Practical:8 Euler methods for solving first order initial value problems of ODE's.

In this practical, we will use Euler's method to solve ode dy/dx=f(x,y)with
initial condition y=y_0 at x=x_0. We find the approximate value of y(x_n)=y_n, where
x_n=x_0+nh and h is the step size.
The general formula is y_(i+1)=y_i+f(x_i,y_i)h.
y_1=y(x_1)= y_0+f(x_0,y_0)h
y_2=y(x_2)= y_1+f(x_1,y_1)h
y_3=y(x_3)= y_2+f(x_2,y_2)h
y_4=y(x_4)= y_3+f(x_3,y_3)h..................

0.1 Question : Consider the IVP dy/dx=(x^2)+y with y(0)=1. Find the approximated value of y at 0.4 or y(0.4) with step size 0.1.

Solution: The number of iterations n =4
x0=0, h=0.1
x1=x0+h=0+0.1=0.1
x2=x0+2h=0+0.2=0.2,x2=x1+h
x3=x0+3h=0+0.3=0.3
x4=x0+4h=0+0.4=0.4
We need to find y(x4).

```
(%i9) kill(all)$
      f(x,y):=x^2+y;
      x0:0;
      y0:1;
      xn:0.4;
      n:4;
      h:0.1;
      print("         ","x0","    ","y0","    ","f(x0, y0)","
          ","y[i]")$;
      for i:1 thru n do(
          slope:f(x0,y0),
          y[i]:y0+h·slope,
          print(i," iteration"),
          print("         ", x0,"    ",y0,"      ",slope,"
                 ",y[i]),
          y0:y[i],
          x0:x0+h);
      print("The approximation y(0.4)=", y[n])$;
```

(%o1) $f(x,y):=x^{2}+y$

(%o2) 0

(%o3) 1

(%o4) 0.4

(%o5) 4

(%o6) 0.1

```
         x0       y0       f(x0, y0)            y[i]
1   iteration
         0        1          1                  1.1
2   iteration
         0.1        1.1          1.11                 1.211
3   iteration
         0.2        1.211          1.251
1.3361
4   iteration
         0.3        1.3361          1.4261
1.47871
```

(%o8) done

The approximation y(0.4)= 1.47871