Homework #1

CS 268P Optimization
Spring 2018
Due: Tuesday April 10 11:59pm on Canvas

Read: Chapters 1 and 2, Chandrupatla and Belegundu

Allowed: Reading (but not copying) pseudocode and code in the three recommended/optional books listed first in the class Syllabus. Also, reading external pseudocode after you have tried to write your own code.
Not allowed: Other outside/external code reading or code use (eg. copying or execution).

Turn in: 1-page written description of your approach and results, together with source code and I/O files proving your results.
Programming language: Python. OK to use numpy, matplotlib, and iPython; but not scipy or sympy.
Formats: Writeups in .doc, .docx, or .pdf. Code in .py ; (or .ipynb or Jupyter, provided a PDF of that is also supplied).

Problem 1 1D unconstrained optimization.

(a) *Write* a functioning one-dimensional black box unconstrained function optimizer, that is, an optimizer of real-valued functions *f(x)* of one real-valued argument *x* using only function calls that evaluate f(x) but no information about derivatives *df/dx*, *d^2f/dx^2*, etc., and no further constraints on the argument *x*. Here "functioning" just means it always produces some numerical answer.

(b) *Test* your code of part (a) on (at least) two different 1D unconstrained optimization problems *f(x)*, with optimization starting points drawn from a probability distribution which you choose and document. *Report* sampled average values, together with estimated error arising from the probabilistic sampling (using $x \pm y$ notation in any tables, and error bars or box plots in any plots), for the following: (i) Number of function evaluations *f(x)*, (ii) wall-clock running time, and (iii) relative distance between output optimum and true mathematical optimum. *Format* these results in a table, eg one row per problem. At most one of your objective functions *f(x)* can be quadratic; otherwise, you choose them and document your choice. You may choose functions with desirable properties such as continuity and/or convexity. *Report* any numerical parameters you used, eg in stopping criteria.

Extra credit on either problem (up to 10% extra credit available on HW1):
Plot the results of 1(b) as you vary some important numerical parameter eg. governing stopping criterion, or any other parameter you held fixed previously that you reasonably expect will affect the results.