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$$y''(t) + \sin(y(t)) = 0, \quad y(0) = 1, \quad y'(0) = 0$$

$$y_1 = y, \quad y_2 = y' \longrightarrow y_2' = y_1', \quad y_1' = y_2$$

$$y_2'(t) = -\sin(y(t))$$

$$y_1' = y_2$$

$$y_2'(t) = -\sin(y(t)) = f(y)$$

$$k_1 = f(u_0) = f(y(0)) = -\sin(u_0)$$

$$k_2 = f(u_0 + \frac{h}{2}k_1) = -\sin(u_0 - \frac{h}{2}\sin(u_0))$$

$$k_3 = f(u_0 + \frac{h}{2}k_2) = -\sin(u_0 - \frac{h}{2}\sin(u_0 - \frac{h}{2}\sin(u_0)))$$

$$k_4 = f(u_0 + hk_3) = -\sin(u_0 - h\sin(u_0 - \frac{h}{2}\sin(u_0 - \frac{h}{2}\sin(u_0))))$$

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$$u_{n+1} = u_n + \frac{h}{6}(k_1 + 2k_2 + 2k_3 + k_4)$$

$$u_1 = u_0 + \frac{h}{6}(-\sin(u_0) - 2\sin(u_0 - \frac{h}{2}\sin(u_0)) - \dots$$

$$- 2\sin(u_0 - \frac{h}{2}(\sin(u_0 - \frac{h}{2}(\sin(u_0)))) - \dots$$

$$- 2\sin(u_0 - \frac{h}{2}(\sin(u_0 - \frac{h}{2}\sin(u_0 - \frac{h}{2}\sin(u_0)))) - \dots$$

$$- \sin(u_0 - \frac{h}{2}\sin(u_0 - \frac{h}{2}\sin(u_0 - \frac{h}{2}\sin(u_0))))$$

$$= 0$$

$$y'(1) \approx u_{n+1}(1) \approx 0.94956$$

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$$y'_1 = y'_2$$

$$k_1 = u^r$$

$$k_2 = \left(1 + \frac{h}{2}\right) u^r$$

$$k_3 = \left(1 + \frac{h}{2} + \frac{h^2}{4}\right) u^r$$

$$k_4 = \left(1 + h + \frac{h^2}{2} + \frac{h^3}{4}\right) u^r$$

$$u_{n+1} = \left(1 + h + \frac{h^2}{2} + \frac{h^3}{6} + \frac{h^4}{24}\right) u^r$$

$$y(1) \approx u_{n+1}(1) \approx 1.64844$$

%y2

%Matt Zeller

%PHYS 428

%12/5/2018

%u2 is solution to $y'(t)$, v2 is solution to $y(t)$

function y2(u1,v1)

format long

u2=u1+(0.5/6)*((-sin(u1)) - 2*(sin(u1 - 2*(sin(u1)))) - 2*(sin(u1 - 2*((✓
sin(u1 - 2*sin(u1)))))) - ((sin(u1 - 2*(sin(u1 - 2*(sin(u1 - 2*sin(u1))))))))

v2=v1*((0.5^4)/24+(0.5^3)/6+(0.5^2)/2+0.5+1)

end

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>> y2(1,1)
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u2 =
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0.949559376650841
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v2 =
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1.648437500000000
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