CS3414. Homework problem set I.

Problem I, 10 points.

Modify `numderivative.cc` to calculate the derivative $exp(x)'$ at $x = 1$ to within 0.05 % relative error by using: $f'(x) \approx (f(x + h/2) - f(x - h/2))/h$. What step size h will you need? What is an advantage of the above formula compared to the one we used in class [*i.e.* $f'(x) \approx (f(x+h) - f(x))/h$]? Using `numderivative.cc` , find the optimum h, and compare it to the optimum for the original `numderivative.cc` .

Problem II, 20 points.

In `numderivative.cc` replace the "exp(x)" with "sin(1/x)" where appropriate to obtain a numerical estimate for the derivative of $f(x) = sin(1/x)$ at

a) $x = 1/\pi$. Choose "h" so that the result is accurate to within at least 4 decimal points. What is your calculated result?

b) What happens when you try the same code for $x = 10^{-20}/\pi$? Why? Use the chain rule to re-formulate the problem into a mathematically equivalent one that is free from the defect, modify the code, and re-compute. What do you get now?