1D MINIMIZATION

Objective function

$$f = \lambda^5 - 5\lambda^3 - 20\lambda + 5$$

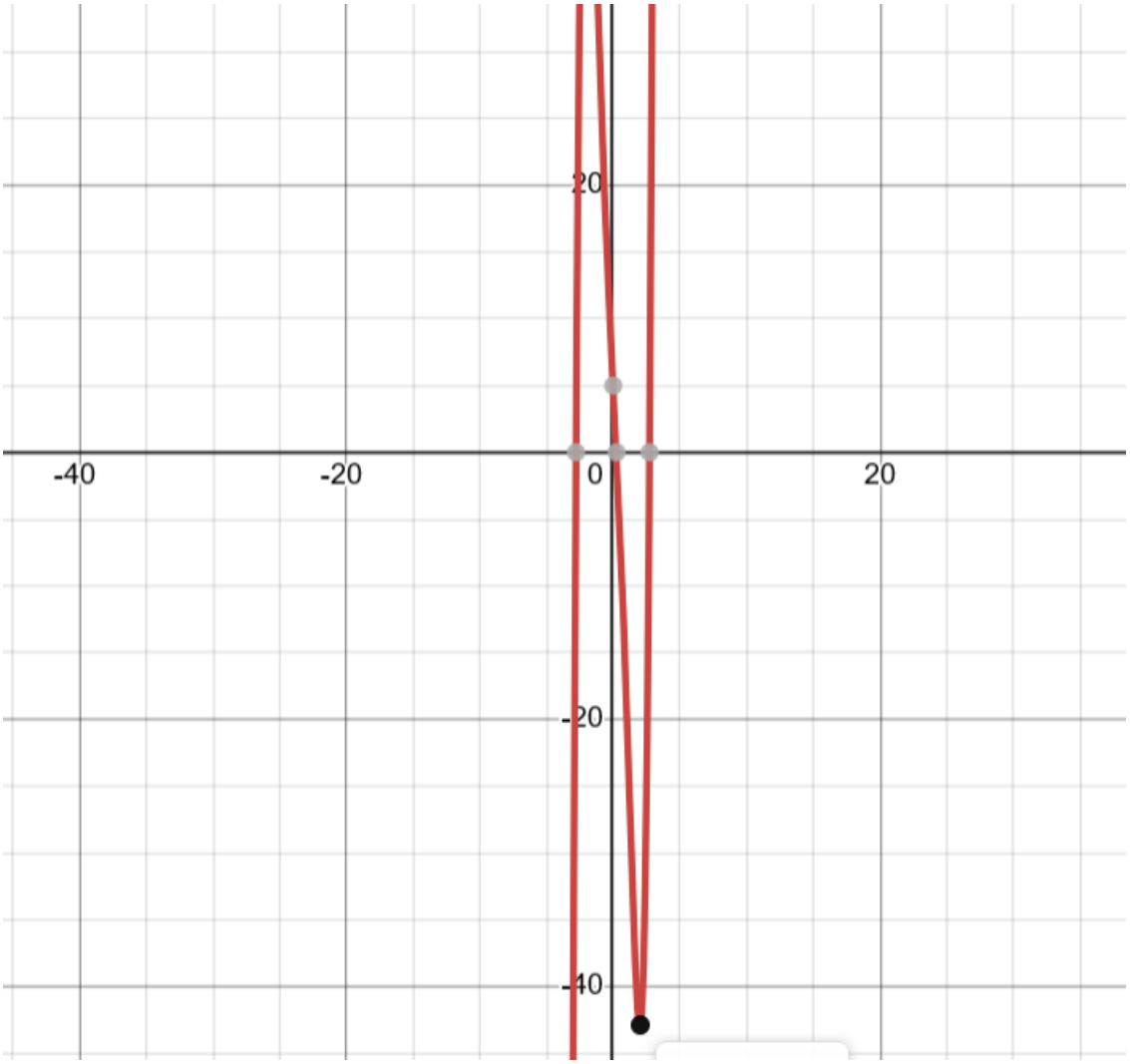
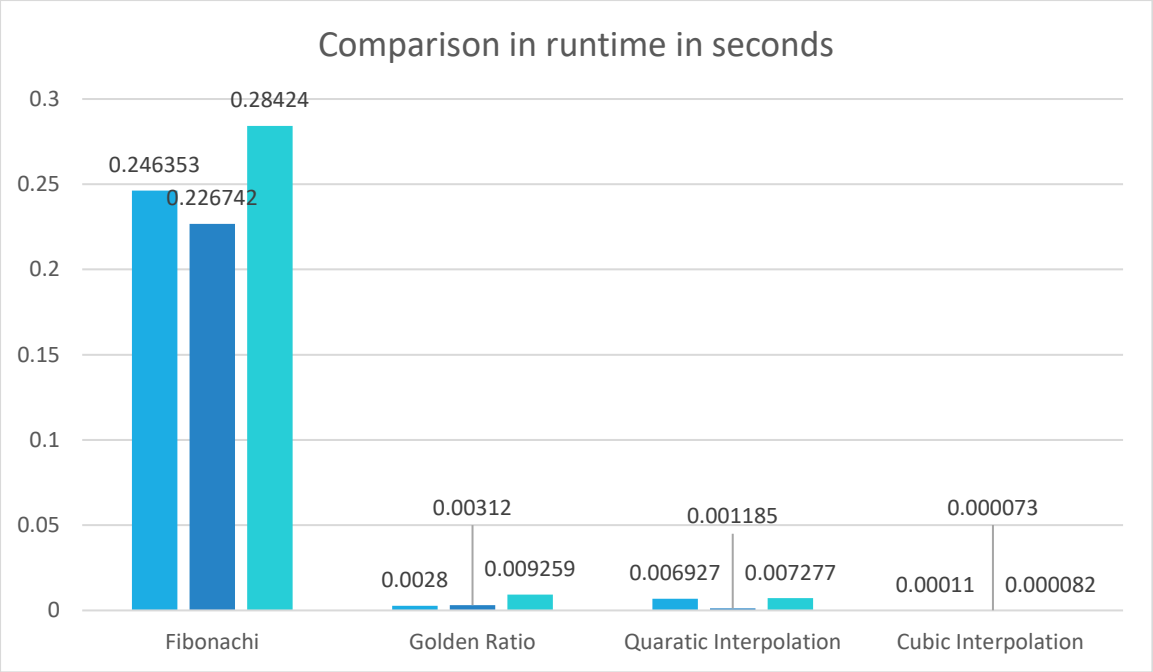
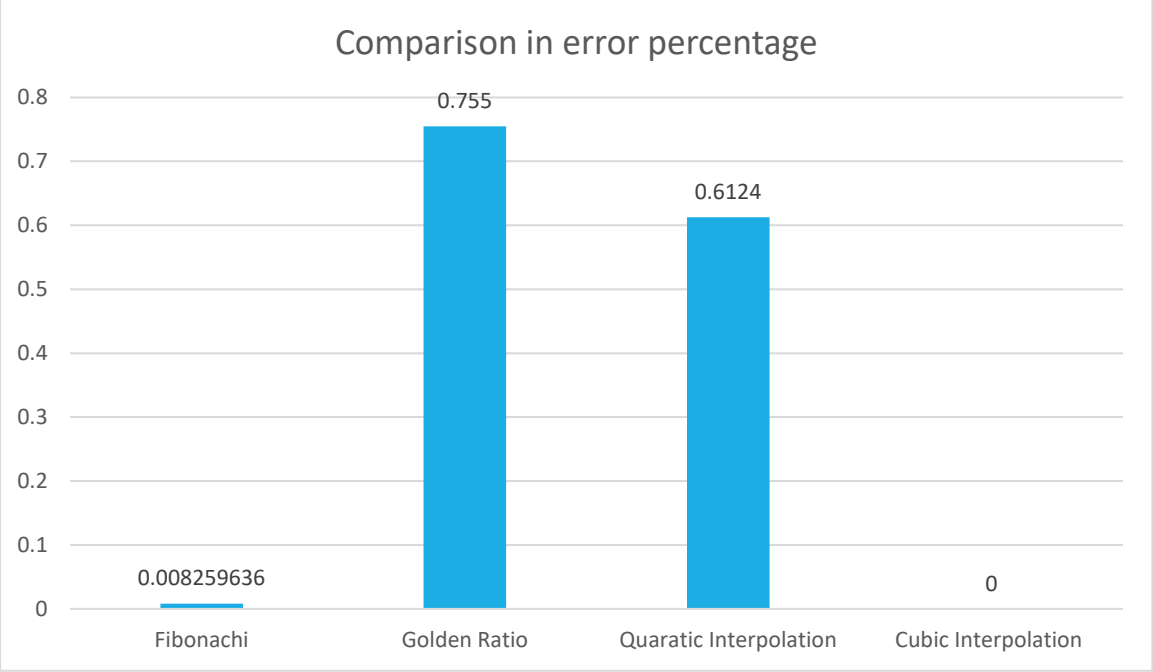


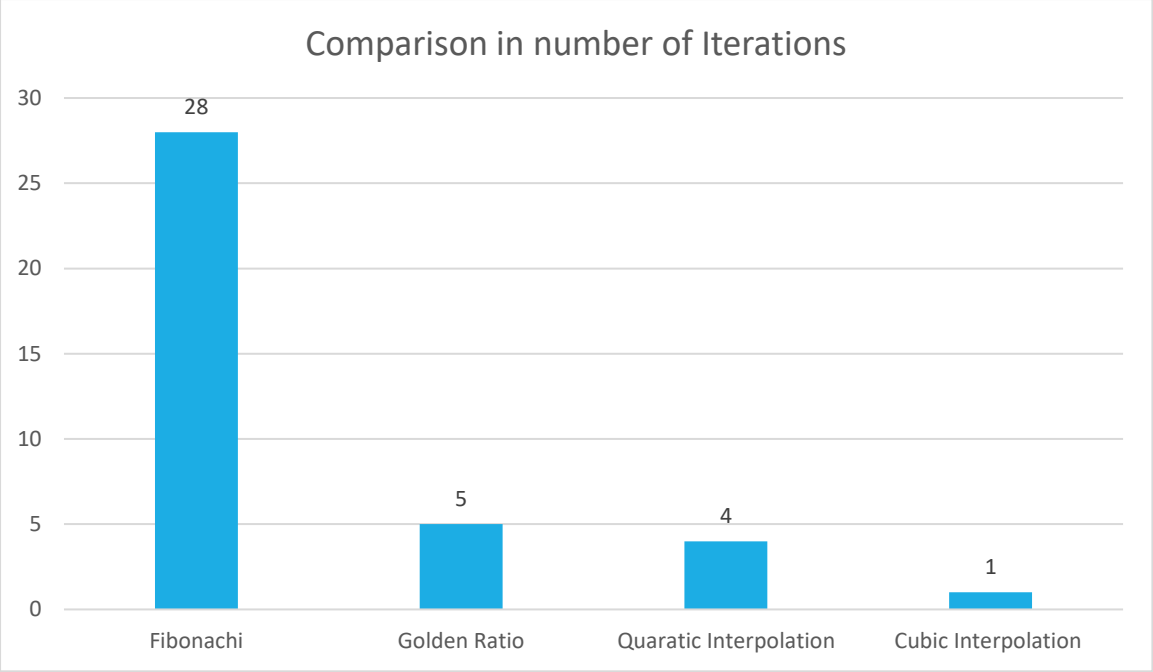
Figure 1 using Desmos, minimum of function at x=2, f(x)= -43

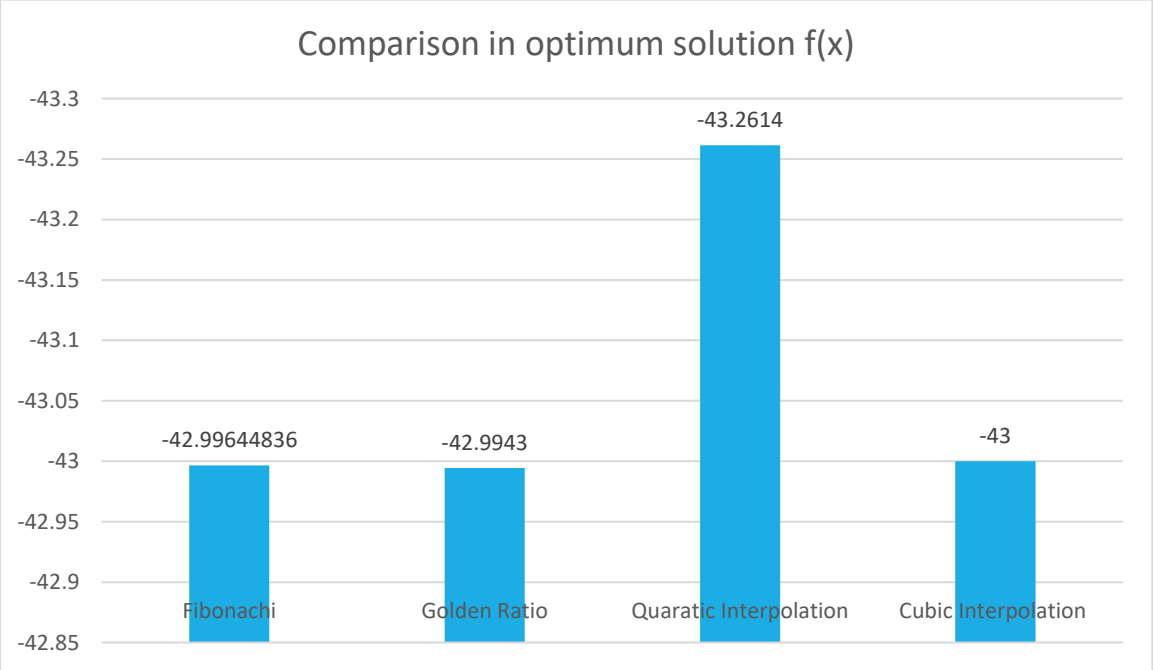
Tolerance error was set as 1%

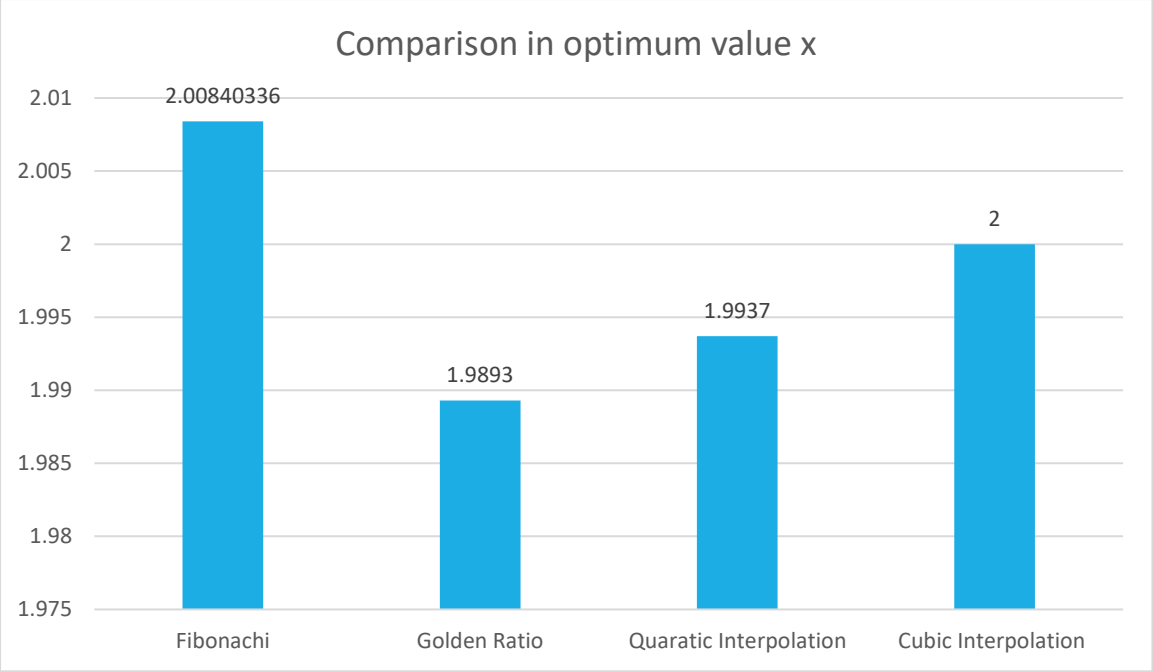


To get an average of runtime, 3 runs were taken.




Comparison in number of Iterations
30
25
20
15
10
5
0
28
5
4
1
Fibonachi
Golden Ratio
Quaratic Interpolation
Cubic Interpolation


Comparison in optimum solution f(x)
-43.3
-43.25
-43.2
-43.15
-43.1
-43.05
-43
-42.95
-42.9
-42.85
-42.99644836
-42.9943
-43.2614
-43
Fibonachi
Golden Ratio
Quaratic Interpolation
Cubic Interpolation



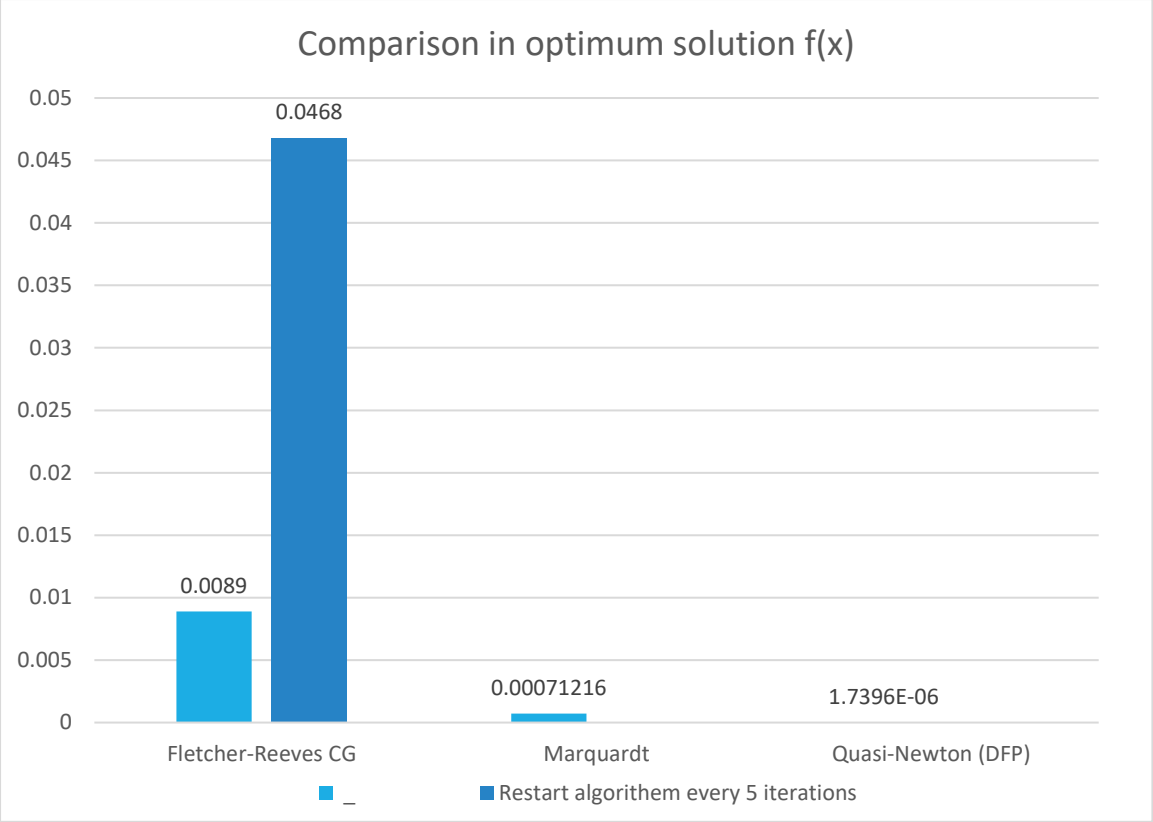
1 UNCONSTRAINED OPTIMIZATION

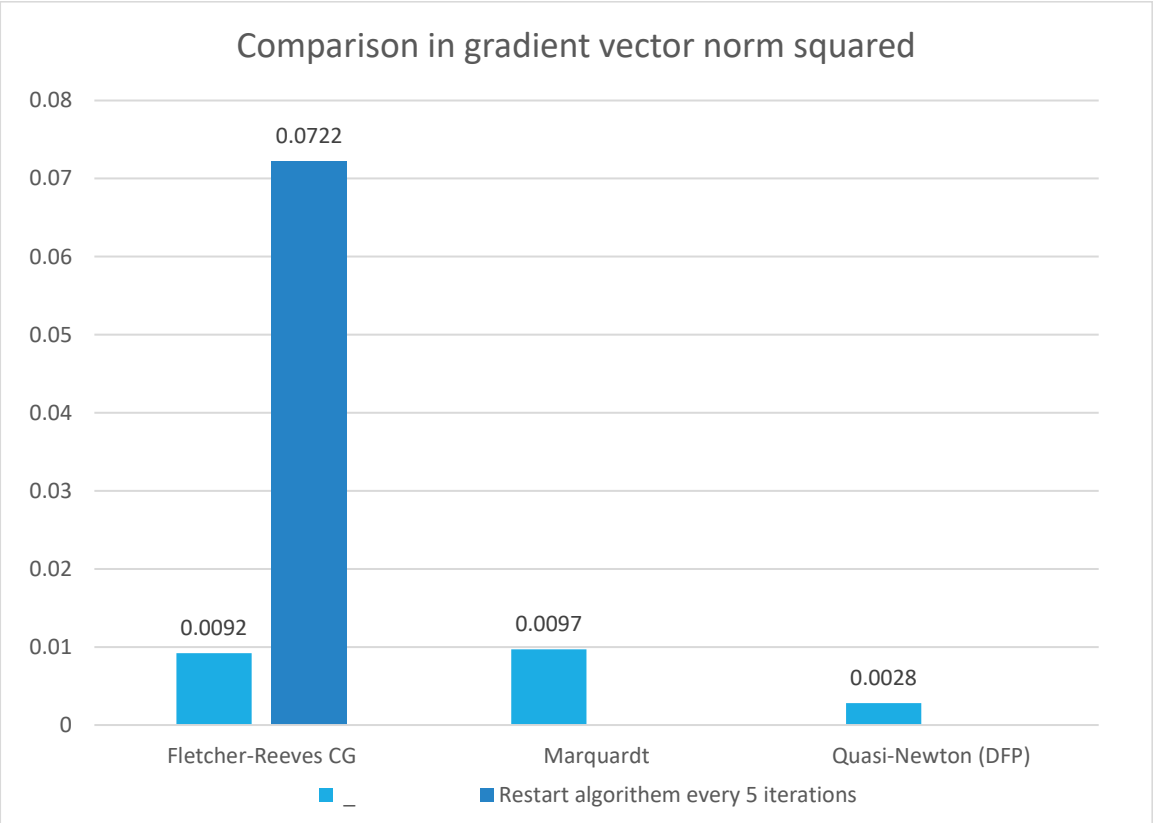
1.1 ROSENBROCK'S PARABOLIC VALLEY FUNCTION

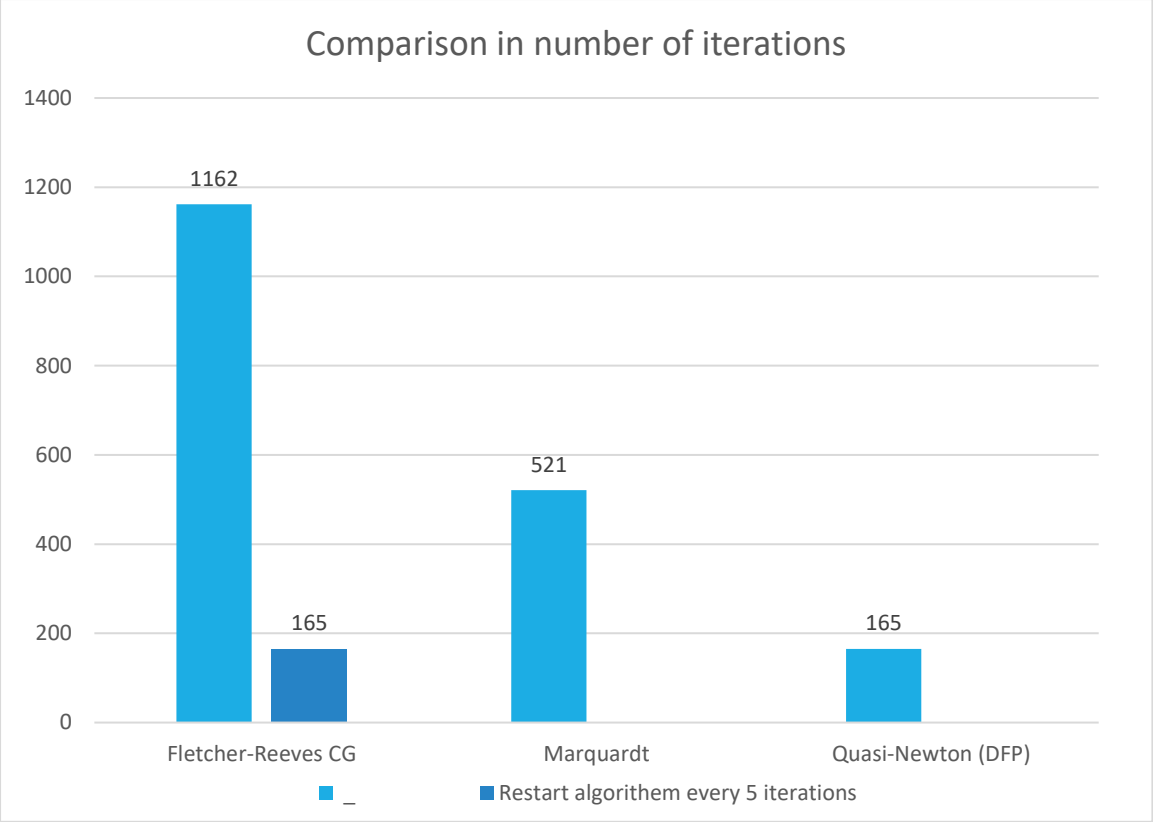
The reference to the norm squared of the gradient matrix was set to 0.01

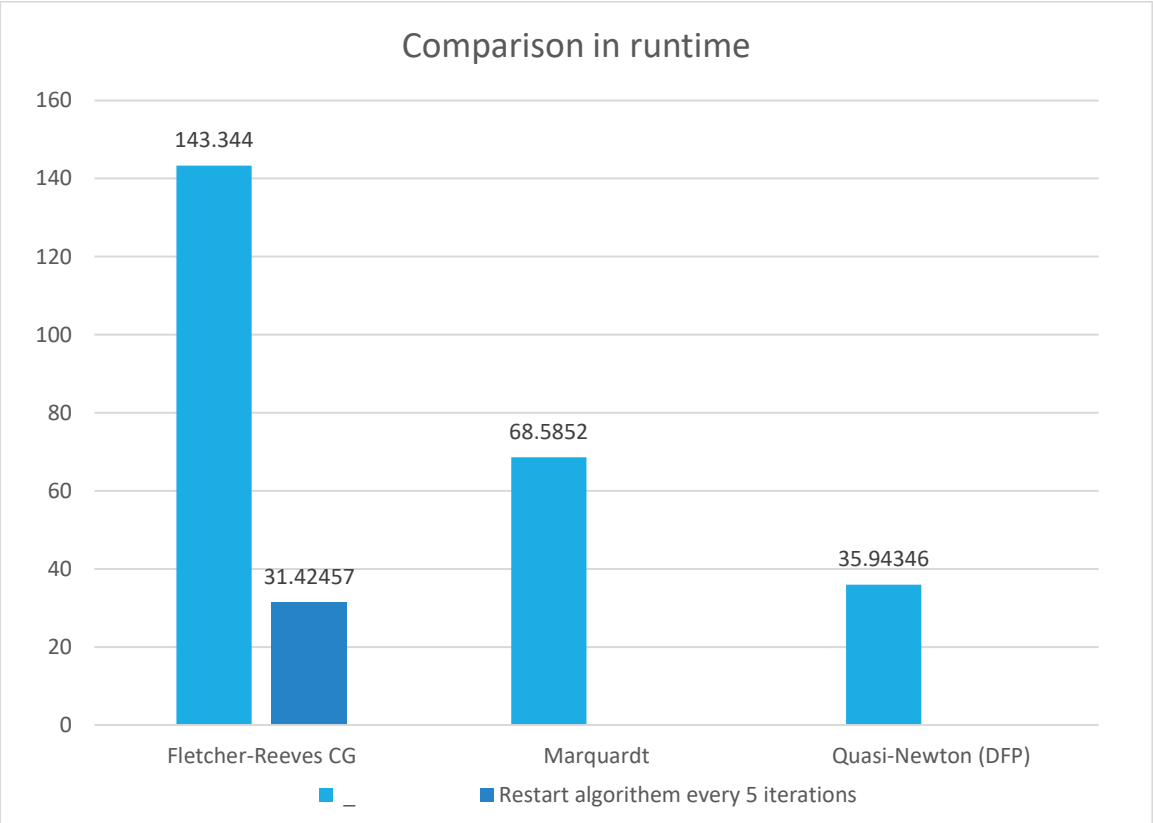
starting from $\boldsymbol{X}0 = (-1.2, 1.0)$

$$f(x_1, x_2) = 100(x_2 - x_1^2)^2 + (1 - x_1)^2$$


Comparison in optimum solution f(x)
0.05
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
0.0468
0.0089
0.00071216
1.7396E-06
Fletcher-Reeves CG
Marquardt
Quasi-Newton (DFP)
_
Restart algorithem every 5 iterations


Comparison in gradient vector norm squared
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0.0722
0.0092
0.0097
0.0028
Fletcher-Reeves CG
Marquardt
Quasi-Newton (DFP)
_
Restart algorithem every 5 iterations

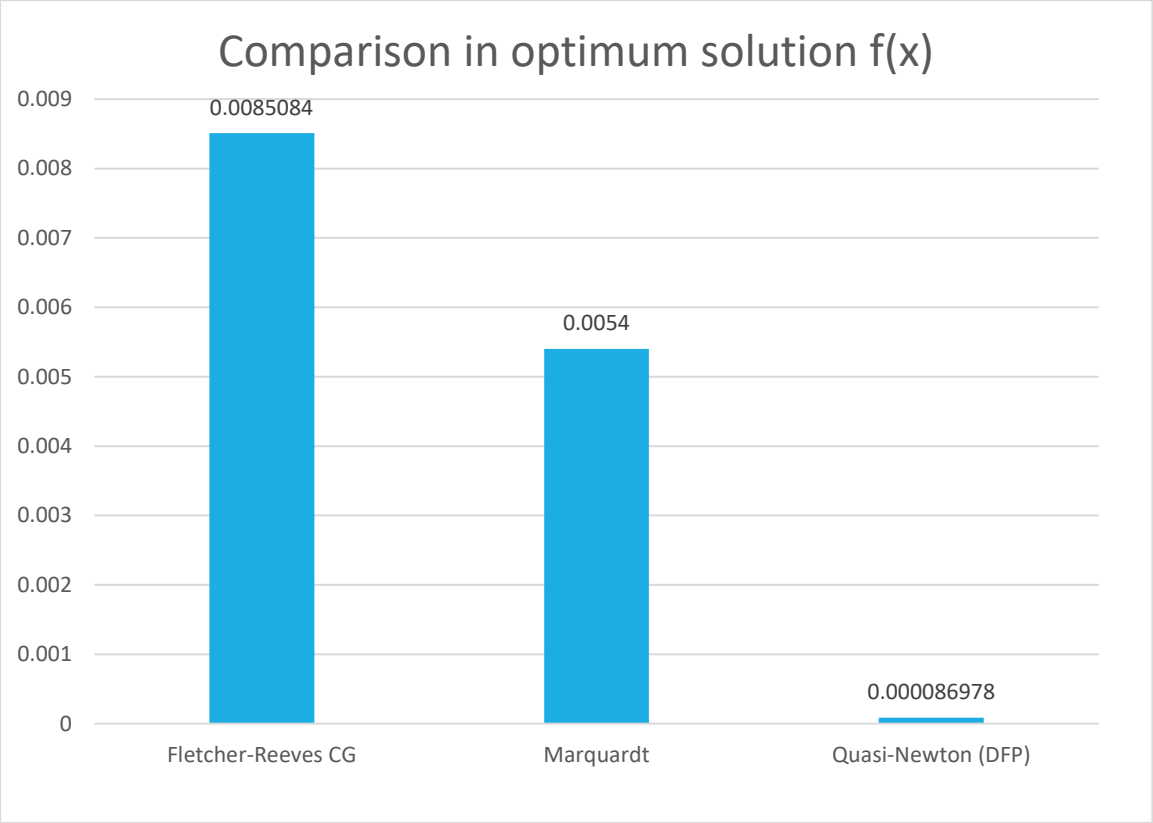


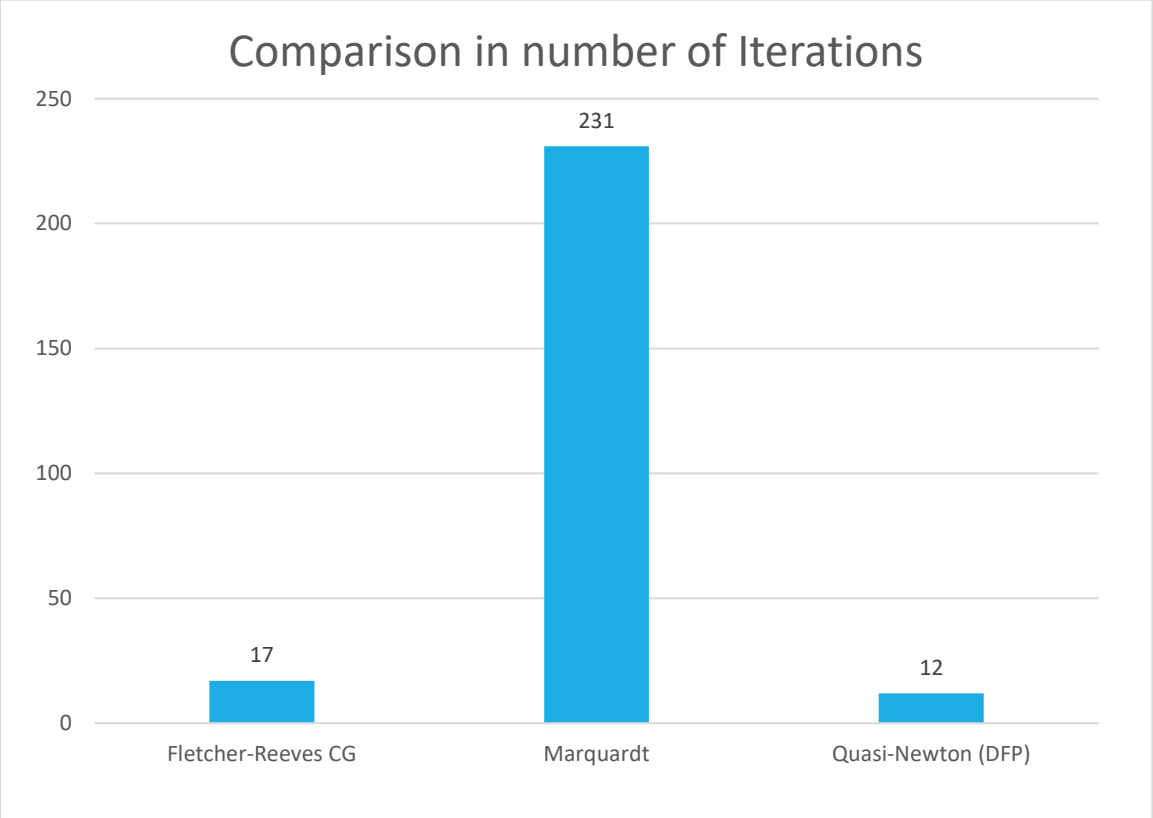


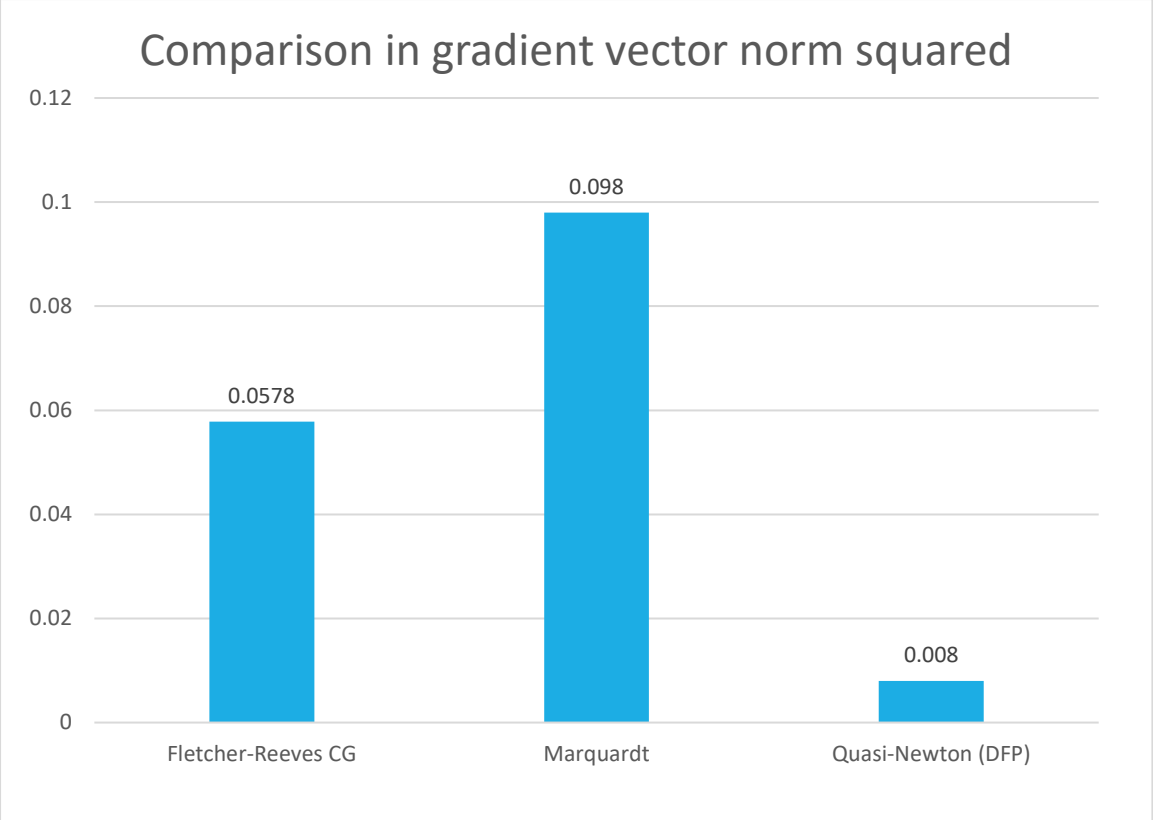
1.2 POWELL'S QUARTIC FUNCTION

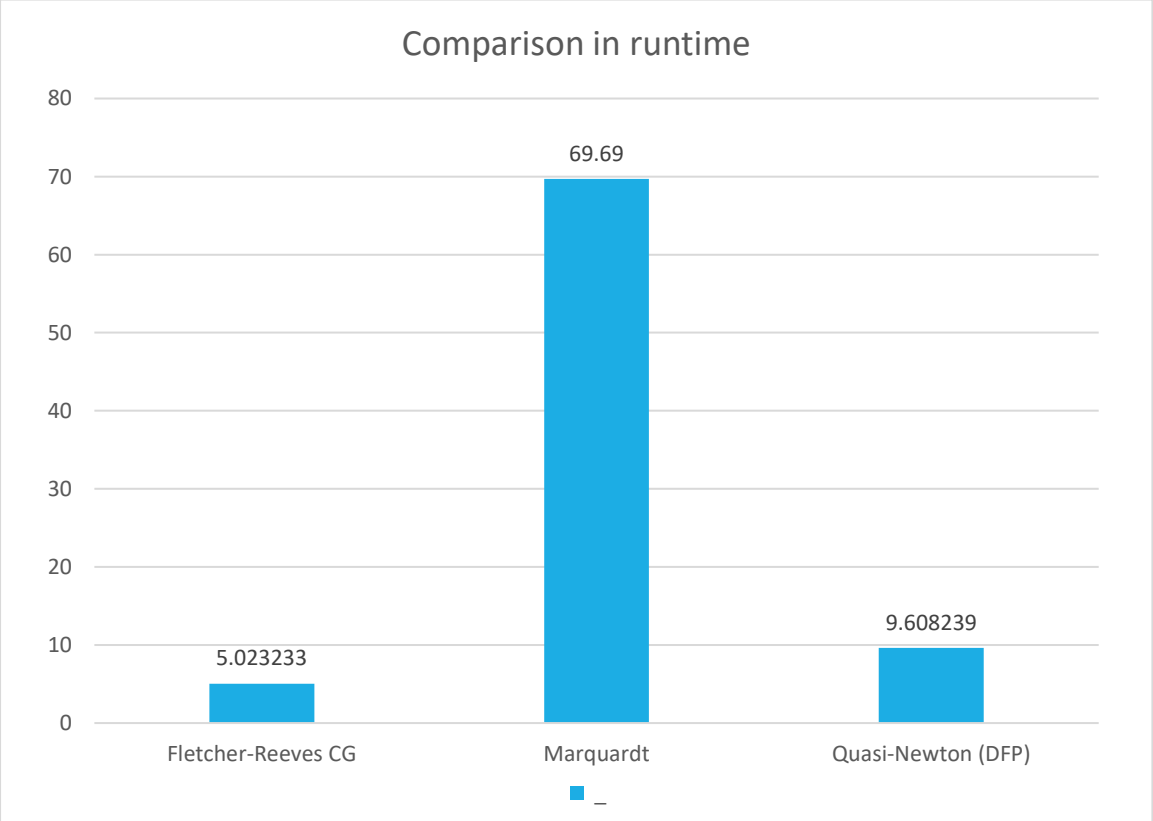
starting from $\boldsymbol{X}0$ = (3.0, − 1.0, 0.0, 1.0)

$$f(x_1, x_2, x_3, x_4) = (x_1 + 10x_2)^2 + 5(x_3 - x_4)^2 + (x_2 - 2x_3)^4 + 10(x_1 - x_4)^4$$






Comparison in gradient vector norm squared
0.12
0.1
0.08
0.06
0.04
0.02
0
0.0578
0.098
0.008
Fletcher-Reeves CG
Marquardt
Quasi-Newton (DFP)


Comparison in runtime
80
70
60
50
40
30
20
10
0
5.023233
69.69
9.608239
Fletcher-Reeves CG
Marquardt
Quasi-Newton (DFP)
_