Before coming to computer lab Friday Jan. 31, please prepare answers to the following three warmup questions:

1. **Timing Sine** (from problem set 1): *Build a table of a million equally-spaced numbers $0 \leq x_n < 2\pi$. Find a method, inside your working environment, for calculating the amount of time a computation takes. Time how long it takes to calculate $\sin(x_n)$ and $x_n^2$ for your million points.*

2. **What is the Taylor series approximating**

   $\sin(x) = \sum_{n=0}^{N-1} a_n x^n \quad (1)$

   about $x = 0$? If we assume the error in the truncated series is roughly given by the first neglected term $a_n x^n$, how big must $N$ be before the absolute error for $\sin(2\pi)$ is less than double-precision machine accuracy $\epsilon_m = 2.22 \times 10^{-16}$? Can we hope to reduce the fractional error to below 1% at $x = 2\pi$?

3. **What is the maximum value of the second derivative $\sin''(x)$?** If we expand

   $\sin(x) \approx \sin(n\Delta) + (x - n\Delta)\sin'(n\Delta) + (x - n\Delta)^2/2!\sin''(n\Delta), \quad (2)$

   how small must $\Delta$ be for the linear approximation error to be less than $\epsilon_m$? (Hint: the maximum distance to the nearest data point is $\Delta/2$.)