

## Mechanical oscillator with weak damping

- Governing (linear) ODE:

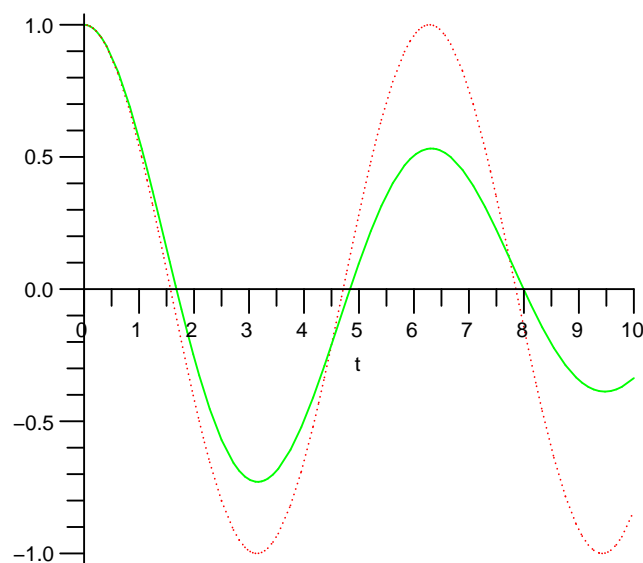
$$\ddot{x} + \epsilon \dot{x} + x = 0$$

subject to the initial conditions

$$x(t = 0) = 1 \quad \text{and} \quad \dot{x}(t = 0) = 0.$$

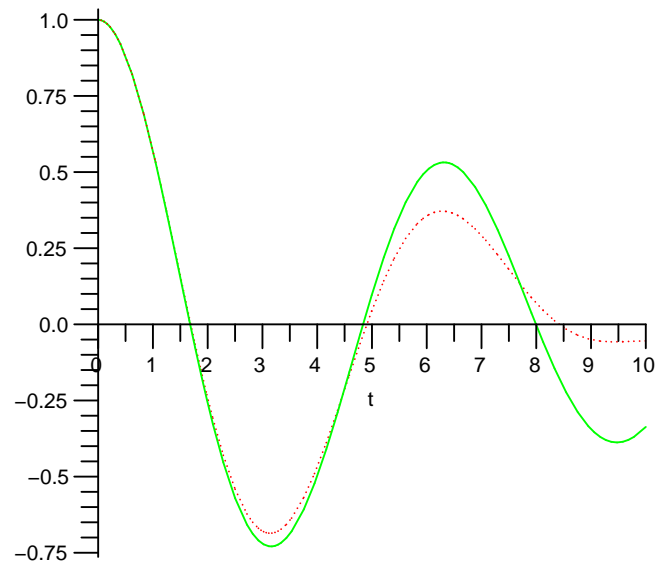
### Comparison between perturbation solution and exact solution for $\epsilon = 0.2$

- One-term perturbation solution (red), exact solution (green):

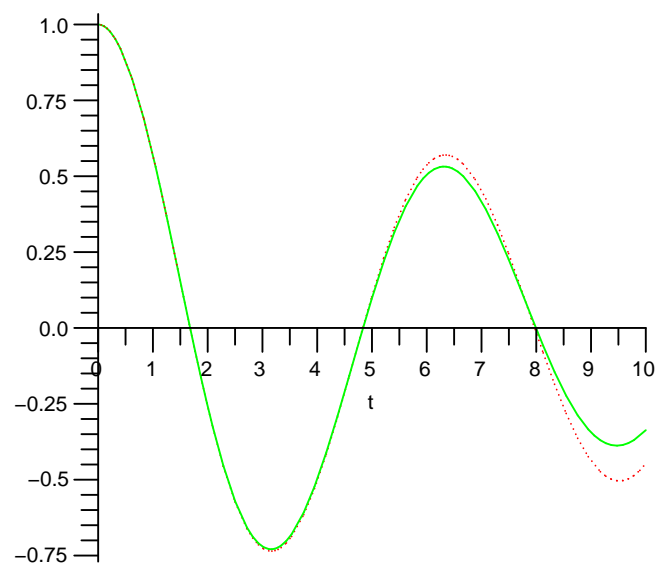


## Comparison between perturbation solution and exact solution for $\epsilon = 0.2$

- Two-term perturbation solution (red), exact solution (green):

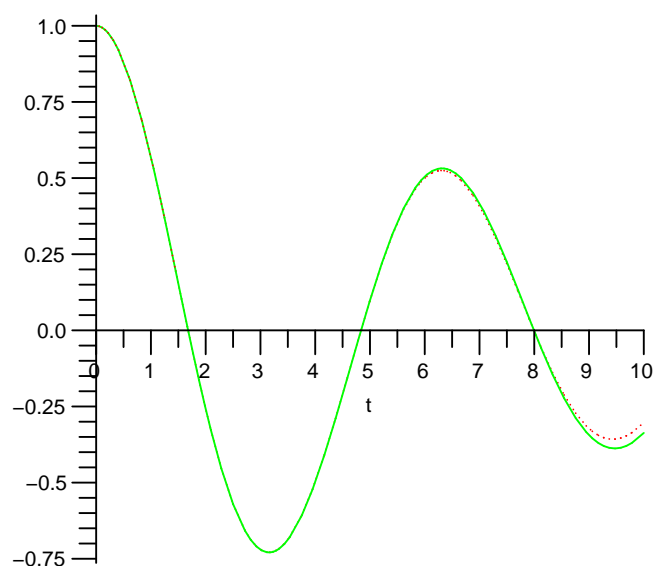


- Three-term perturbation solution (red), exact solution (green):



## Comparison between perturbation solution and exact solution for $\epsilon = 0.2$

- Four-term perturbation solution (red), exact solution (green):



- Agreement over a finite time-interval is very pleasing. However, over sufficiently large times, the perturbation solution diverges:

