ME7223: ASSIGNMENT 6

SAARTHAK SANDIP MARATHE | ME17B162

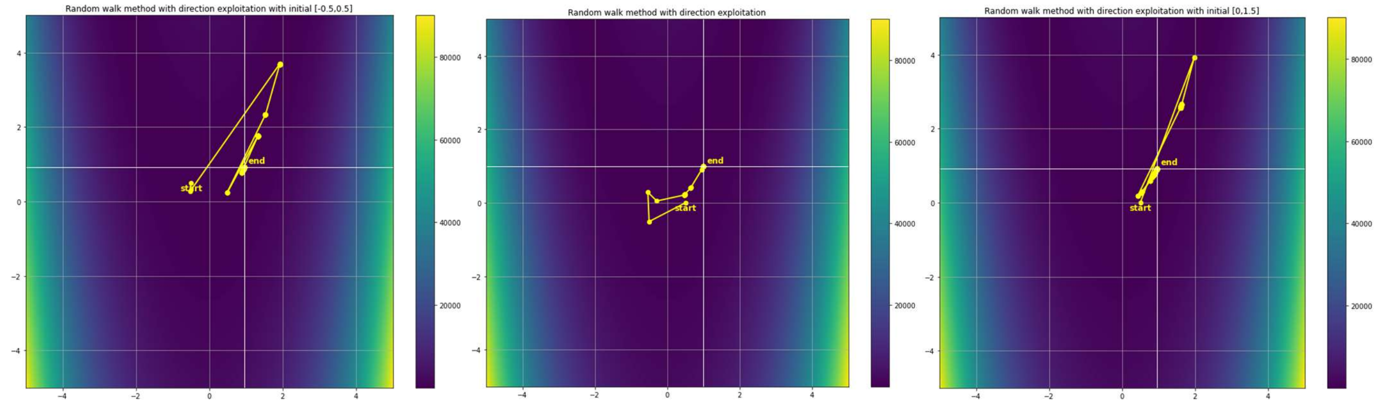
Question 1:

Random walk method with direction exploitation				
Initial guess	**Final optimal value**	**No of iterations**	**Final error f(x*)**	**Observations**
[-0.5,0.5]	[0.96103528, 0.92363284]	873	0.00152	f(x) starts with 2.3167 and then moves on to 0.10560 to 0.01000, 0.00354 with 100 iterations increment which shows decent convergence rate
[-1,0]	[0.99622582, 0.99245153]	978	1.42650396 e-05	The starting value of f(x) was 60.1598 and next was 0.0002 for a bit of iterations which suggested that it converges very fast for this guess
[0,1.5]	[0.96228833, 0.92591662]	806	0.00142	Starting with 0.9111, it moved on to 0.32141, 0.01984 which shows the fastest convergence as compared to others
Univariate method				
Initial guess	**Final optimal value**	**No of iterations**	**Final error f(x*)**	**Observations**
[-0.5,0.5]	[0.98556204, 0.97133254]	2001	0.00021	The starting value of f(x) was 0.08536 and next was 0.05431, 0.03638 with a jump of 100 iterations each which shows steady approach to the opt values
[-1,0]	[0.98082389, 0.96201549]	2000	0.00037	Higher final error than before. F(x) starts with .77111 then 0.17386, 0.09489 with a jump of 100 iterations each which is worse than before but has better convergence rate.
[0,1.5]	[1.02809272, 1.05697465]	2000	0.00079	Higher final error than before and the output is higher than the actual value. f(x) starts with 0.05043 which is lower than all the previous but the convergence rate is very low with f(x) being 0.04265, 0.03584 after next 100 iterations
Conjugate directions (Powell's) method				
Initial guess	**Final optimal value**	**No of iterations**	**Final error f(x*)**	**Observations**
[-0.5,0.5]	[0.96782695, 0.936689]	339	0.001035	The starting value of f(x) was 0.08536 and next was 0.01141, 0.01141 with a jump of 100 iterations each which shows a bit faster than univariate method
[-1,0]	[0.37833942, 0.11892133]	2001	0.44512	The final point doesn't converge at the required point which shows that it has found a nearby point of inflexion to converge to
[0,1.5]	[0.88413459, 0.78018583]	2001	0.01365	Very slow convergence after a point. F(x) started with 0.05043 and then moved to 0.01365 till the end which shows that it was in the range of the output solution since 100 iterations

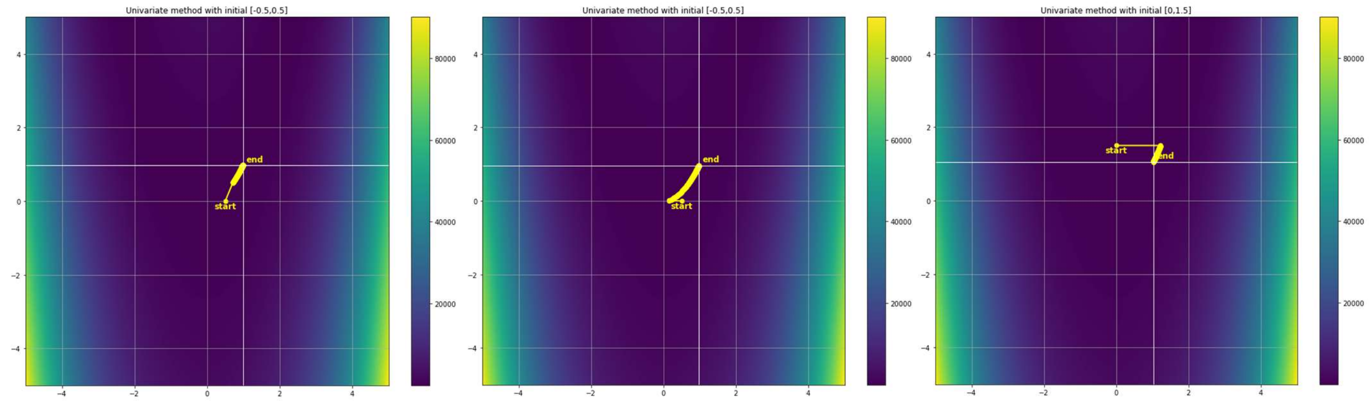
Observations:

- On an average, random walk method shows the fastest convergence rate as compared to the other two methods used here with the least used no of iterations. Most accurate among all for initial value [-1,0] but comparatively higher error for other two initial starting points.
- Univariate method uses all the 2000 iterations which is the upper limit use here. It converges fast initially but lingers around the optimum point for a long point and never reaches the final optimum point as it converges slowly after a point. It has the closest solution among all the methods for all the initial points
- This method shows oscillatory behaviour after a point and converges very slowly after a point (mostly after 100 iterations). It does not reach the required optimal solution when we start with [-1,0] and in general has higher final error when compared to the other two methods.

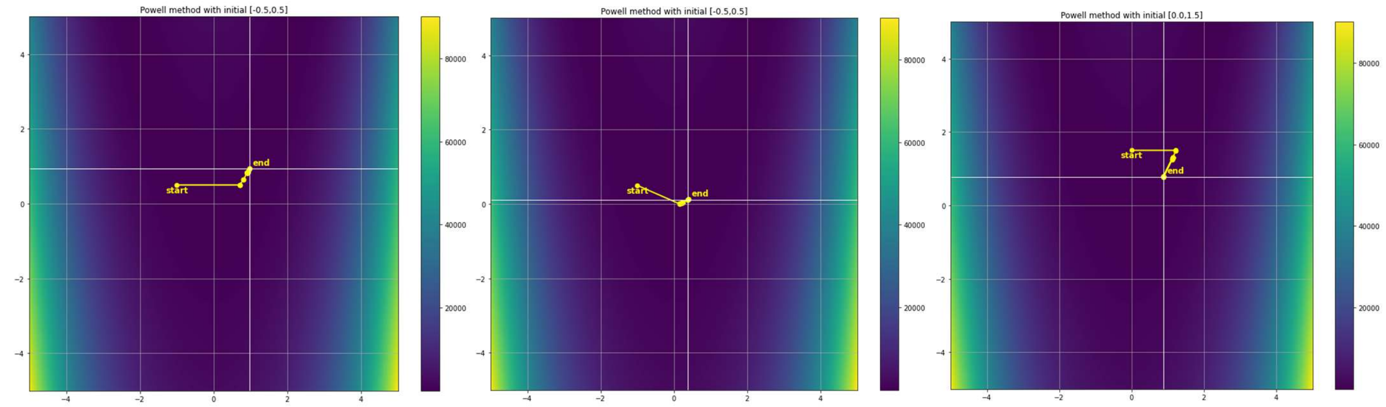
SAARTHAK SANDIP MARATHE | ME17B162



Random walk method for initial points: [-0.5,0.5], [-1,0], [0,1.5]



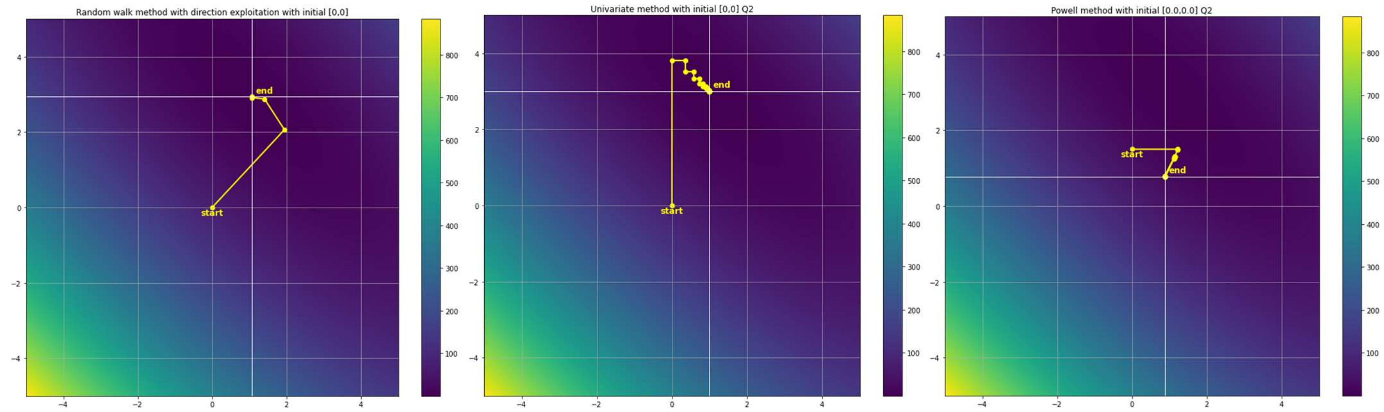
Univariate method for initial points: [-0.5,0.5], [-1,0], [0,1.5]



Powell's method for initial points: [-0.5,0.5], [-1,0], [0,1.5]

Question 2:

Method	Initial point (x*)	Final opt value	No of iterations	Final error f(x*)	Observations
Random walk method with direction exploitation	[0,0]	[1.06874236, 2.94175084]	5	0.00000	It converged from f(x) being 1.76891 to 0.0000 in 5 iterations which shows the fastest convergence
Univariate method	[0,0]	[1., 3.]	151	0.00000	It converged from f(x) being 1.8000 to 0.0000 within 200 iterations
Conjugate directions (Powell's) method	[0,0]	[1., 3.]	9	0.00000	It converged from f(x) being 1.8000 to 0.0000 within 10 iterations which shows 2ND fastest convergence



Random walk, Univariate, Powell's method for initial point [0,0]

Question 3:

- Univariate method takes more no of iterations to converge to a point than Powell's method for both question 1 and question 2.
- Powell's method tends to oscillate after a point whereas the Univariate method converges fast initially but the rate drops drastically after a point leading to never-reaching the optimum point in 2000 iterations. The Powell method follows a similar rate of convergence as Univariate initially but then Powell's method converges quicker than Univariate method (seen for the first initial point for question 1). At points like [-1,0] used in question 1, the Powell method fails to converge at the required point whereas the Univariate method does. This shows that the first question not being strictly convex plays a role here as the method could have encountered an inflexion point in between.