**Topic:** Ordinary Differential Equations
**Read:** Ch 22: 22.1, 22.2, 22.5; Chapter 23: 23.1.1
Include a plot with every problem unless otherwise instructed. Each step should be represented with a marker, connected by a solid line. Place a title and label the axes

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**Handwork problems:**

**HW12_1** Solve the following initial value problem to find *y*(2).

$$\frac{dy}{dt} = yt^2 - 1.1y, \qquad y(0) = 1$$

using midpoint method with h=0.5

**HW12_2**The *van der Pol* equation is a model of an electronic circuit that arose back in the days of vacuum tubes:

$$\frac{d^2y}{dt^2} - (1 - y^2)\frac{dy}{dt} + y = 0$$

Given the initial conditions $y(0) = y'(0) = 1$, solve this equation from $t = 0$ to 1 using Euler's method with a step size of 0.25.

**Coding problems:**

**HW12_3:** Solve the ODE from 12_1 above with a MATLAB code implementing both Euler's method and midpoint method with a step size of 0.1. Also display the results from both methods on the same plot along with the analytical result

$$y(t) = e^{(t^3 - 3.3t)/3}$$

Use proper legend with your plot.

**HW12_4:** Solve the system of nonlinear equations over the interval $0 \le t \le 0.03$ using `ode45`. Display the results on the same graph. Include a legend. $x(0)=3,\ y(0)=2,\ z(0)=1$

$$\frac{dx}{dt} = -x^4 + yt$$

$$\frac{dy}{dt} = -x + (y + y^4) + z^4$$

$$\frac{dz}{dt} = (y + y^4) + z^4 + t$$