Numerical Computing
Fall 2001
Homework 1: Due Thursday September 6

Instructions:
Hand in answers to questions 3-6 inclusive.

1. Read Recktenwald, Chapters 2, 3 and 4.

2. Read article by Cleve Moler on IEEE-754 floating-point representation. (See Numerical Computing web page)

3. Let $x$ and $y$ be positive adjacent floating point numbers. Answer the following questions for a single precision system.
   a) What is the minimum distance between $x$ and $y$?
   b) What is the maximum distance between $x$ and $y$?
   c) Repeat a) and b) for a double precision system.

4. For a double precision system, calculate the number of floating-point numbers that lie strictly between successive powers of 2 in the floating-point range $[\text{realmin}, \text{realmax}]$, i.e. strictly between $2^n$ and $2^{n+1}$ where both of these numbers lie in the range $[\text{realmin}, \text{realmax}]$.

5. Calculate the total number of floating-point numbers that can be represented in a double precision system. (Exclude numbers that fall in the subnormal, underflow or overflow regions.)

6. Using MATLAB, compute the value of $(1+1/n)^n$ for $n=10^k$ with $k = 1, 2, 3,\ldots, 20$. Confirm that once $k$ reaches a certain value $k_m$ that the calculation fails to produce an accurate answer (as $n \to \infty$, the quantity should approach $e$). Explain how you would predict (or estimate) $k_m$ before doing the calculation. Based upon this reasoning, for what value of $k$ would predict failure when calculating $(1+1/m)^m$ where $m=n^2$?