HW 1: Floating Point Homework

1. Short answer questions

   (a) What is 9452 in binary?

   (b) In decimal, $1/3 = .333\bar{3}$ repeating. What is $1/3$ in binary?

   (c) What is the largest integer (approximate decimal size OK) that can be represented exactly in single and double precision floating point?

   (d) What floating point numbers can be represented exactly as integers? What is the relative error of those numbers that can't be represented exactly?

   (e) For what values is computing the function $f(x) = \sin(x)$ ill-conditioned? (Hint: Look somewhere besides $x = 0$).

2. What do you expect the output to be of the following loop?

   ```
   double num = 1.0;
   while (1.0 + num > 1.0) {
       num = num / 2;
   }
   
   print num;
   ```

   Run it (using a high level language besides Matlab) to verify your answer. This number is called \textit{machine epsilon}. Alternatively some people define it as the smallest number one can add to 1.0 to get the next larger number.

3. What is the result in your computer of the the following operation (your program might crash before printing)? Report the operating system and the compiler you used to generate this.

   ```
   numer = 1.;
   denom = 0.;
   result = numer/denom;
   ```

4. (a) What does your computer do (in a language besides Matlab) if you compute the square root of -1?

   (b) If your program doesn’t crash, what is the result of the logical test

   ```
   num = sqrt(-1);
   if (num == num) then
       printf(" program did not crash");
   else
       printf(" no crash and not equal");
   ```

5. In class we computed an approximation to the derivative of the function $f(x) = \sin(x)$ at $x = 1$ using

   $$f_1(x) \approx \frac{f(x+h) - f(x)}{h}$$

   for different values of $h$. Modify the program (using Matlab or octave) to approximate the derivative using the formula

   $$f_2(x) \approx \frac{f(x+h) - f(x-h)}{2h}$$

   What are the differences?