

## Computational Techniques/Physics

- ✓ 1. Consider  $f(x) = (x+1)(x-1)(x-1/2)$ . Use bisection method on the interval  $[-2, 1.5]$  to find  $p_3$  (it denotes the midpoint of the interval on the third iteration step). (4)
- ✓ 2. Suppose you are given an equation  $f(x) = 0$  to solve, such that computation of  $f'(x)$  is numerically expensive. Which method would you choose and why? (3)
- ✓ 3. How would you compile C codes without linking using gcc compiler? (1)
- ✓ 4. While studying linear regression, we minimize the least square error:  $\psi = \sum_i (f(x_i) - y_i)^2$ . Can't we just take the absolute difference  $|f(x_i) - y_i|$  or the forth power of that  $= \sum_i (f(x_i) - y_i)^4$ ? Do you see any issues with these choices? (3)
- ✓ 5. Suppose you are trying to find out the root of the equation  $x^2 - 5 = 0$  using Fixed Point method. The first step is to construct a function  $g(x)$  such that  $x = g(x)$  is your fixed point problem.
  - ✓ (a) Verify that the following forms of  $g(x)$  are obtainable from the original equation-
    - ✓ (i)  $x = \frac{x+5}{x+1}$ , and (ii)  $x = \frac{3x^2-5}{2x}$ . (3)
    - ✓ (b) Check the convergence, i.e. if they will converge to the root after a sufficient number of iterations (hint- the root is given by  $x = \sqrt{5}$ ). (3)
- ✓ 6. Consider finding the root of the equation  $f(x) = x^3 - \cos(x) = 0$ . Use Newton's method to compute  $x_2$  starting from  $x_0 = 1$ . Can you use  $x_0 = 0$ ? (3+2)
- ✓ 7. Consider the following data *sample.txt*. Try to fit the lowest order polynomial to it and make a plot (with the data and the fitting form). Attach the figure\*\* and write down the values of the fit parameters. (6)

\*\* P.S.- you can submit the figure along with the coding project. But don't forget to write down the values of the fitting parameters here.