

**Homework 1, due January 26**

In Exercises 1 and 2, find approximate solutions of the form  $x \approx x_0 + \epsilon x_1$  ( $\epsilon$  small).

1.  $x^3 + \epsilon x^2 + 1 = 0$
2.  $x^5 + \epsilon x - 32 = 0$
3. Consider  $x^2 + 2\epsilon x - 1 = 0$ .
  - (a) Find approximate solutions of the forms  $x \approx x_0 + \epsilon x_1$  and  $x \approx x_0 + \epsilon x_1 + \epsilon^2 x_2$ .
  - (b) Check the consistency of your answers to (a) with the Taylor expansion of the exact solution.
  - (c) Compare the first-order, second-order, and exact solutions numerically, for  $\epsilon = 10, 1, 0.1$ , and  $0.01$ .
4. Find the second-order solutions ( $x \approx x_0 + \epsilon x_1 + \epsilon^2 x_2$ ) to  $x^4 + \epsilon x - 1 = 0$ .