{n+1} = y_n + f\left(x_n + \frac{h}{2}, y_n + \frac{h}{2} f(x_n, y_n)\right) h$$

Use the above midpoint method to create a procedure in Maple to approximate a solution to

$$\frac{dy}{dx} = y, \;\; y(0) = 1$$

with stepsize $\Delta x = 0.1$.

You may want to set up your x values first, using a `for` loop:

```
x[i]=x[i-1]+h
```

To implement this, you may want to have two steps within another `for` loop.

```
k:=(h/2)*f(x[i],y[i])
y[i]:=y[i-1]+h*f(x[i-1]+(h/2),y[i-1] + k)
```

You can hardcode in the particular example. That is, you do not need to make it for a general function f. You can verify your answers by plotting the results along with the exact solution of the differential equations.