LO1 ODEs

Monday, August 17, 2020 11:19

ODE's: order of equation, degrees of freedom, initial conditions

Reduction of nth order to n 1st order equations

1. Leapfrog technique, illustration in Excel
2. Linear interpolation, lookup in Excel

$y(x) \qquad y'' + y' = x$

$y'' = F(x, y, y') = -y' + x$

$y_0 = y(x) \qquad y_0'(x, y_0, y_1) = y_1$

$y_1 = y'(x) \qquad y_1'(x, y_0, y_1) = F(x, y, y')$

$F = ma \qquad x(t) \xrightarrow{d/dt} v(t) \xrightarrow{d/dt} a(t)$

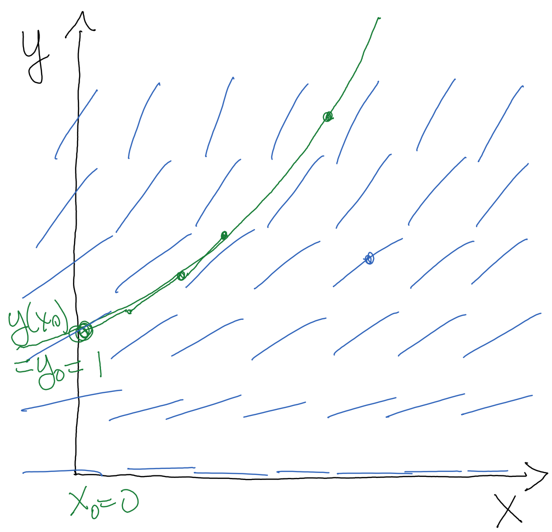
$\ddot{x}(t) = a = F(t, x, v)/m.$

$x(t)$

$v(t) = \dot{x}(t)$

$\dot{x} = v$

$\dot{v} = a = F(t, x, v)/m$



$y' = F(x, y).$

$= y$

$\frac{dy}{dx} = y$

$dy = y\,dx$

$\int_{y_0}^{y} \frac{dy}{y} = \int_{x_0}^{x} dx$

$\ln y = x + C$

$y = e^x$

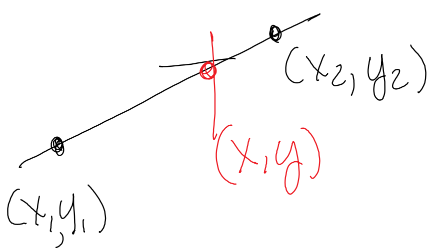
$\Delta y = y \, \Delta x$

$y_{n+1} - y_n = y \, \Delta x$

$y_{n+1} = y_n + y \, \Delta x.$

$x_0 \quad x_1 \quad \ldots$

$y = y_0 \quad y_1 \ldots$



$$\frac{y - y_1}{x - x_1} = m = \frac{y_2 - y_1}{x_2 - x_1}$$

$$y = \frac{x_2 - x_1}{x_2 - x_1} y_1 + \frac{x - x_1}{x_2 - x_1}(y_2 - y_1)$$

$$= \frac{x_2 - x}{x_2 - x_1} y_1 + \frac{x - x_1}{x_2 - x_1} y_2$$

$$x = \frac{y_2 - y}{y_2 - y_1} x_1 + \frac{y - y_1}{y_2 - y_1} x_2$$