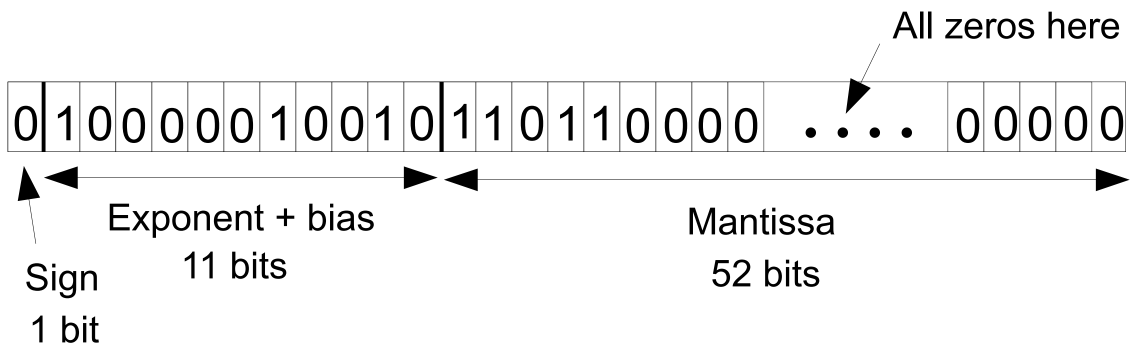
# MAE384 Fall 2012   Homework #1

**1 point = 1% of your total score for the semester**
Unless otherwise noted, in all homework and exams the argument of a sinusoidal function is in radian

**1**. (a) Under the IEEE-754 standard in Sec 1.2, what is the following 64-bit (double precision) binary number when it is restored to its decimal representation? Hint: Remember to take into account the "bias" in the exponent. You might find the example in Fig. 1-7 useful.




(b) Under the IEEE-754 standard, the smallest positive 64-bit binary number that's allowed by the system is $2^{-1023} \sim 1.1 \times 10^{-308}$. We have found in class that a much smaller number is allowed in Matlab (therefore it is likely that Matlab adopted a different standard for its 64-bit variables). Try to search for the smallest positive number that's allowed, i.e., the threshold for underflow, in Matlab. Explain how you find that number. **[1 point]**

**2**. (a) Find the positive solution of the equation

$$\sin(x) = 0.25\,x$$

using the Bisection method with [2, 3] chosen as the initial interval. The solution will be considered satisfactory if its uncertainty (numerical error) is within ± 0.02. Show your procedure or Matlab code. **[1 point]**

**3**. (a) Given $f(x) \equiv \cos(x) + 0.1x^2 - 0.5$, find all solutions of $f(x) = 0$ within the interval of $0 < x < 4$ by Newton's method. Show your procedure or Matlab code. A numerical solution, $x_N$, will be considered satisfactory if $|x_N - x_{N-1}| < 0.01$, where $x_N$ is the solution after the N-th iteration. (The initial guess is $x_0$.) (b) Discuss how the choice of the initial guess affects the solution. Try to systematically explore the interval of $0 < x_0 < 4$. Hint: You might find the behavior of the solution more interesting when $x_0$ is located near the point where $f'(x) = 0$
**[3 points]**