

HW1: MATH/CSCI-4800-02 Numerical Computing

Due 4pm on 1.22.2019 (Tuesday)

1. Text exercises on page 5: 6.(b)
2. Computer problem on page 5: 2. (*either use nest.m or myPolyEval.m shared by Prof. Li*)
3. Convert the following binary numbers to base 10: (a) 101.101, (b) $10.\overline{101}$
4. Text exercises on page 16: 6.(a) (check your answer using matlab)
5. Text exercises on page 17: 14.(c)
6. Let $x = 2$. To avoid subtraction of nearly equal numbers, find an alternative form to evaluate

$$f(h) = \frac{x^4 - (x - h)^4}{h} \quad (1)$$

for small h . Compute $f(h)$ using matlab based on $f(h)$ in (1) and the alternative form of $f(h)$ you propose, and report your results for $h = 10^{-1}, 10^{-2}, \dots, 10^{-15}$. Summarize and comment on your observations.

7. To find the roots of $ax^2 + bx + c = 0$, one can use the quadratic formula

$$x_1 = \frac{-b - \sqrt{b^2 - 4ac}}{2a}, \quad x_2 = \frac{-b + \sqrt{b^2 - 4ac}}{2a}. \quad (2)$$

Consider an example with $a = 1$, $b = 1.234 \times 10^5$, and $c = 4.567 \times 10^3$.

- (a) Use 4-digit, base 10, floating-point arithmetic to compute two approximated roots \hat{x}_1 and \hat{x}_2 based on (2). (*This means, all intermediate steps also involve 4-digit, base 10, floating-point arithmetic.*) In addition, compute the two roots x_1 and x_2 using Matlab and regard them as the exact roots. Based on your results, compute the relative errors in \hat{x}_1 and \hat{x}_2 . Are the 4-digits in \hat{x}_1 and \hat{x}_2 accurate?
- (b) For the one which has larger relative error, rewrite the root formula based on (0.13) or (0.14) on page 20 of the textbook, and re-compute this approximate root. Still, use 4-digit, base 10, floating-point arithmetic. Now recompute the relative error of this re-computed root.

(Reference reading pages 19-20)

Instructions:

- Justify your results and answers with sufficient details.
- For computer problems, in addition to the results and/or tables and/or plots (if required in the problem description), you are required to include the codes you write (such as scripts, functions etc). A log of your Matlab session can be included if you find it important to support your results.