Machine Learning (WiSe 2025/2026)

Author: Suvansh Shukla
Matriculation No. 256245

Assignment 2 Task 2.3

Nr.	y	^y1	^y2	^y3	^y4	^y5	^y6	^y7	^y8	^y9
1	1	1	0	0	- 2	1	- 2	- 3	- 1	1
2	4	0	1	0	3	4	2	1	2	4
3	3	- 1	0	1	0	0	- 1	2	2	3
4	7	4	2	4	4	5	7	7	7	6

Formula for SSE:

$SSE_j = \sum_i (y_i - \hat{y_{ij}})^2$

Calculating SSE for each parameter:

$SSE_1 = ((1-1)^2 + (4-0)^2 + (3+1)^2 + (7-4)^2 = 0 + 16 + 16 + 9 = 41$

$SSE_2 = (1-0)^2 + (4-1)^2 + (3-0)^2 + (7-2)^2 = 1 + 9 + 9 + 25 = 44$

$SSE_3 = (1-0)^2 + (4-0)^2 + (3-1)^2 + (7-4)^2 = 1 + 16 + 4 + 9 = 30$

$SSE_4 = (1+2)^2 + (4-3)^2 + (3-0)^2 + (7-4)^2 = 9 + 1 + 9 + 9 = 28$

$SSE_5 = (1-1)^2 + (4-4)^2 + (3-0)^2 + (7-5)^2 = 0 + 0 + 9 + 4 = 13$

$SSE_6 = (1+2)^2 + (4-2)^2 + (3+1)^2 + (7-7)^2 = 9 + 4 + 16 + 0 = 29$

$SSE_7 = (1+3)^2 + (4-1)^2 + (3-2)^2 + (7-7)^2 = 16 + 9 + 1 + 0 = 26$

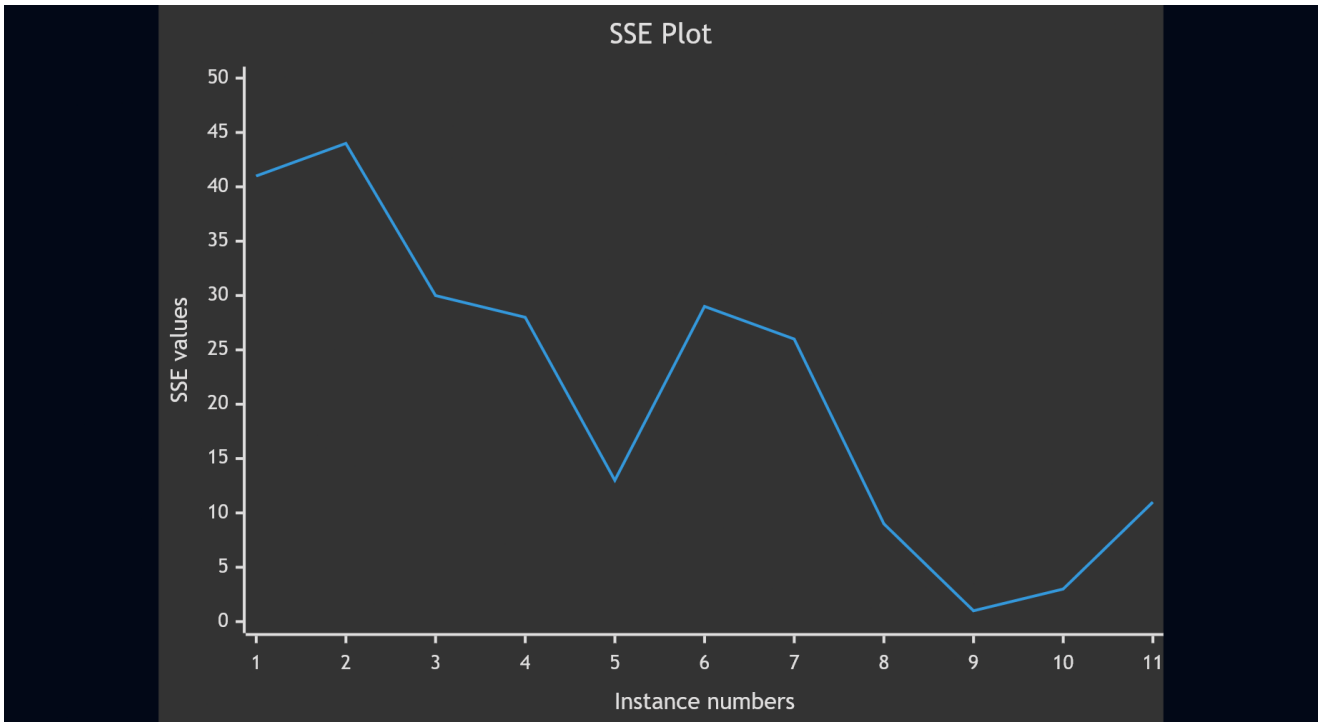
$SSE_8 = (1+1)^2 + (4-2)^2 + (3-2)^2 + (7-7)^2 = 4 + 4 + 1 + 0 = 9$

$SSE_9 = (1-1)^2 + (4-4)^2 + (3-3)^2 + (7-6)^2 = 0 + 0 + 0 + 1 = 1$

$SSE_{10} = (1-0)^2 + (4-3)^2 + (3-2)^2 + (7-7)^2 = 1 + 1 + 1 + 0 = 3$

$SSE_{11} = (1+2)^2 + (4-3)^2 + (3-3)^2 + (7-6)^2 = 9 + 1 + 0 + 1 = 11$

Plotting the points on a graph



In the graph we can see that values start out high, then start to descend.
Then towards the end of the graph we see that error values are starting to climb again.

My interpretation

- The SEE is chaning in a non-uniform manner (non-liner)
- The lowest SSE is seen for instance 9 (global minimum), making it the best parameter

What can go wrong with regular gradient descent

- We might end up in a series of similar values, thus getting stuck in a value that is not the global minimum
- Learning rate can cause issues where we might start to shift between multiple minimum values and never reach the absolute minimum. Possibly overshoot and oscilate or get stuck in a flat region or converge too slowly
- Noise and outliers may cause issues in convergence
- there may be no guarantee that an absolute minimum is found