Faculty of Computer Science
CS 3113
Fall 2003

Assignment # 1 **Due:** 8:30am, Sept 29, 2003

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1. Consider a normalized 7-bit floating point number system with base 2, consisting of one sign bit, a 3 bit mantissa and a 3-bit exponent (including sign bit).
   (a) How many distinct numbers are there in this system?
   (b) What is the largest positive number?
   (c) What is the smallest (most negative) number?
   (d) What is the positive number having the smallest magnitude?
   (e) What is the negative number having the smallest magnitude?
   (f) Which integers can be represented exactly?
   (g) In general, how many integers can be represented exactly in a given floating point number system?

2. (a) Evaluate the polynomial $y = x^3 - 5x^2 + 6x + 0.55$ at $x = 2.73$. Use 3-digit floating point arithmetic with chopping (i.e., don't round when you convert results of operations to 3 digits). Evaluate the error.
   (b) Repeat 2a, but express y as $y = [(x - 5)x + 6]x + 0.55$. Evaluate the percent relative error and compare with part 2a.

3. (a) Find the Taylor polynomial of degree $n = 4$ for each function below, expanded about the given value of a:
      i. $f(x) = e^{-x}$, $a = 0.25$
      ii. $g(x) = x^4$, $a = 1$
      iii. $h(x) = \sin(x)$, $a = \frac{\pi}{6}$
   (b) Approximate $f(1)$, $g(2)$, and $h(\frac{\pi}{5})$ using the Taylor polynomials that you calculated in part (a) and compute the relative error for each.
   (c) Multiply out, collect and simplify all terms in the Taylor expansion of $g(x)$ and explain the result.

4. Use zero- through fourth-order Taylor series expansions to predict f(3) for $f(x) = \ln x$ using a base point at $x = 1$. Compute the percent relative error for each approximation. Discuss the meaning of the results.

5. Recktenwald, Numerical Methods with MATLAB (NMM), Chapter 2, exercises 3, 11, 12, 28

6. NMM, Chapter 3, exercise 39

7. NMM, Chapter 5, exercise 4