**HEUN’S METHOD**

**#RK Method (2ND order or Heun'S method)**

**import matplotlib.pyplot as plt**

**[xo,xn,yo,h]=[0,4,1,0.5]**

**n=(xn-xo)/h**

**#f(x.y)=dy/dx (i.e derivative/slope of original; function)**

**print("HEUN METHOD")**

**def f1(x,y):**

**return -2\*(x)\*\*3+12\*(x)\*\*2-20\*(x)+8.5**

**#f(x,y)=y(i.e integral of f1 which is original function)**

**def f2(x,y):**

**return (-0.5\*x\*\*4+4\*x\*\*3-10\*x\*\*2+8.5\*x+1)**

**print("xi \t yi \t k1 \t xi+h \t yi+1 \t y(true)")**

**print("==================================================================")**

**a=[]**

**b=[]**

**c=[]**

**for i in range(0,int(n)+1):**

**yi\_heun=yo+((1/2)\*(f1(xo,yo)+(f1(xo+h,yo+(h\*f1(xo,yo))))))\*h**

**print(round(xo,4), ' \t', round(yo,4), '\t',round(f1(xo,yo),4), '\t', round(xo+h,4), '\t',round(yi\_heun,4), '\t',round(f2(xo,yo),4))**

**a.append(round(xo,2))**

**b.append(round(yo,2))**

**c.append(f2(xo,yo))**

**xo=xo+h**

**yo=yi\_heun**

**print("\_\_\_\_\_\_\_\_\_")**

**print("x=",a,"\ny(euler)=",b,"\ny(true)=",c)**

**plt.plot(a,b,label = "y(euler)=dy/dx")**

**plt.plot(a,c,label = "y(true)=y")**

**plt.title('EULER\'S METHOD')**

**plt.xlabel('x')**

**plt.ylabel('f(x,y)')**

**plt.legend()**

**OUTPUT**

**HEUN METHOD**

**xi yi k1 xi+h yi+1 y(true)**

**==================================================================**

**0 1 8.5 0.5 3.4375 1.0**

**0.5 3.4375 1.25 1.0 3.375 3.2188**

**1.0 3.375 -1.5 1.5 2.6875 3.0**

**1.5 2.6875 -1.25 2.0 2.5 2.2188**

**2.0 2.5 0.5 2.5 3.1875 2.0**

**2.5 3.1875 2.25 3.0 4.375 2.7188**

**3.0 4.375 2.5 3.5 4.9375 4.0**

**3.5 4.9375 -0.25 4.0 3.0 4.7188**

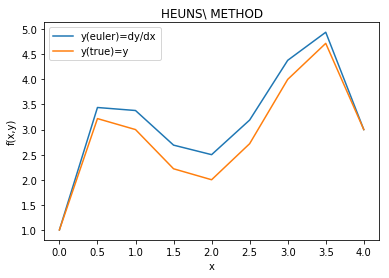
**4.0 3.0 -7.5 4.5 -4.0625 3.0**

**\_\_\_\_\_\_\_\_\_**

**x= [0, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0]**

**y(euler)= [1, 3.44, 3.38, 2.69, 2.5, 3.19, 4.38, 4.94, 3.0]**

**y(true)= [1.0, 3.21875, 3.0, 2.21875, 2.0, 2.71875, 4.0, 4.71875, 3.0]**

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