

# STAT 598Z: Homework 3

Due: 28th February 2012

1. This homework will contribute 10 points towards your final score.
2. Attempt as many problems as possible.
3. Only neatly handwritten solutions will be accepted. Alternatively you may use  $\text{\LaTeX}$  to typeset your solutions.
4. Hand in your HW (including print outs of your source code) at the beginning of the class on 28th of February 2012. Additionally source code (if any) should be emailed to `stat598z@gmail.com` **before** the assignments are submitted in the class. No late submissions will be accepted!
5. Program files should be named after the problem (e.g. solution to problem 1 should be `problem1.py` etc).

**Problem 1 (2 pt)** Write a Python function `bubble_sort(b)` which takes as input a list of integers `b` and implements the Bubble Sort algorithm. Your function must return a list `s` containing the elements of `b` in non-descending sorted order. Test your code on various inputs to ensure correctness. In particular, check that your function works can correctly sort the following input `[10, 10, 5, 6, 10, 3, 4, 31, 0, -2, 5]`.

**Problem 2 (2 pt)** Review the numpy documentation.

- Create a numpy vector `x` which contains `(1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12)` and print it.
- Reshape `x` into a  $4 \times 3$  matrix `A` and print `A`.
- Extract the 1st, 2nd, and 4th row and 1st and 2nd column of `A` into a matrix `B` and print `B`. Multiply `B` by the vector `(6, 8)` and print the result.

**Problem 3 (2 pt)** Write Python code using numpy to calculate the mean, std, var, max, and min of an array with shape `(4, 3, 8, 6)` containing floats drawn from a Gaussian distribution with mean 5 and standard deviation 2.

**Problem 4 (2 pt)** Write a Python function `f(x)` to compute the value of  $f(x) = 2x^2 + 8\sin x$ . Using `fmin_bfgs` from the scipy package `optimize`, compute the minimum of  $f(x)$ . Using `matplotlib`, produce a plot of the function for  $x \in [-10, 10]$ . State whether the minimum visible on the plot agrees with the result of `fmin_bfgs`

**Problem 5 (2 pt)** Write Python functions `f(x)`, `g(x)`, `p(x)`, and `q(x)` to compute  $f(x) = x$ ,  $g(x) = x^2$ ,  $p(x) = x^3$ , and  $q(x) = x^4$ . Use `matplotlib` to plot them for  $x \in [-10, 10]$ . Arrange them as subplots in a single figure with two rows and two columns: place  $f(x)$  in the upper left,  $g(x)$  in the upper right,  $p(x)$  in the lower left, and  $q(x)$  in the lower right. Label the x-axes as 'x' and the y-axes as 'f(x)', 'g(x)', 'p(x)', and 'q(x)', respectively. Give the four subplots the titles, 'Linear', 'Quadratic', 'Qubic', and 'Quartic', respectively. Use `set_position` to adjust the positions and size of the subplots so as to eliminate any overlap between axes and labels from neighboring subplots.