Project 2 Questions

1.2 Compare your result (e.g. iteration number, running time, etc.) with the other steepest descent methods in project 1. Is the backtracking step length selection method better than them?

The backtracking step length selection method is better inexact steepest descent but not exact steepest descent. This is because the exact steepest descent only took 13 iterations to get to the minimizers while backtracking method took 111 iterations.

What if you change the ρ to be 0.5 or 0.9, what do you observe?

When $\rho = 0.5$, the iterations is 55 and when $\rho = 0.9$, the iteration is 798. This can mean that the number of iterations from high to low oscillates depending on what ρ is.

1.3 Starting point $x\hat{} = (1.2, 1.2)$, find out how many iterations have the above methods used, what are the convergence types (Q-linear, Q-superlinear, Q-quadratic)?

The backtracking steepest descent method used 264 iterations while the backtracking newton's method used 13734 iterations. They're both Q-linear.

Starting point $x\hat{} = (-1.2, 1)$, find out how many iterations have the above methods used, what are the convergence types (Q-linear, Q-superlinear, Q-quadratic)?

The backtracking steepest descent method used 946 iterations while the backtracking newton's method used 5644 iterations. They're both Q-linear.

2.1 Test your heavy ball function on Rosenbrock function, what is the iteration number? What is the convergence type (Q-linear? Q-superlinear? Q-quadratic?).

The heavy ball have 4686 iterations before getting to the minimizer. The rate of convergence is Q-linear.

Compare this result against your previous steepest descent methods (exact line search, fixed step length, backtracking), which one performs better on Rosenbrock?

It seems that the backtracking steepest descent method performs the best on Rosenbrock with only 946 iterations while the heavy ball method comes in second place amongst the other.