Scientific Computing for DPhil Students I
Assignment 4

Due at the AWB reception before 3:00 on Tuesday, 3 December 2019. No papers will be accepted after this hour, and solutions will be posted at this time. This is the last of four assignments this term. See you again next term! — Tuesdays and Thursdays of Weeks 1–6 at 10:00 in L3.

In these problems, please report both minimum values and their positions to at least six digits.

1. *Chebfun.* Download Chebfun from GitHub or `www.chebfun.org` and put it in your Matlab path. Construct the bivariate function $f(x, y)$ via `rng(1), f = randnfun2(.5)` and make a contour plot of it. Using `min2`, add a red dot to the plot showing the global minimum; also report the value of this minimum. Using `min`, make plots of $\min_y f(x, y)$ as a function of x and $\min_x f(x, y)$ as a function of y. Explain how these 1D plots relate to the 2D plot.

   To explore Chebfun, you may find the Chebfun Guide under Docs at `www.chebfun.org` useful. Since f is bivariate, it is a "chebfun2".

2. *BFO.* Download `bfo.m` ("Brute Force Optimization", by Philippe Toint) from `https://courses.maths.ox.ac.uk/node/45032`. You will see from the extensive comments that the code can do a very wide range of things. All you have to do, though, is solve the same global optimization problem as in problem 1. Note that $f(x, y)$ is defined just for $-1 \le x, y \le 1$, and beyond this, you should pretend you know nothing about it (i.e., you are not allowed to use an inspired initial guess!).

   By default, `bfo` reinitializes MATLAB's random number generator each time it is called. If this causes you trouble, you can turn off the reinitialization with the strings `'reset-random-seed','no-reset'`.

3. *A 3D problem of your own choosing.* Define a function $f(x, y, z)$ that interests you on the unit cube $[-1, 1]^3$ and find its global minimum using both Chebfun and BFO. This doesn't have to be especially complicated, but try to make your writeup convincing and interesting by suitable plots and discussion.