AA 222: Engineering Optimization
Project 1

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1 Methods chosen for each function

Function type	Function name	Method chosen	Score
simple_1	Rosenbrock	Hooke-Jeeves	-0.8075
simple_2	Powell	Hooke-Jeeves	-0.0123
simple_3	Himmelblau	Hooke-Jeeves	-0.0971
secret_1	secret_1	Fibonacci with bounds of (-100,100)	40.0972
secret_2	secret_2	Fibonacci with bounds of (-50,50)	97.9922

For the three simple functions (Rosenbrock, Powell, and Himmelblau) I chose to use the direct method of Hooke-Jeeves, i.e. simple pattern search in the coordinate directions. This worked well and better than a Fibonacci search because the number of dimensions was low and no iterations were wasted on gradient evaluations.

For the two secret functions, I initially tried Hooke-Jeeves which gave decent but not stellar results. Both Nesterov Momentum and Adagrad methods were promising for the secret functions but the minima was very sensitive to the values of learning rate and momentum decay chosen so I instead had better scores using a Fibonacci search. In general however, the Fibonacci search might not be the best method because I simply tried an initial bracketing interval of (-50,50) and essentially got lucky. In case the minima were far from the origin, the second order methods like Nesterov Momentum would be better.

Function type	Function name	Alternate method	Alternate score
simple_1	Rosenbrock	Fibonacci	-0.9898
simple_2	Powell	Fibonacci	-8.0000
simple_3	Himmelblau	-	
secret_1	secret_1	Nesterov Momentum	-0.8149
secret_2	secret_2	Adagrad	-3199.5839

2 Rosenbrock function plots

See Figure 1 for an example of how the Hooke-Jeeves (pattern search) method can be sensitive to the initial position. Picking an initial point of (2,2) meant that the subsequent points easily found the local minima whereas picking other initial points would not find the absolute minima and were more likely to get stuck closeby. The blue points are the evaluations, the red point in the best minima found by the algorithm, and the green point in the true global minimum.

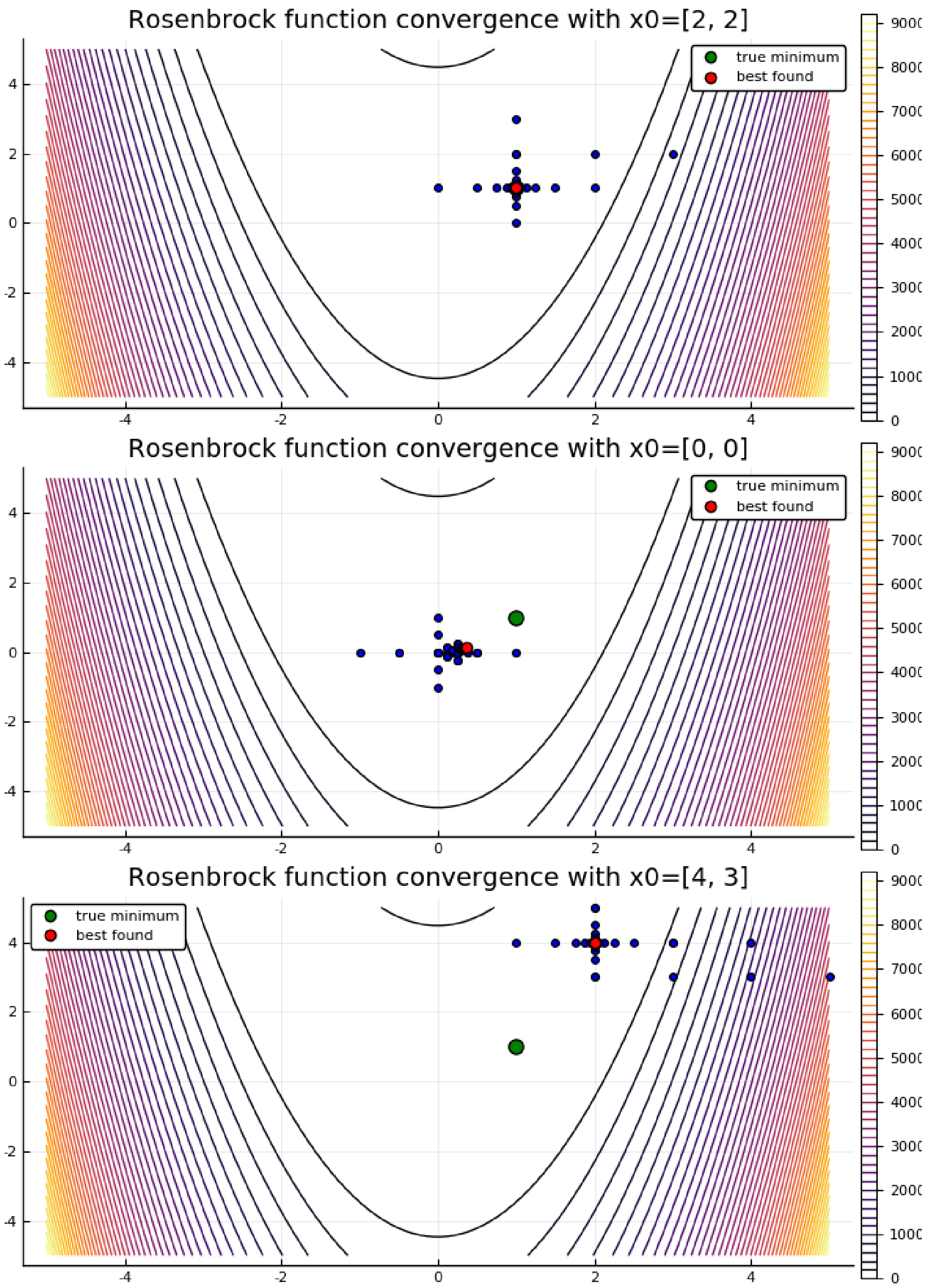

Figure 1: Points evaluated for Rosenbrock Function starting at different points

3 Convergence plots

See Figure 2 for an illustration of convergence to almost 0 (i.e. a local minima) for all three functions. The Rosenbrock function takes 20 iterations, the Powell function takes 40 iterations, and the Himmelblau function takes 100 iterations. Note that I picked the origin (0,0) as the starting point for all three of these graphs but picking a different starting point near the origin yields very similar graphs. Note also that convergence is not monotonic because this is a pattern search algorithm.

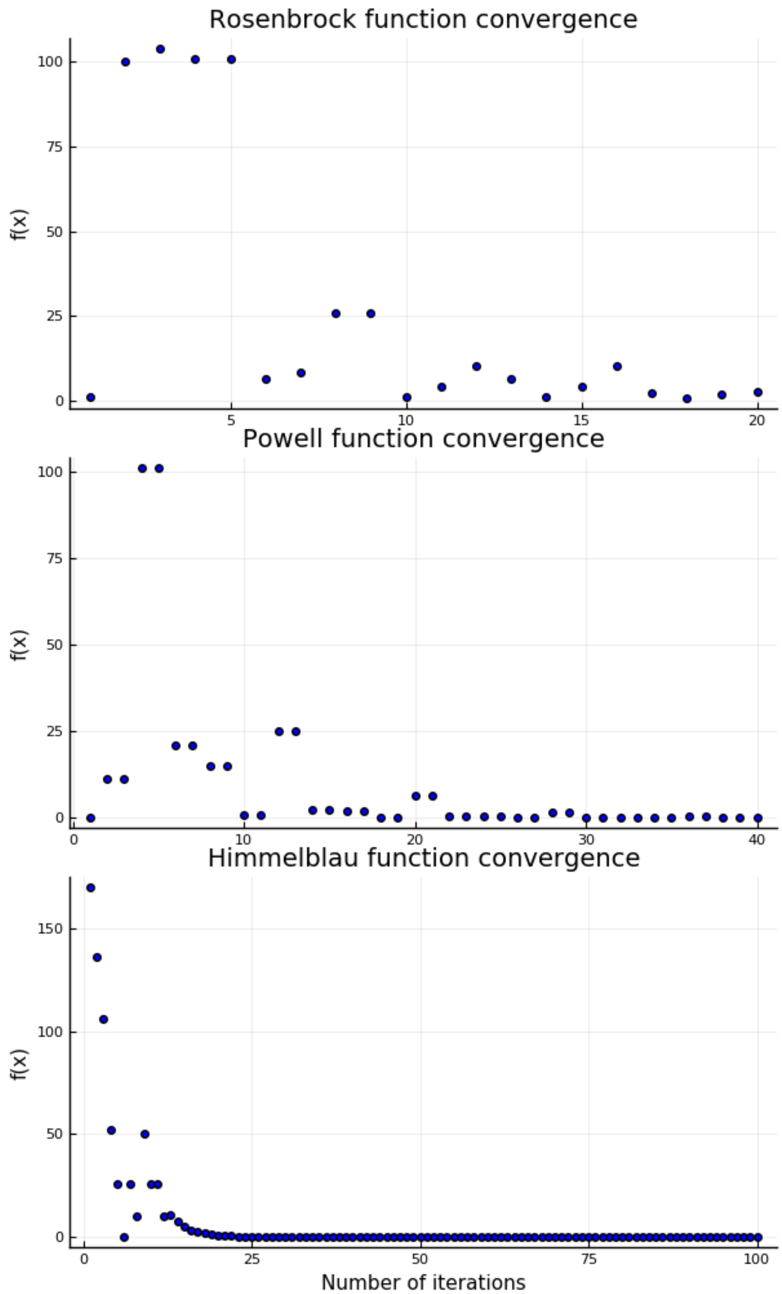

Figure 2: Convergence to local minima for three simple functions